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(BEYOND MIDDLEBOROUGH ROAD)

FEASIBILITY STUDY

SEPTEMBER 1982

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## SUMMARY

This report is a study of the feasibility of extending the East Burwood tram route beyond the existing terminus at Middleborough Road.

In the report, three possible extensions are examined. These are :

- (a) Middleborough Rd. to Blackburn Rd. - 1.7 km
- (b) Middleborough Road to Springvale Rd. - 3.3 km
- (c) Middleborough Rd. to Vermont South Shopping Centre - 4.6 km

### (i) Patronage

Patronage estimates for each extension have been derived from the results of surveys conducted amongst passengers using the service between Warrigal Road and Middleborough Road and amongst local residents. Patronage estimates for each extension are shown below.

Terminus	Estimated Daily Patronage	
	Opening Year	1990
Blackburn Road	2900	3500
Springvale Road	4200	5000
Vermont South	5100	6100

TABLE 1. ESTIMATED DAILY PATRONAGE.

The 20% patronage increase between the opening year and 1990 is expected to occur due to population growth in the area, increased employment opportunities (including the ABC studio and redevelopment of the Tally Ho Boys Farm) and the movement of people into the area who could make use of a high quality transport service for travel to work, school, shopping and recreational locations.

A total of 12 factors was considered, including reduction in road accidents, consumption of energy resources, traffic congestion, flexibility of operation, air and noise pollution and mobility. It was concluded that the tramway displayed advantages in 10 of the 12 factors considered. Benefit-cost evaluations of each proposal were also conducted. In these evaluations the proposed tramway was compared with the existing private bus service. These results are shown in Table 3.

Terminus	Benefit-Cost Ratio	
	7%	10%
Blackburn Road	1.2	1.0
Springvale Road	1.0	0.8
Vermont South	1.0	0.8

TABLE 3. BENEFIT-COST RATIOS.

Although benefit-cost analysis attempts to quantify some of the non-monetary aspects of a proposed investment, the applicability of the technique to the evaluation of short extension proposals, such as these, is questionable. The analysis is particularly sensitive to certain key assumptions which are difficult to predict with a large degree of certainty (especially when a low standard bus service is to be replaced by a high standard light rail service). The additional problem of evaluating these extensions in isolation from the total transport infrastructure in the area, reduces the usefulness of benefit-cost analysis in assessing the value of the extensions to the community.

An assessment of other factors not quantified in the benefit-cost analysis (reductions in road accidents, consumption of energy resources, air and noise pollution etc.) suggests some of the additional benefits of the extensions. It also indicates that the benefit-cost ratios calculated must be regarded as less than the real community benefit that would result.

From the study, it appears that the logical limit of an extension would be to Springvale Road.

This extension would substantially improve east-west access between East Burwood and the middle and inner suburbs.

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From the study, it appears that the logical limit of an extension would be to Springvale Road.

This extension would substantially improve east-west access between East Burwood and the middle and inner suburbs.

It would facilitate the development of an improved public transport network in the area, providing connections with north-south bus routes along Blackburn Road and Springvale Road and feeder bus services from the Vermont South area.

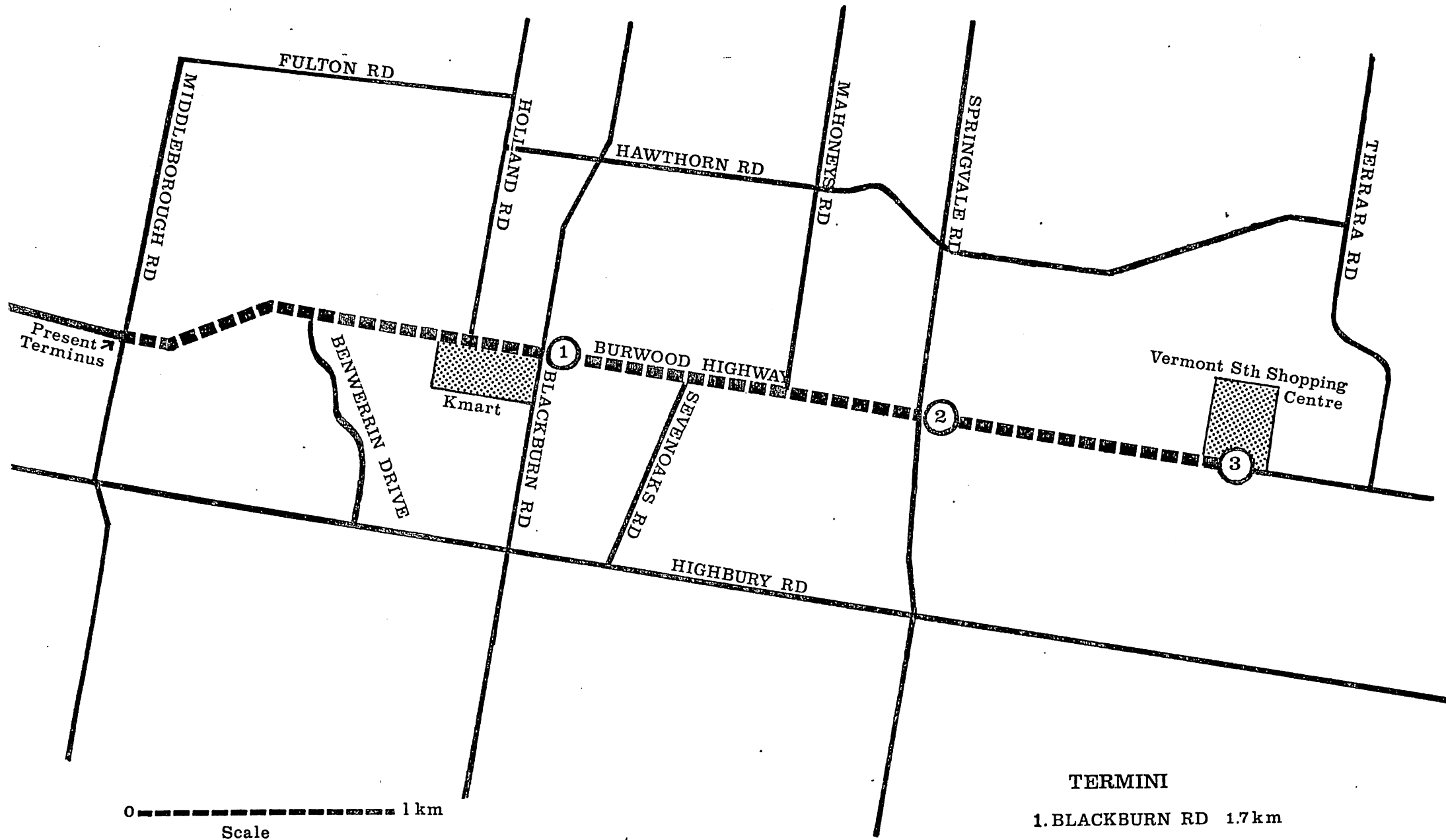
It would service proposed land use developments in the area, particularly the new ABC studios and the industrial and residential developments at the Tally Ho Boys Farm.

The area beyond Springvale Road would appear to be more appropriately suited to an upgraded bus system rather than a tramway extension.

## 1. INTRODUCTION

In July 1978 the extension of the Burwood tram line from Warrigal Road to Middleborough Road was opened for service. That extension has attracted a growing patronage, 3,000 passengers per day were carried shortly after the opening and recent counts show that patronage is approximately 4,400. This feasibility study examines the further extension of the tram line, from its present terminus at Middleborough Road to three possible new termini at Blackburn Road, Springvale Road or Vermont South Shopping Centre. The area and proposed termini are shown in Figure 1.1.

The area under review is similar in many ways to the area around the recent extension. It lies some 2.5 kilometres north of the Glen Waverley rail line and 3.3 kilometres south of the Box Hill rail line. Public transport services are provided by two private bus operators. There is however a need to upgrade the existing public transport services in the area to improve access to travel in the east-west direction.



**TERMINI**

- 1. BLACKBURN RD 1.7km
- 2. SPRINGVALE RD 3.3km
- 3. VERMONT STH SHOPPING CENTRE 4.6km

**FIGURE 1·1 POSSIBLE EXTENSION**



## 2. PROPOSALS CONSIDERED

The proposals considered for this feasibility study involved three possible extensions along the Burwood Highway from the East Burwood terminus at Middleborough Road. The extensions considered were to -

- (a) Blackburn Road - (1.7 km)
- (b) Springvale Road - (3.3 km)
- (c) Vermont South Shopping Centre - (4.6 km)

Each extension would be constructed within the central median reservation of the highway. This will provide a separate reserved right of way for the trams. In these conditions a faster, more reliable service can be provided than is possible where trams are operating on road space used by motor traffic.

Examination of the route indicated that no major construction problems would be anticipated. Grades along the route would be suitable for tram operation. Construction would be similar to that used for the earlier extension. The type of track construction is illustrated in Figures 2.1 and 2.2, which shows the tram line between Warrigal Road and Middleborough Road.

### SCHEME A - Terminus at Blackburn Road -

A double track tramway extension of 1.7 km from the existing terminus at Middleborough Road to Blackburn Road.

Some retaining walls will be required over certain sections of track due to level changes in the heights of the road carriageways but they will not lead to significantly increased costs. A new substation will not be required for this extension. The estimated total construction cost at September 1982 cost levels is \$2.9 million. Construction costs are detailed in Appendix 1.

### SCHEME B - Terminus at Springvale Road -

A double track tramway extension of 3.3 km from the existing terminus at Middleborough Road to Springvale Road.

A new substation with one rectifier unit will be required for this extension. The estimated total construction cost at September 1982 cost levels is \$5.9 million. Construction costs are detailed in Appendix 1.

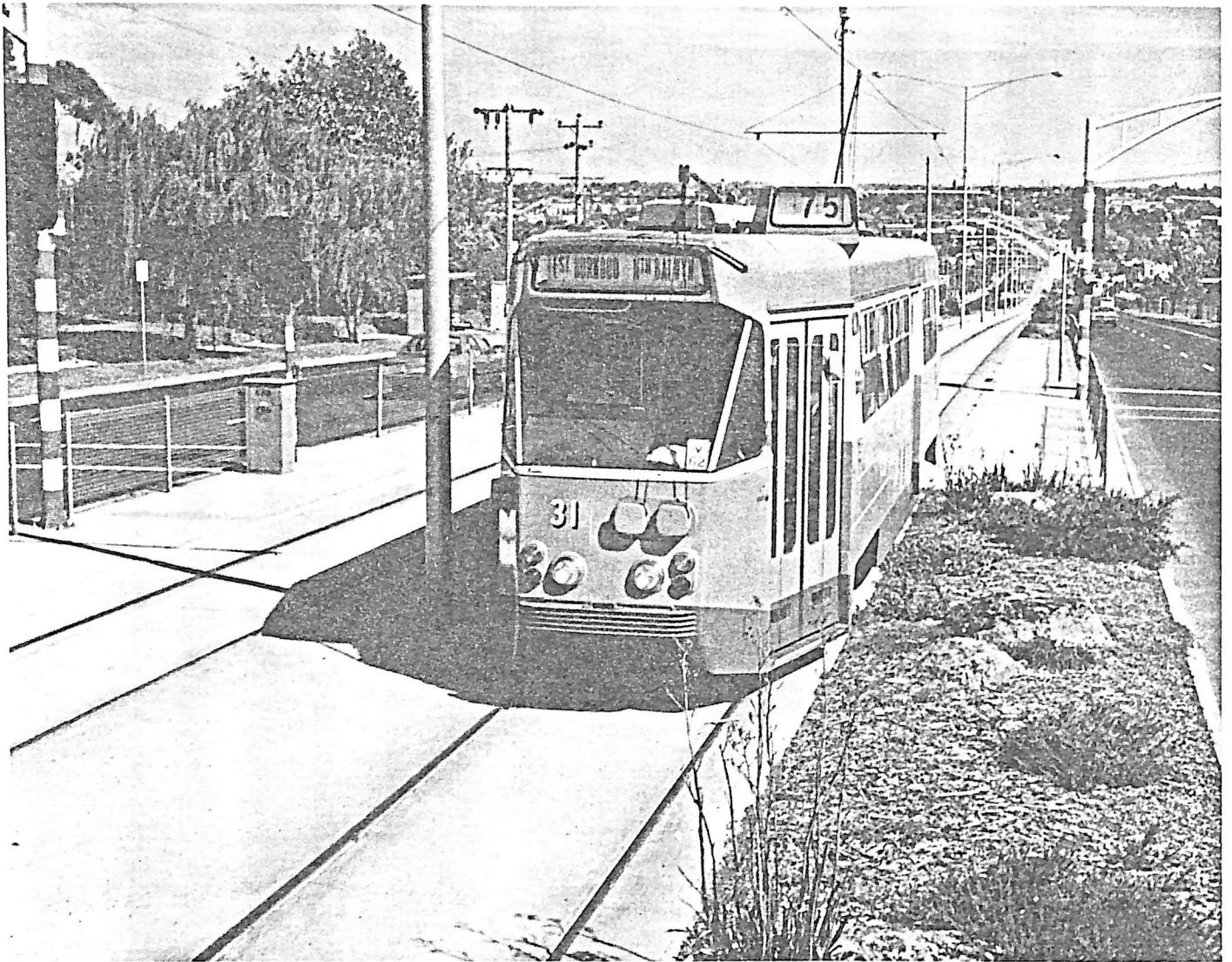


Figure 2.1. Recent tramway extension between Warrigal Road and Middleborough Road.



Figure 2.2. Recent tramway extension between Warrigal Road and Middleborough Road.

SCHEME C - Terminus at Vermont South Shopping Centre -

A double track tramway extension of 4.6 km from the existing terminus at Middleborough Road to Vermont South Shopping Centre.

As for the previous scheme one new substation would be required, however two rectifier units would be needed for this longer extension. The estimated total construction cost at September 1982 cost levels is \$8.3 million. Construction costs are detailed in Appendix 1.

### 3. POPULATION AND LAND USE CHARACTERISTICS

The population and land use surrounding each of the three extensions are discussed separately below. Each area is predominantly residential with some small industrial and commercial areas. Over 96 percent of the housing stock in the area is single family homes. The population and car ownership figures are based on the 1976 Census.

Terminus : Blackburn Road -

The principal area of influence of the tram route is considered to extend 800 metres either side of the route. The catchment area from Middleborough Road to Blackburn Road incorporates a total area of 3.5 sq.km and contains a population of about 9,900 persons in 2,680 households. The average household size is 3.7 persons. Car ownership rates average 1.5 cars per household.

There are three primary schools within the catchment area with a total enrolment of approximately 1,100 students. Enrolments at individual institutions are given in Table 3.1. The locations of these schools within the study area are shown in Figure 3.1.

The area includes a number of small retail outlets (e.g. Milkbars, Newsagents), and a major shopping centre, K-mart, on the corner of Burwood Highway and Blackburn Road.

The major sources of employment in the area are K-mart, which has a full-time staff of 120 with a part-time staff of 150, Brick and Pipe Industries Ltd., with an office staff of 30 and another 30 drivers, and the RSPCA with a full-time staff of 24 and 4 part-timers. These last two are already partially served by the present East Burwood Terminus. The primary schools would employ 15-25 teachers each plus office staff.

The street layout is a basic grid with streets running at right angles and parallel to Burwood Highway. Access to the route from the local streets occurs at about 250 metre intervals, though access is limited to 500 metres in some areas. There is some direct residential frontage onto Burwood Highway west of Blackburn Road, but residential frontages are limited east of Blackburn Road by the location of scattered businesses and subdivision layout.

Terminus : Springvale Road -

The additional catchment area of this extension lies from 800 metres east of Blackburn Road to 800 metres east of Springvale Road. It covers a 2.8 sq.km area containing a population of 4,536 persons in 1975 households (1976 census). This gives an average household size of 3.8 persons. The 1976 Census identified average car ownership as 1.6 cars per household.

A large portion of the area is used for non-residential purposes. A recreational centre comprising football oval, basketball stadium, tennis courts and cycle track fronts directly onto Burwood Highway. The MMBW owns a large tract of vacant land and Channel 10 TV operates a studio adjacent to Springvale Road. There is another large area of vacant land (Tally Ho Boys Farm) where rezoning for industrial and commercial use is being sought. Immediately south of this area a new ABC office and studio complex, is being constructed. Eventually the ABC plans to have between 1600 and 2000 employees working in the complex. The Burvale Hotel/Motel is situated on the corner of Springvale Road and Burwood Highway.

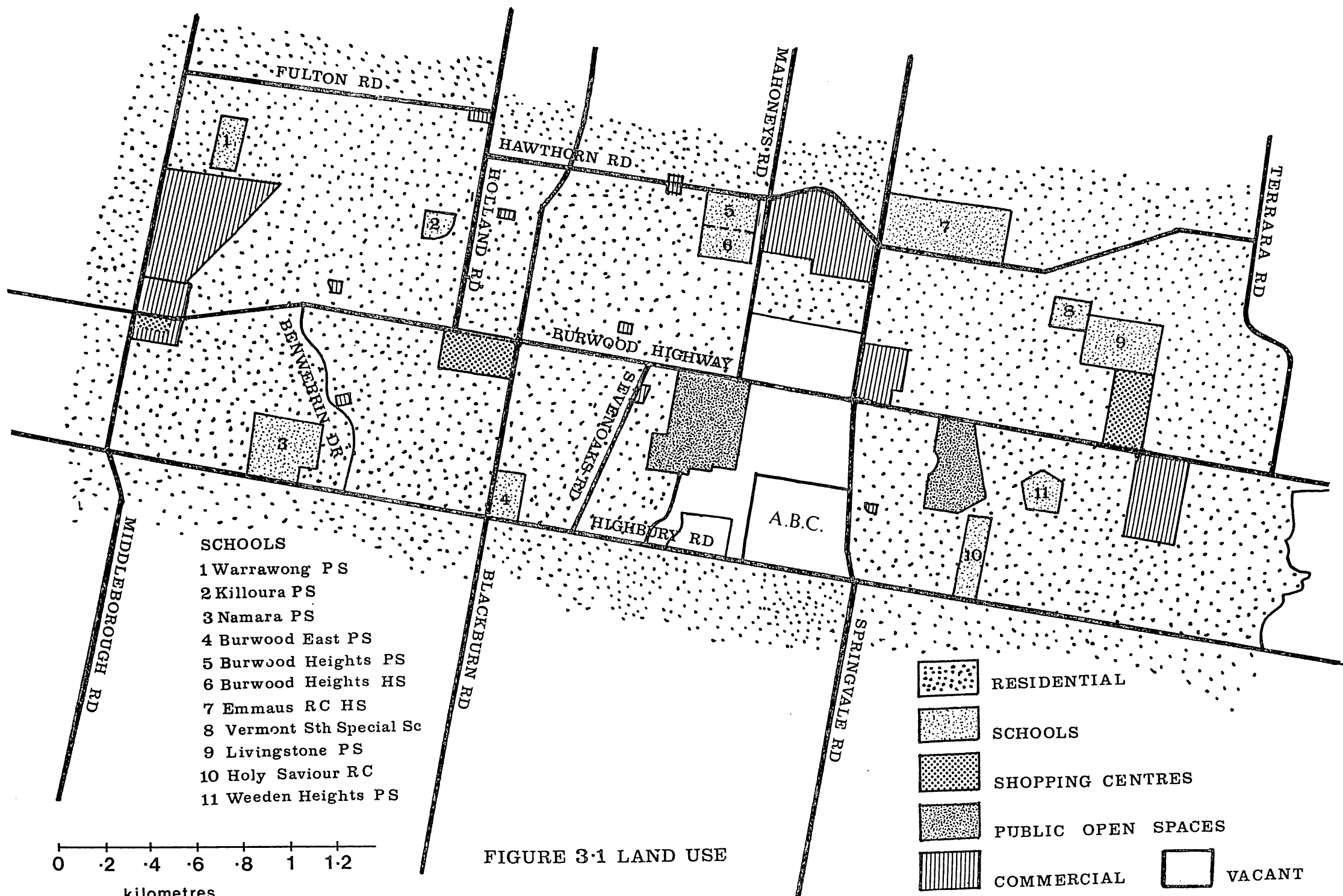
The area contains two primary schools and one secondary school with a combined enrolment of approximately 1,700. There are only two local retailers and no large shopping centre or supermarkets.

Other than the schools, the only employment opportunities in the area are Channel 10 TV studios, with an administration staff of 100 and another 250-300 staff on shift-work, and the Burvale Hotel/Motel with a full-time staff of 25 and a part-time casual staff of 75 persons.

Terminus : Vermont South Shopping Centre -

The additional catchment area of this extension lies from 800 metres east of Springvale Road to 800 metres east of Vermont South Shopping Centre and covers 1.5 sq.km. The area contains an estimated population of 3,742 in 970 households. This includes an estimate of the likely increase in households since the 1976 Census as much of the area is still developing. The average household size is 3.8 persons and average car ownership is around 1.6 cars per household.

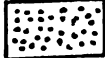





This area includes three primary schools, one special school and one private secondary school with a total enrolment of approximately 2,600. The secondary school, formerly St.Thomas More, was recently amalgamated with Chavoin College which is located on Warrigal Road near Burwood Highway. Both schools are now part of the same High School, Emmaus College, and share facilities and some teaching staff. Employers include the one major shopping



**SCHOOLS**

- 1 Warrawong PS
- 2 Killoura PS
- 3 Namara PS
- 4 Burwood East PS
- 5 Burwood Heights PS
- 6 Burwood Heights HS
- 7 Emmaus RC HS
- 8 Vermont Sth Special Sc
- 9 Livingstone PS
- 10 Holy Saviour RC
- 11 Weeden Heights PS

**FIGURE 3-1 LAND USE**

-  RESIDENTIAL
-  SCHOOLS
-  SHOPPING CENTRES
-  PUBLIC OPEN SPACES
-  COMMERCIAL
-  VACANT

0 0.2 0.4 0.6 0.8 1 1.2  
kilometres

centre, Vermont South, and the Australian Road Research Board. The Vermont South Shopping Centre contains 40 shops - mostly small retailers but also containing a supermarket and a department store. The ARRB has a staff of 130, 4 of whom are part-time. The schools employ approximately 45 teachers and administrators.

There is limited access to Burwood Highway in this area, and all frontages are separated from the Highway by service roads. Between Springvale Road and the Vermont South Terminus there are only two intersections though an additional five streets have access to the service roads.

<u>Institution</u>	<u>Enrolment February 1981</u>
Middleborough Road - Blackburn Road	
Warrawong Primary School	294
Killoura Primary School	328
Narmara Primary School	<u>475</u>
	Sub-total : 1,097
Blackburn Road - Springvale Road	
Burwood East Primary	504
Burwood Heights Primary School	502
Burwood Heights High School	<u>712</u>
	Sub-total : 1,718
Springvale Road - Vermont South	
Livingstone Primary School	602
Holy Savior RC Primary School	540
Vermont South Special School	145
Emmaus RC College	900
Weeden Heights Primary School	<u>400</u>
	Sub-total : <u>2,587</u>
	TOTAL : <u>5,402</u>

TABLE 3.1. EDUCATIONAL INSTITUTIONS IN THE EAST BURWOOD EXTENSION AREA.



#### 4. PUBLIC TRANSPORT SERVICES

##### A. EXISTING BUS NETWORK

The area under consideration is currently serviced by two private bus companies operating six bus routes through the study area. The major routes are the north-south routes connecting Box Hill and Blackburn, north of the study area with Mt.Waverley and Glen Waverley to the south. Two routes service Burwood Highway east of the tram terminus at Middleborough Road, and a further east-west route operates on Highbury Road. The six routes, their service hours and headways are shown in Table 4.1.

The closest railway line, Glen Waverley, is located 2.5 kilometres south of Burwood Highway. Three of the bus routes operate services to stations along this line. The Box Hill/Ringwood railway line is located 3.3 kilometres north of Burwood Highway.

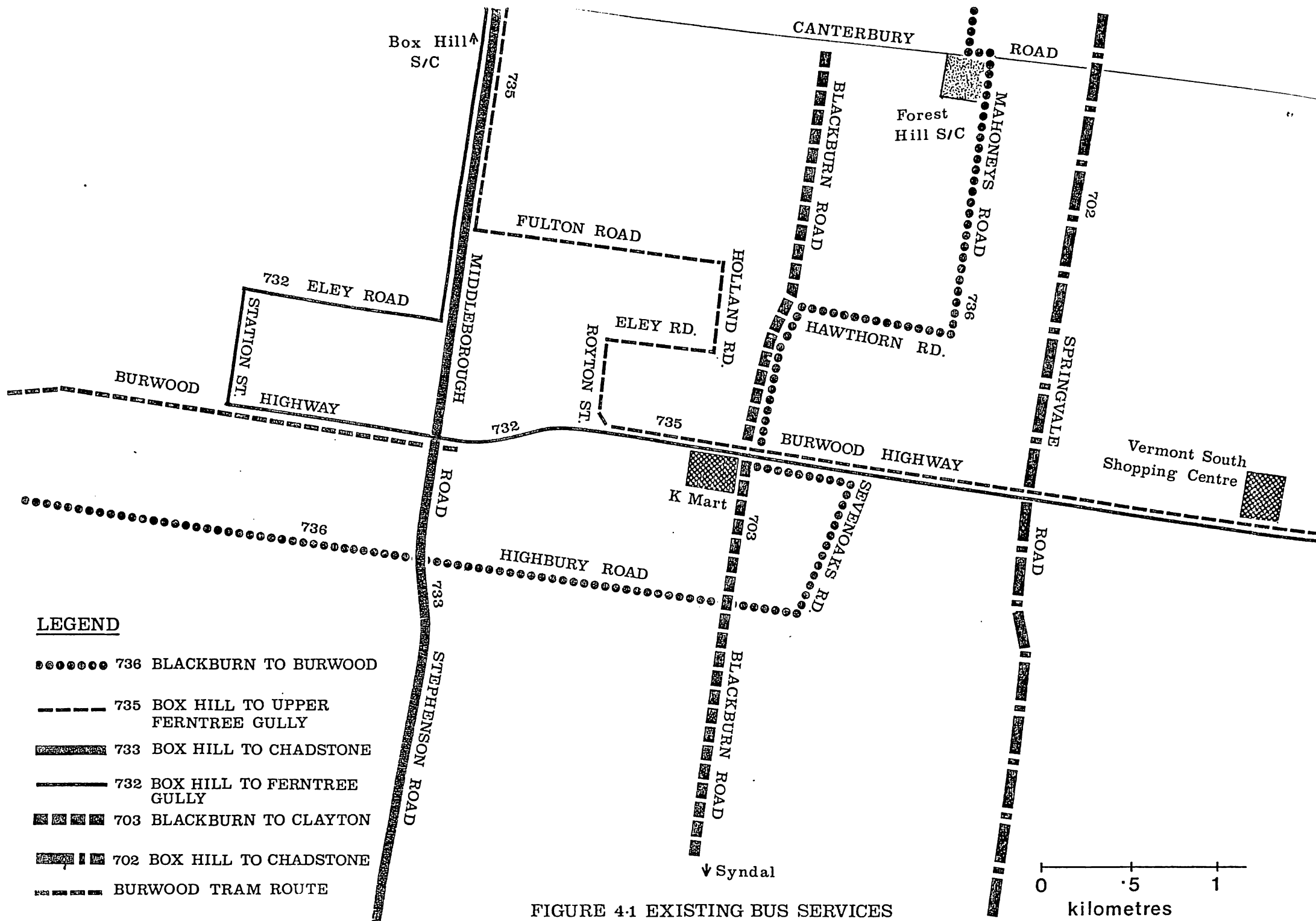
Generally, the north-south routes through the study area provide 20 minute peak service and 30 minute off-peak service over a 12-15 hour operating day. These routes also offer a Saturday service of 2 buses per hour over a 12-13 hour day. The east-west routes are more circuitous. Routes 735 and 736 offer a much lower level of service with uneven headways and no weekend operation.

Figure 4.1 shows these routes in relation to the study area.

The tram extension would provide an improved level of service in the east-west direction along Burwood Highway. All bus routes in the area could provide direct connection to an extended tram line.

Bus Route	Headway	Hours of Operation
733 Box Hill to Chadstone S/C (Ventura Bus Lines)	AM Peak 20 min. PM Peak 20 min. Off Peak 30 min. Saturdays 30 min.	Weekdays 6.15am-7.30pm Saturday 7.00am-6.30pm
No Service Sunday or Public Holidays		
703 Blackburn to Clayton (Clarinda Transport)	AM Peak 20 min. PM Peak 20 min. Off Peak 30 min. Saturday 30 min.	Weekdays 6.15am-10.00pm Saturday 6.15am-8.00pm
No Service Sunday or Public Holidays		
702 Box Hill to Chadstone (Clarinda Transport)	AM Peak 25-35 min. PM Peak 25-35 min. Off Peak 30 min. Saturday 30 min.	Weekdays 6.30am-9.00pm Saturday 7.00am-7.00pm
No Service Sunday or Public Holidays		
735 Box Hill to Upper Ferntree Gully (Ventura Bus Lines)	6 buses/day	Weekdays 7.00am-5.15pm
No Service Weekends or Public Holidays		
736 Blackburn to Burwood (Ventura Bus Lines)	AM Peak 35 min. PM Peak 35-40 min. Off Peak 40 min.	Weekdays 6.30am-7.00pm
No Service Weekends or Public Holidays		
732 Box Hill to Ferntree Gully (Ventura Bus Lines)	AM Peak 20-30 min. PM Peak 20 min. Off Peak 30 min. Saturday 30 min.	Weekdays 6.00am-7.15pm Saturdays 7.00am-8.00pm
No Service Sundays or Public Holidays		

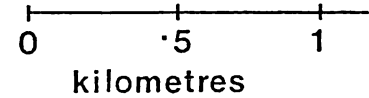
TABLE 4.1. PRIVATE BUS ROUTES IN EAST BURWOOD.



**LEGEND**

- 736 BLACKBURN TO BURWOOD
- 735 BOX HILL TO UPPER FERNTREE GULLY
- ===== 733 BOX HILL TO CHADSTONE
- 732 BOX HILL TO FERNTREE GULLY
- 703 BLACKBURN TO CLAYTON
- 702 BOX HILL TO CHADSTONE
- - - - - BURWOOD TRAM ROUTE

FIGURE 4-1 EXISTING BUS SERVICES



## 5. PATRONAGE

There are four major factors which contribute to the attraction of passengers to a new public transport service. These are :

- the nature of land use development in the area served, including the extent of employment and educational opportunities, the quantity and quality of shopping facilities, and the density of residential development.
- the trip destinations that the route or connecting routes serve.
- the level of service, speed, comfort and convenience of the service compared with the relative attractiveness of alternative transport modes.
- the population characteristics and present mobility of the households in the area.

Many of these factors in the extension area are similar to those in the area surrounding the tram line between Warrigal Road and Middleborough Road. The results of studies of the earlier extension have therefore been used in the production of a patronage estimate. A home interview survey was carried out between Middleborough Road and Springvale Road in June 1979 and the results of that survey had also been used.

### Trips by Residents

Two methods have been used to estimate trips made by residents of the catchment area.

#### (a) Trip Rates -

Tram trip production rates have been devised for the residents living adjacent to the Warrigal Road to Middleborough Road extension. These trip rates have been applied to the population living in the catchment areas of the extensions to obtain a residential patronage estimate for the three termini. These trip rates are based on counts conducted nearly two years after the opening of the extension and therefore allow for some initial growth in patronage.

Table 5.1 shows the number of trips per day for each trip purpose for each termini together with the associated trip production rate. Total daily residential trips for the extension to Blackburn Road is 2,300, to Springvale Road 3,350 and to Vermont South 4,200.

In general, the East Burwood area under consideration has a lower population density than that of the previous extension. The population is younger and thus less independently mobile even though the number of cars per household and the driver's licence ownership among persons over 18 is higher. This dependency is

Trip Purpose	Trip Rate	TERMINUS					
		Blackburn Road		Springvale Road		Vermont South	
		Resident Population	Estimated Patronage	Resident Population	Estimated Patronage	Resident Population	Estimated Patronage
School	195 per 1000 students	3258	635	4755	930	5989	1167
Work	210 per 1000 workers	3949	829	5763	1215	7260	1525
Shopping	80 per 1000 households	2678	214	3873	310	960	387
Other	62 per 1000 residents	9872	612	14408	895	18150	1125
TOTAL	232 per 1000 residents	9872	2290	14408	3350	18150	4204

TABLE 5.1. TRIP RATES AND ESTIMATED RESIDENTIAL PATRONAGE

revealed by the fact that children in 23% of East Burwood households are driven to school compared with only 15% in Burwood. The average household size in East Burwood is 3.7 persons while in Burwood it is 3.2 persons. There are fewer workers and more school children in East Burwood than in Burwood.

From this analysis of population characteristics it would appear that there is a large potential school trip population, and a moderate work trip segment. The shopping trip population is more difficult to identify, for even though 36% of the households do their major food shopping at K-Mart, which would be on the tram extension, the high two cars per household ownership rate would indicate less need to use public transport for such trips.

The proposed extension area does not contain a large number of schools - 8 primary and 2 secondary - but as indicated earlier in this report the previous Burwood extension area does attract a large number of school trips - a large proportion of which would be from the East Burwood area. K-Mart and Vermont South are the major shopping centres in the area and might attract a considerable number of trips from outside the area.

Employers in the area would include Channel 10 Television Studios, K-Mart, RSPCA and local shops and schools. The extent of their work trip attraction may be minimal. The lower proportion of persons not working may indicate a lower potential market for trips other than work, school or shopping. These 'other' trips presently make up about 30% of trips along the Burwood extension.

(b) Home Interview Survey -

The East Burwood Home Interview survey identified a portion of the resident population who were most likely to immediately benefit from the construction of a tram extension - those who presently use public transport for work and school trips and whose destinations lie within the area served by the East Burwood tram route.

The survey found that 714 persons living between Middleborough Road and Blackburn Road and a further 270 persons living between Blackburn Road and Springvale Road used public transport to reach work and school destinations lying within the area served by the tram between East Burwood and the city. Work and school trips represent only about 60% of all trips by tram, thus, allowing for other trip purposes this represents 2270 daily trips on the extension to Blackburn Road and 3130 daily trips on the extension to Springvale Road. These estimates are consistent with the previous estimates for residents trips produced using the Burwood trip production rates.

## External Trips

Studies of the Burwood extension found that 25% of trips along the extension were made by non-residents. While it is difficult to determine exact numbers, approximately 40% of these trips were to and from work, and 55% were to and from school. Another 5% were for shopping or other purposes.

In the East Burwood area, the land use patterns in the three areas can be used to determine what type of trips might be attracted.

There is not a significant amount of employment in the area, but the CBD may still attract some work trips from beyond the extension. The area does not have a large number of schools which would attract non-local school children. There are only two high schools and one special school. The Burwood area, west of Middleborough Road, on the other hand, is known to attract a large number of school trips to its private secondary schools and technical and teachers colleges, some through trips by scholars may therefore be expected.

The two major shopping centres in the area are the only significant trip attractors to the area, however, shoppers generally represent only a small proportion of public transport users in the Burwood area.

The following percentages have been taken as estimates of the likely non-resident use of the East Burwood extension :

to Blackburn Road	-	20% of residential trips = 600 trips
to Springvale Road	-	15% of residential trips = 200 trips
to Vermont South	-	10% of residential trips = 100 trips

### Total Trips

#### - Initial Year

Total trips for the extension terminating at Blackburn Road are estimated to be 2900 trips per day; for the extension terminating at Springvale Road the estimate is 4,200 trips per day and for the extension to Vermont South a total of 5100 trips per day are expected.

#### - 1990 Patronage

It is expected that patronage will grow in the years following the opening of the extension because of residential development

east of Springvale Road. Also in the longer term, higher patronage levels would be expected because the presence of a high quality public transport service would influence peoples' residential location decisions with regard to access to work, school, shopping and recreational locations. It is estimated that this will lead to a 20% increase in patronage by 1990. Table 5.2 summarizes the expected patronage for each terminus.

Terminus	Expected Daily Patronage	
	Opening Year	1990
Blackburn Road	2,900	3,500
Springvale Road	4,200	5,000
Vermont South	5,100	6,100

TABLE 5.2. ESTIMATED DAILY PATRONAGE.



6. OPERATING COSTS

Proposed Service

Peak period service on the Board's routes is generally determined by demand, with a more frequent service being provided on more heavily patronized routes. At off-peak times when passenger demand is low, vehicle frequency is generally determined by the Board's policy of maintaining reasonable standard of service throughout the day.

The service headways on the existing East Burwood route are : peak hour - approximately 4 minutes; between peaks - approximately 12 minutes; evening - 20 minutes. Weekend headways vary between 12 minutes (Saturday mornings) and 30 minutes (Sundays).

Patronage data indicates that similar service frequencies would be required on all proposed extensions. The a.m. peak service on the recent extension to Middleborough Road is now the same as that on the rest of the route. Service standards for the extensions have been based on the need to maintain reasonable peak and off-peak headways and to have vehicle operation compatible with the existing East Burwood route.

Rolling stock requirements in the first year of operation, are shown in Table 6.1.

Terminus	Number of Trams Required
A. Blackburn Road	2
B. Springvale Road	4
C. Vermont South	5

TABLE 6.1. ROLLING STOCK REQUIREMENTS.

Operating Costs

The following components have been used to calculate the annual operating costs.

- (i) Capital Servicing Charges - the annual interest payment on the capital costs for each extension, consisting of construction costs and vehicle acquisition costs.
- (ii) Direct Operating Costs - the annual cost of staffing, operating and maintaining the rolling stock, trackwork and electrical equipment.

The following cost estimates are based on September 1982 cost levels:-

(i) Capital Servicing Charges

Capital servicing charges have been calculated using a 16% rate of interest on capital.

The annual servicing charges are detailed in Table 6.2 and are derived from :

- (a) Construction costs which are detailed in Appendix 1 and summarized in Chapter 2.
- (b) Rolling stock costs, based on the requirement shown in Table 6.1, and assuming a cost of \$490,000 per tram.

Terminus	Annual Capital Servicing Charges \$'000
A. Blackburn Road	620
B. Springvale Road	1,260
C. Vermont South	1,720

TABLE 6.2. ANNUAL CAPITAL SERVICING CHARGES.

(ii) Direct Operating Costs

The annual direct operating costs for each of the extensions are detailed below. The costs are based on the Board's operating costs at September 1982 price levels.

Terminus	Traffic Operation	Maintenance & Energy	Total
A. Blackburn Road	\$145,000	\$ 60,000	\$205,000
B. Springvale Road	\$290,000	\$120,000	\$410,000
C. Vermont South	\$360,000	\$165,000	\$525,000

TABLE 6.3. ANNUAL DIRECT OPERATING COSTS.

(iii) Total Costs

The total annual costs of each of the extensions are shown in Table 6.4.

	A Blackburn Rd.	B Springvale Rd.	C Vermont South
	\$'000	\$'000	\$'000
Capital Servicing Charges	620	1,260	1,720
Direct Operating Costs	205	410	525
TOTAL	825	1,670	2,245

TABLE 6.4. TOTAL ANNUAL OPERATING COSTS.

## 7. REVENUE

Revenue calculations have been made using the Board's current section fare structure introduced in October 1981. It has been assumed that section points would be at Blackburn Road, Springvale Road and Vermont South Shopping Centre, and that the three extensions under consideration lie in Fare Zone 2.

The estimated annual revenue in the opening year for each extension is shown in Table 7.1. The estimate includes an allowance for the marginal additional revenue that would be collected from passengers who already use the tram from Middleborough Road.

Terminus	Revenue
Blackburn Road	\$420,000
Springvale Road	\$675,000
Vermont South	\$845,000

TABLE 7.1. ESTIMATED REVENUE IN FIRST YEAR OF OPERATION.

On the basis of these revenue estimates and the operating costs shown in Chapter 6, the estimated annual financial results for the three terminus points, in the opening year and 1990, are shown in Table 7.2.

The figures show the impact that the construction and operation of any of the extensions would have on the annual operating subsidy provided by the Government. The result for 1990 has been calculated on the basis that direct operating costs and revenue will increase by 10% per annum. Capital servicing charges remain constant throughout the evaluation period.

Terminus	Operating Results	
	Initial Year	1990
Blackburn Road	- \$ 405,000	- \$135,000
Springvale Road	- \$ 995,000	- \$615,000
Vermont South	- \$1,400,000	- \$940,000

TABLE 7.2. ANNUAL OPERATING RESULT (Interest Rate 16%).

The results shown in Table 7.2 are based on the use of a 16% rate of interest to calculate capital servicing charges. Because capital charges represent such a large proportion of annual operating costs, operating results are very sensitive to prevailing interest rates. Table 7.3 shows anticipated operating results should the Board's borrowing rate drop to 10% per annum in line with a general decrease in interest rates.

Terminus	Operating Results	
	Initial Year	1990
Blackburn Road	- \$175,000	+ \$100,000
Springvale Road	- \$520,000	- \$140,000
Vermont South	- \$755,000	- \$300,000

TABLE 7.3. ANNUAL OPERATING RESULT (Interest Rate 10%).

The cost recovery rates (revenue as a percentage of operating costs) for each extension, using 16% and 10% interest rates are shown in Table 7.4.

Terminus	Cost Recovery Rates			
	Rate of Interest : 16%		Rate of Interest : 11%	
	Initial Year	1990	Initial Year	1990
Blackburn Road	51%	86%	71%	114%
Springvale Road	40%	68%	56%	9%
Vermont South	38%	63%	53%	8%

TABLE 7.4. COST RECOVERY RATES.

The desirability of providing any community service can be assessed by many different types of criteria. In this section an attempt has been made to compare the benefits and disbenefits of the proposals by subjective means by listing and discussing the community effects. In addition a social benefit-cost analysis has been carried out comparing the proposed tram extensions with a base case of the existing public transport services in the area.

A. General Community Effects.

The traditional benefit-cost analysis can be used to assess the probable flow of benefits and costs of those effects that can be identified, quantified and valued in dollars and cents. Whilst this forms an analytical basis for comparing projects which has been widely used in the past and is included in the second part of this assessment, this type of analysis imputes a zero value to those effects which cannot be quantified.

Despite a wealth of research efforts, no acceptable technique has yet been developed for incorporating all of these effects into the framework of the traditional benefit-cost analysis. This should not be taken as a warrant for excluding them from all consideration.

It has now become obvious that the more subjective intangible effects are of greater importance to the community than those which can be quantified. For this reason some of the more important effects of the projects are discussed here. For each effect, the provision of the tram services is compared with the continuation of current trends (i.e., a "no-build" option) including current private bus operations.

- (a) A reduction in the number of road accidents could be expected from any project which induces more public transport usage and less private car usage. Accident records for buses and trams show an average of .08 injuries per million passenger-kilometres compared with a figure of .61 for cars (660% higher). The corresponding figure for tram operating in separate right-of-way is not known but it would be very low.

Although it is possible to quantify property damage effects, there is no real measure of the value of loss of life or the pain and suffering which result from road accidents.

- (b) The finite quantity of all traditional energy resources, and in particular the comparative scarcity of liquid energy sources, has become obvious in recent years. Based on average vehicle occupancy levels, the "energy intensiveness" of each of the relevant modes is about 1300 kJ/passenger-km for tram, 3600 kJ/passenger-km for cars. During peak periods these figures become 900 kJ/passenger-km for tram and 4500 kJ/passenger-km for cars. A conversion of any passengers from private car use to tram use would result in a reduction in the consumption of energy resources.
- (c) Associated with the consumption of energy is the availability of the required energy source. Electric traction vehicles can derive power from a range of primary energy sources, particularly coal, of which Australia has known supplies which would provide about  $600 \times 10^{15}$  kJ of energy. (2) In comparison, known crude oil reserves in Australia for powering cars and buses are of the order of  $10 \times 10^{15}$  kJ of energy. Shortage of supply for these modes might curtail their future use and/or substantially increase their operating costs relative to those of the tram. There is little doubt that Australia will be forced to import almost all of its fuel oil requirements within a very few years.
- (d) Introduction of the tram project would reduce the number of vehicles using Burwood Highway and adjacent streets below that which would otherwise occur. This would improve the running times and running costs for the remaining traffic.
- (e) Due to uncertainty in future travel needs, there is a benefit to be derived from flexibility in operation. The tram alternative would be less flexible than the present bus service. However, it is likely that future public transport routes will continue to use major arterial roads such as Burwood Highway.

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(2) See "Transport and Energy in Australia; Part 1 - Review" Prepared for Bureau of Transport Economics by Nicholas Clark and Associates (1975).



- (f) The acceptability of a project in terms of its visual intrusion upon the landscape is difficult to assess but the tram right-of-way would probably be more intrusive than buses in mixed traffic.
- (g) Regulations to control exhaust emissions from motor vehicles to the atmosphere have recently been introduced. The Environment Protection Authority estimates that, at present, automobiles produce more than 80% of the carbon monoxide in Melbourne's atmosphere, 60% of the nitrogen oxides and 55% of reactive hydrocarbons. The use of trams would be the more desirable to help overcome the air pollution problem.
- (h) Another form of transport-related pollution is that of noise. Tests conducted by the Board indicate that modern trams on good tracks are no noisier than motor buses. In these projects the location of the tram tracks in the central median would result in less noise intrusion to adjoining residences than would be caused by buses. The use of trams would be preferable to an unchecked build-up in private car use as would occur in the do-nothing case.
- (i) The tram proposal would provide a valuable social service in off-peak hours when existing private operators can provide only relatively infrequent services.
- (j) The tram project involving improved public transport services would increase the mobility of that section of the community which does not have a car available for regular use. It would extend the range of urban activities which could be reached within a reasonable travel time.
- (k) The cost of a second family car can be a necessity in some cases but can also be a severe financial burden. The provision of the improved public transport service would reduce the need for a second car in many cases.
- (l) A tram in its own reservation would offer a more comfortable and reliable service than the present bus service.

The advantages of each of the two projects are listed below.

No attempt will, or could, be made to compare the relative importance of these twelve criteria as bases for decision-making. The qualitative analysis purely sets out the factors, beyond those included in the traditional benefit-cost analysis, which may warrant consideration when the projects are to be assessed.

Advantages of Tram Extension :

- (a) Reduction in number of Road Accidents
- (b) Consumption of Energy Resources
- (c) Reliability of Energy Sources
- (d) Reduced Road Traffic Congestion
- (g) Less Air Pollution
- (h) Less Noise Pollution
- (i) Provision of Off-Peak Services
- (j) Improved Mobility for Car-less Households
- (k) Reduced Need for a Second Family Car
- (l) Comfort and Reliability

Advantages of Existing Bus Service :

- (e) Flexibility
- (f) Visual Intrusion

## B. Benefit-Cost Analysis

Social benefit-cost analyses of the three extensions have been made and are contained in Appendix II of this report. A summary of these analyses is presented here.

The technique used in these analyses is a procedure that examines total community costs and benefits from the extensions. The project cases are the three extensions. These project cases have been compared with the existing bus services operating over each extension with the same hours of service, service frequencies and pricing policies as at present.

Each extension has been analysed over a 30 year project period and discounted back to present values using both a 10% discount rate and a 7% discount rate.

Patronage differences between the project and base cases have been estimated using data collected on the previous East Burwood extension and from a home interview survey carried out in the area of the proposed extension. It is estimated that 15% of the project case patronage will be new or generated trips i.e. trips not at present made. These trips will be made because of the improvement in public transport accessibility that the tram extension will create. The majority of passengers using the tram extension will be existing bus and train users. However there will be some passengers who previously used a car or walked.

The project case costs would be the cost of constructing the tram line, purchasing the rolling stock and operating the service. These costs were discussed in Chapters 2 and 6.

The benefits of the tramway extensions would accrue to both users and non-users of the system. The benefits quantified in the analyses are summarized below :-

- (i) People converting from bus travel in the base case would benefit from faster travel speeds, the elimination of a mode change at Middleborough Road and increased travel comfort.

- (ii) People converting from train travel in the base case would benefit from reduced access mode travel times and the majority will benefit from the elimination of a mode change at rail stations.
- (iii) People converting from cars would personally benefit from the conversion to the tram mode (otherwise they would not convert). At the same time there would be a saving in community resources from reduced car usage and a reduction in road congestion.
- (iv) People converting from walking would benefit primarily from faster trip times.
- (v) People who did not make a trip in the base case would derive benefit from making the trip in the project case (otherwise the trip would not be made).
- (vi) The cost of operating base case bus services along Burwood Highway would be saved when a tram service was in operation.

Although patronage has been reduced on the rail mode no cost savings that might result from this reduction have been included in this analysis.

The present value of the costs and benefits of each extension for 10% and 7% discount rates and the benefit-cost ratios are shown in Table 8.1.

Extension	Present Value of Costs (\$'000)	Present Value of Benefits (\$'000)	Benefit-Cost Ratio
10% Discount Rate			
A. Blackburn Road	5,610	5,835	1.0
B. Springvale Road	11,320	9,000	0.8
C. Vermont South	15,125	12,185	0.8
7% Discount Rate			
A. Blackburn Rd.	6,295	7,695	1.2
B. Springvale Rd.	12,695	12,065	1.0
C. Vermont South	16,885	16,090	1.0

TABLE 8.1.

## APPENDIX I.

## CONSTRUCTION COSTS

## MIDDLEBOROUGH ROAD TO BLACKBURN ROAD

\$'000

## Trackwork -

Concrete to surface, double track construction including overhead wiring, feeder cables and poles

1,365

## Roadwork -

New paving, kerbing and channeling, footpaths, nature-strip and drainage, modification to traffic signal controllers, overhead skates and loops and connecting wiring to traffic lights

875

Relocation of services

555

1,430

## Passenger Shelters -

Manufacture and erection of 6 shelters

30

TOTAL

2,825

Say \$2.9 million

MIDDLEBOROUGH ROAD TO SPRINGVALE ROAD

\$'000

Trackwork -

Concrete to surface, double track construction including overhead wiring, feeder cables and poles

2,650

Roadwork -

New paving, kerbing and channeling, footpaths, nature-strip and drainage, modification to traffic signal controllers, overhead skates and loops and connecting wiring to traffic lights

1,690

Relocation of services

1,085

2,775

Substation -

Land acquisition

50

Building costs

120

One rectifier unit, breaker, feeder panels and miscellaneous equipment

210

380

Passenger Shelters -

Manufacture and erection of 12 shelters

55

TOTAL

5,860

Say \$5.9 million

MIDDLEBOROUGH ROAD TO VERMONT SOUTH

\$'000

Trackwork -

Concrete to surface double track construction including overhead wiring, feeder cables and poles

3,700

Roadwork -

New paving, kerbing and channeling, footpaths, nature-strip and drainage, modification to traffic signal controllers, overhead skates and loops and connecting wiring to traffic lights

2,370

Relocation of services

1,500

3,870

Substation -

Land acquisition

50

Building costs

120

Two rectifier units, breakers and feeder panels and miscellaneous equipment

420

590

Passenger Shelters -

Manufacture and erection of 18 shelters

85

TOTAL

8,245

Say \$8.3 million

Social benefit-cost analysis is a technique used for indicating the worth of projects involving public expenditure. In addition to analysing the direct costs and benefits of the project, the analysis also evaluates some of its community and social effects.

Essentially, the analysis attempts to add the costs and benefits of travel associated with the project being investigated (project case) and compares these with costs and benefits associated with making those same trips if the project was not implemented (base case). In addition to direct costs and benefits (capital and operating costs, savings in bus operating costs) which are included in the analysis, benefits such as reduced travel times, increased comfort and convenience to public transport passengers and reductions in road congestion costs are also considered.

However, because they cannot at this time be measured objectively, many other community benefits including reducing the use of scarce oil resources, reducing pollution levels, and enabling families in newly developed housing areas to provide for their transport needs without purchasing a second car have not been included. The social benefit-cost ratios are therefore lower than they should be, but it is not possible to say by how much. It therefore becomes a subjective judgement to assess the worth of these intangible community benefits.

The project cases in this analysis are the three possible tramway extensions -

Project Case A	-	Blackburn Road
Project Case B	-	Springvale Road
Project Case C	-	Vermont South

The analysis is shown for both a 7% and 10% discount rate and covers a 30 years project period. In the analysis all costs and benefits are discounted back to present values. When the ratio of the present values of the discounted benefits to discounted costs equals or exceeds 1.0, it is considered that the community would benefit from the project.

#### Patronage Differences between Project and Base Cases

The patronage estimates for the various project cases are the same as those discussed in Chapter 5 and shown in Table 5.2. It has been assumed that patronage would remain constant after 1990.



The modes that would be used in the base cases are shown in Table 1. The figures were estimated using data collected on the tram extension between Warrigal Road and Middleborough Road and from a home interview survey of residents in the area of the extension.

The additional public transport trips in the project cases would come from people who would, in the base case, travel by car or walk, or who would not have made a trip at all.

<u>Blackburn Road</u>			
	<u>Initial Year</u>		<u>1990</u>
Generated	435		522
Walk	247		296
Train	741	(Bus 370 (Car 120 (Walk 251	(Bus 444 (Car 144 (Walk 301
Bus	568		682
Tram	420	(Bus 140 (Car 70 (Walk 210	(Bus 168 (Car 84 (Walk 252
Car Driver	296		355
Car Pass.	<u>198</u>		<u>238</u>
TOTAL	<u>2,905</u>		<u>3,486</u>
<u>Springvale Road</u>			
Generated	622		748
Walk	353		424
Train	1,059	(Bus 530 (Car 177 (Walk 352	(Bus 636 (Car 212 (Walk 422
Bus	862		974
Tram	459	(Bus 140 (Car 109 (Walk 210	(Bus 168 (Car 131 (Walk 252
Car Driver	494		593
Car Pass.	<u>353</u>		<u>424</u>
TOTAL	<u>4,153</u>		<u>4,983</u>
<u>Vermont South</u>			
Generated	765		918
Walk	434		521
Train	1,302	(Bus 650 (Car 217 (Walk 435	(Bus 780 (Car 260 (Walk 522
Bus	998		1,198
Tram	521	(Bus 150 (Car 161 (Walk 210	(Bus 180 (Car 193 (Walk 252
Car Driver	651		781
Car Pass.	<u>434</u>		<u>521</u>
TOTAL	<u>5,105</u>		<u>6,126</u>

TABLE 1. MODE OF TRAVEL IN BASE CASES. (TRIPS PER DAY).

B. Costs

Project Case

For these evaluations it has been assumed that each of the extensions would be built within one year and that operations would commence in 1985 when the new trams necessary to operate the service would be purchased. These trams would be replaced after 30 years service.

The capital and operating costs of the projects - tram purchase costs, maintenance costs, platform staff costs, traction energy costs, track and overhead costs, and administrative and stores costs - were discussed in Chapters 2 and 6.

The present value of these various cost items are shown in Table II.

	Blackburn Rd.	Springvale Rd.	Vermont South
	\$'000	\$'000	\$'000
<u>10% Discount Rate</u>			
Construction Costs	2,760	5,620	7,905
Rolling Stock Costs	890	1,780	2,230
Operating Costs	1,960	3,920	4,990
Total	5,610	11,320	15,125
<u>7% Discount Rate</u>			
Construction Costs	2,805	5,700	8,020
Rolling Stock Costs	915	1,835	2,290
Operating Costs	2,580	5,160	6,575
Total	6,300	12,695	16,885

TABLE II. PRESENT VALUE OF PROJECT CASE COSTS.

Base Case

The cost of operating the base case bus services along the Burwood Highway would be saved if the tram extensions were built. These

savings in bus operating and capital costs have been treated as benefits to the project case and are discussed in the Benefits sections.

C. Benefits

The benefits of the tramway extension would accrue to individuals using the tramway and, in some cases, to non-users of the system. These benefits are quantified under the following headings.

1. Benefits to converted bus travellers.
2. Benefits to converted train travellers.
3. Benefits to converted car travellers and remaining road users.
4. Benefits to converted walkers.
5. Benefits to generated passengers.
6. Savings in bus operations.

1. Benefits to Converted Bus Travellers

People who converted from bus travel in the base case to tram travel in the project case would benefit in three ways. Firstly, their journey times along the extensions would be faster because of the improved level of service and because of the trams faster operating speeds. Secondly, for those people travelling through the present extensions, there would be a significant time saving resulting from the elimination of the change of mode. Thirdly, passengers would benefit from the greater comfort of tram travel compared with bus travel.

2. Benefits to Converted Train Travellers

People who converted from train travel in the base case to tram travel in the project case would benefit in two ways. Firstly, there would be a significant reduction in walking and waiting time involved in accessing the main travel mode. Secondly, there would be a significant time saving resulting from the elimination of the change of mode.

3. Benefits to Converted Car Travellers and Remaining Road Users

The following benefits resulting from the conversion of car drivers and passengers to tram travel have been identified.

- (i) Base case passengers converting from car travel in the base case to tram travel in the project case would derive benefits from the mode conversion. If this was not the case then conversion would not take place. Because of difficulties in quantifying these benefits it has been assumed that converting car travellers would derive benefits equal to half the rate applying to converting bus travellers.
- (ii) The saving in community resources. By not travelling in private cars, but rather travelling by public transport which will be operating anyway, the resource cost of these car trips will be saved. Also there will be a resource saving in not having to provide car parking spaces for these vehicles.
- (iii) The benefit to remaining road users. The remaining road users would benefit from the reduction in private vehicles on the roads, and therefore a reduction in traffic congestion.

4. Benefits to Converted Walkers

To converted walkers the benefit of the tramway extensions would be the time saving and convenience that the tram service would offer for that section of the walk trip made along the proposed routes.

The benefit accruing to converted walkers is calculated as being half the rate applying to base case bus travellers.

5. Benefits to Generated Passengers

Generated passengers are those people who make a trip in the project case that would not be made in the base case. These people will not or cannot make a car, bus or walk trip in the base case, but will make a trip in the project case using the tramway service.

The benefit accruing to generated passengers is calculated as being half the rate applying to base case bus travellers.

6. Savings in Base Case Operations

The resource savings obtained by not operating base case bus services have been treated as benefits to the project cases.

In the opening year one bus would be required for a bus service to Blackburn Road, one bus to Springvale Road and 2 buses to Vermont South.

The present values of the base case capital and operating costs are shown in Table III.

	Blackburn Rd.	Springvale Rd.	Vermont South
	\$'000	\$'000	\$'000
<u>10% Discount Rate</u>			
Capital Costs	140	140	280
Operating Costs	550	630	930
Total	690	770	1,210
<u>7% Discount Rate</u>			
Capital Costs	140	140	280
Operating Costs	715	830	1,225
Total	855	970	1,505

TABLE III. PRESENT VALUE OF BASE CASE COSTS.

D. Summary

The present value of the benefits and costs of each extension and the benefit cost ratios are shown in Table IV.

Termini	Present Value of Costs	Present Value of Benefits	Benefit-Cost Ratio
	\$'000	\$'000	
<u>10% Discount Rate</u>			
Blackburn Road	5,610	5,835	1.0
Springvale Road	11,320	9,000	0.8
Vermont South	15,125	12,185	0.8
<u>7% Discount Rate</u>			
Blackburn Road	6,300	7,695	1.2
Springvale Road	12,695	12,065	1.0
Vermont South	16,885	16,090	1.0

TABLE IV. PRESENT VALUES AND BENEFIT-COST RATIOS.