

**MENAI AREA
TRAFFIC STUDY**

**Client: Transport Planning Section
Roads and Traffic Authority**

**Consultant:
Traffic Planning Pty Ltd, 92 Cathedral Street, Woolloomooloo NSW 2011.**

CONTENTS

1.0	INTRODUCTION	1
2.0	EXISTING TRAFFIC NETWORK	4
	2.1 THE ROAD NETWORK	4
	2.2 TRAFFIC VOLUMES AND GROWTH	5
	2.3 PERFORMANCE OF THE EXISTING ROAD SYSTEM	7
3.0	ORIGIN DESTINATION SURVEY	10
4.0	ACCIDENT HISTORY	11
	4.1 CASUALTY ACCIDENT RATES	11
	4.2 LOCATION OF SERIOUS CRASHES	12
	4.3 PEDESTRIAN/CYCLE CRASHES	13
5.0	POPULATION GROWTH	14
6.0	PUBLIC TRANSPORT	16
	6.1 BUS SERVICES	16
	6.2 TRAINS	16
7.0	PROPOSED ROAD PROJECTS	18
8.0	FUTURE TRAFFIC VOLUMES AND ASSIGNMENT	22
	8.1 FUTURE TRAFFIC VOLUMES	22
	8.2 TRIP DISTRIBUTION OF LOCAL TRAFFIC	24
	8.3 TRIP ASSIGNMENT	24
	8.4 HEAVY GOODS VEHICLE MOVEMENTS	27
9.0	ECONOMIC EVALUATION	34
10.0	CONCLUSIONS	36

APPENDIX 1 - Origin & Destination Survey Results

List of Figures:

Figure 1.1 Study Area

Figure 1.2 Road Proposals

Figure 2.1 Existing AADT volumes

Figure 2.2 Average Travel Speeds from RTA speed survey

Figure 8.1 Existing Traffic Volumes

Figure 8.2 Volumes on Road Network in 1995

Figure 8.3 Volumes on Road Network in 1995

Figure 8.4 Volumes on Road Network in 1995

Figure 8.5 Volumes on Road Network in 1995

Figure 8.6 Volumes on Road Network in 2000

1.0 INTRODUCTION

This study was commissioned by the Roads and Traffic Authority (RTA) to investigate the strategic needs of the major road system in the Menai area. The study area is shown on figure 1.1. The Menai area is going to be the focal point of substantial residential development in the forthcoming decade and beyond and the effect of this development will be to increase vehicular trip making for a number of trip purposes (ie. work, shop, educational and social) to adjacent centres such as Sutherland, Liverpool and Bankstown. The existing centres of Sutherland and surrounding areas therefore require direct road connections to the adjacent centres mentioned above.

The RTA is currently constructing a new four lane deviation of Old Illawarra Road north of Menai Road and further road improvement proposals are presently being evaluated for other major roads in the study area, e.g. Menai Road, River Road, Alford's Point Road, Old Illawarra Road, New Illawarra Road and Heathcote Road (see figure 1.2).

This study has considered the existing road system, the growth in traffic and population and the opportunity for upgrading the major road network in the short and long term.

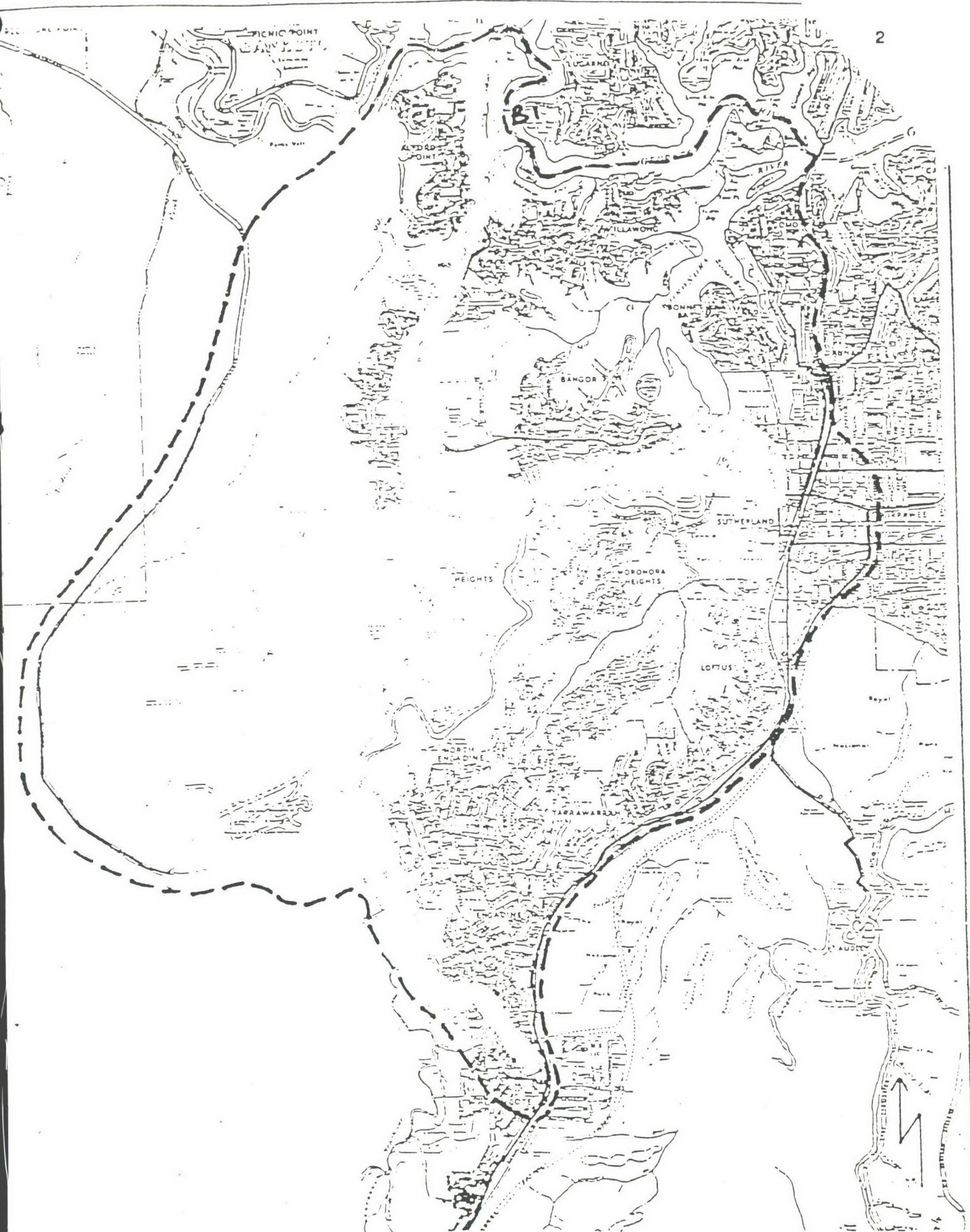


FIGURE 1.1: STUDY AREA

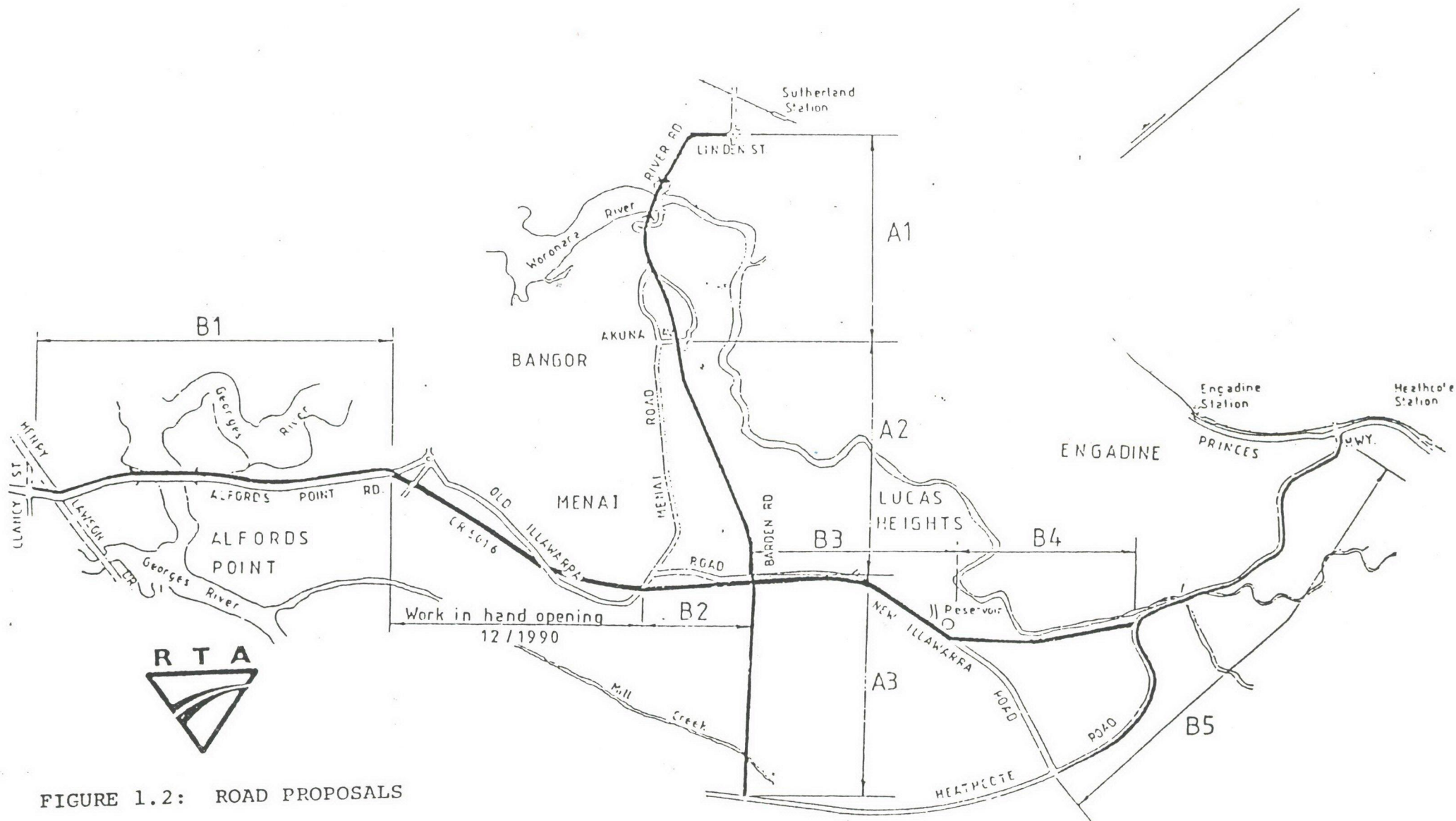


FIGURE 1.2: ROAD PROPOSALS

2.0 EXISTING TRAFFIC NETWORK

2.1 THE ROAD NETWORK

The road hierarchy within the study area is described below.

2.1.1 Arterial Roads

Arterial roads predominantly carry through traffic from one region to another; and are usually part of the classified Main Road system. Arterial roads within the study area are described below.

1. The **Princes Highway** provides a major north-south regional link between Sydney and Wollongong, and further south. In the vicinity of the study area, it is generally a divided 6 lane carriageway.
2. **Old and New Illawarra Roads** run north-south, from the study area border in the south to its junction with Alford's Point Road north of Menai. It is an undivided 2 lane carriageway.
3. **Alford's Point Road** provides the only crossing directly from the study area across the Georges River to Padstow and Henry Lawson Drive. It has an undivided 4 lane carriageway, except for the Alford's Point Bridge which has 3 lanes with tidal flow.
4. **Heathcote Road** runs from the Princes Highway in the south of the study area to Liverpool. It is an undivided 2 lane carriageway with climbing lanes for most of its length.
5. **Menai Road** forms part of an east-west link in the study area between the Woronora River and Old Illawarra Road. It is an undivided 2 lane road from its junction with River Road at the Woronora River to just east of Old Illawarra Road and a divided 4 lane road from there to its intersection with Old Illawarra Road. A continuous arterial route east of the Woronora River Bridge is provided by River Road, Linden Street, The Grand Parade and the Old Princes Highway.

2.2 TRAFFIC VOLUMES AND GROWTH

Average annual daily traffic figures are shown in figure 2.1. These figures were obtained from the Roads and Traffic Authority, Traffic Volumes and Supplementary Data, 1987. For the Princes Highway, Alfords Point Bridge and the existing Woronora Bridge, the RTA supplied recent classified counts (1989, 1990).

The location of the counting stations is as follows:

- Heathcote Road, west of Princes Highway
- New Illawarra Road, north of Heathcote Road
- Alfords Point Road at Alfords Point Bridge
- Menai Road, east of Old Illawarra Road
- Menai Road, at the bridge over the Woronora River

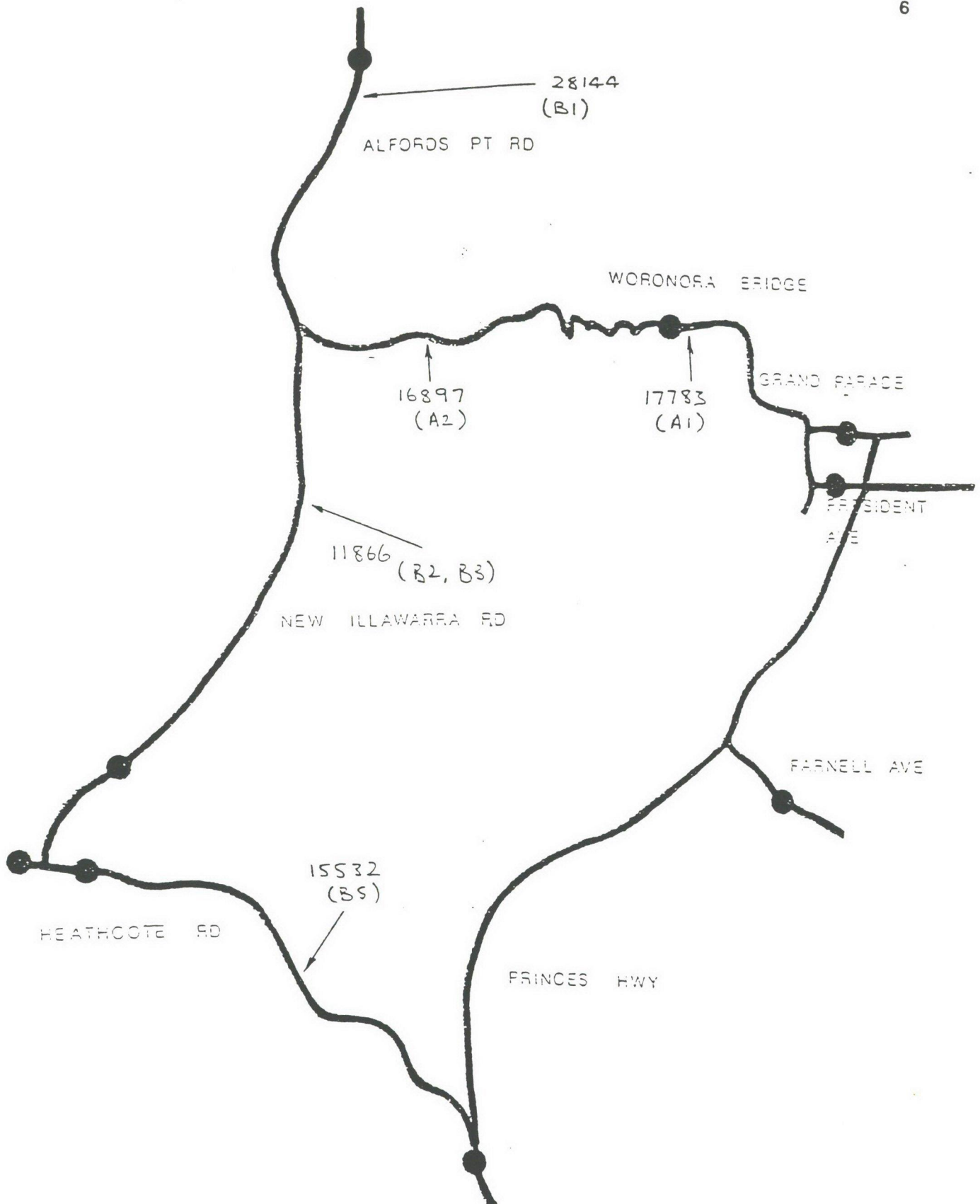


FIGURE 2.1: EXISTING AADT VOLUMES

The annual growth of traffic on the road network has been between 3% and 10% per annum since 1979, although this growth has been slowing in recent years. Table 2.1 shows the average growths for key roads in the study area.

**Table 2.1 : Annual Growth of Traffic for Key Roads
within the Study Area.**

Road	Location	Growth (% p.a.)	
		1979-1987	1985-1988
Princes Highway	Sth of Farnell Ave	3.1*	6.4**
Alfords Point Rd	Alfords Point Bridge	9.9*	5.9**
Menai Road	Woronora Bridge	8.0	6.2
Menai Road	East of Old Illawarra Rd	7.9	6.1
Old Illawarra Rd	North of Menai Rd	8.6	7.0
Old Illawarra Rd	South of Menai Rd	7.1	10.3
		*1979-1988	**1987-1988

2.3 PERFORMANCE OF THE EXISTING ROAD SYSTEM

The two major indicators of the performance of the present major road system are travel speeds and intersection delays.

2.3.1 Travel Speeds

From the origin and destination survey (see Section 3) average travel speeds were identified for both cars and trucks over various routes through the study area. Table 2.2 sets out the travel speeds on the various segments of the routes, calculated from data collected in the O.D. survey. In addition travel speeds were measured by the RTA using the floating car method and these speeds are shown on figure 2.2. It can be seen that travel speeds in the a.m. peak period on Menai Road and Heathcote Road average 55 km/hr. Speeds on Alfords Point Road northbound are higher at 69 km/hr and on New Illawarra Road recorded at 73 km/hr.

Table 2.2 Speeds calculated from travel times from the RTA's O.D. Study

Start Point	End Point	Length (km)	Time (min)	Average Speed (km/hr)
Alfords Pt Rd Survey Station	Grand Parade Survey Station	10.2	14.5	42
Grade Parade Survey Station	Alfords Point Survey Station	10.2	20.4	30
Alfords Pt Rd Survey Station	Heathcote Rd Survey Station	9.5	5.0	114
Alfords Pt Rd Survey Station	Princes Highway Survey Station	12.9	15.0	52
Princes Hwy Survey Station	Alfords Pt Rd Survey Station	12.9	22.0	35
Heathcote Road Survey Station	Alfords Point Survey Station	9.5	11.0	52
Heathcote Road Survey Station	Princes Highway Survey Station	4.2	7.6	33
Princes Highway Survey Station	Heathcote Road Survey Station	4.2	10.8	23

2.3.2 Intersection Delays

All intersections appear to operate satisfactorily except the intersection of Old Illawarra Road and Menai Road. This intersection is signalised and heavily trafficked in the morning and evening periods. In the morning peak, large delays are experienced by northbound traffic on the south and east approaches due to inadequate carriageway capacity north of the intersection. Queue lengths of 1.5 km were observed in the morning peak on the southern and eastern approaches to this intersection.

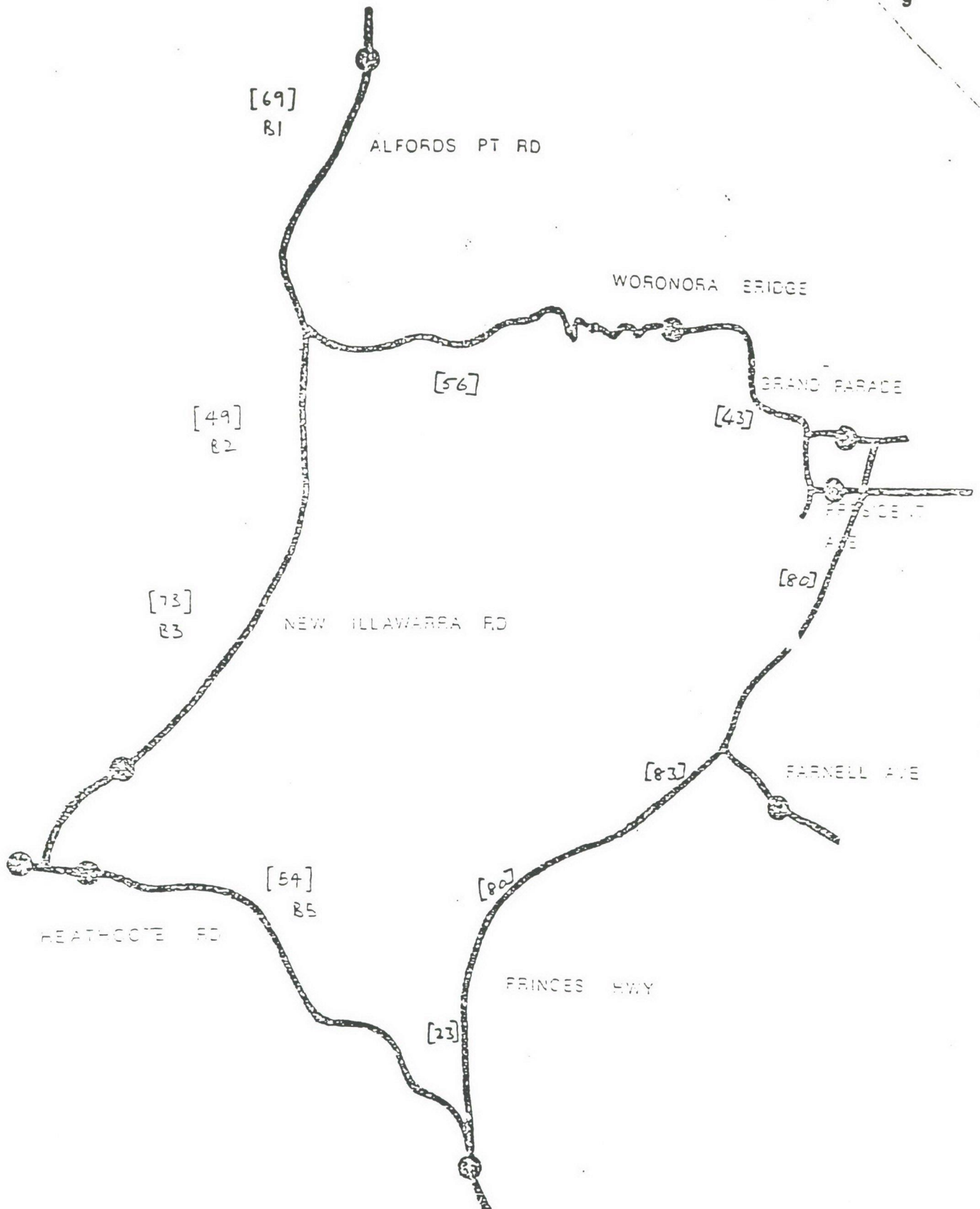


FIGURE 2.2 : AVERAGE TRAVEL SPEEDS
km/hr (all vehicles)
AM PEAK PERIOD

3.0 ORIGIN DESTINATION SURVEY

A survey of vehicle origins and destinations in the study area was undertaken by the RTA on Tuesday 20/2/90 and Sunday 18/2/90. The survey was able to distinguish between light and heavy vehicles and thus determine truck routes. The results of this survey are presented on Table 3.1, for the weekday morning peak periods.

It can be seen from Table 3.1 that through traffic comprises a small proportion of traffic entering at stations on Heathcote Road, Alfords Point Road, The Grand Parade and President Avenue. Only a small proportion of traffic entering the study area on the Princes Highway exits through the study area. Through movements on the Princes Highway, however, would obviously account for a high proportion of traffic observed at the Princes Highway station.

Truck routes were also observed, and it can be seen from Table 3.1 that though trucks were not observed using the Menai Road, River Road route. Truck routes were observed using Heathcote Road, New Illawarra Road, Old Illawarra Road and Alfords Point Road.

There are strong north-south movements taken up by the Princes Highway, Heathcote Road and Old Illawarra Road. The east-west movement at present is devious as there is no short connection between Menai Road and Heathcote Road.

By improving some part of the road network it is possible that some extraneous trips (ie. presently outside the study area) could be drawn into the area by the improved level of service. The only likely possibility for such a redistribution of trips would be the long distance east-west movement. If the River Road, Menai Road route together with a direct connection to Heathcote Road were constructed to a high standard then it is possible that trips from the Ramsgate and southern areas with a journey to Liverpool and beyond (and return) could be attracted to the upgraded east-west route. It is unlikely that trips further north say from Botany or Sydney Airport would be attracted to the east-west route as the increased journey distance would not be worth any travel speed benefits. So the number of heavy through trips which can be expected to divert to Menai Road can be expected to be small.

Appendix I shows the origin Destination Survey's results diagrammatically.

**Table 3.1: Results of Number Plate Survey
Weekday Morning Peak Two Hour Period**

Entry Station	Exit Station	Via	Sample		Cars	Matched % of Sample	Trucks	%
			Cars	Trucks				
Alfords Pt Rd	Woronora Bridge	Woronora Bridge	163	76	22	13.5	2	2.6
	Grand Parade		163	76	13	8.0	1	1.3
	Old Illawarra Rd		163	76	47	28.8	38	50.0
	Heathcote Rd (East)	Old Illawarra Rd	163	76	12	7.4	2	2.6
	Princes Hwy	Old Illawarra Rd & Heathcote Rd	163	76	9	5.5	2	2.6
Princes Highway	Heathcote Rd (East)	Heathcote Rd (East)	360	83	54	15.0	10	12.0
	Heathcote Rd (West)		360	83	21	5.8	0	0.0
	Old Illawarra Rd		360	83	22	6.1	5	6.0
	Alfords Pt Rd	Heathcote Rd (East) & Old Illawarra Rd	360	83	16	4.4	0	0.0
	Woronora Bridge	Woronora Bridge	360	83	4	1.1	0	0.0
	Grand Parade		360	83	12	3.3	0	0.0
	President Avenue		360	83	2	0.6	0	0.0
Heathcote Rd (West)	Old Illawarra Rd	Old Illawarra Rd	80	31	9	11.3	1	3.2
	Woronora Bridge		80	31	3	3.8	0	0.0
	Heathcote Rd (East)		80	31	7	8.8	0	0.0
	Princes Hwy	Heathcote Rd (East)						
Grand Parade	Woronora Bridge	Woronora Bridge	133	14	29	21.8	1	7.1
	Alfords Pt Rd		133	14	11	8.3	0	0.0
	Heathcote Rd (West)		133	14	1	0.8	0	0.0
President Avenue	Woronora Bridge		108	5	22	20.4	0	0.0

4.0 ACCIDENT HISTORY

4.1 CASUALTY ACCIDENT RATES

The RTA's Transport Planning Section provided an analysis of accidents on major roads in the Menai area. (Roads and Traffic Authority, 1990. Menai Accident & History. Transport Planning, Consulting Services). The roads included in the analysis for the period 1971 to 1978 and 1982 to 1988 were as follows:

- Alford's Point road
- New Illawarra Road
- Old Illawarra Road
- Menai Road
- River Road
- Linden Street
- Loftus Avenue
- Heathcote Road and
- Princes Highway between Heathcote Road and Kirrawee.

Accident data for 1978 to 1981 was not available.

The reason for the gap in the years of analysis is the change in the computerised recording system in this intervening period.

A total of 2034 crashes were collated for the 11 year recording period with 1985 the worst year with 275 recorded crashes. The breakdown of the total crash sample is as follows:

		%
Fatalities	34	1.7
Admitted Injury	188	9.2
Treated Injury	472	23.2
Untreated Injury	29	1.4
Tow away	<u>1311</u>	<u>64.5</u>
Total	2034	100

In terms of the individual roads Table 4.1 provides an indication of the latest casualty rates (using 1987-88 data as a basis). From Table 4.1 it is apparent that the route with the worst casualty crash rate (0.73 casualty crashes per million vehicle kilometres) is the section of the Old Illawarra Road from Barden Road to Menai Road.

The second worst accident location in terms of casualty crash rate is the section of road Linden Street/River Road/Menai Road with a rate of 0.61 crashes per million vehicle kilometres. The third worst accident rate is the section of Heathcote Road from New Illawarra Road to Princes Highway with a casualty crash rate of 0.57 crashes per million vehicle-km. To put these figures into perspective it is the RTA's corporate target to reduce to 0.7 casualty crashes per million vehicle kilometres on arterial roads in metropolitan areas.

4.2 LOCATION OF SERIOUS CRASHES

By plotting the location of serious crashes (ie. fatality or admitted injury) for the period 1982 to 1988 it is possible to identify stretches of road that have been subject to concentrations of crashes.

The following locations were identified from a plot of serious crashes:

- (i) Heathcote Road
 - at a sharp bend one kilometre west of the junction with New Illawarra Road.
 - Deadmans Creek
 - on both approaches to the Woronora River.
 - on the eastern approach to New Illawarra Road.
- (ii) Old Illawarra Road south of Menai Road and north of Bishop Road.
- (iii) Old Illawarra Road near Rosewall Drive.
- (iv) Menai Road, from the existing Woronora River bridge to Anzac Road.
- (v) Princes Highway
 - at Engadine
 - close to the Royal National Park turnoff (Farnell Avenue).

Table 4.1: Casualty Accident Rates

Project	Location	AADT (veh)	Length In km	N° of Crashes Total	1987 & 1988 Casualty Crashes	Persons Killed	Persons Injured	Casualty Crash Rate (mlll/veh-km)
A1	Linden/River/Menai Rds	17,783	2.9	68	23	1	22	0.61
A2	Menai Rd (west of Akuna Ave)	16,987	2.3	46	13	0	21	0.46
B1	Alfords Point Rd	28,144	2.7	15	5	0	8	0.09
B2	Old Illawarra Rd (Barden/Menai Rds)	11,866	1.1	18	7	1	9	0.73 ^a
B3	Old/New Illawarra Rd	11,866	2.0	10	5	0	6	0.29
B4	New Illawarra Rd	9,556	3.0	7	3	0	3	0.14
B4 & B5	Heathcote Rd (Woronora Bridge/ New Illawarra Rd)	14,420	3.0	42	16	3	21	0.51
B5	Heathcote Rd (East of Woronora Bridge)	15,532	2.8	57	18	0	23	0.57
	Heathcote Rd (West of New Illawarra Rd)	21,453	9.0	26	13	5 ^b	20	0.09
	Linden St/Loftus Ave	7,530	3.7	24	11	0	13	0.54
	Old Illawarra Rd (North of Menai Rd)	23,381	2.5	25	10	1	12	0.23
	Princes Highway	33,365	7.7	146	44	0	75	0.23

Source: Roads and Traffic Authority. Menai Accident History 1990.

Legend: ^a A higher than RTA's corporate target of 0.7
^b These fatalities occurred west of the study area near Deadmans Creek

4.3 PEDESTRIAN/CYCLE CRASHES

Pedestrian and cycle crashes were also plotted in order to identify if these groups of road users were vulnerable in the study area. The majority of pedestrian and cycle crashes took place on the Princes Highway. In the case of cycle crashes it is not unexpected that the Princes Highway would be a location for such events as the route is a popular location for cycle activities. Away from the Princes Highway there are very few cycle crashes. Cyclist facilities have been improved on the Princes Highway by sealing of road shoulders between Sutherland and Heathcote.

The Princes Highway was also the most common location for pedestrian accidents, with Engadine and north of its junction with the Old Princes Highway the most prevalent sites of crashes involving pedestrians.

5.0 POPULATION GROWTH

The Sutherland Shire has a number of development areas in the west of the shire that will directly impinge on the road network discussed in this report. The development areas are shown in table 5.1 together with the estimated final population and the estimated increase in population between the present and final development.

**Table 5.1 : Residential Development Areas
In the Menai Area**

	Total Projected		Increase in		Development Horizon
	Dwellings	Population	Dwellings	Population	
Bangor	1,700	5,610	240	790	1992
Menai	1,207	3,980	170	560	1992
Illawong	2,273	7,500	250	830	1994
Alfords Point	917	3,000	210	690	1992
Lucas Heights	1,385	4,570	870	2870	1994
West Menai (1995)	500 to 700	1,650 to 2,300	500 to 700	1,650 to 2,300	1995
West Menai (2000)	3,800	12,500	3,800	12,500	2000
Menai Town Centre + adjacent	1,250	4,130	340	1,120	1995
Total	12,532	41,290	5,880	19,360	(2000)
West Menai (post 2000)	5,000	16,500	5,000	16,500	2005

Source Sutherland Shire Council, 1990.

From the above table it is apparent that in the period 1992 to 2010 the study area could be subject to substantial increases in population which would increase the level of vehicular trip making in the area. In the period 1990 to 1995 there could be as many as 6,900 additional people living in the area together with additional work and retail opportunities in close proximity to the Menai Town Centre.

The Department of Housing is proposing to develop the West Menai area. Discussions were held with Department of Housing officers and they indicated that the development is very likely to proceed as it is one of the few remaining large development areas with good rail and road connections to Sydney. The east-west link road (project A3) would be integral to this development proceeding.

From previous studies by the RTA (Roads and Traffic Authority. Shire of Sutherland Roads Needs and Traffic Study 1989) a trip generation figure of 0.73 trips per dwelling per

morning peak hour was established. From the figures in Table 5.1 it is apparent that trip activity in the overall study area could increase dramatically by the year 2000.

6.0 PUBLIC TRANSPORT

6.1 BUS SERVICES

At present there is a reasonable level of bus services into the Menai region with the majority of the services focussing on the Sutherland Town Centre and the Railway Station at Sutherland in particular. The Lucas Heights Atomic Energy Establishment is not served by a regular bus service but the suburbs of Alford's Point, Illawong, Menai, Bangor, Woronora, Woronora Heights, Engadine and North Engadine, Yarrowarra and Loftus do have such services.

There is an awareness by both State Transit and the private operators of the growth in population and the need to provide new and expanded bus services to accommodate the new residents of the Menai area. There is also an awareness of some operators to provide "through ticketing" from the Menai area to Miranda and return which is likely to be established and expanded with the growth of bus users in the Menai area.

6.2 TRAINS

The main focus of public transport in the region is Sutherland Station. The combination of Illawarra Line trains and the Cronulla Line service results in very low headways between railway services especially at peak hours. The result of this high level of service is that patrons use the service heavily and this arrangement will continue into the future.

Sutherland Station will be a strong focus of public transport trips from the Menai area whether it is accessed by bus or by private car. A conscious decision to provide car parking around the station has resulted in a considerable number of vehicular trips generated by the station and this trip making has commercial spin-off to the Sutherland Town Centre.

There is the potential for the development of the Sutherland Station complex for a mixed commercial development but this would not alter the level of service provided by the SRA. The development of further rail connections such as a connection from Sutherland to East Hills is not part of SRA plans. Any such rail links would require a complete new corridor for the facility and would require at least new major bridge crossings of the Georges River and possibly Woronora River.

From the above comments it is apparent that in the future development of the Menai area the prime mode of public transport access will be bus which in turn will require an efficient road network to operate effectively.

7.0 PROPOSED ROAD PROJECTS

PROJECT DESCRIPTION

The study area has a limited number of major roads and a number of projects have already been suggested that would improve various deficiencies in the existing road network. These road proposals have been identified as:

Schemes A1, A2, A3 - the east-west road improvements
and B1, B2, B3, B4 and B5 - the north-south road improvements.

A brief description of each scheme is set out below

The East-West Improvements

A1. Crossing of the Woronora River

This scheme has been designed to alleviate the poor alignment and steep topography associated with the existing route which has low speed bends and steep grades without climbing lanes. The proposal would involve the construction of a new bridge over the Woronora River and improved approaches. For approximately half of the route the new road shares the existing road corridor created by River Road and Menai Road. It is only to the west of the existing river bridge that a separate road reservation exists to the south of the existing Menai Road road reservation. Sutherland Shire Council is currently building a road within this reservation to remove two hairpin bends.

If the subsequent section of the route to the west, described in A2 below, is not constructed at the same time as the new bridge then traffic would connect with the existing Menai Road using a short section of Akuna Road.

A2 Menai/Bangor

At present there is a wide (as much as 100 metres in some places) corridor designated for the development of a new road connecting Akuna Ave to Old Illawarra Road. Potentially the road could provide access to developments to the south of Menai Town Centre and to potential development areas to the north of the Woronora River but the question of having direct access off a new arterial road needs further evaluation. At this stage the road proposal is at a fairly preliminary stage but it is envisaged the road would be a dual 2 lane facility with at least a 5 metre wide median.

The road corridor is wide enough to accommodate noise attenuation measures on either side of the road. The intersection of this new road with Old Illawarra Road and Department of Housing Road (see A3) may need to be constructed to a higher standard, possibly being grade separated.

At the eastern end of the proposed new road only two ramps would be needed at Akuna Road (ie. ramps at Akuna Road for eastbound traffic and on ramps for westbound traffic would not be needed). This arrangement would be cost effective and yet access and egress to the west would be achieved via the Menai Road/Old Illawarra Road route.

Access to the Woronora River areas off Shackel Road and Anzac Road have yet to be determined but it is possible to have the area served by one bridge/underpass to avoid the need for at grade intersections which would disadvantage through traffic in the east-west direction. The only vehicular bridge included in the proposed road works is the direct (ie. no ramps) bridge from Australia Road into the new development area to the north.

A3. The Department of Housing's East West Road Link (the West Menai Link Road).

The Department of Housing wish to develop the area of land to the west of Old Illawarra Road and intend to create a new road that would link the Old Illawarra Road with Heathcote Road over Mill Creek. (A3 link).

If this route is constructed to a high standard and in conjunction with schemes A1 and A2 it could establish an attractive east-west corridor which could have a regional role in the outer Sydney road network. There could be some traffic attracted to this route from other routes but the sphere of influence would be limited. If the road was constructed to local road standard (ie. narrow lanes) such a design could be a deterrent to through movements. However when the RTA's regional model (TRANSPLAN) was used to assess this potential it was found that this route did not attract a large volume of additional users.

This east-west route may eventually require the construction of a full interchange on Old Illawarra Road in the future.

This east-west road is a fundamental part of the Department of Housing's subdivision development which is due for commencement in 1992 but full occupation will occur closer to 2005, so it is likely that this route in some form (whether a local route or constructed to a higher standard) will proceed. The Department of Housing is currently developing a detailed design for this link which allows an ultimate dual two lane road with 80km/hr design speed, but discussions with the Department have revealed that this road would not be constructed before 1995.

From the above comments is apparent that there are detailed proposals for an east-west route. At present the existing east-west traffic levels are growing at approximately 6% per annum.

The North-South Improvements

There are a number of north-south road proposals which have already been suggested by the RTA as possible improvements. The following comments refer to the schemes B1, (Between B1 and B2), B2, B3, B4 and B5. In addition there is the potential improvements for the Princes Highway which are also discussed below.

B1 The duplication of Alfords Point Bridge and associated works

The next logical stage from the tidal flow system at Alfords Point Bridge would be duplication of the existing bridge as well as the road works on the northern and southern approaches. The major part of the work are the new bridges which would duplicate the existing facilities and for which the foundations have already been constructed. The route would be of a high standard with limited opportunities for access and egress for local commuters. The timing of such duplication is discussed in a later section

Between B1 and B2.

The RTA is building a new deviation of Old Illawarra Road constructed as a limited access carriageway 4 lanes wide. The existing Old Illawarra Road would be left intact with a new junction between it and the new road to allow for local access.

B2 Upgrading of Old Illawarra Road from Menai Road south to Barden Road.

The RTA has plans to deviate Old Illawarra Road, and the relatively short stretch of new road would circumvent the existing Menai Road/Old Illawarra Road junction and connect north-south traffic to the new deviation north of Menai Road.

B3 Upgrading of Old Illawarra Road between Barden Road and Lucas Heights Reservoir.

This section of road would be upgraded to the same standard as the upgrade south of Menai Road (B2 above).

B4 Lucas Heights Link

This link would be constructed to provide a more direct north-south connection between New Illawarra Road and Heathcote Road. It would run between a point on Illawarra Road near the Lucas Height Reservoir and Heathcote Road just west of the Woronora River. While there would be significant savings for trips from the Princes Highway to Alfords Point Road and the reverse, it crosses an environmentally sensitive area.

B5 Upgrading of Heathcote Road between Princes Highway and New Illawarra Road.

8.0 FUTURE TRAFFIC VOLUMES AND ASSIGNMENT

8.1 FUTURE TRAFFIC VOLUMES

In estimating future traffic volumes, it was assumed that traffic growth would be made up of two components, viz:

- growth in through traffic
- traffic generated by additional residences in the area.

It was assumed that existing traffic would not divert away from the study area in the future and therefore additional generated traffic was added to existing traffic to estimate future traffic volumes. Existing traffic volumes were obtained from traffic count data and are shown in figure 8.1. In this study the future traffic assignment was based on the 7.00 -9.00 am morning peak two hour period, and future traffic volumes were estimated for 1995 and 2000.

The growth in through traffic was assumed to be 5% per annum for five years. This is consistent with observed traffic growth in the study area (see section 2.0). After 1995, no growth in through traffic was assumed.

The number of trips generated in each direction by new residences in each of the development areas was calculated using an average two hour peak period generation rate of 1.04 trips per household and 0.42 inbound trips per household. The increase in number of households is shown in table 5.1. Table 8.1 shows the numbers of additional trips generated by each residential development area by 2000.

Table 8.1 Additional Vehicle Trips during Morning Peak Two Hour Period

Location	Additional Households	Increase In	
		Outbound Trips Per 2 hrs	Inbound Trips
Bangor	240	250	100
Menai	170	180	70
Illawong	250	260	110
Alfords Pt	210	220	90
Lucas Heights	870	900	370
West Menai	3800	3950	1600
Menai Town Centre	<u>340</u>	<u>350</u>	<u>100</u>
TOTAL	5880	6110	2440

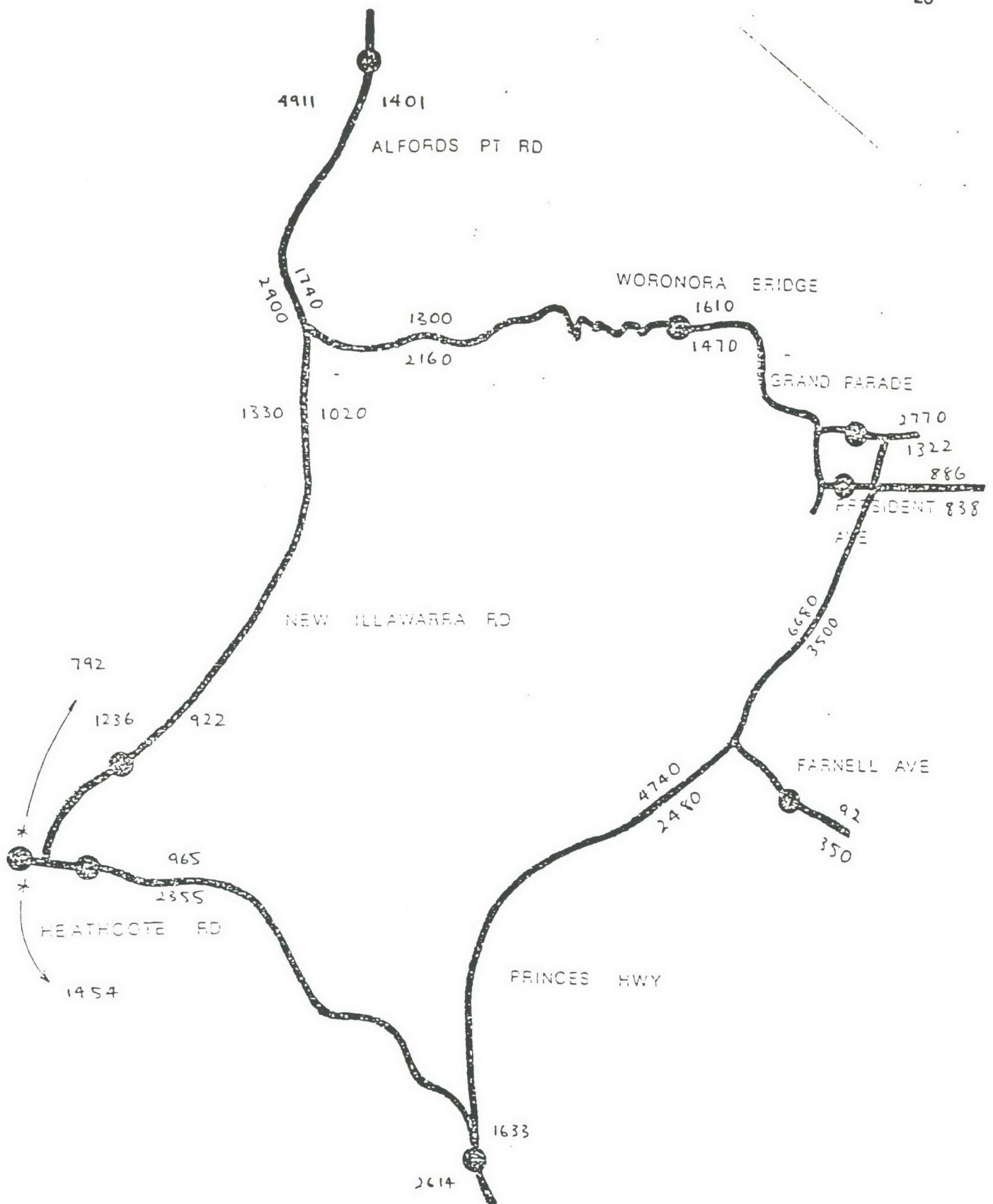


FIGURE 8.1: EXISTING TRAFFIC VOLUMES
 (includes through traffic
 Source: RTA 1989/90
 2hr AM peak period volumes

A small number of trips, 5% from and 3% to West Menai, would travel to or from Liverpool

Trips from West Menai were assigned to the network using the same distribution described below for the remainder of the Study Area, when the West Menai link (A3) was in place. For all other assignments, trips to and from West Menai were not included. It was assumed that West Menai would only be developed after the West Menai link was in place.

8.2 TRIP DISTRIBUTION OF LOCAL TRAFFIC

The distribution of trips into and out of residential areas from and to the north, south, east and west was estimated using TRANPLAN assignments, together with the relative proportions of the turning movements at the intersection of Menai Road and Old Illawarra Road, and the intersection of Heathcote Road and Old Illawarra Road.

The distribution of trips adopted is shown in Table 8.2.

Table 8.2: Distribution of Morning Peak Period Trips To and From New Residential Developments

To/From	Proportion of Trips	
	From Development Area	To Development Area
North	55%	83%
South	15%	22%
West	5%	3%
East	25%	41%
Total	100%	100%

8.3 TRIP ASSIGNMENT

Morning peak 2 hour trip volumes were assigned to each of networks. The networks represented the following:

- (i) do-minimum (complete current projects)
- (ii) Woronora Bridge (A1)
- (iii) Woronora Bridge plus Menai Road Deviation (Akuna Ave to Barden Road) (A1 + A2)
- (iv) Woronora Bridge plus Menai Road Deviation plus east-west link (A1 + A2 + A3)

- (v) upgrading of Old Illawarra Road from Menai Road to Lucas Heights Reservoir (B2 + B3)
- (vi) as above plus duplicate Alfords Point Bridge (B1 + B2 + B3)
- (vii) upgrading of Heathcote Road (B5)
- (viii) Lucas Heights Link (B4)
- (ix) Woronora Bridge and widening of Menai Road West of Akuna Ave (A2 modified)

Each assignment consists of 3 components, namely:

- existing traffic, described in section 2.0.
- through trips, which were estimated from the RTA's origin-destination survey February 1990. It is important to note that the through trips were subtracted from existing counts to obtain the existing local traffic. The through trips were then assumed to growth at 5% per year, and were added back to the network.
- the trips generated by new residential developments.

Each of these components were assigned using the rules explained below.

- (i) When calculating travel times and speeds of existing roads, the speed-flow curve for non-commercial arterial roads in TRANPLAN was used. This speed-flow curve was modified to estimate the speeds on upgraded and new 80km/hr links.
- (ii) The capacity of roads was estimated using NAASRA, 1988 Guide to Traffic Engineering Practice Part 2, - Roadway Capacity.
- (iii) All trips followed their existing routes through the network, except when new links offering considerable time and distance savings are added to the network. Where the addition of new links created a choice between routes, traffic was assigned to the network so that travel times on each route were approximately equal.
- (iv) Upgrades to existing links did not attract additional trips from alternative routes, because upgrades result only in an increase in speed, and did not decrease travel distance. The resultant time savings would not significantly shift the network travel patterns.

8.3.1 Woronora Bridge (A1)

In this case, the bridge is assumed not to attract additional through trips from routes outside the Study Area, as it can be regarded as an upgrade to the existing route. While speeds may be significantly increased, the length of the link is too short to reflect significant time savings.

In reality, the bridge will offer an easier route across the gorge especially for heavy vehicles. However, because there is no data available regarding route choice behaviour in this case, the economically conservative assumption that no additional traffic will be attracted was made.

8.3.2 Woronora Bridge and Menai Road Deviation (A1 + A2.)

Trips travelling from the south and west to the east, and from the east to the south and west along Old Illawarra Road were all assigned to the new links. Twenty percent of trips travelling from the north to the east and vice versa were assigned to the new links. These volumes are such that the travel times on each route became approximately equal.

8.3.3 West Menai Link (A1 + A2 + A3.)

All trips between the west and the east and vice versa which used Heathcote Road and Old Illawarra Road at present were assigned to the new links. In addition 70% of trips which were recorded entering the study area on Heathcote Road and recorded at the internal station on Heathcote Road and not recorded again were assumed to have been through trips from the west to the north along the Princes Highway and were assigned to the new links. (ie. 30% of this traffic has local destinations and would not divert to the new links).

8.3.4 Lucas Heights Link (B4.)

All trips travelling from the south to the north and vice versa on Heathcote Road and Old Illawarra Road were assigned to the new link. It was assumed that the new link would not provide a viable alternative route for other trips, and no further reassignments were undertaken.

8.3.5 Other Road Improvements Proposals

The remaining road proposals (B2 + B3, B1 + B2 + B3, B5) involve upgrading of existing links only and therefore no reassignment of trips was necessary and the do-minimum, base case assignment was used.

8.3.6 Results of Assignments

The results of the assignments are shown in figures 8.2-6. In these figures the three components of the assignment (existing traffic, additional local traffic, additional through traffic) have been shown separately.

The additional trips shown in traffic assignments represent a total annual growth rate of approximately 8%, which is consistent with growth rates of traffic in the area over the past 5 years. If the West Menai development proceeds, the average annual growth is likely to rise to approximately 10%.

In brief, the results of the assignments show that the West Menai development would be the major factor affecting traffic in the area. Without this development, there is no need for additional works on network apart from those already planned by the RTA.

After West Menai is developed, there is likely to be a considerable increase in congestion and delay on the network, and a number of additional road construction projects may be required.

8.4 HEAVY GOODS VEHICLE MOVEMENTS

The proportion of heavy vehicles in the traffic volumes at specific points on the road network is shown in Table 8.6.1.

**Table 8.6.1 Proportion of Heavy Vehicles
on Road Network at Present**

		Time Period		
		Morning Peak	Off Peak	Sunday Afternoon
Alfords Pt Bridge	(N/B)	2.2	7.0	0.5
	(S/B)	5.5	5.5	0.2
Grand Parade	(W/B)	0.8	1.0	0.0
	(E/B)	0.0	0.1	0.0
President Ave	(W/B)	0.9	1.8	0.0
	(E/B)	1.0	0.9	0.2
Princes Highway (South of Heathcote Rd)	(N/B)	2.8	5.3	0.1
	(S/B)	5.7	5.6	0.0
Heathcote Road (West of Illawarra Rd)	(W/B)	2.5	12.1	0.4
	(E/B)	4.4	9.7	0.3
Woronora Bridge	(W/B)	0.9	1.9	0.1
	(E/B)	0.9	2.1	0.2
New Illawarra Rd	(N/B)	11.3	24.5	0.5
	(S/B)	13.7	25.8	0.7
Heathcote Road (East of Illawarra Rd)	(W/B)	3.6	13.2	0.1
	(E/B)	10.1	11.0	1.3

In 1989, the Bureau of Transport Economics made projections of growth of heavy vehicle volumes. Table 8.6.1 shows these growths.

**Table 8.6.2: Annual Growth Rates in
Commercial Vehicles 1982 to 2011 for
NSW (% per annum) from Bureau of Transport Economics**

Period	High	Medium	Low
1982-1985	4.1	3.1	2.6
1985-1990	4.8	4.0	3.3
1990-1995	4.4	3.6	2.9
1995-2000	3.8	3.0	2.2

It can be seen that even at a high rate of growth, the growth of all vehicle traffic shown in 8.6.2 is higher than the growth of heavy vehicles. This suggests that the proportion of heavy vehicles will drop.

At present, the number of heavy vehicles which use the Woronora Bridge in both directions is about 35 during the morning 2 hour peak period and 50 during the 2 hour period from 11 am to 1 pm each day. The time profile of heavy vehicle flow between 7 am and 1 pm is approximately mirrored in the period from 1 pm to 7 pm, and it can be estimated that about 250 heavy vehicles per day used the Woronora Bridge at present in the 12 hour period 7am-7pm. Allowing for vehicles which use the bridge during the early morning hours and at night the total number of heavy vehicles crossing the Woronora

Bridge in a 2 hour period is approximately 300. At the highest rate of growth shown in Table 8.6.2, this number may rise to 370 vehicles per day by 2000.

In addition to the regional growth, the new bridge may attract heavy vehicles travelling through the area from the west to the east and vice versa along Heathcote Road and Princes Highway. The number plate survey showed that these movements would total 350 heavy vehicles in the morning peak 2 hour period, which would correspond to a daily total of about 2,000 heavy vehicles. Of these it can be estimated from the O.D. Survey, that only 10% could use Woronora Bridge to shorten their journeys, so that the daily number of heavy vehicles which could potentially use the new Woronora Bridge is 200. The journey time over both routes between Heathcote Road and Sutherland would be approximately equal. It has therefore been conservatively estimated that 80% of these use the new Woronora Bridge thus bringing a maximum of 160 extra heavy vehicles per day in addition to regional growth across the new bridge.

Most of the heavy vehicles which use the Woronora Bridge at present will use the new bridge, thereby leaving River Road and the eastern portion of Menai Road free of heavy vehicles. In addition, the temptation for heavy vehicle drivers to use the existing Woronora Bridge in the early hours of the morning will be removed by the construction of the new bridge.

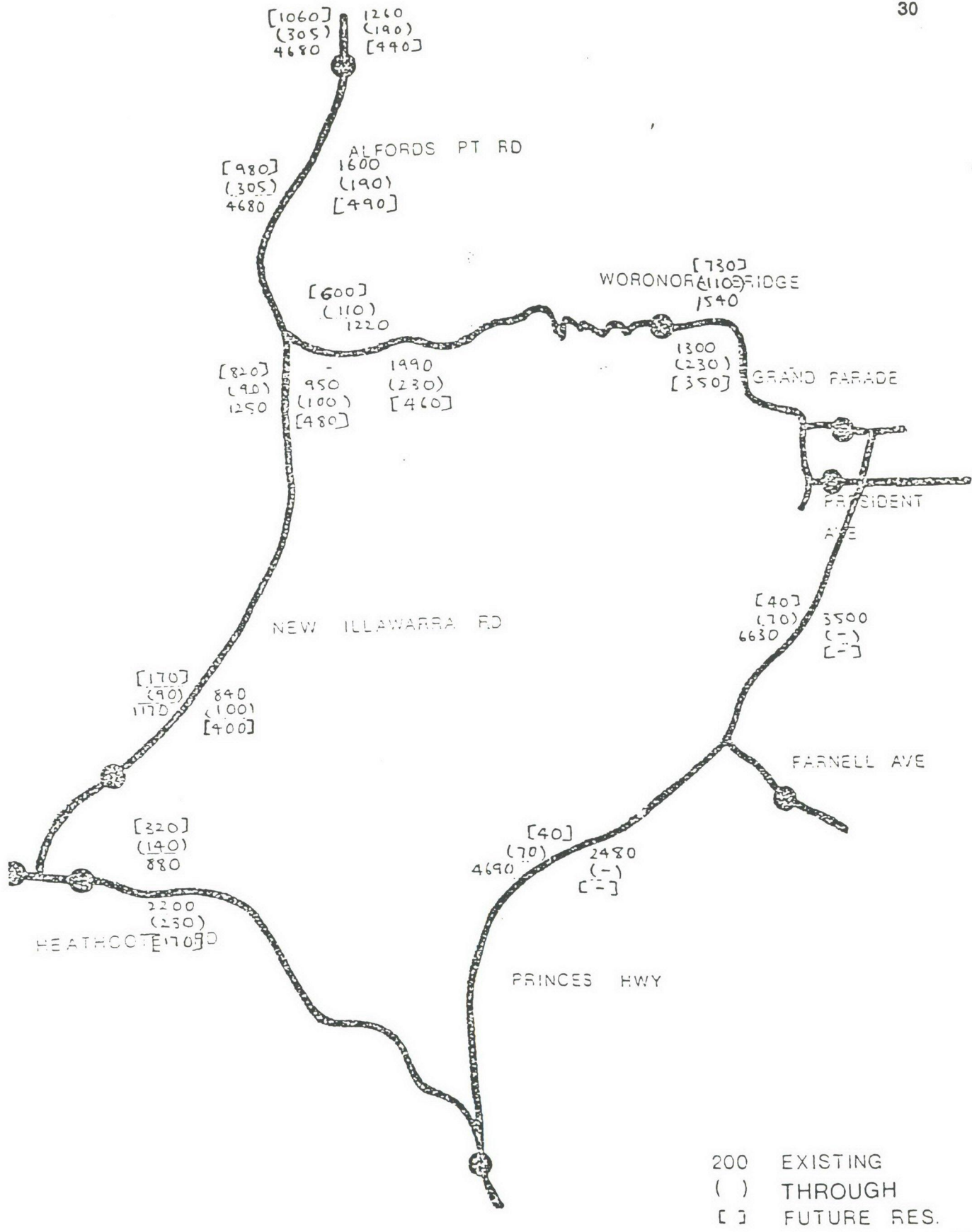


FIGURE 8.2: VOLUMES ON ROAD NETWORK IN 1995
2hr morning peak volumes
DO MINIMUM CASE & B2+B3;
B1+B2+B3;B5

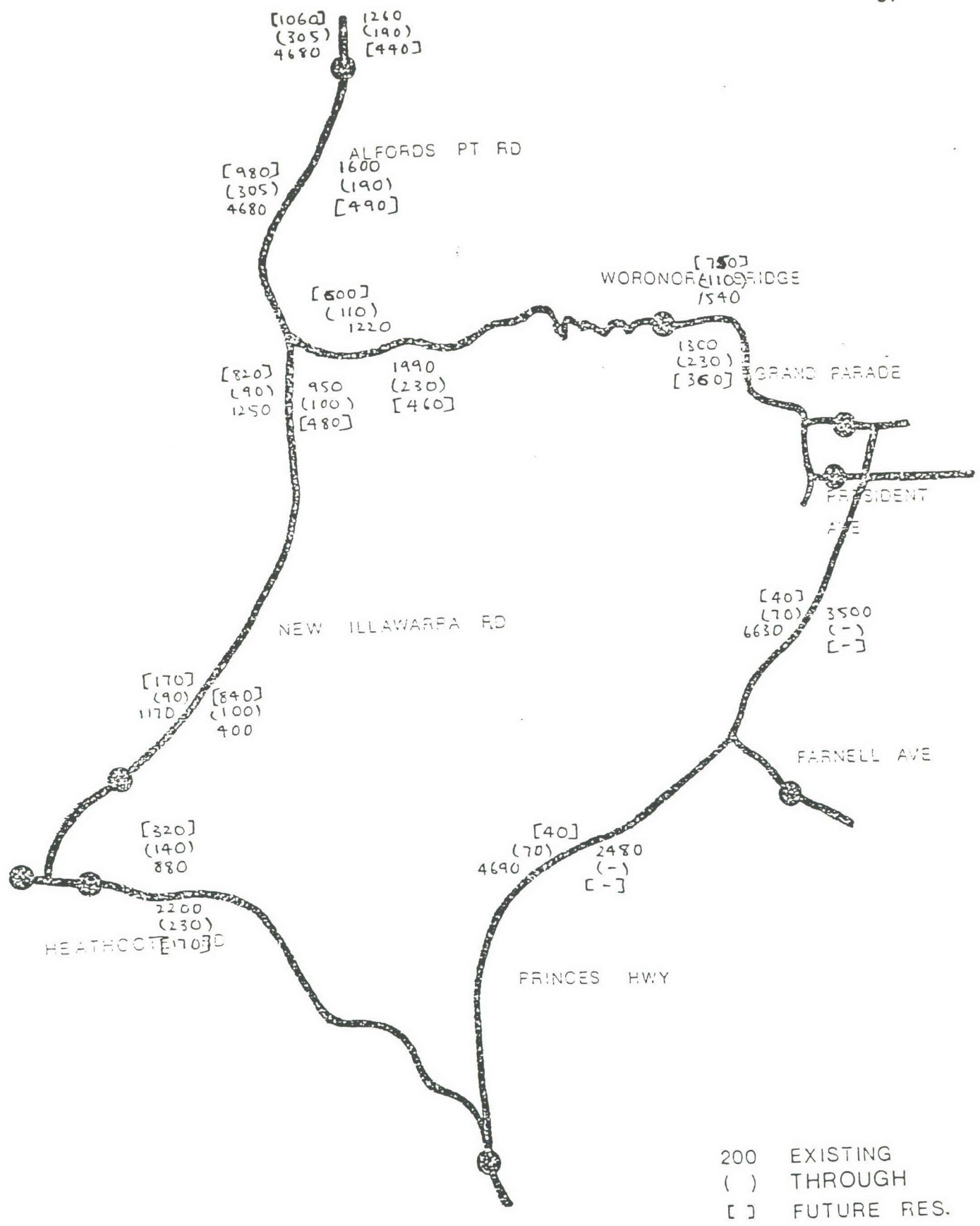


FIGURE 9.3: VOLUMES ON ROAD NETWORK IN 1995
2hr morning peak volumes
NEW WORONORA BRIDGE

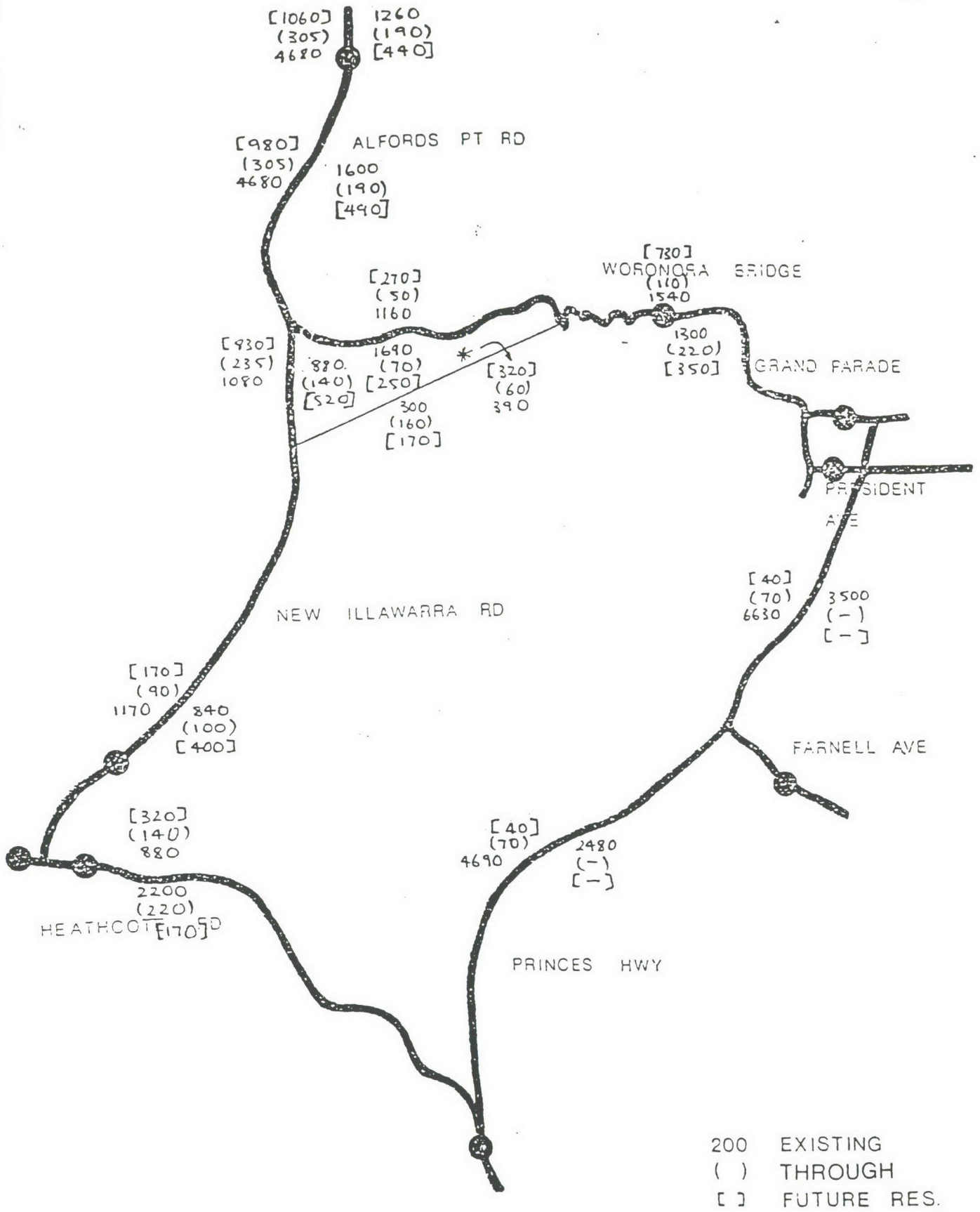


FIGURE 8.4: VOLUMES ON ROAD NETWORK IN 1995

2hr morning peak volumes
 WORONORA BRIDGE & MENAI
 ROAD DEVIATION; A1+A2

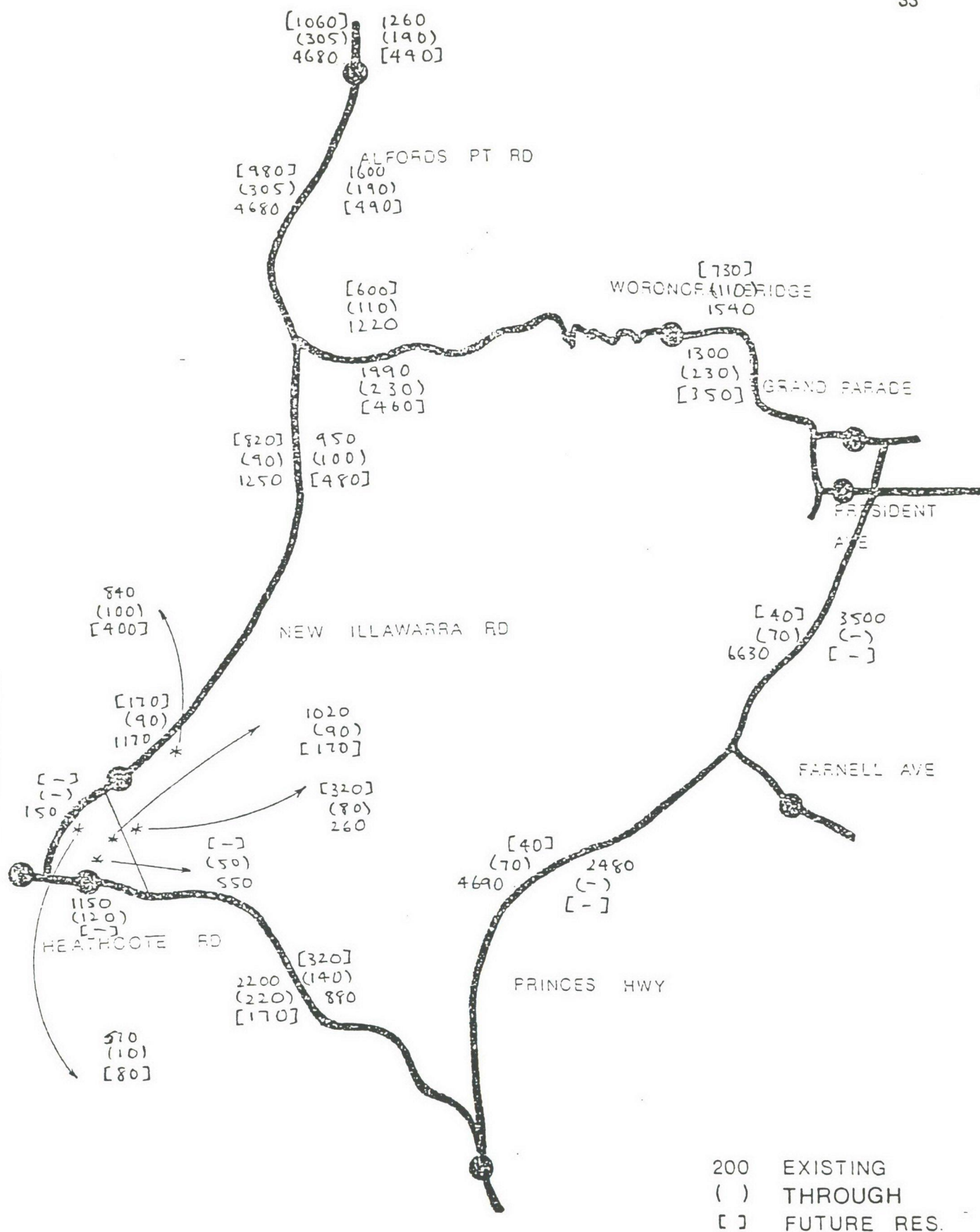


FIGURE 8.5: VOLUMES ON ROAD NETWORK
IN 1995
2hr morning peak volumes
LUCAS HEIGHTS LINK;B4

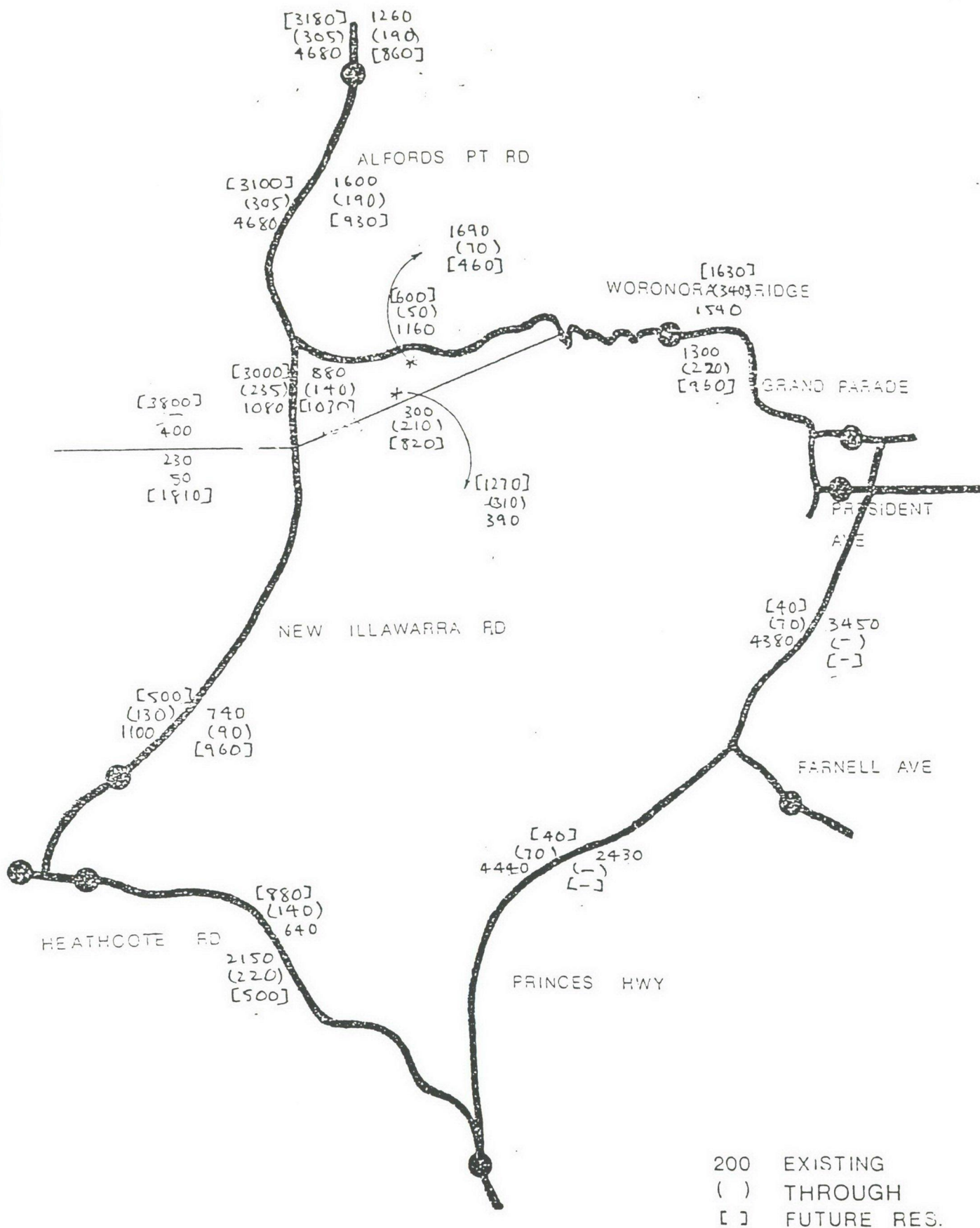


FIGURE 8.6: VOLUMES ON ROAD NETWORK IN 2000
 2hr morning peak volumes
 WORONORA BRIDGE/MENAI ROAD
 DEVIATION & WEST MENAI
 LINK;A1+A2+A3

9.0 ECONOMIC EVALUATION

An economic analysis using a spreadsheet which incorporates the methodology of the RTA's SIMBCA (Simplified Benefit Cost Analysis) method was used to estimate benefit cost ratios for each set of road proposals tested. Travel time savings, travel distance savings and casualty accident savings were estimated to determine the projects benefits.

Unit costs were supplied by the RTA and are the most recent costs in use for evaluation of urban road projects. The costs were:

Vehicle operating costs:	\$0.08/km and \$5.38/hr
Travel time costs:	\$17.24 per hour
Accident costs:	\$25,900 per casualty accident

Changes in vehicle-kilometres travelled on the road network were determined from AADT volumes. Changes in vehicle-hours on the road network were based on travel time savings only accruing during the am and pm two hour weekday peak periods. Changes in accident rate were calculated assuming that each new or upgraded link would achieve the RTA corporate accident target of 0.7 casualty accidents per million-vehicle kilometres, in the few cases where this rate was exceeded..

Table 9.1 shows the travel time and distance savings for each project. Accident savings were negligible.

Table 9.1 : Benefits associated with each project

	SAVINGS	
	Distance (x10 ⁶ veh.kms)	Time (x10 ⁶ veh hrs)
A1 (2 lanes)	19.8 (4.8%)	0.12 (7.2%)
A1 (4 lanes)	19.8 (4.8%)	0.18 (10.6%)
A1+A2(2 lanes)	-42.8(-10.4%)	0.20 (12.2%)
A1+A2 (4lanes)	-42.8(-10.4%)	0.25 (14.9%)
A1+A2(modified)	19.8(4.8%)	0.26(15.9%)
B2+B3	0	0.05 (3.0%)
B1+B2+B3	0	0.23 (13.8%)
B5	0	0.10 (6.2%)
B4	8.8 (2.1%)	0.10 (6.2%)
A1+A2+A3(2 lanes)	13.7(2.4%)	-0.36(14.1%)
A1+A2+A3(4 lanes)	13.7(2.4%)	0.61(23.6%)

It is important to note that for the costs involving the West Menai link, the do-minimum case is different from that for all other cases. For the West Menai link, all savings resulting from the addition of the West Menai link are included in the do-minimum because it has been assumed that the link will be funded by the Department of Housing.

The large negative savings are a result of the large number of additional trips on the network.

10.0 CONCLUSIONS

The order of projects by benefit cost ratio is as follows:

Project	Benefit Cost Ratio
Woronora Bridge, with 2 lanes, Menai Road west of Akuna Ave with 4 lanes	2.83
Lucas Heights Link (B4)	2.24
Upgrade of Old Illawarra Road (B1+B2+B3)	2.04
Woronora Bridge with 4 lanes (A1)	2.03
Woronora Bridge with 2 lanes (A1)	1.97
Upgrade of Heathcote Road (B5)	1.31
Upgrade of Old Illawarra Road (+B2+B3)	1.08
Woronora Bridge and Menai Road deviation with 2 lanes (A1+A2)	0.35
Woronora Bridge and Menai Road deviation with 4 lanes (A1+A2)	-.20

When the West Menai residential area and the West Menai Road link are introduced into the network, the do-minimum case against which improvements to the network are evaluated is different from that of the above. The benefit-cost ratios calculated for the two options with West Menai in the network are:

Woronora Bridge and Menai Road deviation, with 4 lanes	2.92
Woronora Bridge and Menai Road Deviation, with 2 lanes	2.41

APPENDIX I: Origin & Destination Survey Results

The station locations, indicated by a . on Figures I.1 and I.2, are as follows:

1. Alfords Point Road Southbound
2. Grand Parade Westbound
3. President Ave. Westbound
4. Farnell Ave. Westbound
5. Princes Highway Northbound
6. Heathcote Road Eastbound
11. Alfords Pt. Rd. Northbound
12. Grand parade Eastbound
13. President Ave. Eastbound
14. Farnell Ave. Eastbound
15. Princes Hwy, Southbound
16. Heathcote Road Westbound
21. Menai Road Eastbound
22. Menai Road Westbound
23. New Illawarra Road Northbound
24. New Illawarra Road Southbound
25. Heathcote Road Eastbound
26. Heathcote Road Westbound

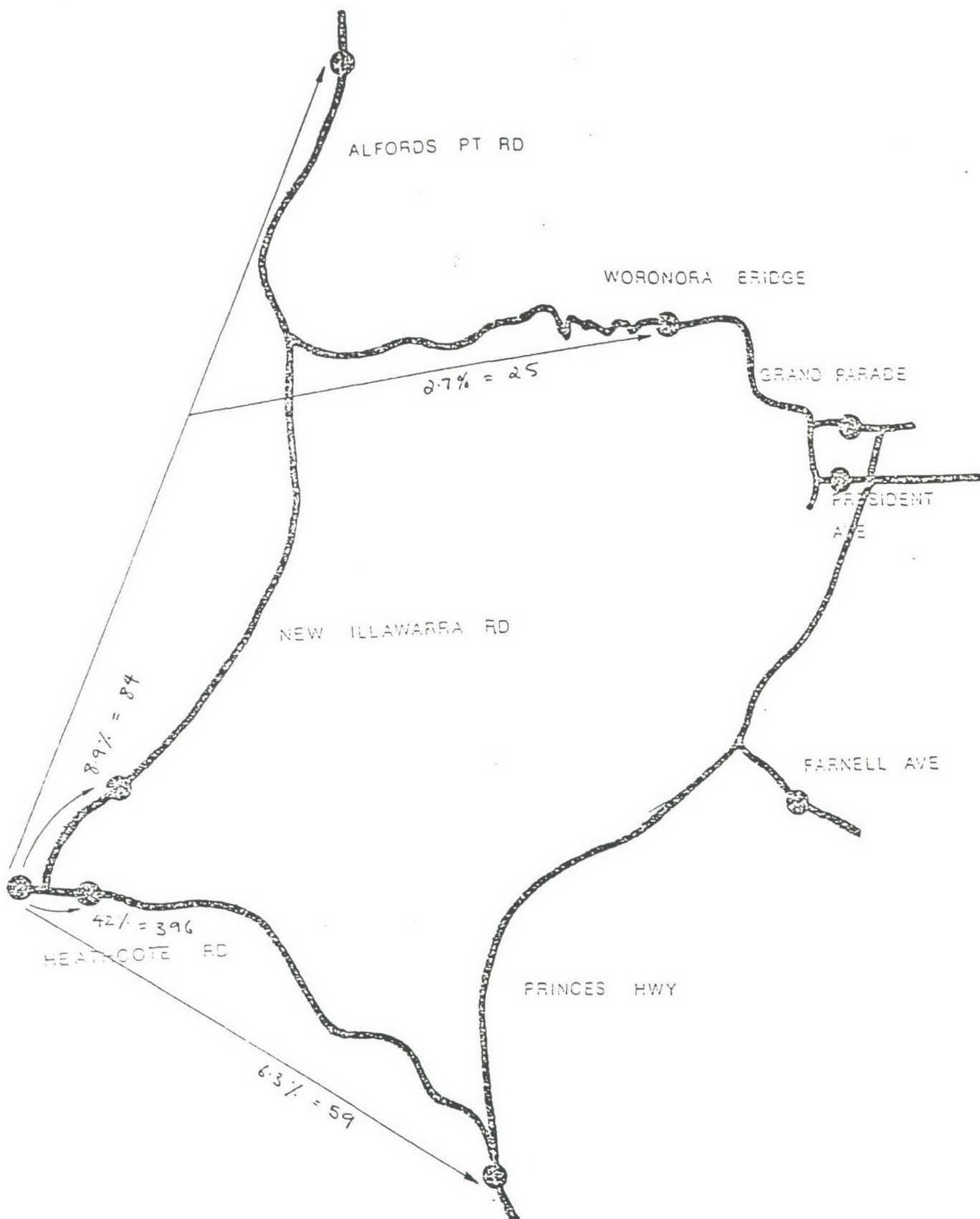


Figure I.1(a) Origin-Destination Survey
All vehicles per AM peak 2 hours entering
through Heathcote Road

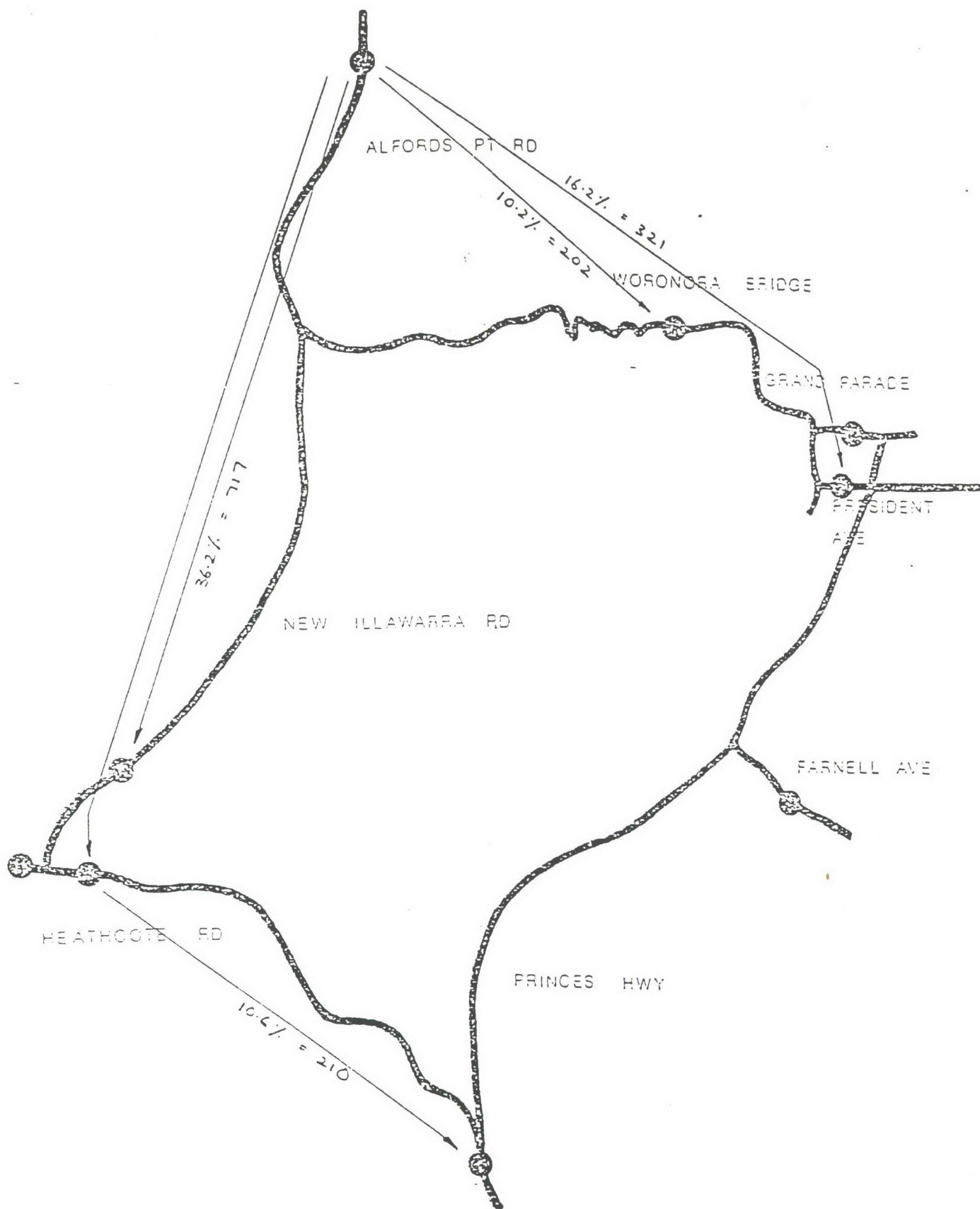


Figure I.1(b) Origin -Destination Survey
 All vehicles per AM peak 2 hours entering
 through Alfords Pt Road

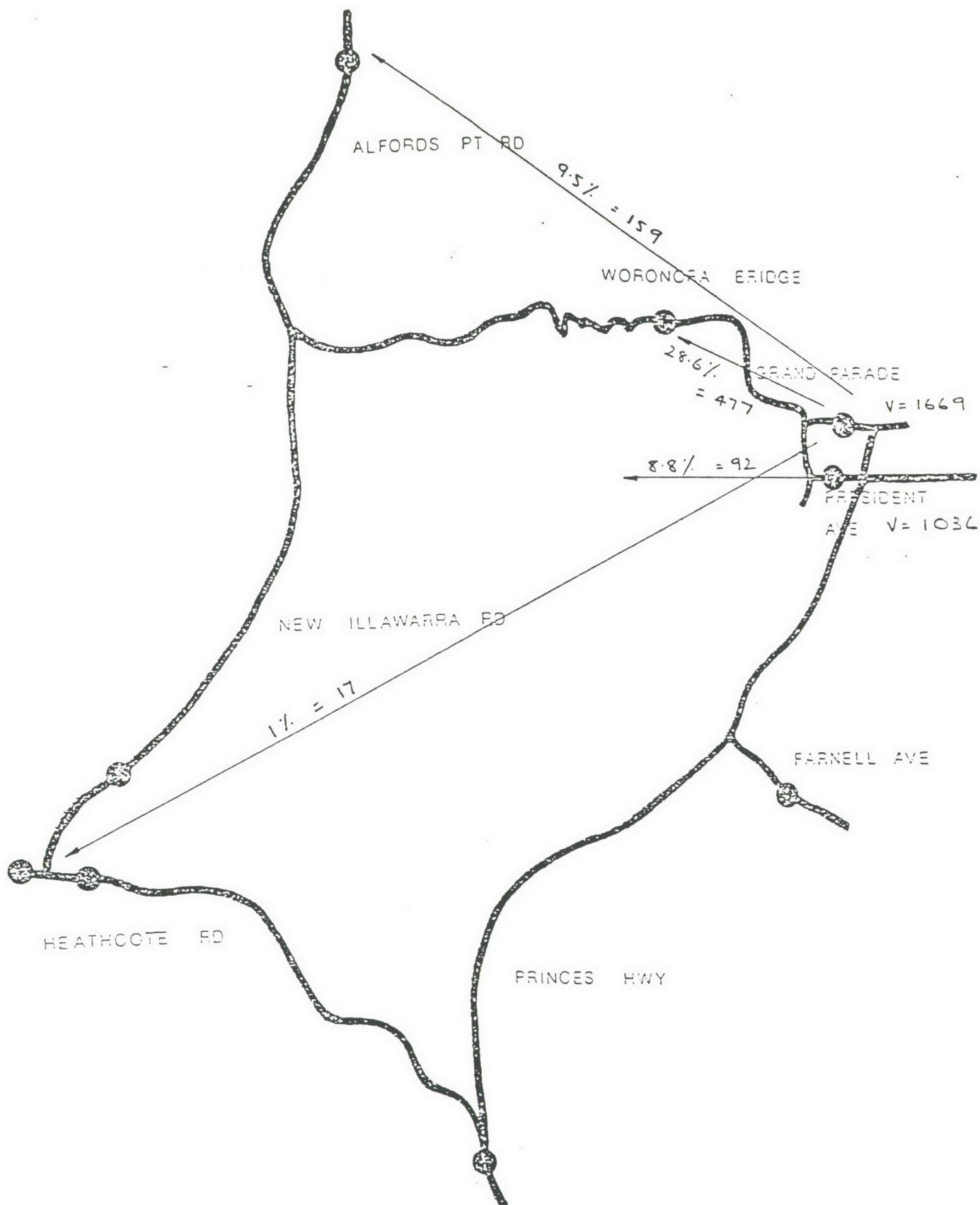


Figure I.1(c) Origin -Destination Survey
All vehicles per AM peak 2 hours entering
from Sutherland

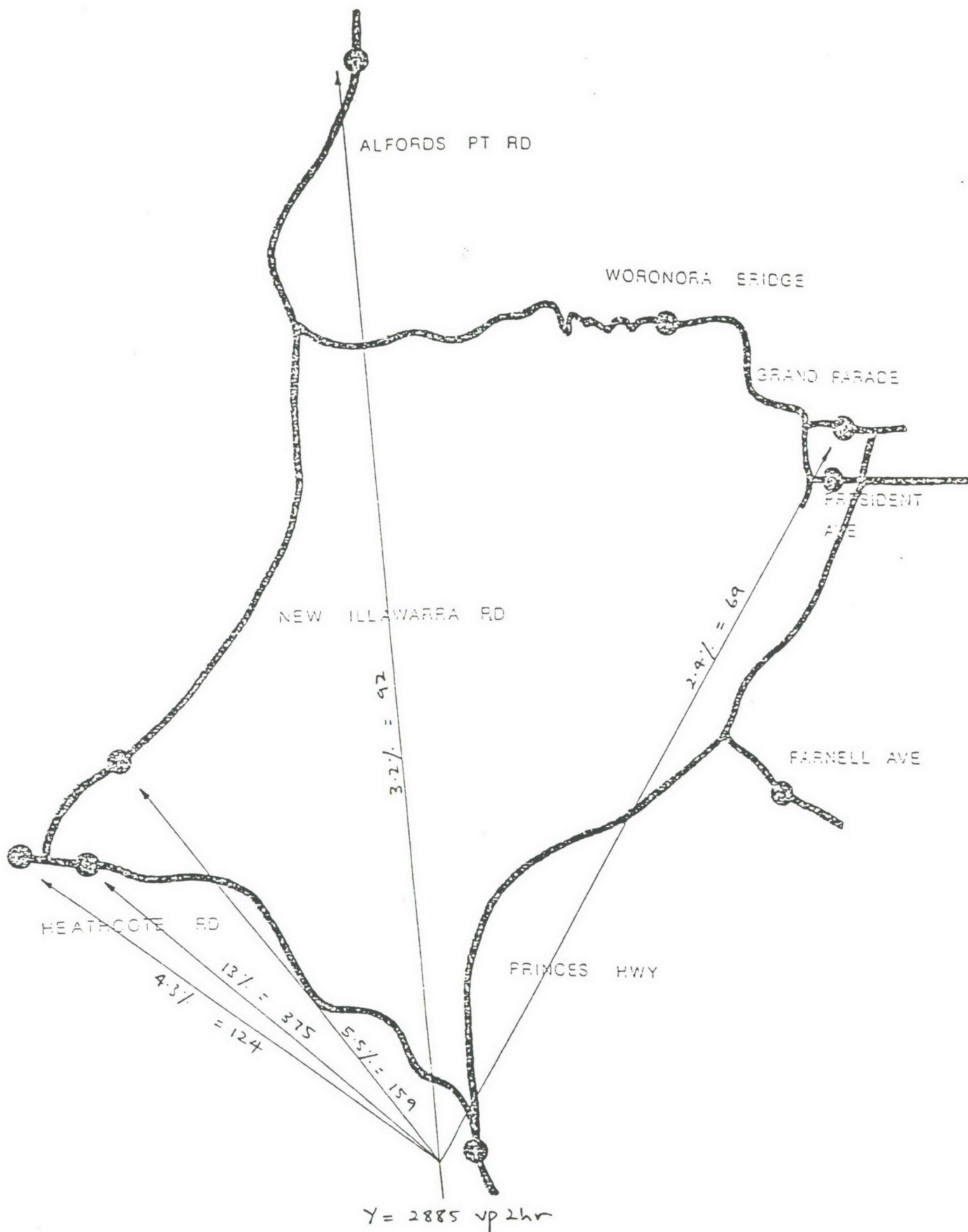


Figure I.1(d) Origin -Destination Survey
 All vehicles per AM peak 2 hours entering
 through Princes Highway south of Heathcote
 Road

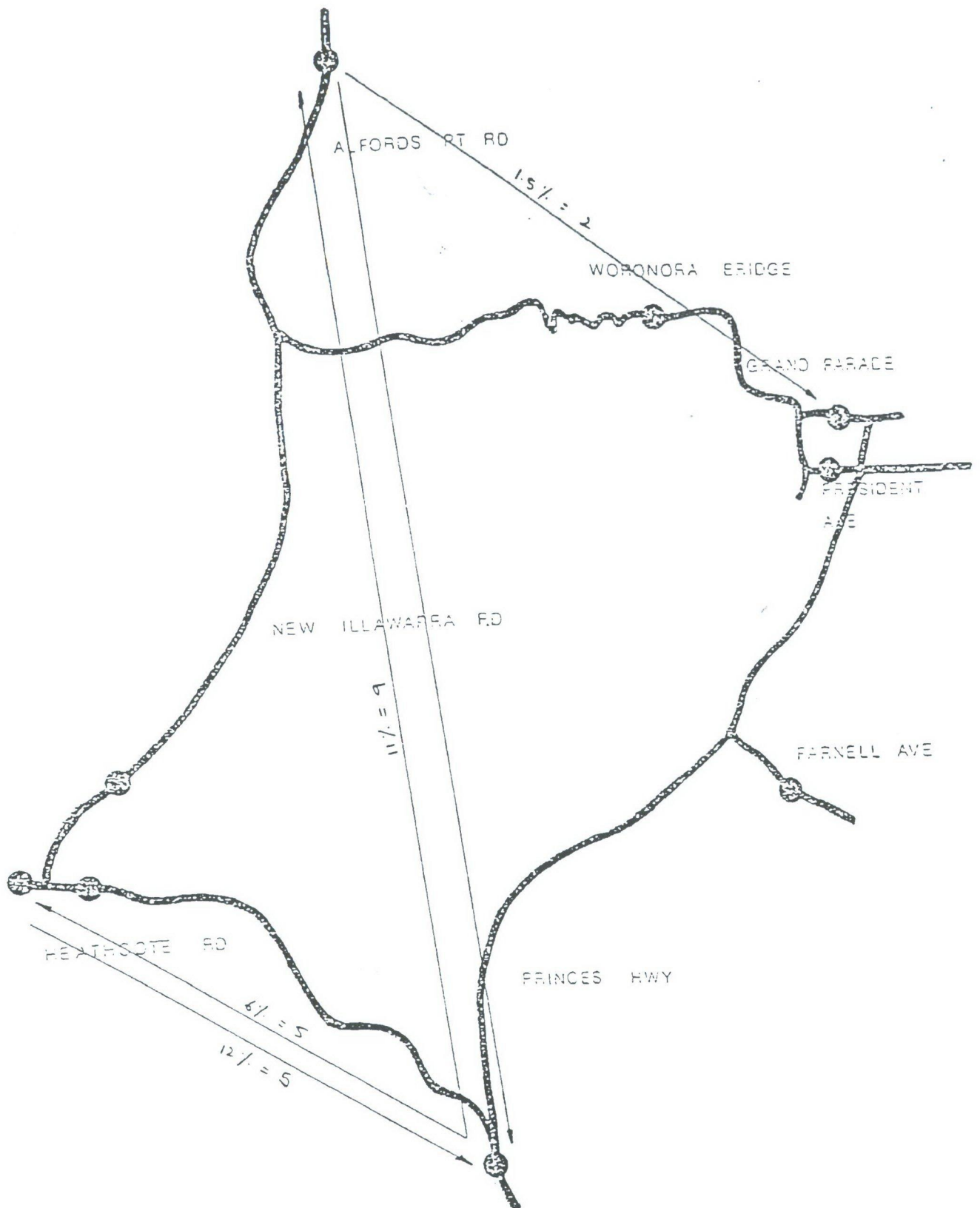


Figure I.2

Origin -Destination Survey
Trucks per AM peak 2 hours