MONASH University
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ENVIRONMENTAL COUNTERMEASURES FOR ALCOHOL-RELATED PEDESTRIAN CRASHES

by

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Environmental Countermeasures for Alcohol-Related Pedestrian Crashes

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Abstract:
Alcohol-affected pedestrians involved in casualty crashes were identified as a significant road safety target group. Whilst pedestrian safety initiatives being implemented in Victoria have focused on the young and the older pedestrian age groups and have addressed behavioural issues, it was considered that greater attention should be given to improving the physical environment at locations where alcohol-affected pedestrian crashes tend to occur.

The major aims of the study were to identify environmental factors associated with alcohol-related pedestrian crashes in Melbourne, and to indicate a strategic approach for implementation of recommended environmental countermeasures which address the identified environmental factors. To achieve these aims, reported casualty crash data over the past ten years in Melbourne were analysed, and five sites in the metropolitan area which had experienced comparatively large numbers of alcohol-related pedestrian casualty crashes were investigated. Through these analyses and site investigations, predominant alcohol-related pedestrian crash types were identified, and corresponding measures with the potential to address each target crash type were proposed.

Based on these findings, a strategic approach to treating alcohol-related pedestrian crashes was recommended. The main elements of this approach involved systematic methods for identifying locations where the problem is greatest and/or more acute; a range of road environment countermeasures which target common alcohol-related pedestrian crash circumstances, and a range of countermeasures aimed at having a general effect. In addition, reference was made to indicative estimates of Benefit-to-Cost Ratios and Net Present Worth values to guide the development of a strategic countermeasure program.

Key Words: (IRRD except when marked*)
Accident, Pedestrian, Alcohol, BAC, Traffic Engineering, Traffic Control Devices, Countermeasures*

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EXECUTIVE SUMMARY

This study developed from a VicRoads proposal and a subsequent recommendation in the project, *Pedestrian Safety Issues for Victoria* (Corben and Diamantopoulou, 1996). The study approach was also guided by findings from the reports of *Accident Data Analysis to Develop Target Groups for Countermeasures* (Cameron, 1992), which identified intoxicated pedestrians as a high risk-group, and *The Role of Alcohol and Age in Predisposing Pedestrian Accidents* (Alexander et al., 1990). Whilst the Victorian Road Safety Strategy had focused on the young and the older pedestrian age groups, and behavioural issues through such programs as "Safe Routes to School", "Walk With Care" and "Responsible Serving of Alcohol", it was considered that the limited attention that has been given to improving the physical environment at locations where alcohol-affected pedestrian crashes occur, should be addressed.

The major aims of the study were to identify environmental factors associated with alcohol-related pedestrian crashes in Melbourne, and to indicate a strategic approach for implementation of recommended environmental countermeasures which address the identified environmental factors. To achieve these aims, reported casualty crash data over the past ten years in Melbourne were analysed and five sites in the metropolitan area which had experienced large numbers of alcohol-related pedestrian crashes were investigated. Through these analyses and site investigations, predominant alcohol-related pedestrian crash types were identified, and corresponding measures with the potential to address each target crash type were proposed.

Based on these findings a strategic approach to the treatment of alcohol-related pedestrian crashes was recommended. The main elements of the strategic approach involved a set of systematic methods for identifying locations where the problem is greatest and/or more acute; a range of road environment countermeasures which target common alcohol-related pedestrian crash circumstances, and a range of countermeasures aimed at having a general effect on the problem.

The environment factors and road environment countermeasures proposed for introduction at specific locations are outlined below:

Reduce pedestrian exposure to high crash risk by:
• introducing traffic management measures to promote inherently safer routes
• reducing excessive roadway widths

Simplify the crossing task for intoxicated pedestrians by:
• providing highly responsive pedestrian-operated signals
• providing medians or pedestrian refuges
• providing well-maintained lane line markings to strengthen driver lane discipline

Improve driver responses to high crash risk by:
• providing "above-standard" street lighting
• providing "above-standard" skid resistant pavement surfaces
• avoiding the need for vehicles to merge
• installing symbolic pedestrian warning signs
• undertaking police enforcement of safe pedestrian and driver behaviour

During high crash risk times, encourage greater pedestrian use of signals by:
• making traffic signals highly responsive to pedestrian calls
• automatically introducing pedestrian phases every cycle
• improving the level-of-service of signals to pedestrians
• erecting fences/barriers to direct pedestrians to cross-walks
• relocating/modifying the use of hotel doorways

Improve the likelihood of safe driver responses at/near intersection signals by:
• during periods of high crash risk, displaying red to all vehicle directions when there is zero traffic demand

Countermeasure options which should form part of a *general* approach to addressing the problems of alcohol-related pedestrian crashes are listed below:

Reduce the incidence and degree of pedestrian intoxication by:
• working with the liquor industry
• implementing local publicity and/or mass media campaigns
• working with selected welfare agencies
• installing coin-in-the-slot breath testing machines in hotels/licensed premises

The final element of any strategy aimed at achieving the maximum crash savings at minimum cost is the estimation of economic worth of countermeasures before they are implemented. Reference is made to indicative estimates of Benefit-to-Cost Ratios (BCR's) and Net Present Worth (NPW's) values to guide the development of a strategic countermeasure program. Although beyond the scope of the current study, it is recommended that countermeasure program development methods be established on the basis of ranking proposed countermeasures by the ratio of their estimated NPW to capital costs, as a means of maximising the road safety benefits per dollar invested in alcohol-related pedestrian crash countermeasures.

1. INTRODUCTION

1.1 BACKGROUND

Pedestrian fatalities in Victoria averaged 116 per annum between 1984 and 1994. Although the number of pedestrians killed has dropped by approximately 42% to an average of 83 per year after 1989 (64 in 1994), the estimated social costs of pedestrian fatal and serious injury crashes alone, in 1994 in Victoria, exceeded $120 million. Pedestrian fatality figures to October 1995 show an increase of some 30%, compared to the corresponding period in 1994.

There is considerable potential to achieve cost-effective safety benefits for pedestrians by focusing research effort on countermeasure development for road environment conditions known to be associated with high pedestrian crash frequencies.

This study developed from a VicRoads proposal and a subsequent recommendation in the baseline project, *Pedestrian Safety Issues for Victoria* (Corben and Diamantopoulou, 1996). The study was also guided by the findings of Cameron (1992), who identified intoxicated pedestrians as a high risk group, and Alexander, Cave and Lyttle (1990).

Cameron (1992) found that of the 6,547 pedestrians aged 18-59 years, involved in casualty accidents during 1984-89, 2,978 or 45.5% had known Blood Alcohol Concentration (BAC) levels available. Of those with known BAC levels, 691 or 23.2% had BAC's above 0.15g/100 ml, and 408 or 13.7% had BAC's above 0.01g/100 ml and up to 0.15g/100 ml.

Whereas the Victorian Road Safety Strategy had focused on the young and the older pedestrian age groups, and behavioural issues through such programs as "Safe Routes to School", "Walk With Care" and "Responsible Serving of Alcohol", it was considered that the limited attention that has been given to improving the physical environment at locations where crashes involving alcohol-affected pedestrians tend to occur should be addressed.

1.2 OBJECTIVES

The objectives of this study were:

1. To identify environmental factors associated with alcohol-related pedestrian crashes.

2. To recommend countermeasures which address the identified environmental factors.

3. To prepare an economic evaluation by estimating the costs and likely safety benefits which would accrue from adoption of the recommended countermeasures.

4. To indicate a strategic approach for implementation of the recommended environmental countermeasures.

While the emphasis of the project was on road environment countermeasures, behavioural and vehicle countermeasures were also considered.

2. STUDY METHOD

2.1 DATA COLLECTION

Records for all pedestrian casualty crashes that occurred in metropolitan Melbourne were extracted from files of the VicRoads database of reported casualty crashes for the years 1985 to 1994. This resulted in a total of 18,840 pedestrian casualty crashes during the ten year period. However, in 14,440 (or 77%) of these crashes the pedestrian's Blood Alcohol Concentration (BAC) and, therefore, their alcohol involvement prior to the crash was not known. Because of this proportion of unknown BAC's, only 4,400 pedestrian crashes (those where the pedestrian's BAC was known) were considered in the crash analysis. In 1,169 of these crashes the pedestrian had a BAC reading in excess of 0.010g/100 ml. These crashes are referred to as alcohol-involved pedestrian crashes, whereas the remaining 3,231 (in which the pedestrian had a known BAC of between 0.000 and 0.010g/100 ml) will be known as non-alcohol-involved crashes.

2.2 CRASH DATA ANALYSIS

Crash characteristics of the 1,169 alcohol-related pedestrian crashes were compared with the 3,231 non-alcohol-related pedestrian crashes (refer Chapter 3). Comparisons were made for situational factors (such as time-of-day and day-of-week), road environment factors (such as road geometry and traffic control type), as well as between pedestrian characteristics (such as age and gender).

Similarly, the characteristics of the alcohol-related and non-alcohol-related pedestrian crashes were examined for each of five individual sites investigated due to their locational clustering of alcohol-related pedestrian crashes.

2.3 SITE SELECTION

Lists of the locations of alcohol-involved pedestrian casualty crashes revealed that there were few locations which had experienced more than one crash. A greater understanding of the spatial distribution of the subject crashes was obtained by examining a map with the crashes plotted thereon. This enabled the ready identification of crashes which occurred close to each other, either within an area or along a road length.

A desktop GIS package (ArcView 2) was used to display, in map form, the location of all pedestrian crashes in Victoria for the period 1985-1994 for which the victim was known to have a BAC greater than 0.010g/100 ml. The number of crashes, from one to six, at each location was indicated by colour coding. Both intersection and mid-block crashes were displayed according to the Road Reference Point (RRP) or Road Segment (RS) classifications assigned in the VicRoads crash database.

In addition to the road network, the GIS package also displayed a grid representing the Melway (street directory) page layout.

A visual scan of the crash plot identified areas warranting closer examination. Areas were selected if they contained one or more of the following:

- an intersection (RRP) with at least three crashes;
- a road segment (RS) with at least three crashes;

- a road length (more than one RS) with at least three crashes within one kilometre;
- an area containing more than one RRP and/or more than one RS with at least five crashes within a 0.5 km square.

Sites which satisfy either of the first two of the above criteria may be readily identified from the VicRoads crash database. However, those locations to which either of the last two criteria apply, only become apparent when plotted on a map.

For example, the map below (Figure 2.1) is of the Brunswick Street, Fitzroy region. The RRP's and RS's that had more than one accident are labelled. Initial scanning of this area resulted in several sites meeting one of the four criteria listed above.

Figure 2.1: Location of Alcohol-Involved Pedestrian Accidents in Brunswick Street and Surrounding Area, Fitzroy, 1985-1994

The original list was then sorted in descending order according to the number of accidents occurring at **each** individual RRP or RS. Only those RRP's or RS's where three or more accidents had occurred were considered. All other locations within the vicinity of those chosen RRP's and RS's were also examined.

In the example above, the RRP's at the Johnston Street/Brunswick Street and the Gertrude Street/Brunswick Street intersections were the only points with three or more accidents. In Brunswick Street, the distance between these two points is less than one kilometre so any alcohol-involved pedestrian accidents occurring between the two points were also included.

There were five sites chosen for investigation within the metropolitan region, namely:

- Moonee Ponds Junction (Mt. Alexander Road, Pascoe Vale Road, Ascot Vale Road, Puckle Street/Dean Street), Moonee Ponds;
- Maroondah Highway (east of Murray Road), Croydon;
- Racecourse Road (between Stubbs Street and Clarence Street/Smithfield Road), Flemington;
- Brunswick Street (between Johnston Street and Victoria Parade), Fitzroy;
- Flemington Road (between Curran and Gatehouse Streets), North Melbourne.

Police Accident Report forms (Form 510) were obtained for the pedestrian casualty crashes which occurred at the sites selected for investigation, with the crashes where the pedestrian involved had a known BAC reading being examined in detail.

2.4 PREPARATION OF COLLISION DIAGRAMS

Collision diagrams for the five selected sites were prepared using information from the VicRoads crash database and Police Accident Report forms (Form 510). Separate collision diagrams were prepared for the alcohol-related (BAC > 0.010g/100 ml) and non-alcohol-related (BAC = 0.000g/100 ml) pedestrian crashes that occurred at each site. The diagrams display the crashes, road environment features, time-of-week of the crash and the pedestrian's BAC if alcohol was involved. The collision diagrams can be found in Attachment 2 of Appendices 1 to 5 for each of the five sites.

2.5 SITE INSPECTIONS

Each of the selected sites was inspected, during both the daytime and at night.

Note was taken of a range of road environment features, including the following:

- surrounding land-use;
- road classification;
- speed limit;
- road width;
- number of traffic lanes;
- linemarking;
- presence of median;
- footpath width;
- road surface;
- presence of trams;
- lighting (subjective);
- parking;
- traffic controls.

2.6 IDENTIFICATION OF ENVIRONMENTAL AND OTHER FACTORS

Data from site inspections and the VicRoads crash database were collated and analysed. Chapter 4 gives details of common crash circumstances ascertained from site inspections, as well as potential countermeasure options which target these main crash types.

3. COMPARISON OF CHARACTERISTICS OF ALCOHOL-RELATED AND NON-ALCOHOL-RELATED PEDESTRIAN CRASHES

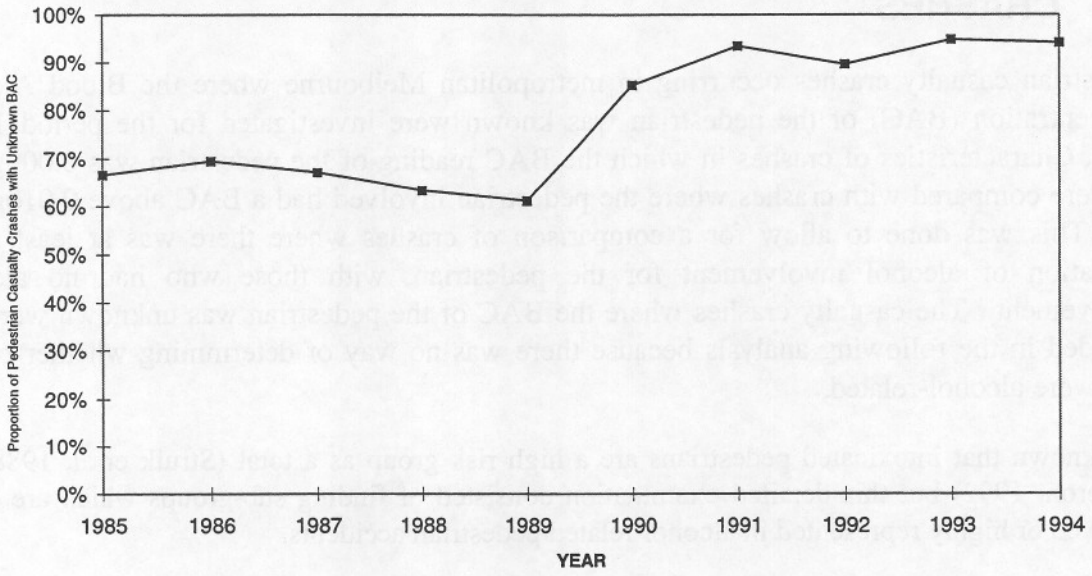
Pedestrian casualty crashes occurring in metropolitan Melbourne where the Blood Alcohol Concentration (BAC) of the pedestrian was known were investigated for the period 1985-1994. Characteristics of crashes in which the BAC reading of the pedestrian was 0.000g/100 ml were compared with crashes where the pedestrian involved had a BAC above 0.010g/100 ml. This was done to allow for a comparison of crashes where there was at least some indication of alcohol involvement for the pedestrian, with those who had no alcohol involvement. The casualty crashes where the BAC of the pedestrian was unknown were not included in the following analysis because there was no way of determining whether or not they were alcohol-related.

It is known that intoxicated pedestrians are a high risk group as a total (Struik et al, 1988 and Cameron, 1992) but this detailed examination consisted of finding sub-groups which are over-involved or highly represented in alcohol-related pedestrian accidents.

Information from Police accident reports covering 18,840 pedestrians involved in casualty accidents in Melbourne during 1985-94 was extracted for this study. The information on the pedestrians BAC levels was obtained either from the Coroner's post-mortem tests or from blood alcohol tests taken from road accident victims treated in hospital. In practice a hospital blood test was not taken for all eligible victims (Cameron, 1992).

Furthermore, during 1989 the practice of taking blood samples in hospitals to determine alcohol content changed (South, 1994). An industrial campaign by medical staff in hospital Emergency Departments in October 1989 disrupted the taking of blood samples, making comparisons with BAC readings from earlier years difficult. After 1991, hospitals agreed to adopt a Code of Practice to take blood samples from all drivers involved in crashes, whereas previously many hospitals took samples only from drivers suspected to have been drinking. However, the degree to which this Code was adhered to is not known. Because of these changes the proportion of hospitalised drivers and motorcycle riders not tested has increased since 1990. The changes that occurred in 1989 appear to also have affected pedestrians with regard to the taking of blood samples. Figure 3.0 depicts the proportion of pedestrians involved in casualty crashes with unknown BAC's for 1985-94. During 1985-89, approximately 65% of pedestrians had unknown BAC readings, whereas by 1994 the rate had increased to 90%. Further, pedestrians with known BAC readings have a larger percentage of severe injuries than those with unknown BAC readings. This may be partially due to the bias resulting from blood samples only being taken from pedestrians killed or treated for serious injury at hospitals.

Figure 3.0: Proportion of Pedestrian Casualty Crashes in which the BAC of the Pedestrian was UNKNOWN for Melbourne, 1985-94



In metropolitan Melbourne for the ten year period, 4,400 pedestrians (or 23%) had a known BAC reading. Of these, 3,231 had a BAC ranging from zero to 0.010g/100 ml (this group will be known as the non-alcohol-related pedestrians), and the remaining 1,169 pedestrians had a BAC reading greater than 0.010g/100 ml (those pedestrians with positive BAC or some alcohol involvement).

Generally, there was also a bias towards testing only pedestrians who had a high blood alcohol content, particularly after the changes in the taking of blood samples had occurred in 1989.

3.1 NIGHT AND DAY PEDESTRIAN CRASHES

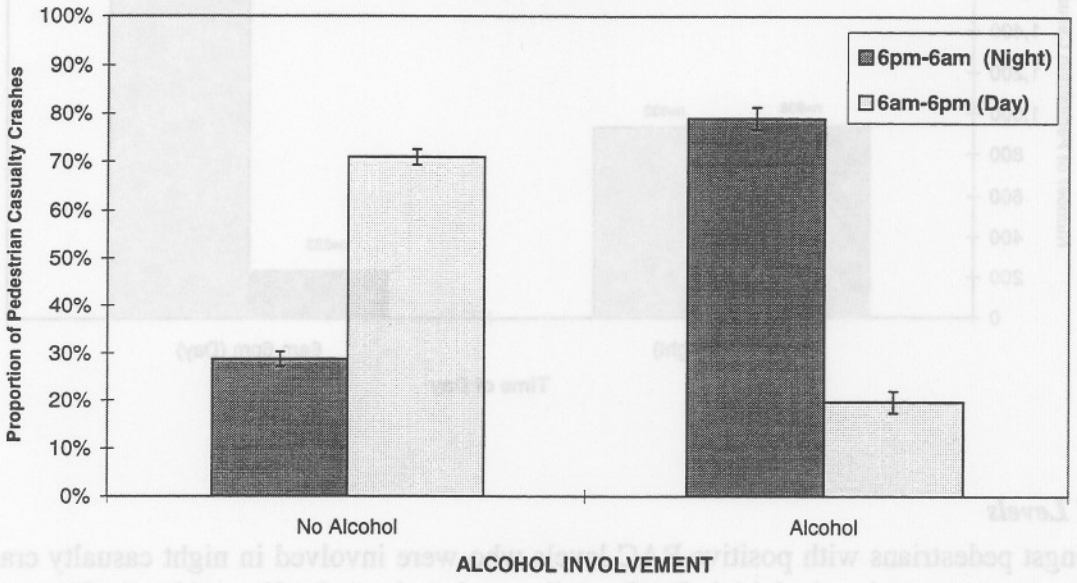
Ideally, high risk pedestrian groups should be determined as the number of accidents per "exposure" measure such as the number of kilometres walked. Unfortunately, in practice this is not known and there is no available method of allowing completely for the exposure differences between intoxicated and sober pedestrians. An alternative to this could be to develop 'high alcohol times' of the day and week for pedestrians, similar to the high alcohol times developed by Harrison (1990) for drivers. This would provide the periods of the week when alcohol-related pedestrian crashes are likely to occur. However to develop these times, a relatively large proportion of ***known*** BAC's is needed to provide a representative sample of alcohol involvement amongst pedestrians. The large unknown BAC rates amongst pedestrians particularly after 1989 would therefore not allow for a reliable estimate of high alcohol times for pedestrians to be determined. Thus, instead of using high alcohol times for this study, to obtain an approximation of the times when alcohol involvement is likely to be greater, the day was divided into the following two periods:

- day (6 a.m. to 6 p.m.);
- night (6 p.m. to 6 a.m.).

Figure 3.1 displays the distribution of alcohol-related and non-alcohol-related pedestrian casualty crashes for the above time periods. Amongst non-alcohol-related crashes, 71% occurred during the day, compared with 29% at night, whereas amongst alcohol-related

crashes the day and night proportions were reversed. Almost 80% of these crashes occurred during night hours, and only 20% during the day. Day and night differences were statistically significant for both non-alcohol-related and alcohol-related pedestrian crashes as depicted by the 95% confidence limits placed on the estimates in Figure 3.1.

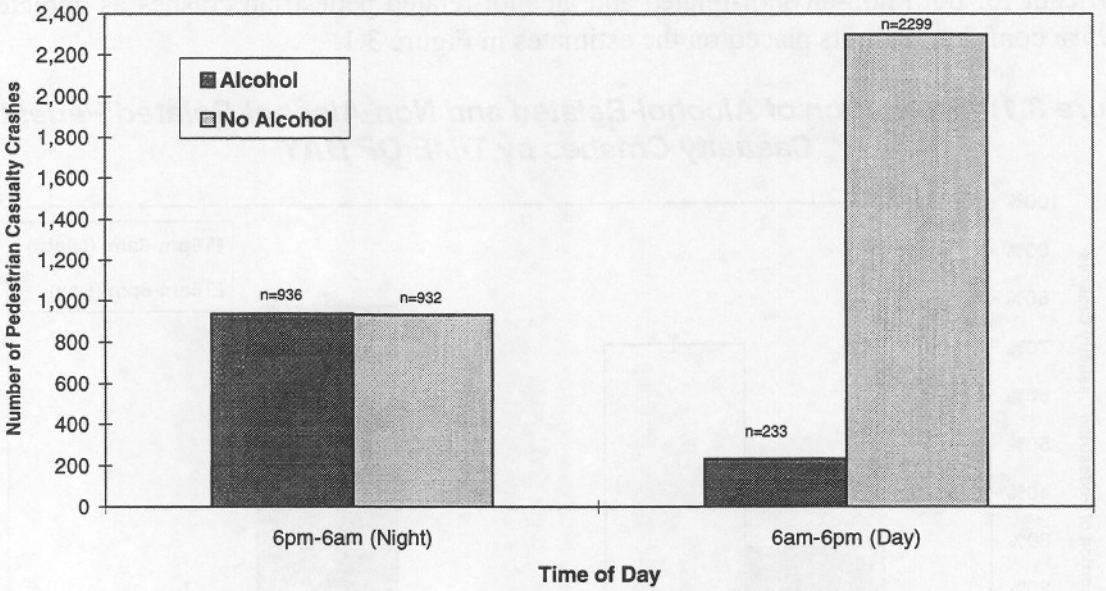
Figure 3.1: Proportion of Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes by TIME OF DAY



These differences in frequencies between night and day crashes could result in some factors being over-represented in the intoxicated pedestrian group due predominantly to differences in the time-of-day rather than differences in accident risk. For this reason the casualty crashes were examined within each time period separately.

Figure 3.2 depicts the distribution of day and night casualty crashes during 1985-94 in which both alcohol and no alcohol was involved. Amongst crashes occurring at night there were equal proportions of alcohol-related and non-alcohol-related pedestrian, but during the day only 9% of the crashes involved alcohol. Thus, daytime alcohol-involved pedestrian accidents occur less frequently than night-time alcohol-involved pedestrian casualty crashes. If this was not taken into account when comparing the proportions from the two groups then there may be a danger in identifying problem areas where the costs of implementing countermeasures would not be worthwhile. Therefore, the rest of this section will focus on night casualty crashes involving alcohol amongst pedestrians.

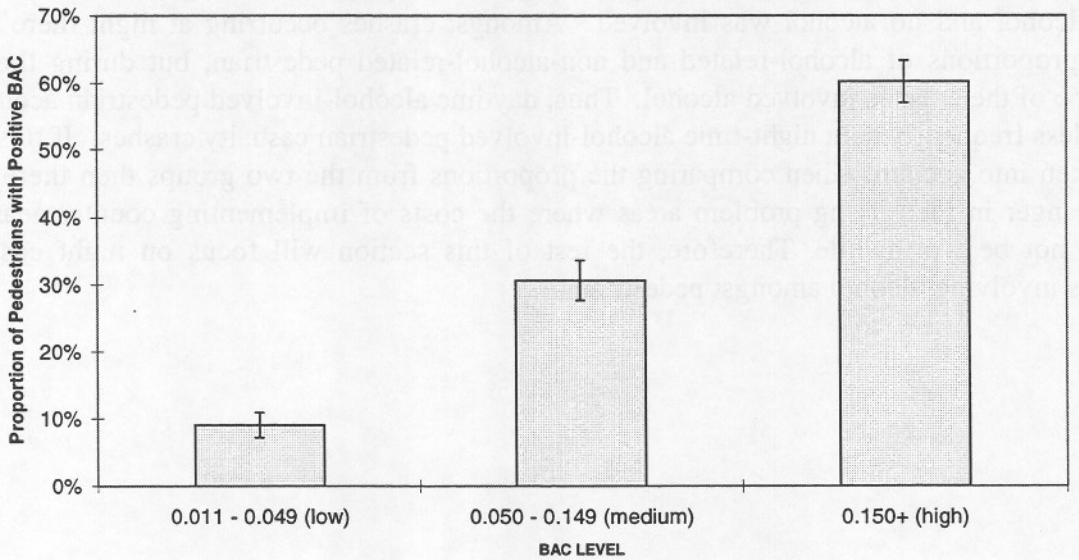
Figure 3.2: Number of Pedestrian Casualty Crashes by TIME OF DAY and Alcohol Involvement for Melbourne, 1985-94



BAC Levels

Amongst pedestrians with positive BAC levels who were involved in night casualty crashes, the greatest proportion had high BAC readings of at least 0.150 g/100 ml (Figure 3.3). Approximately 60% of pedestrians with positive BAC levels had high BAC readings compared with 31% with BAC's ranging from 0.050-0.149 g/100 ml, and 9% with low BAC's between 0.011-0.049 g/100 ml.

Figure 3.3: Proportion of Pedestrians with LOW, MEDIUM and HIGH BAC amongst NIGHT Casualty Crashes in Melbourne, 1985-94



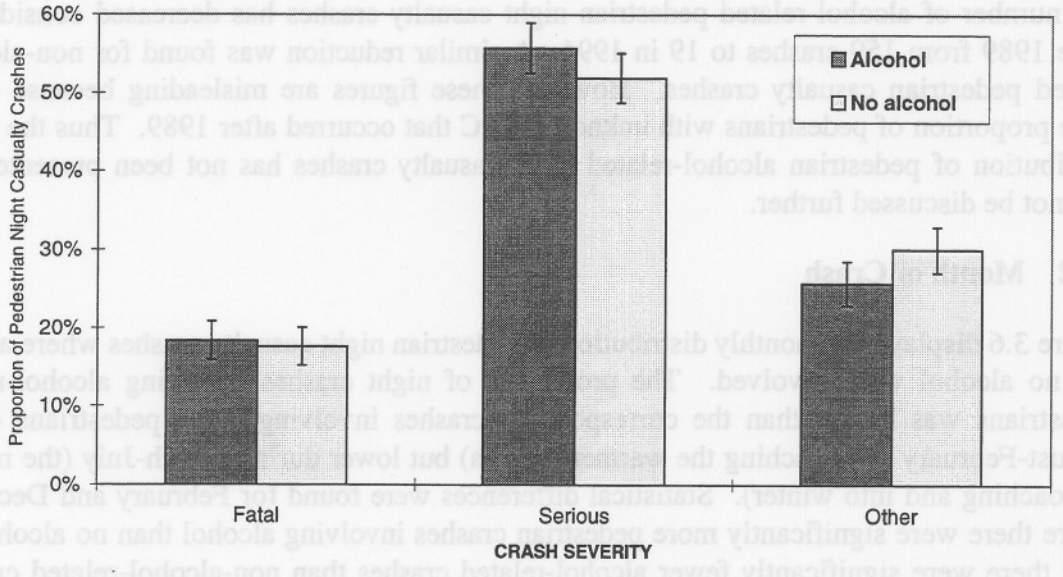
3.2 CRASH CHARACTERISTICS

This section compares characteristics of alcohol-related pedestrian night casualty crashes with those involving sober pedestrians, according to crash type, situational factors, road environment and pedestrian characteristics. Whenever the crash distributions involving intoxicated pedestrians differ from those where the pedestrian had a zero BAC reading, the distributions for the two groups were presented for comparison; otherwise only the distributions involving alcohol-related pedestrian casualty crashes have been presented.

3.2.1 Crash Severity

Figure 3.4 presents the crash severity level for alcohol-related and non-alcohol-related pedestrian casualty crashes occurring at night in Melbourne during 1985-94. There was little difference in crash severity between alcohol-related and non-alcohol-related pedestrian crashes, with alcohol-related crashes being marginally more severe - 74% of pedestrian crashes where alcohol was involved resulted in a fatal or serious injury compared with 70% for non-alcohol-related crashes. However, there were no statistically significant differences between the two groups with regard to fatalities, serious injuries and other injuries. This may be because pedestrians with ***known*** BAC are likely to be involved in fatal or serious injury crashes irrespective of whether they had a zero or positive BAC reading.

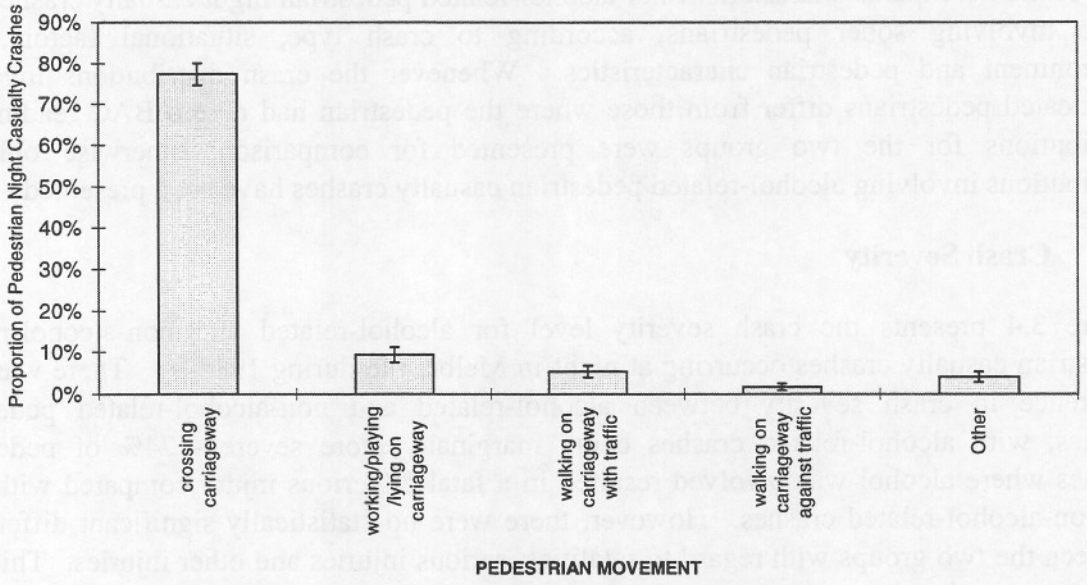
Figure 3.4: Crash SEVERITY of Alcohol-Related and Non-Alcohol-Related Pedestrian NIGHT Casualty Crashes in Melbourne, 1985-94



3.2.2 Pedestrian Movement

Figure 3.5 presents the pedestrian movement distribution for alcohol-involved pedestrians at night. The majority of alcohol-involved pedestrians (77%) were struck while crossing the carriageway during night hours. The corresponding distribution for pedestrians with no alcohol involvement was similar with no statistically significant differences found.

Figure 3.5 Proportion of Alcohol-Related Pedestrian NIGHT Casualty Crashes by PEDESTRIAN MOVEMENT for Melbourne, 1985-94



3.3 SITUATIONAL FACTORS

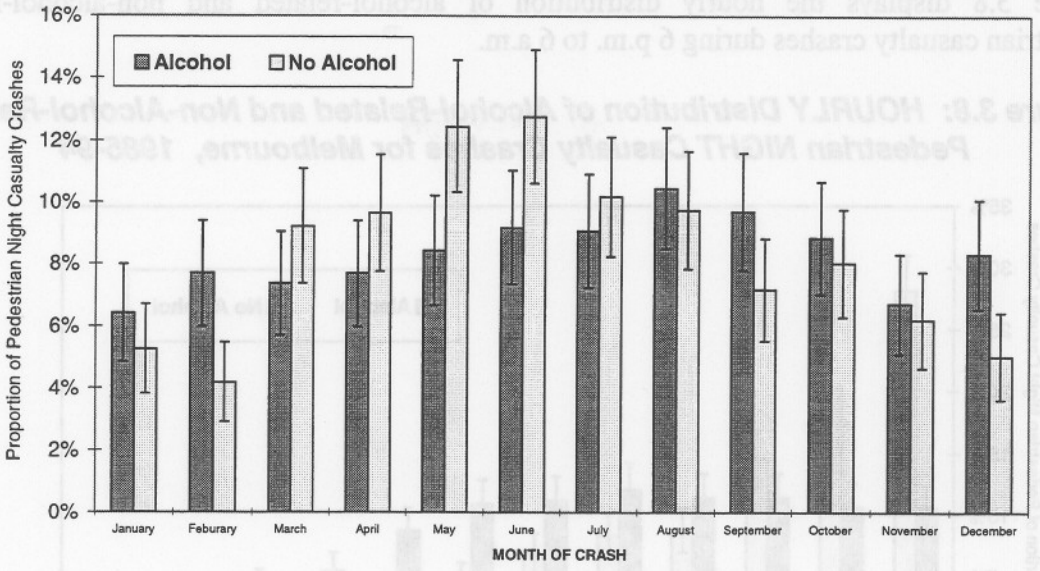
3.3.1 Year of Crash

The number of alcohol-related pedestrian night casualty crashes has decreased considerably since 1989 from 159 crashes to 19 in 1994. A similar reduction was found for non-alcohol-related pedestrian casualty crashes. However, these figures are misleading because of the large proportion of pedestrians with unknown BAC that occurred after 1989. Thus the yearly distribution of pedestrian alcohol-related night casualty crashes has not been presented and will not be discussed further.

3.3.2 Month of Crash

Figure 3.6 displays the monthly distribution of pedestrian night casualty crashes where alcohol and no alcohol were involved. The proportion of night crashes involving alcohol-related pedestrians was higher than the corresponding crashes involving sober pedestrians during August-February (approaching the warmer months) but lower during March-July (the months approaching and into winter). Statistical differences were found for February and December where there were significantly more pedestrian crashes involving alcohol than no alcohol. In May there were significantly fewer alcohol-related crashes than non-alcohol-related crashes. However for both groups of pedestrians the highest crash frequencies occurred in winter. Amongst alcohol-involved pedestrian crashes, 11% occurred in August, and amongst the non-alcohol-involved crashes, 13% occurred in June.

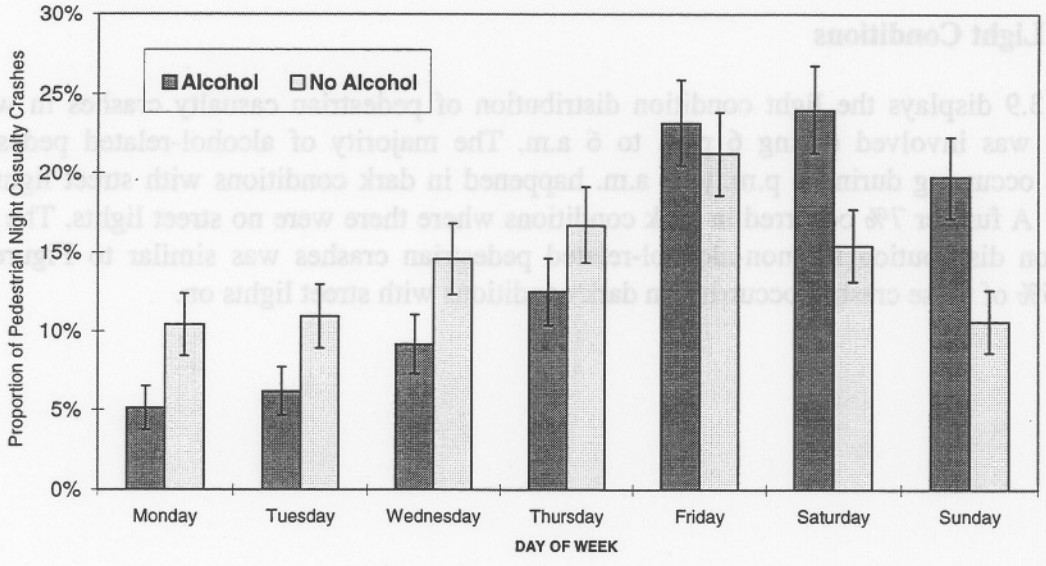
Figure 3.6: MONTHLY Distribution of Alcohol-Related and Non-Alcohol-Related Pedestrian NIGHT Casualty Crashes for Melbourne, 1985-94



3.3.3 Day-of-Week

Figure 3.7 presents the weekly distribution of alcohol-related and non-alcohol-related pedestrian casualty crashes occurring during night hours. The greatest proportion of alcohol-related crashes occurred on Friday (23%), Saturday (24%) and Sunday (20%) nights. These proportions were significantly greater than the proportions occurring on weekday nights. Further, there were significantly more alcohol-related crashes on Saturday and Sunday (between the hours of midnight - 6 a.m. and between 6 p.m. - midnight) than non-alcohol-related crashes. However, for the weekday nights (Monday to Thursday) non-alcohol crashes occurred in greater proportions than alcohol-related crashes, with statistically significant differences found for Monday-Wednesday.

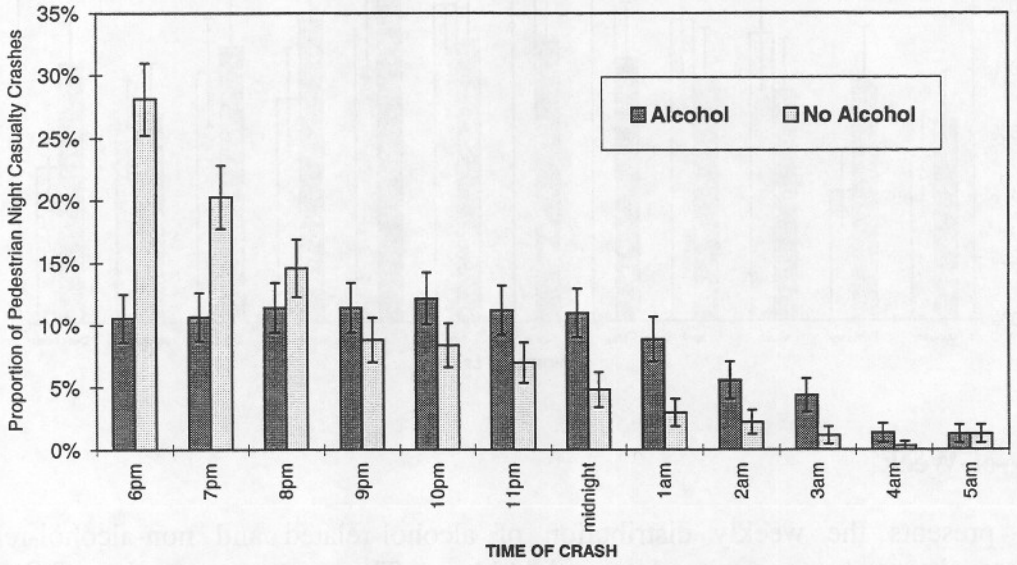
Figure 3.7: WEEKLY Distribution of Alcohol-Related and Non-Alcohol Related Pedestrian NIGHT Casualty Crashes for Melbourne, 1985-94



3.3.4 Time-of-Day

Figure 3.8 displays the hourly distribution of alcohol-related and non-alcohol-related pedestrian casualty crashes during 6 p.m. to 6 a.m.

Figure 3.8: HOURLY Distribution of Alcohol-Related and Non-Alcohol-Related Pedestrian NIGHT Casualty Crashes for Melbourne, 1985-94



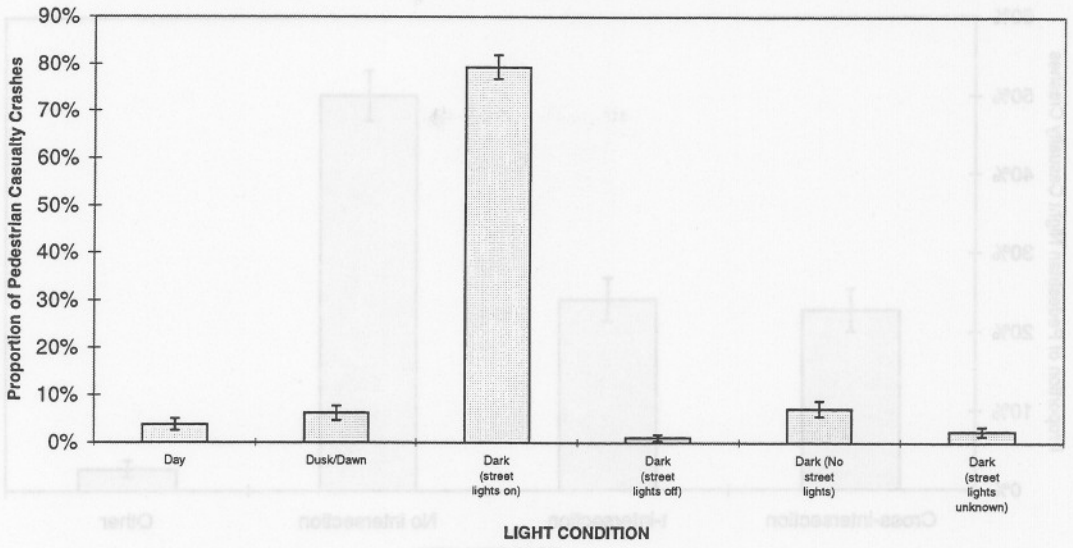
There were significantly more non-alcohol-related pedestrian crashes occurring during 6 p.m. - 8 p.m. (48%) than alcohol-related crashes (21%). Between 9 p.m. and 5 a.m. there were more alcohol-related pedestrian crashes than non-alcohol-related crashes, but the alcohol proportion was only statistically significantly greater during 11 p.m. to 4 a.m. (the respective alcohol and non-alcohol proportions were 41% and 18%).

Amongst alcohol-related crashes, no statistically significant differences were found during 6 p.m. to 1 a.m. However, there was significantly more alcohol involvement amongst pedestrians during 2 a.m. to 6 a.m. than during 6 p.m. to 2 a.m.

3.3.5 Light Conditions

Figure 3.9 displays the light condition distribution of pedestrian casualty crashes in which alcohol was involved during 6 p.m. to 6 a.m. The majority of alcohol-related pedestrian crashes occurring during 6 p.m. to 6 a.m. happened in dark conditions with street lights on (79%). A further 7% occurred in dark conditions where there were no street lights. The light condition distribution for non-alcohol-related pedestrian crashes was similar to Figure 3.9 with 75% of these crashes occurring in dark conditions with street lights on.

Figure 3.9: LIGHT CONDITION Distribution of ALCOHOL-Related Pedestrian Casualty Crashes Occurring between 6 p.m. to 6 a.m. in Melbourne, 1985-94



3.4 ROAD ENVIRONMENT FACTORS

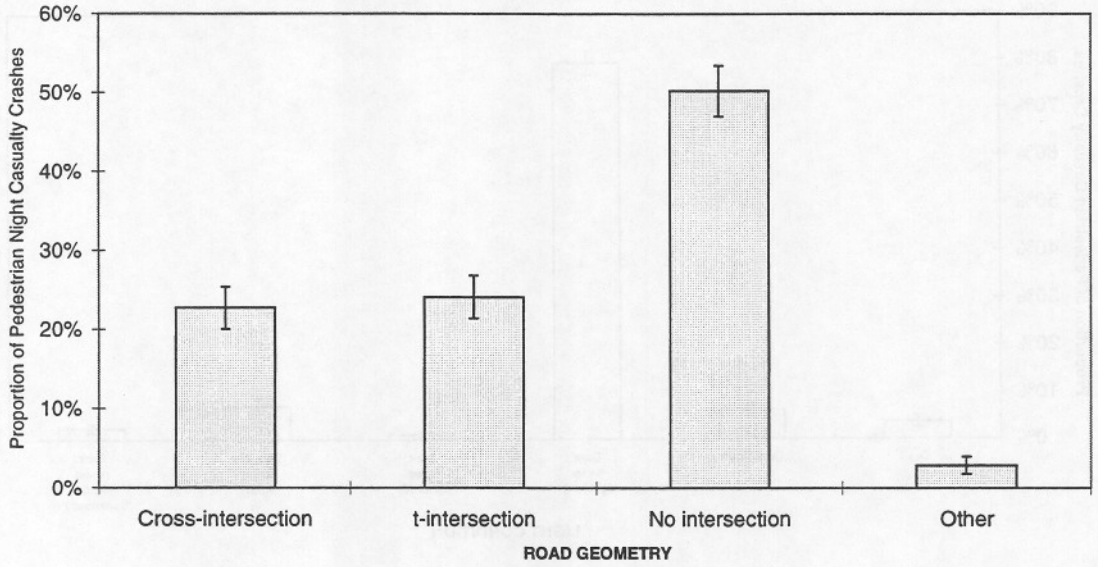
3.4.1 Road Location Type

Amongst alcohol-related pedestrian casualty crashes at night, a greater proportion occurred at mid-blocks (51%) than at intersections (49%), whereas for non-alcohol- related pedestrian crashes these proportions were reversed. However, there were no statistically significant differences between the proportions at intersections or at mid-blocks for either group, and no significant differences between alcohol-related and non-alcohol-related pedestrian crashes with respect to road location type.

3.4.2 Road Geometry

Alcohol-related pedestrian night casualty crashes predominantly (50%) occurred where there was no intersection (Figure 3.10). There were significantly fewer crashes at either a cross intersection or a T-intersection. The corresponding road geometry distribution for non-alcohol-related crashes was similar to Figure 3.10 (49% of crashes were not at an intersection.) It should be noted that there are more T-intersections than cross intersections in Melbourne in general, which may explain the greater proportion of crashes at T-intersections.

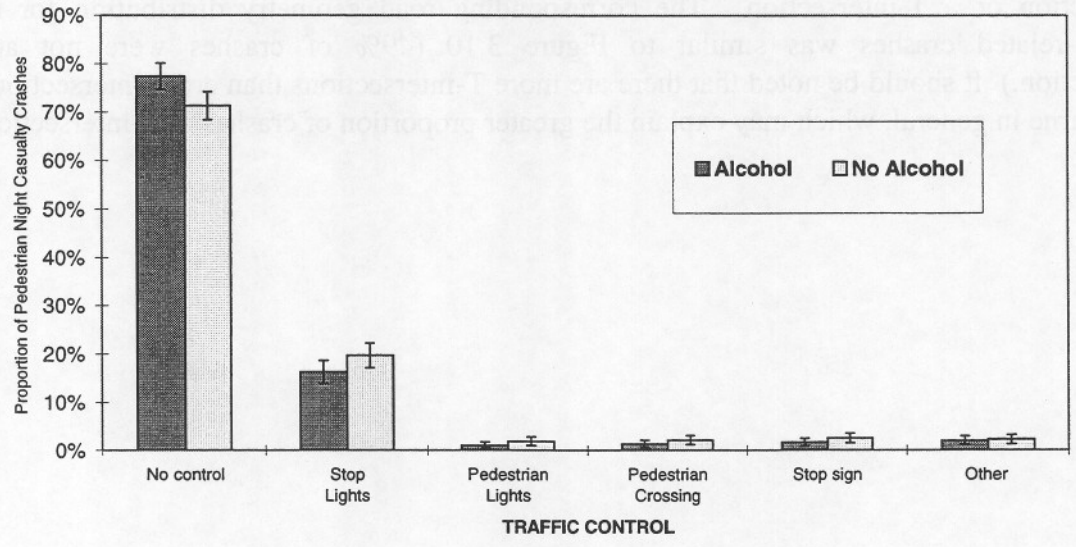
Figure 3.10: ROAD GEOMETRY of Alcohol-Related Pedestrian Casualty Crashes Occurring at NIGHT in Melbourne, 1985



3.4.3 Traffic Control

Figure 3.11 gives the distribution of traffic control types for both alcohol-related and non-alcohol-related pedestrian casualty crashes occurring at night. Amongst alcohol- related pedestrian crashes at night, significantly more crashes occurred where there was no traffic control (78%). A further 16% of crashes occurred at a stop light. In addition, there was a significantly greater proportion of alcohol-related pedestrian crashes occurring where there was no control than non-alcohol-related crashes (respective proportions of 78% and 71%). There were no statistically significant differences between the two groups of crashes for other traffic controls.

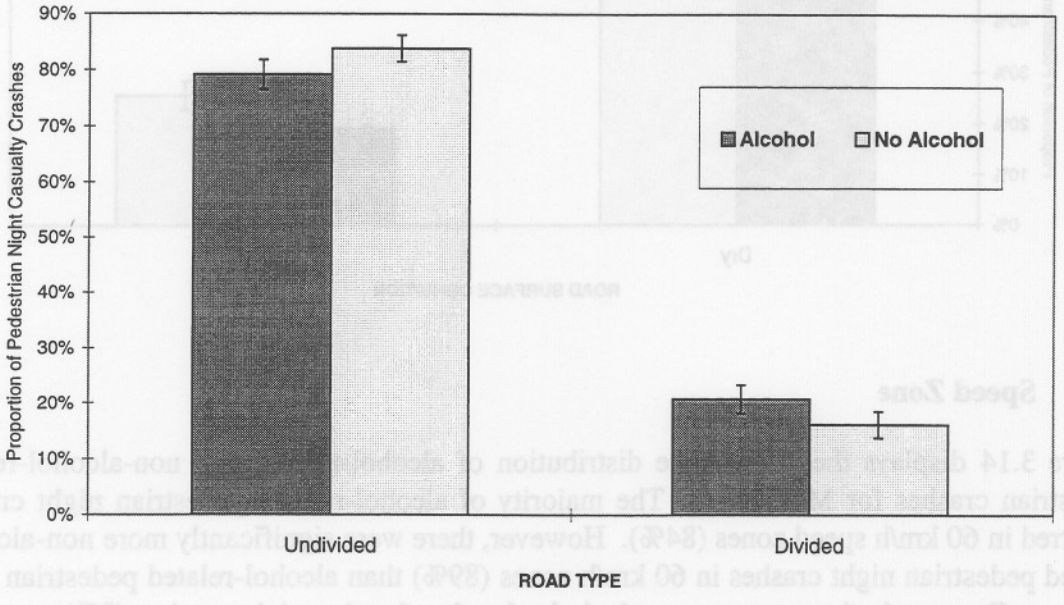
Figure 3.11: TRAFFIC CONTROL Distribution of Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes Occurring at NIGHT in Melbourne, 1985-94



3.4.4 Road Type

There were significantly more alcohol-related pedestrian night crashes occurring on undivided roads (79%) than on divided roads (21%) in Melbourne (Figure 3.12). However, this was also true for non-alcohol-related pedestrian crashes (84% on undivided roads and 16% on divided roads). No statistically significant differences between the two types of crashes with respect to road type were found.

Figure 3.12: ROAD TYPE of Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes Occurring at NIGHT in Melbourne, 1985-94

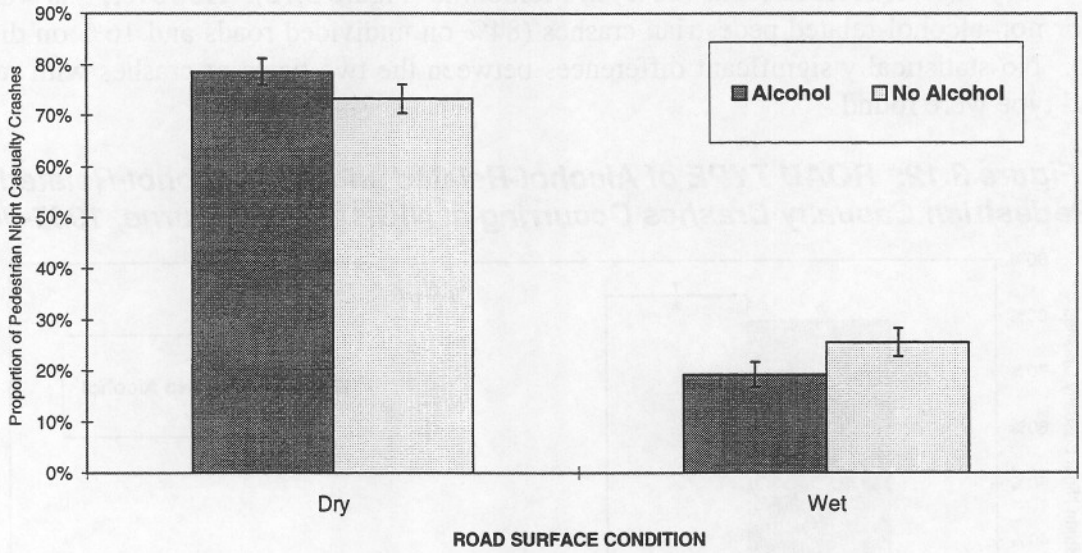


The majority of alcohol-related pedestrian crashes occurring at night in Melbourne happened on straight roads (97%). A similarly high proportion of non-alcohol-related pedestrian crashes (98%) occurred on straight roads also. For both types of crashes approximately 2% of the accidents occurred on curved roads.

3.4.5 Road Surface Condition

Figure 3.13 displays the road surface distribution of alcohol-related and non-alcohol- related pedestrian casualty crashes occurring at night. For both groups of crashes, significantly more crashes occurred in dry conditions than in wet conditions. However, amongst wet road crashes, there was a significantly smaller proportion (19%) involving alcohol than no alcohol (26%). Conversely, amongst crashes occurring on dry roads there were more crashes involving alcohol (79%) than no alcohol (73%), although the difference was not statistically significant.

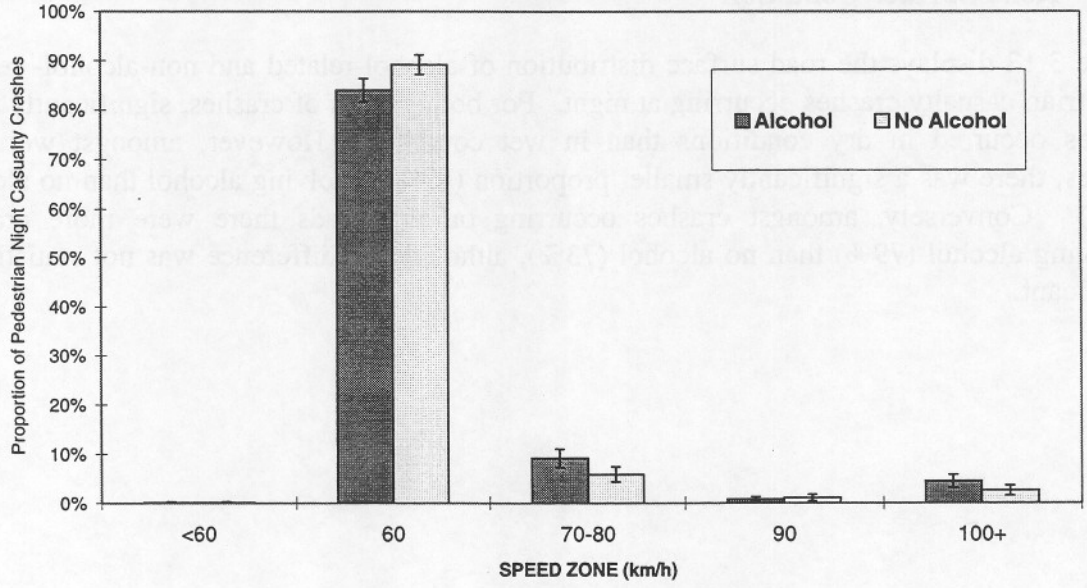
Figure 3.13: ROAD SURFACE Condition of Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes Occurring at NIGHT in Melbourne, 1985-94



3.4.6 Speed Zone

Figure 3.14 displays the speed zone distribution of alcohol-related and non-alcohol-related pedestrian crashes for Melbourne. The majority of alcohol-related pedestrian night crashes occurred in 60 km/h speed zones (84%). However, there were significantly more non-alcohol-related pedestrian night crashes in 60 km/h zones (89%) than alcohol-related pedestrian night crashes. Conversely there were more alcohol-related pedestrian night crashes (9%) occurring in 70-80 km/h zones than non-alcohol-related night crashes (6%), although no statistically significant differences were found. This finding was also apparent for pedestrian night crashes occurring in high speed zones of 100 km/h or more.

Figure 3.14: SPEED ZONE of Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes Occurring at NIGHT in Melbourne, 1985-94



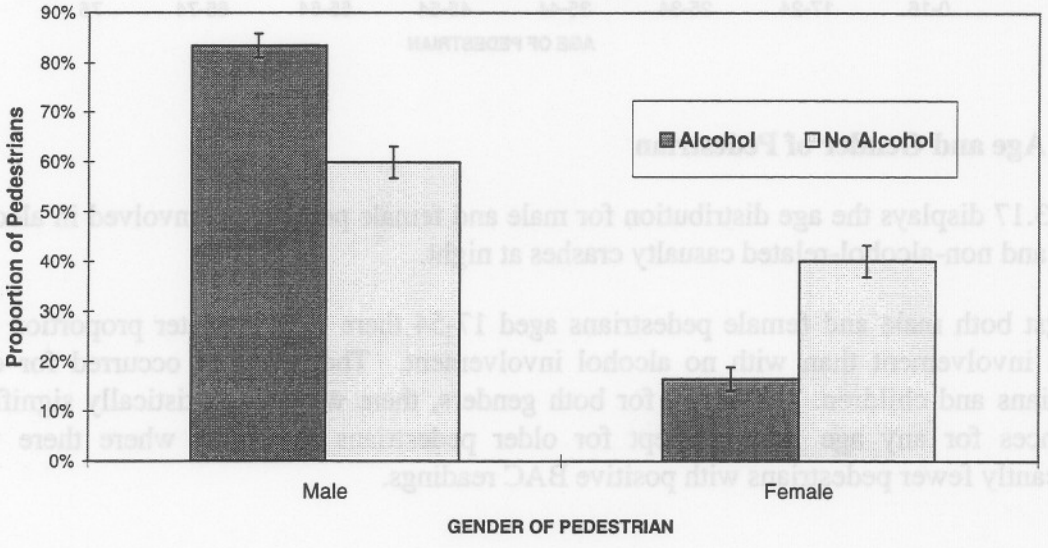
3.5 ROAD USER CHARACTERISTICS

3.5.1 Gender of Pedestrian

The proportions of male and female pedestrians in which alcohol and no alcohol was involved prior to a casualty crash are depicted in Figure 3.15.

For both alcohol-related and non-alcohol-related crashes, male pedestrians were over-represented. For males, however, a significantly greater proportion of night crashes involved alcohol (83%) than no alcohol (60%). But for females this was not evident. There were significantly fewer female alcohol-related pedestrians (17%) than sober female pedestrians (40%).

Figure 3.15: Proportion of MALE and FEMALE Pedestrians involved in Alcohol-Related and Non-Alcohol-Related Casualty Crashes at NIGHT in Melbourne, 1985-94

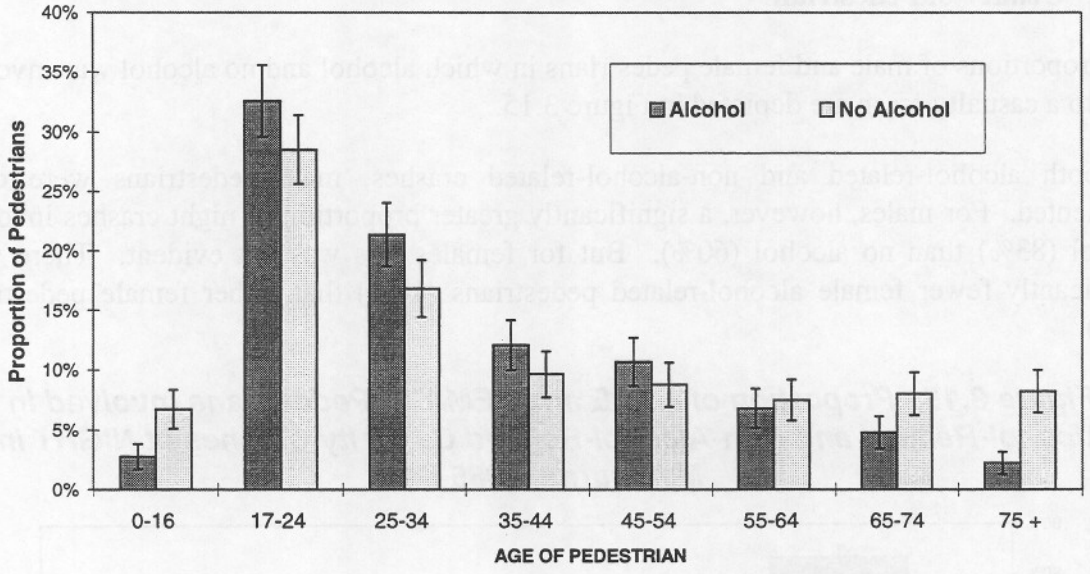


3.5.2 Age of Pedestrian

Figure 3.16 compares the age distributions of pedestrians who had some alcohol involvement with those with no alcohol involvement. Although a greater proportion of pedestrians aged 17-54 had some alcohol involvement than no alcohol involvement, there were no statistically significant differences in the age distributions amongst alcohol-related and non-alcohol-related pedestrians for this group. But when pedestrians aged 17-54 were treated as one group, there were significantly more crashes involving alcohol than no alcohol. Further, there were significantly fewer pedestrians aged 75+ and 0-16 with alcohol involvement than no alcohol involvement.

Amongst alcohol-involved pedestrians, there were significantly more young adults aged 17-34 involved, than pedestrians aged 35 years and above. However, this was also true for pedestrians with no alcohol involvement.

Figure 3.16: AGE Distribution of Pedestrians involved in Alcohol-Related and Non-Alcohol-Related Casualty Crashes at NIGHT in Melbourne, 1985-94

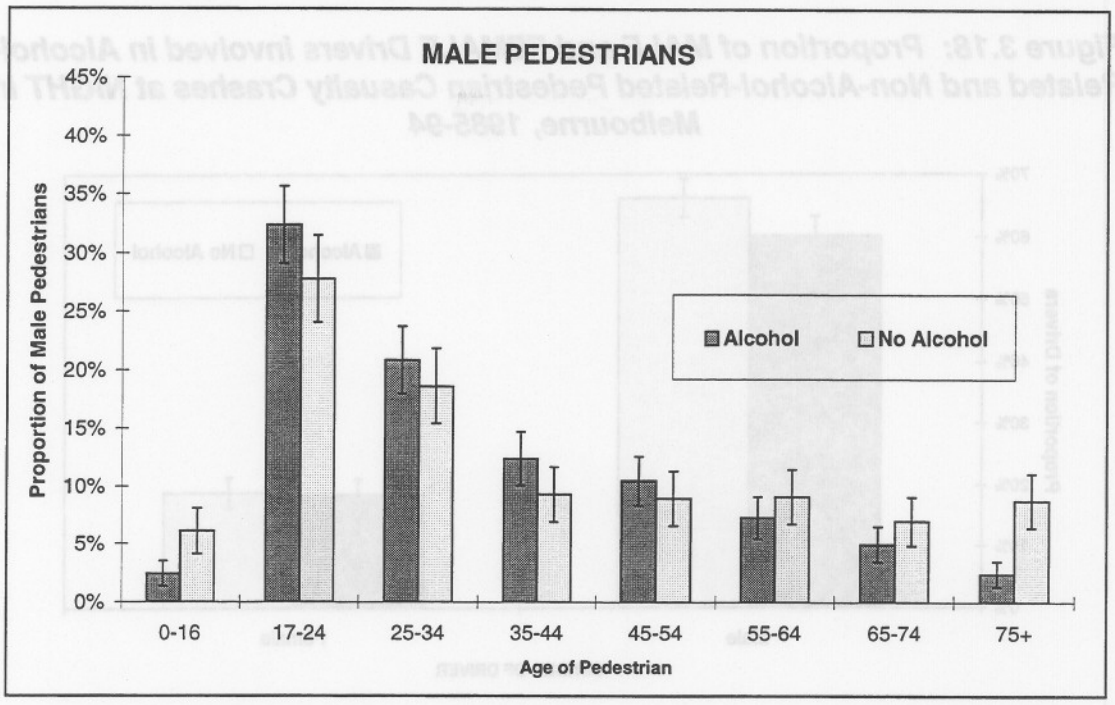


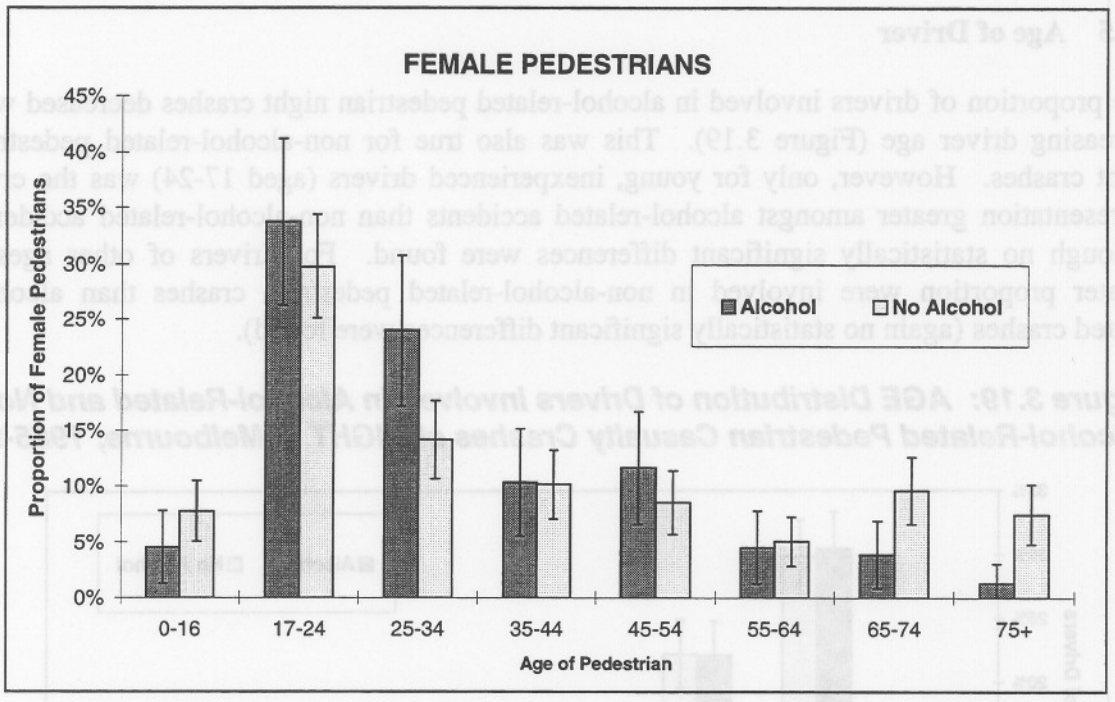
3.5.3 Age and Gender of Pedestrian

Figure 3.17 displays the age distribution for male and female pedestrians involved in alcohol-related and non-alcohol-related casualty crashes at night.

Amongst both male and female pedestrians aged 17-54 there was a greater proportion with alcohol involvement than with no alcohol involvement. The converse occurred for older pedestrians and children. However, for both genders, there were no statistically significant differences for any age group except for older pedestrians aged 75+ where there were significantly fewer pedestrians with positive BAC readings.

Figure 3.17: AGE Distribution of MALE and FEMALE Pedestrians involved in Alcohol-Related and Non-Alcohol-Related Casualty Crashes at NIGHT in Melbourne, 1985-94



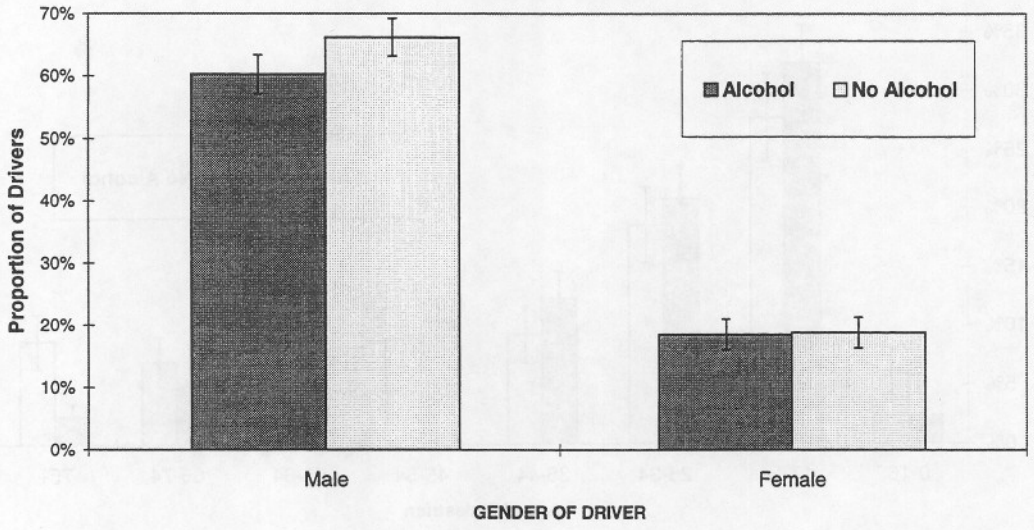


3.5.4 Gender of Driver

The proportion of male and female drivers involved in alcohol-related and non-alcohol-related pedestrian night crashes in Melbourne is depicted in Figure 3.18. For both types of crash, there were significantly more male drivers involved (over 60%) than female drivers (approximately 19%).

It is worth noting that the gender of the driver involved was unknown in 21% of the alcohol-related pedestrian crashes and in 15% of the non-alcohol-related pedestrian crashes, suggesting the failure of the driver to stop after the accident particularly at night.

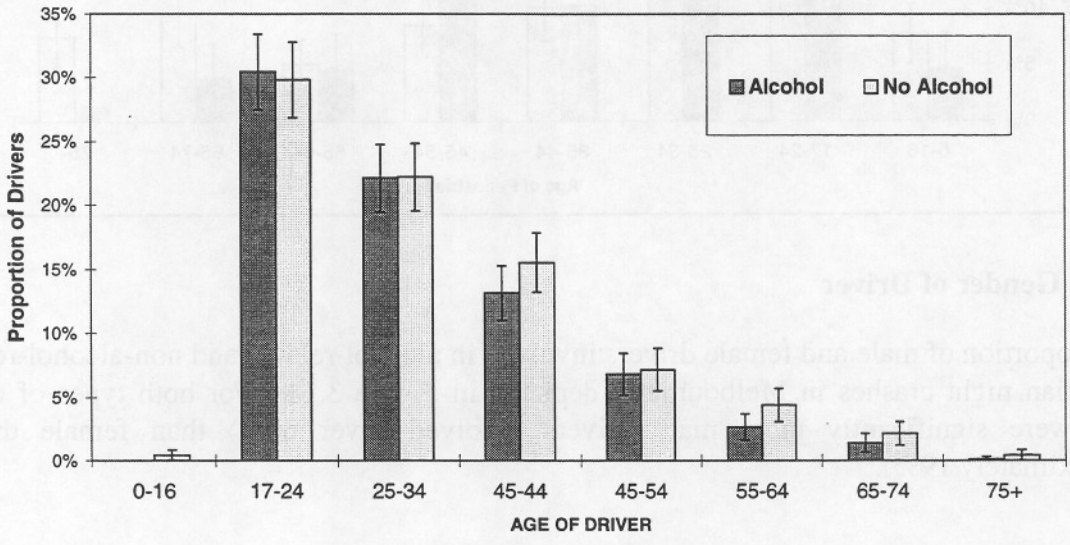
Figure 3.18: Proportion of MALE and FEMALE Drivers involved in Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes at NIGHT in Melbourne, 1985-94



3.5.5 Age of Driver

The proportion of drivers involved in alcohol-related pedestrian night crashes decreased with increasing driver age (Figure 3.19). This was also true for non-alcohol-related pedestrian night crashes. However, only for young, inexperienced drivers (aged 17-24) was the crash representation greater amongst alcohol-related accidents than non-alcohol-related accidents, although no statistically significant differences were found. For drivers of other ages, a greater proportion were involved in non-alcohol-related pedestrian crashes than alcohol-related crashes (again no statistically significant differences were found).

Figure 3.19: AGE Distribution of Drivers involved in Alcohol-Related and Non-Alcohol-Related Pedestrian Casualty Crashes at NIGHT in Melbourne, 1985-94



3.5.6 BAC of Driver

The BAC reading of the drivers involved in the alcohol-related pedestrian night crashes in Melbourne during 1985-94 was unknown in 92% of the accidents. The corresponding unknown BAC rate for non-alcohol-related pedestrian crashes was 94%. For the pedestrian crashes in which the driver's BAC ***was known***, there was a greater proportion of drivers with positive BAC's (BAC > 0.010 g/100 ml) amongst the non-alcohol-related crashes, however no statistically significant differences were found.

3.6 SUMMARY

In Melbourne during 1985-94, 4,424 pedestrians involved in casualty crashes had a known BAC. Of these, 1,184 had some alcohol involvement, that is a positive BAC > 0.010g/100 ml. The remaining 3,240 pedestrians were considered to have no alcohol involvement.

Comparison between the alcohol-related and non-alcohol-related pedestrian crashes found the following characteristics:

- almost 80% of alcohol-related pedestrian crashes occurred at night between 6:00 p.m. - 6:00 a.m.;
- amongst the night crashes, there were equal proportions in which the pedestrian had a positive BAC and a zero BAC;
- approximately 60% of pedestrians involved in alcohol-related pedestrian casualty crashes at night had excessive BAC's greater than 0.150g/100 ml;
- 74% of pedestrian night crashes where alcohol was involved resulted in a fatal or serious injury, however this was not significantly different from crashes in which the pedestrian had no alcohol involvement;
- the majority of alcohol-involved pedestrians (77%) were struck while crossing the carriageway during night hours;
- there were significantly more pedestrian night crashes involving alcohol than no alcohol during February and December. In May there were significantly fewer alcohol-related than non-alcohol-related pedestrian crashes. However for both groups of pedestrians the highest crash frequencies occurred in winter;
- there were significantly more alcohol-related crashes occurring on Friday, Saturday and Sunday nights than on weekday nights. Further there were significantly more alcohol-related crashes on Saturday and Sunday (between the hours of midnight and 6 a.m. and between 6 p.m. - midnight) than non-alcohol-related crashes.
- between 9 p.m. and 5 a.m. there were more alcohol-related pedestrian crashes than non-alcohol-related crashes, but the alcohol proportion was only significantly greater during 11 p.m. to 4 a.m.;
- there was a significantly greater proportion of intoxicated pedestrians involved in casualty crashes during 2 a.m. to 6 a.m. than during 6 p.m. to 2 a.m.;
- 79% of the alcohol-related pedestrian crashes occurring during 6 p.m. to 6 a.m. happened in dark conditions with street lights on;

- half of the alcohol-related pedestrian night crashes occurred where there was no intersection, with significantly fewer crashes occurring at either a cross intersection or T-intersection;
- a significantly greater proportion of alcohol-related pedestrian night crashes occurred where there was no traffic control than non-alcohol-related night crashes (respective proportions of 78% and 71%);
- amongst wet road night crashes, there was a significantly smaller proportion (19%) involving alcohol than no alcohol (26%);
- there were significantly fewer alcohol-related pedestrian night crashes in 60 km/h zones (84%) than non-alcohol-related pedestrian night crashes. Conversely there were more crashes involving alcohol in speed zones greater than 60 km/h;
- for male pedestrians a significantly greater proportion of night crashes involved alcohol (83%) than no alcohol (60%), whereas there were significantly fewer female alcohol-related pedestrians (17%) than sober female pedestrians (40%);
- amongst alcohol-involved pedestrians at night, there were significantly more young adults aged 17-34 involved, than pedestrians aged 35+ years;
- there were significantly more male drivers (60%) involved in the alcohol-related pedestrian night crashes than female drivers (19%).

4. INVESTIGATION OF SITES AT HIGH RISK OF ALCOHOL INVOLVEMENT

Five sites which have experienced relatively large numbers of alcohol-related pedestrian crashes were investigated. Extensive reports on the investigated sites giving details of the alcohol-related crashes, location details, factors contributing to crash occurrence and potential countermeasure options for each site can be found in the following Appendices:

APPENDIX 1 Moonee Ponds Junction (Mt. Alexander Road, Pascoe Vale Road, Ascot Vale Road, Puckle Street/Dean Street), Moonee Ponds;

APPENDIX 2 Maroondah Highway (east of Murray Road), Croydon;

APPENDIX 3 Racecourse Road (between Stubbs Street and Clarence Street/Smithfield Road), Flemington.

APPENDIX 4 Brunswick Street (between Johnston Street and Victoria Parade), Fitzroy;

APPENDIX 5 Flemington Road (between Curran Street and Gatehouse Street), North Melbourne.

From these individual site reports the following high risk behaviours were identified and potential countermeasures proposed.

4.1 HIGH RISK BEHAVIOURS AND POTENTIAL COUNTERMEASURES

This section summarises the main alcohol-related pedestrian crash types identified through investigations at five high crash frequency locations and proposes corresponding measures with the potential to address each target crash type. The first category describes a range of measures which are generally applicable, while the other measures are grouped according to the specific circumstances that they address.

4.1.1 General

This section addresses the situation of **intoxicated pedestrians being struck while making (erratic) crossings of wide arterial roads** and suggests a number of potential countermeasures of a general nature.

Measures to reduce the incidence and degree of intoxication in pedestrians include:

- **continuing to work with key elements of the liquor industry** to develop and more effectively target programs such as "Responsible Serving of Alcohol" and "Responsible Consumption of Alcohol";
- **installing coin-in-the-slot breath testing machines** in hotels and selected licensed premises to encourage drinkers to both monitor *and* control their blood alcohol levels. Use of these machines by pedestrians may need to be strongly promoted, as breath testing devices may be regarded as being for drivers rather than pedestrians;

- **working with selected welfare agencies** which are situated in high risk locations (e.g. Flemington Road, North Melbourne and Brunswick Street, Fitzroy) to develop programs to reduce alcohol-related pedestrian crash risk. Simple initiatives such as welfare agencies issuing conspicuous and highly reflective clothing and/or footwear to the homeless may assist drivers, especially at night, to see intoxicated pedestrians sooner and therefore take evasive action;
- **developing and implementing both local publicity and mass media campaigns** to highlight the extent of the problem of alcohol in serious pedestrian crashes and to encourage more responsible consumption of alcohol.

Measures to reduce the exposure of intoxicated pedestrians to arterial road traffic:

- where practicable, **introduce traffic management measures**, such as signal operational strategies during off-peak/high risk periods (e.g. late night and early morning), to promote and facilitate the use of alternative, inherently safer, arterial routes;
- **reducing excessive roadway widths**, through footpath widening or kerb extensions, thereby reducing the time that pedestrians are exposed to vehicles while crossing and, in the case of kerb extensions, improving sight distances between pedestrians and drivers.

Measures to increase the likelihood of safe driver responses to high risk circumstances include:

- **providing "above-standard" street lighting** to enable drivers to more easily see intoxicated pedestrians crossing in darkness (e.g. during "don't walk" periods at signals);
- **providing "above standard" skid resistant pavement surfaces** on the approaches to high risk locations (such as traffic signals), to improve vehicle braking performance in both wet and dry weather conditions;
- **avoiding the need for vehicles to merge** in the vicinity of high risk locations so that drivers can direct more of their attention to pedestrians ahead;
- **installing symbolic pedestrian warning signs** to alert drivers to the heightened crash risk in the vicinity;
- **undertaking police enforcement of safe pedestrian and driver behaviour**, especially during high risk times of the day and days of the week. Enforcement might include increased emphasis on Random Breath Testing (RBT) for drink-driving, and speed camera and/or laser gun technology in high risk areas.

4.1.2 Traffic Signals

One of the common crash circumstances found was **intoxicated pedestrians being struck while crossing near intersection or pedestrian-operated signals but not within marked cross-walks, and intoxicated pedestrians failing to comply with signal displays.** Possible countermeasures are described below.

Measures to encourage greater pedestrian use of signals include:

The following signal-related initiatives would generally be restricted to signals in the vicinity of hotels and other licensed premises, and in the case of measures affecting traffic capacity, to high risk, non-peak traffic periods. The effectiveness of these measures will depend on the particular circumstances under which they are used, making it highly desirable that they be trialed and evaluated to quantify potential benefits.

- **making traffic signals highly responsive to pedestrian calls;**
- **automatically introducing pedestrian phases every cycle;**
- **improving the level-of-service to pedestrians** through longer walk times and shorter signal cycle times;
- **erecting fences, or other carefully designed barriers,** to strongly direct pedestrians to marked cross-walks. Appropriate signing to promote (correct) use of signals could be fixed to fencing or in the near vicinity;
- **relocating, or modifying the use of, hotel doorways,** where necessary, to align with preferred pedestrian crossing locations.

Measures to increase the likelihood of safe driver responses at and near intersection signals include:

- **displaying red to all vehicle directions, during periods of zero traffic demand**, so that drivers approach high risk intersections at lower speed than if a green signal were displayed as they approached. Once detected, drivers would receive a green signal in the normal way, and when vehicle demand has ceased, the signals would revert to red in all directions.

4.1.3 Mid-block Crossings

This section considers the common crash situation of **intoxicated pedestrians being struck while crossing wide, multi-lane carriageways, away from pedestrian facilities and/or in the vicinity of curves,** and describes some potential countermeasures.

Measures to simplify the road crossing task for intoxicated pedestrians include:

The pedestrian facilities mentioned below should be carefully positioned so as to maximise the likelihood of them being used by intoxicated pedestrians, and be accompanied by fencing (or other barriers) to strongly direct pedestrians to them.

- **providing highly responsive pedestrian-operated signals** to separate in time, pedestrian movements from vehicle movements;
- **providing medians or pedestrian refuges** to reduce the complexity of the road crossing task by breaking it into two simpler tasks;
- **providing well-maintained lane line markings** to strengthen driver lane discipline and, therefore, improve the ability of pedestrians to predict safe vehicle paths.

4.2 ASSESSMENT OF ECONOMIC WORTH OF ENGINEERING-BASED COUNTERMEASURES

One of the objectives of this study was to prepare an economic evaluation of proposed countermeasures by estimating the costs and likely safety benefits which would accrue from the adoption of the recommended engineering-based countermeasures. A more comprehensive evaluation will result if account is also taken of the effects of measures on all pedestrian crashes, including those not involving alcohol.

The literature suggests that many of the engineering-based measures proposed in this study have not been implemented and subsequently evaluated in terms of their actual effectiveness in reducing pedestrian crashes in general or alcohol-related pedestrian crashes in particular. However, most of the proposed countermeasures have been subject to an assessment of expected economic worth in a related study of pedestrian crashes by Corben and Diamantopoulou (1996).

This related study investigated pedestrian crashes at a number of the same locations as were investigated in the present study of alcohol-related pedestrian crashes. It is believed, therefore, that the results of these earlier evaluations provide reliable indications[1] of the economic worth of measures proposed here for reducing alcohol-related pedestrian crashes.

Corben and Diamantopoulou (1996) suggest that recommended engineering-based, alcohol-related pedestrian crash countermeasures would be economically worthwhile, assuming that *all* pedestrian crashes (not just those known to be alcohol-related) are included in the evaluation. In the vast majority of cases, these treatment types are expected to be economically worthwhile even at modest levels of effectiveness. BCR estimates indicate that for many treatment types safety benefits would commonly exceed treatment costs by a factor of at least ten and sometimes considerably higher.

4.3 SUMMARY OF RECOMMENDED COUNTERMEASURES FOR ALCOHOL-RELATED PEDESTRIAN CRASHES

Section 4.1 proposed a range of countermeasures with the potential to be generically applied to the problem of alcohol-related pedestrian crashes. These countermeasures were described in terms of the particular crash circumstances they address. Since the main emphasis of this study is on environmental countermeasures, Section 4.3 presents these countermeasures in categories more directly aligned to the study objectives, namely countermeasures which involve improvements to the road environment, countermeasures which target road users through education and enforcement or countermeasures which address other noteworthy aspects of the alcohol-related pedestrian crash problem.

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[1] In the case of the Maroondah Highway location (Appendix 3), there were very few pedestrian crashes which did not involve alcohol and therefore a site-specific evaluation of economic worth would be warranted to assess the particular measures recommended for this location.

4.3.1 Environmental Measures

Traffic Management

- **introduce traffic management measures** to promote and facilitate the use of alternative, inherently safer, arterial routes during high risk times.

Traffic Signals

- **provide highly responsive pedestrian-operated signals** to separate in time, pedestrian movements from vehicle movements;
- during high risk times, make traffic signals highly responsive to pedestrian calls, automatically introduce pedestrian phases every cycle and improve the level-of-service to pedestrians through longer walk times and shorter cycle times;
- **display red to all vehicle directions during periods of zero traffic demand**, so that drivers approach high risk intersections at lower speed than if a green signal were displayed as they approached.

Road Geometry

- **reduce excessive roadway widths**, through footpath widening or kerb extensions, thereby reducing the time that pedestrians are exposed to vehicles while crossing;
- **provide medians or pedestrian refuges** to reduce the complexity of the road crossing task by breaking it into two simpler tasks.

Road Pavement

- **provide "above standard" skid resistant pavement surfaces** on the approaches to high risk locations to improve vehicle braking performance.

Vehicle Path Definition

- **avoid the need for vehicles to merge** in the vicinity of high risk locations so that drivers can direct more of their attention to pedestrians ahead;
- **provide well-maintained lane line markings** to strengthen driver lane discipline and, therefore, improve the ability of pedestrians to predict safe vehicle paths.

Roadside

- **erect fences, or other carefully designed barriers,** to strongly direct pedestrians to marked pedestrian cross-walks;
- **install symbolic pedestrian warning signs** to alert drivers to the heightened crash risk in the vicinity.

Street Lighting

- **provide "above-standard" street lighting** to enable drivers to more easily see intoxicated pedestrians crossing in darkness.

4.3.2 Road User Measures

Education

- **develop and implement both local publicity and mass media campaigns** to encourage more responsible consumption of alcohol.

Enforcement

- **undertake police enforcement of safe pedestrian and driver behaviour**, especially during high risk times, emphasising Random Breath Testing, and speed camera and/or laser gun technology.

4.3.3 Other Measures

Liquor Industry and Licensees

- **continue to work with key elements of the liquor industry** to improve existing programs for reducing alcohol consumption at high risk locations;
- **install coin-in-the-slot breath testing machines** in selected hotels and licensed premises to encourage drinkers to both monitor *and* control their blood alcohol levels;
- **relocate or modify the use of hotel doorways** to align with preferred pedestrian crossing locations.

Welfare Agencies

- **work with selected welfare agencies** which are situated in high risk locations to develop programs to reduce alcohol-related pedestrian crash risk.

5. RECOMMENDATIONS FOR A STRATEGIC APPROACH TO COUNTERMEASURE IMPLEMENTATION

Section 5 describes a strategic approach to the treatment of alcohol-related pedestrian crashes. The proposed approach comprises elements which can either be targeted at specific locations identified because of their high crash risk, or which can be expected to have a general effect on alcohol-related pedestrian crash risk. The approach draws on the findings set out in earlier sections of this report.

5.1 ROAD ENVIRONMENT COUNTERMEASURES

Road environment countermeasures for alcohol-related pedestrian crashes, by their nature, are applied at specific locations. As a consequence, an important aspect of a *strategic approach* to applying these countermeasures is the identification of locations at which the greatest crash savings can be achieved at the lowest cost.

5.1.1 Identification of Locations for Road Environment Countermeasures

Accident "black spot" programs, which involve the application of road environment countermeasures at hazardous locations, have operated very successfully over several decades, both internationally and locally. A principle reason for this success, namely the *systematic identification* of candidate locations for treatment, is recommended for adoption here.

While there are a number of alternative methods for identifying candidate locations for treatment, a strategy based on the following is proposed:

First Priority - locational clustering of alcohol-related pedestrian casualty crashes

This method involves the analysis of at least five years of reported casualty crash data across metropolitan Melbourne to identify locations where clustering of alcohol-related pedestrian casualty crashes has occurred. The GIS-based approach described in Section 2.3 of this report is recommended, as there are few individual intersections or mid-block locations where significant clustering occurs.

Second Priority - locational clustering of pedestrian casualty crashes indicative of alcohol involvement

As described in Section 2 of this report, there is a very low level of reported testing of blood alcohol levels among pedestrians. This is due largely to a major change in policy which took place in Victorian hospitals in 1989. As a result, there is a serious lack of reliable crash data with known BAC's to be used to identify locational clustering. While the clustering of known positive BAC's is regarded as the best method of indicating high crash risk, only a limited number of sites worthy of treatment will be identified by this method.

To overcome this reporting deficiency, it is recommended that additional locations be identified using a surrogate indicator of alcohol-related pedestrian crashes. Such an indicator should be based on the predominant characteristics, as identified through the analysis of alcohol-related pedestrian casualty crashes, spanning metropolitan Melbourne over the past ten years (refer Section 3). Specifically, the surrogate indicator should be defined as reported pedestrian casualty crashes:

- occurring at night-time, between the hours of 6 p.m. and 6 a.m.;
- occurring on Fridays, Saturdays or Sundays;
- involving male pedestrians, aged between 18 and 54 years.

Third Priority - road and land use characteristics indicative of crash risk

The third and final step, after all worthwhile options have been exhausted in the "First and Second Priority" methods, is to assess crash risk on the basis of road and land use characteristics. These characteristics should include:

i. the presence of hotels on or in the near vicinity of arterial routes, with additional priority given to the presence of other licensed premises;

and/or

i. the presence of welfare agencies on or in the near vicinity of arterial routes. This should include related support services attracting homeless people, many of whom may suffer from alcoholism;

Higher priority would then be given to locations identified under i or ii above, if they present a significant degree of complexity either for:

i. *drivers*, in the form of:

- >60 km/h speed zones;
- lane merging;
- poor street lighting;
- complex traffic signal designs,

or,

ii. *pedestrians,* in the form of

- wide, undivided roadways;
- multiple lanes to cross;
- high night-time traffic volumes (generally assessed after say 8 p.m.);
- changing vertical and/or horizontal alignment.

5.1.2 Summary of Road Environment Countermeasures

In summary, the road environment countermeasures proposed for introduction at specific locations identified through the sequence of steps outlined above, are:

Road Environment Countermeasures

1. Reduce pedestrian exposure to high crash risk by: (refer Section 4.1.1)
• introducing traffic management measures to promote inherently safer routes
• reducing excessive roadway widths

2. Improve driver responses to high crash risk by: (refer Section 4.1.1)
• providing "above-standard" street lighting
• providing "above-standard" skid resistant pavement surfaces
• avoiding the need for vehicles to merge
• installing symbolic pedestrian warning signs
• undertaking police enforcement of safe pedestrian and driver behaviour

3. During high crash risk times, encourage greater pedestrian use of signals by: (refer Section 4.1.2)
• making traffic signals highly responsive to pedestrian calls
• automatically introducing pedestrian phases every cycle
• improving the level-of-service of signals to pedestrians
• erecting fences/barriers to direct pedestrians to cross-walks
• relocating/modifying the use of hotel doorways

4. Improve the likelihood of safe driver responses at/near intersection signals by: (refer Section 4.1.2)
• during periods of high crash risk, displaying red to all vehicle directions when there is zero traffic demand

5. Simplify the crossing task for intoxicated pedestrians by: (refer Section 4.1.3)
• providing highly responsive pedestrian-operated signals
• providing medians or pedestrian refuges
• providing well-maintained lane line markings to strengthen driver lane discipline

5.2 A GENERAL APPROACH

There are a number of countermeasure options which should form part of a general approach to addressing the problems of alcohol-related pedestrian crashes. The main options are listed below:

Other Countermeasures

6. Reduce the incidence and degree of pedestrian intoxication by: (refer Section 4.1.1)
• working with the liquor industry
• implementing local publicity and/or mass media campaigns
• working with selected welfare agencies
• installing coin-in-the-slot breath testing machines in hotels/licensed premises

5.3 ECONOMIC WORTH

Section 5 aims to provide a strategic approach to addressing the problems of alcohol-related pedestrian crashes. The main elements of the strategic approach involve:

- a set of systematic methods for identifying locations where the problem is greatest and/or most acute;
- a range of road environment countermeasures which target common alcohol-related pedestrian crash circumstances, and a range of other countermeasures aimed at having a general effect on the problem.

The *final element* of any strategy aimed at achieving the maximum crash savings at minimum cost is the estimation of economic worth of countermeasures before they are implemented. Section 4.3 provides indicative estimates of Benefit-to-Cost Ratios (BCR's) and Net Present Worth values (NPW's) to guide the development of a strategic countermeasure program. Though beyond the scope of the current study, it is recommended that countermeasure program development methods be established on the basis of ranking proposed countermeasures by the ratio of their estimated NPW to capital costs, as a means of maximising the road safety benefits per dollar invested in alcohol-related pedestrian crash countermeasures.

5.4 RECOMMENDATION TO INCREASE THE TESTING OF PEDESTRIANS INVOLVED IN CASUALTY CRASHES FOR BLOOD ALCOHOL CONCENTRATION

One of the limitations of this study has been the lack of reliable information on pedestrian BAC's. To obtain a greater and, indeed earlier, understanding of the degree of the problem of alcohol amongst pedestrians involved in crashes, it is recommended that ***all pedestrians*** injured, seriously injured or killed in crashes are tested for blood alcohol content. The disruption that took place in 1989 in the practice of taking blood samples in Victorian hospitals has created a bias in BAC data for drivers, motorcycle riders and pedestrians in the pre-1989 and post-1989 periods. This has led to unknown BAC rates of up to 90% for pedestrians during the 1990's, compared with 65% during 1985-89. Comparisons between the pre-1989 and post-1989 pedestrian BAC data would therefore not be valid.

Further, pedestrians with known BAC readings have a larger percentage of severe injuries than those with unknown BAC readings. This may be partially due to the bias resulting from blood samples only being taken from pedestrians killed or treated for serious injury at hospitals. Thus the recommendation that ***all pedestrians*** involved in casualty crashes be tested for blood alcohol content would eliminate this bias as well.

6. REFERENCES

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APPENDIX 1

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES AT MT. ALEXANDER ROAD, MOONEE PONDS

Location: Moonee Ponds Junction

(Mt. Alexander Road, Pascoe Vale Road,

Ascot Vale Road, Puckle Street/Dean Street),

MOONEE PONDS

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES - 1985 to 1994

Location: *Moonee Ponds Junction (Mt Alexander Road, Pascoe Vale Road, Ascot Vale Road Puckle St/Dean Street)*

Date of Inspection: March 1996

1. Details of Crashes

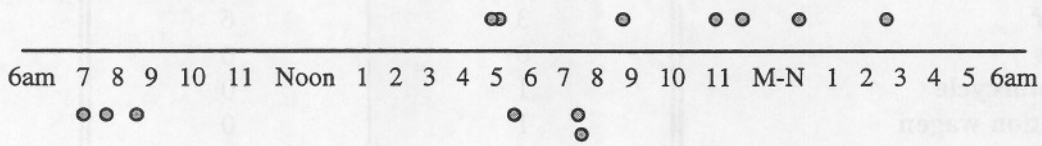
CATEGORIES	*NUMBER OF CRASHES*	
	"BAC > 0.01g/100 ml" Crashes	"Zero BAC"[1] Crashes
Injury Level		
Fatal	1	1
Serious Injury	2	3
Other Injury	4	2
Total	**7**	**6**
Vehicle Type		
Car	3	6
Bus	0	0
Motorcycle	1	0
Station wagon	1	0
Taxi	1	0
Unknown	1	0
Crash Type[2]		
Near Side (100)	5	2
Emerging (101)	0	1
Far Side (102)	1	2
Walking with Traffic (104)	1	0
Struck while boarding/ alighting vehicle (108)	0	1
Pedestrian Blood Alcohol Levels:		
0.010 to 0.050 g/100 ml	0	
0.051 to 0.150 g/100 ml	1	All zero
0.151 to 0.250 g/100 ml	4	
0.251 to 0.350 g/100 ml	2	
Pedestrian Gender:		
Male	7	1
Female	0	5

[1] Zero BAC is defined as ranging from 0.000 g/100 ml to 0.010g/100 ml.
[2] Classified according to the VicRoads' definitions for classifying accidents or DCAs.

Pedestrian Age:		
0 to 17 years	0	1
18 to 25 years	2	1
26 to 35 years	2	2
36 to 45 years	3	0
46 to 55 years	0	0
56 years and over	0	1
Driver Age:		
0 to 17 years	0	0
18 to 25 years	4	2
26 to 35 years	0	3
36 to 45 years	1	1
46 to 55 years	0	0
56 years and over	0	0
unknown	2	0
Driver Gender:		
Male	5	4
Female	0	2
Unknown	2	0

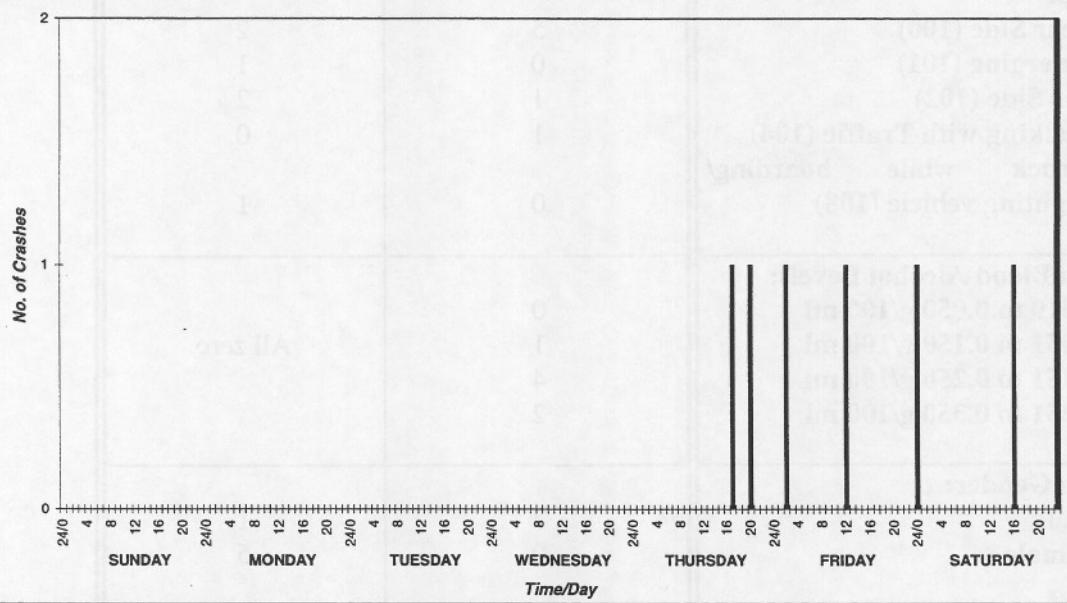
Time of Day:

BAC > 0.01 g/100 ml

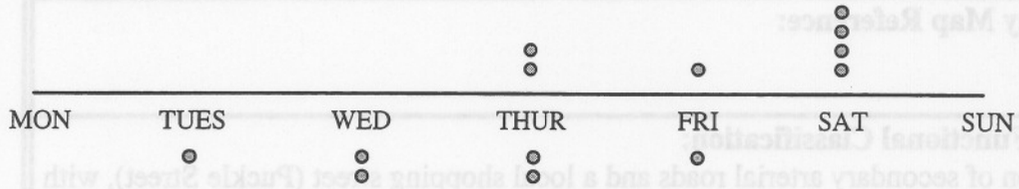


Zero BAC

Time of Week:



Light Condition:		
Day light	2	5
Dusk/Dawn	1	0
Dark (street lights on)	4	1

Atmospheric Conditions:		
Clear	7	5
Rain	0	1
Road Conditions:		
Dry	6	4
Wet	1	2
Day of Week: *BAC > 0.01 g/100 ml*  *Zero BAC*		
Month of Year:		
December-February	2	1
March-May	2	0
June-August	2	3
September-November	1	2
Initial Direction of Vehicles		
northbound	5	2
southbound	1	3
westbound	1	0
eastbound	0	1
Pedestrians		
southbound	0	1
westbound	4	
eastbound	2	5
other/unknown	1	0
Other Patterns/Comments:	Alcohol-related pedestrian crashes clustered in Mt Alexander and Ascot Vale Roads, south of Puckle and Dean Streets.	There is no discernible clustering of "zero BAC" crashes around the junction.

2. Location Details

Street Names:
Moonee Ponds Junction (Mt Alexander/Pascoe Vale/Ascot Vale Roads/Puckle/ Dean Streets)

Suburb and Local Government Area:
Moonee Ponds, City of Maribyrnong

Melway Map Reference:
28, J7

Road Functional Classification:
Junction of secondary arterial roads and a local shopping street (Puckle Street), with tram services operating along Mt Alexander Road (south-east approach), Pascoe Vale and Ascot Vale Roads.

Alignment/Topography:
Generally flat at the main crash site with a slight uphill grade on the northbound approach and changing horizontal geometry for some major vehicle movements through the intersection.

Intersection Geometry (if applicable):
Complex, multi-leg intersection.

Traffic Control Type:
Signalised intersection with complex layout and phasing arrangements. Pedestrian signals at nearby Alexandra Avenue.

Surrounding Land Use:
Predominantly commercial

- Suburban shopping - food, clothing, specialty and other assorted shops;
- Restaurant/cafes;
- Former hotel on south-east corner of intersection, now operates as Tabaret gaming facility and licensed premises;
- Night club (Cactus Club) on south-west corner of intersection
- Public transport (trams/buses) modal interchange situated in the Mt Alexander Road median

Divided/Undivided Roadway:
Mt Alexander Road divided north of Puckle Street, otherwise undivided.

Speed Zone:
60 km/h all approaches.

Number of Traffic Lanes:
Major road approaches are generally two lanes wide, although the cross-walk on the southern approach to Puckle and Dean Streets is unusually wide at this point.

Pedestrian (or other vulnerable road user) Activity:
Pedestrian activity is high during daytime/shopping periods and medium at night.

Characteristics of Traffic (Control) Operation:
Complex signal phasing and generally long delays for pedestrians.

Other Observations/Comments:
Pedestrian activity is mainly associated with:

- the shopping centre in Puckle Street;
- use of public transport services, located around the intersection but concentrated in the median immediately north-west of the intersection;
- the Tabaret gaming facility and associated licensed premises on the south-east corner;
- the "Cactus Club" licensed night club on the south-west corner.

3. Factors Contributing to Alcohol-Related Pedestrian Crashes

This section describes the factors which may have contributed to the occurrence of the alcohol-related pedestrian crashes. Where applicable, distinctions are drawn between the crashes with BAC's > 0.01 g/100 ml and those reported to be zero.

Road Width:
Probably - pedestrians cross wide carriageways on most approaches, but especially on the southern side of the junction, where most alcohol-related pedestrian crashes have occurred. This makes gap selection demanding for pedestrians (especially for intoxicated pedestrians) who choose not to comply with the pedestrian signals at the intersection. The alcohol-affected pedestrians appear to take erratic crossing paths, exposing themselves to high risk for more time than is necessary.

Alignment/Topography:
Unlikely - other than for pedestrians struck in Mt Alexander Road north of Puckle Street. In these two cases, drivers/riders approaching from the southern leg of Mt Alexander Road or from Ascot Vale Road may have had their sight distance to the pedestrians limited by the change in horizontal alignment between the approach and departure sections of road.

"Zero BAC" crashes seem to have been unaffected by alignment and grade.

Intersection Geometry (if applicable):
Potentially - the complex intersection geometry, combined with the need for drivers to monitor closely traffic signal displays, limits the attention-sharing capacities of drivers to search for pedestrians when approaching and negotiating the intersection. Drivers are therefore less likely to be able to detect and react appropriately to erratic pedestrian movements in unexpected locations or at unexpected times. Identifying valid vehicle paths at this Junction is complex, especially for drivers unfamiliar with or lacking confidence in negotiating the intersection.

Intersection Control (if applicable):
Potentially - the situation described above ("Intersection Geometry") is likely to place greater demands on both drivers and pedestrians, where complex signal phasing is involved. Long cycle times may also contribute to a reluctance by pedestrians to wait for "their opportunity" in the signal sequence to cross legally and with greater safety. It is also of relevance that pedestrian crashes are one of the characteristic crash types at traffic signals, with non-compliance with signals by pedestrians a common contributing factor in environments such as Moonee Ponds Junction.

Road Surface (friction and roughness):
Possibly - the major routes through the intersection carry high volumes of traffic including large numbers of heavy vehicles. The pavement is therefore more likely to have road surface condition and skid resistance deficiencies as a result of high traffic volumes. These deficiencies may be more critical for vehicles travelling at higher speeds, as may be the case in the alcohol-related pedestrian crashes which occurred mainly at night when traffic volumes are usually lower.

Roadside Features/Hazards: *Unlikely.*
Land Use: *Highly likely* - there appears to be a strong association between crash location and the presence of licensed premises on the south-east and south-west corners of the intersection. The direction of travel of pedestrians before their crashes suggests that *at least* four of the seven pedestrians struck may have been leaving either of the two licensed premises on the south side of the intersection.
Traffic Operation: *Possibly* - vehicle flows tend to be light after evening peak traffic periods, at the predominant time of the alcohol-related pedestrian crashes - a situation which may place higher demands on alcohol-affected pedestrians to select a safe gap in randomly arriving vehicles. The need for some northbound drivers to deviate into Mt Alexander Road may reduce driver attention to pedestrians crossing ahead. In contrast, vehicle flows were probably high at the predominant times of the "zero BAC" crashes.
Delineation: *Possibly* - lane-markings are faded throughout, leading to reduced lane discipline by drivers and hence greater uncertainty for pedestrians in anticipating vehicle paths.
Street lighting: *Potentially* - while street lighting appears to meet normal standards, this may be insufficient, given the presence of highly intoxicated pedestrians during periods of darkness and other prevailing circumstances described above. Night-time visibility of pedestrians for drivers relies on there being adequate contrast between the pedestrian and the level of background illumination. The majority of "zero BAC" crashes occurred during daylight hours.
Sight Distance: *Potentially* - refer to "Alignment/Topography" above.
Road Divided/Undivided: *Unlikely* - traffic signals are located at or near all alcohol-related pedestrian crash sites, lessening the need for a storage area to assist pedestrians to cross in stages.
Lane Configuration (e.g. lane drop/merge, etc.): *Unlikely.*
Lane Provision for Turning: *Unlikely.*

Speed:
Probably - low traffic volumes late at night and drivers approaching on a green signal together suggest that vehicle speeds are generally 60+ km/h (this inference is supported by corresponding site observations). Given the crash and location circumstances described in Section 3 of this report, many drivers would have difficulty successfully avoiding a collision with an alcohol-affected pedestrian crossing in darkness when approaching at 60 km/h or higher.

Other:
Erratic crossing behaviour by intoxicated pedestrians (stumbling/falling onto roadway, commencing crossing movement and turning back, or failing to comply with signals) appears to have been a major factor in the occurrence of alcohol-related pedestrian crashes at Moonee Ponds Junction.

4. Summary of Main Crash Circumstances

The main circumstances for alcohol-related pedestrian crashes are summarised below:

Pedestrians:

- all were males, with ages scattered in the range 18 to 45 years
- typically with high BAC's, mostly above 0.150 g/100 ml
- received either serious or fatal injuries in three of seven cases

Drivers:

- predominantly males aged between 18 and 25 years

Vehicles:

- predominantly car/station wagon, but included a taxi and a motor cycle

Road Environment:

- crashes clustered near licensed premises and generally on wide carriageways;
- crashes occurred predominantly at or near intersection signals;
- changes in horizontal alignment, together with poorly maintained lane markings, increase the crash risks to pedestrians;
- deficiencies in pavement surface condition and skid resistance increase crash risks of all types, including pedestrian crashes.

Situational:

- most crashes occurred at night or early morning, in darkness (street lights on);
- crashes occurred throughout the week but more so between the "higher alcohol periods" of Thursday to Saturday;
- most crashes involved pedestrians being struck from the right (or near-side);
- for most crashes, vehicle flows were probably low and vehicle speeds relatively high, making gap selection among randomly arriving vehicles more difficult.

5. Countermeasure Options for Alcohol-Related Pedestrian Crashes

Pedestrians:

- target local licensed premises to introduce (more effective) alcohol intervention programs for patrons and to install coin-in-the-slot breath testing machines so both drivers and pedestrians may monitor their blood alcohol levels;
- place signs or posters in local licensed premises warning pedestrians and drivers of the hazardous pedestrian environment around the Moonee Ponds Junction;
- inform local people of the high crash risk at Moonee Ponds Junction. Traffic safety pamphlets could be distributed to local shops and community venues.

Drivers:

- place signs or posters in hotels and other licensed premises as described above.

Vehicles:

None

Road Environment:

- erect additional fencing to strongly direct alcohol-affected pedestrians to cross at signalised cross-walks;
- automatically introduce pedestrian phases at the Junction's intersection signals during the high risk times of late night and early morning (i.e. between 8 p.m. and 3 a.m.). Short cycle lengths and longer walk times would also help intoxicated pedestrians to cross in greater safety
- during the late night and early morning, operate intersection signals to display red to *all* drivers and green to pedestrians crossing in an east-west direction, when there are no approaching vehicles. The green signals for northbound or southbound drivers would be introduced upon detection of an arriving vehicle. The safety advantages of this form of operation include reduced average speeds for vehicles approaching high risk intersections, while disbenefits for traffic operation would be minor outside peak traffic periods.
- to encourage greater use of and compliance with pedestrian signals by intoxicated pedestrians, ensure that, during the high risk times referred to above, the signals are made highly responsive to pedestrian calls and that an extended walk time is provided (this could involve use of new technology designed to sense walking speeds and adjust times accordingly)
- upgrade street lighting to "above standard" levels of illumination;

- provide "above standard" skid resistant pavement surfacing, possibly incorporating measures which influence driver sensory perception, such as providing a tactile and/or audible stimulus, to reduce vehicle speeds and to alert drivers to the heightened risks of pedestrian crashes;
- simplify the driving task for drivers on all approaches by installing raised reflective pavement markers on lane lines and raised ceramic pavement markers within the intersection to assist with the definition of vehicle paths within this complex multi-leg intersection.

Situational/Other:

- undertake Police enforcement of vehicle speeds, and safe and legal pedestrian crossing behaviour during high risk periods/conditions

6. Conclusions and Countermeasure Recommendations

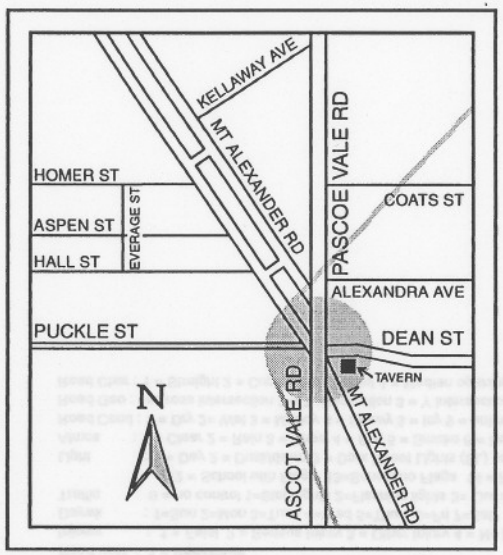
Alcohol-related pedestrian crashes are considered to be primarily due to the presence and very high levels of alcohol in many pedestrians struck. At high BAC's, the abilities of pedestrians to judge speed and distance of approaching vehicles are severely affected. However, there are additional factors which, in combination with the intoxicated state of pedestrians, contribute to crash risk. These factors include:

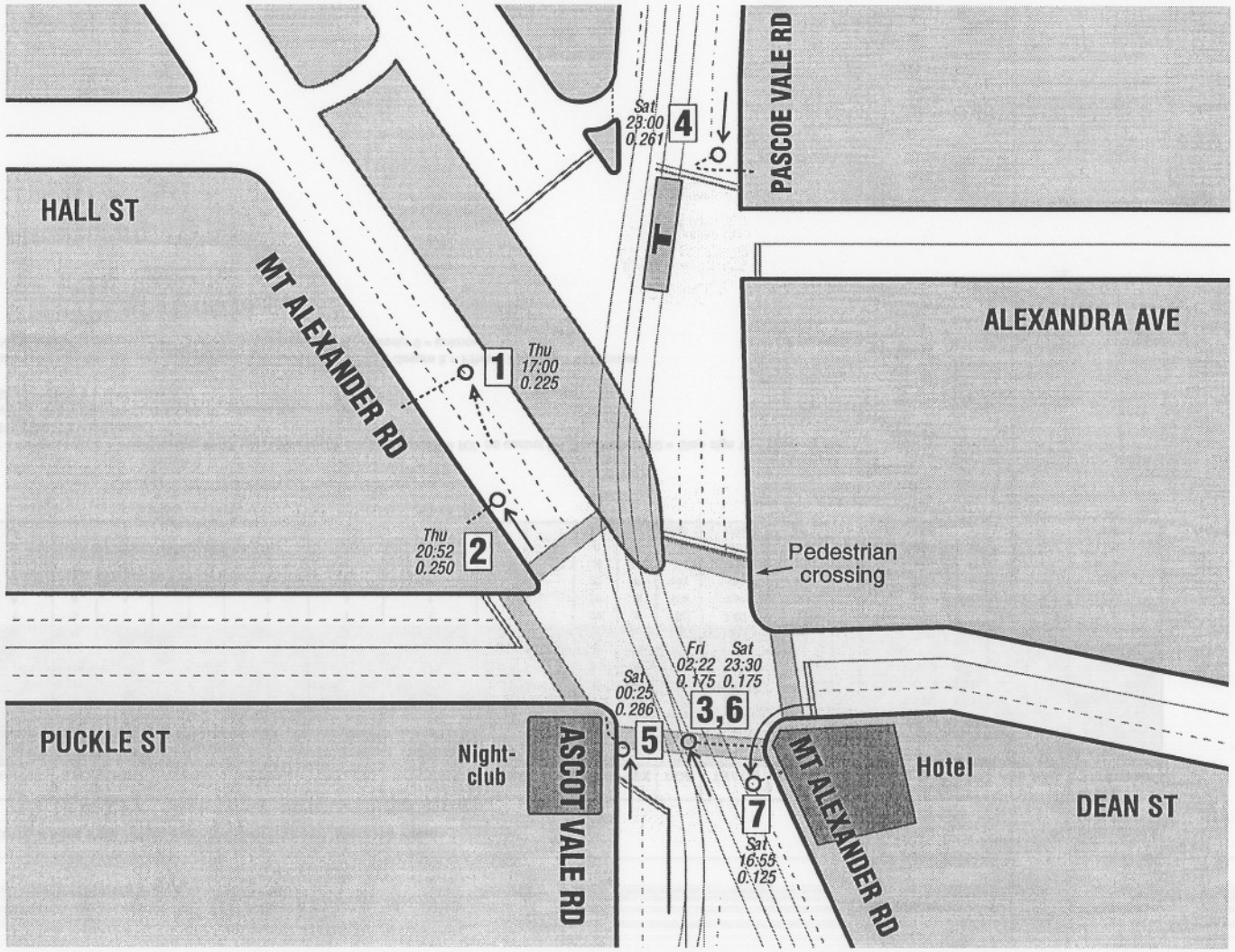
- the failure by pedestrians to use traffic signals or to comply with signal displays. Randomly arriving vehicles, late at night and at relatively high speeds, make unaided gap selection difficult;
- potential difficulties for approaching motorists in seeing/responding to pedestrians soon enough to avoid a collision in this complex traffic environment;
- poorly maintained or non-existent lane markings;
- potentially inadequate street lighting for the circumstances;
- possible deficiencies in pavement skid resistance.

A number of countermeasure options have been proposed to address these factors, **with the following countermeasures recommended for particular attention:**

- introduce targeted local education/publicity and alcohol intervention programs;
- erect fencing/barriers to strongly channel intoxicated pedestrians to the signals;
- during high risk/non-peak times, automatically introduce pedestrian phases, shorten signal cycle lengths, lengthen walk times and ensure that the signals are highly responsive to pedestrian calls;
- during the late night and early morning, operate intersection signals to display red to *all* drivers and green to pedestrians when there are no approaching vehicles;
- upgrade street lighting to "above standard" levels of illumination;
- provide "above standard" pavement skid resistance, possibly incorporating measures to influence driver sensory perception, and erect symbolic "pedestrians ahead" warning signs on the approaches to the Junction;
- simplify the driving task by improving vehicle path definition for drivers approaching, within and departing from this complex multi-leg intersection;
- enforce safe vehicle speeds and pedestrian behaviour during high risk periods.

CASE	CASE DETAILS	KEY
C-1	*ATTACHMENT 2: COLLISION DIAGRAM* - PEDESTRIAN CASUALTY CRASHES WITH KNOWN BAC > 0.01 - 1985 TO 1994 INCLUSIVE DAY OF WEEK, TIME OF DAY & BAC SHOWN FOR EACH CRASH **MOONEE PONDS JUNCTION, MOONEE PONDS**	Pedestrian Vehicle Tram Tram lines Stationary vehicle Motorbike Queued vehicle Traffic Signals Pedestrian Signals





ATTACHMENT 1

Moonee Ponds Junction (Mt Alexander Road, Pascoe Vale Road, Ascot Vale Road, Puckle/Dean Streets), Moonee Ponds

ACCID	INJNEW	DAY	MONTH	YEAR	DAYWK	TRAFFIC	BAC	LIGHT	ATMOS1	RDCOND1	GEOLOC	ROADCHR1	ROADCHR2	AGE	SEX	DCA	TMACC	D_AGE	D_SEX	D_BAC	VT	POS BAC	ZERO BAC
B86024490	1	31	7	1986	5	0	225	1	1	1	5	1	n/a	40	M	100	1700	23	M	999	10	1	
B87005228	3	19	2	1987	5	1	250	2	1	1	4	3	n/a	31	M	100	2052	25	M	999	2	2	
B87022283	2	26	6	1987	6	1	175	3	1	1	4	1	3	20	M	102	222	999	U	999	3	3	
B88007806	3	20	2	1988	7	1	261	3	1	1	4	1	n/a	21	M	100	2300	20	M	999	1	4	
B88046689	3	26	11	1988	7	1	286	3	1	2	1	1	n/a	41	M	104	25	39	M	999	1	5	
B85032524	2	9	3	1985	7	1	175	3	1	1	4	1	3	36	M	100	2330	999	U	999	99	6	
B85009720	3	30	3	1985	7	1	126	1	1	1	4	1	n/a	27	M	100	1655	23	M	75	1	7	
B87041636	2	13	11	1987	6	0	45	1	1	1	2	1	n/a	2	M	106	1215	25	M	999	6	8	
B88028347	3	29	6	1988	4	1	5	1	1	1	1	1	3	26	F	102	740	31	M	999	1		1
B85029245	3	23	8	1985	6	0	5	1	1	2	5	1	0	26	M	108	700	36	M	999	1		2
B85039174	2	7	11	1985	5	0	5	1	1	1	5	1	0	72	F	102	835	25	F	999	1		3
B85039602	2	7	11	1985	5	0	5	1	1	1	5	1	0	20	F	101	1920	32	F	999	1		4
B89025501	1	14	6	1989	4	0	0	3	2	2	5	1	0	8	F	100	1930	23	M	999	1		5
B87044344	2	8	12	1987	3	4	5	1	1	1	2	1	0	57	F	100	1730	30	M	999	1		6

Road user : 1 = Pedestrian
Injnew : 1 = Fatal 2 = Serious Injury 3 = Other Injury 4 = No Injury
Daywk : 1=Sun 2=Mon 3=Tues 4=Wed 5=Thurs 6=Fri 7=Sat
Traffic : 0 = no control 1=Stop lights 2=Flashing lights 3= Out of Order 4 = Ped Lights 5 = Ped Crossing 6=RX gates/Booms 7 = RX bells/lights 8 = RX no control 9 = Roundabout 10 = Stop sign 11 = Giveway sign
12 = School with Flags 13=School no Flags 14 = Police 15 = Other 99 = unknown
Light : 1 = Day 2 = Dusk/dawn 3 = Dark Street Lights (SL) on 4 = Dark SL off 5 = Dark no SL 6 = Dark SL unkown 9 = unknown
Atmos : 1 = Clear 2 = Rain 3 = Snow 4 = Fog 5 = Smoke 6 = Dust 7 = Strong Winds 9 = not known
Road Cond : 1 = Dry 2= Wet 3 = Muddy 4 = Snowy 5 = Icy 9 = unknown
Road Geo : 1=Cross intersection 2 = T intersection 3 = Y intersection 4 = Multiple intersection 5 = Not at intersection 6 = Dead end 7 = Road closure 8 = Private Property 9 = unknown
Road Char : 1 = Straight 2 = Curved 3 = Divided 4 = Median opening 5 = Bridge, culvert or causeway 6 = Driveway or Crossover 7 = Roadworks 9 = unknown

CASE

C-1

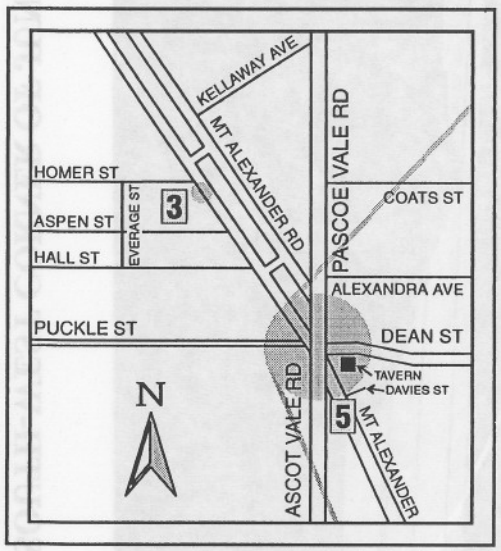
CASE DETAILS

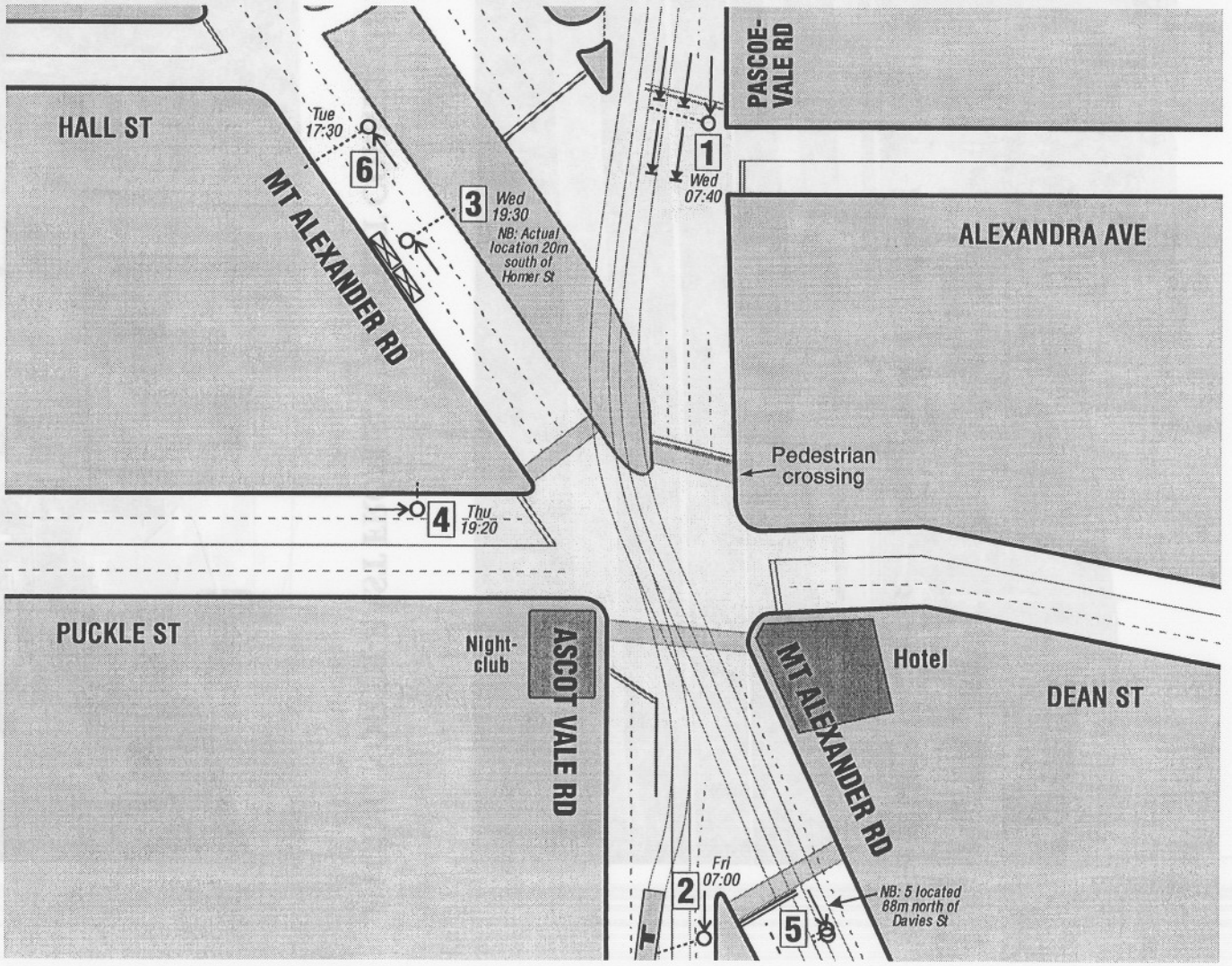
ATTACHMENT 2: COLLISION DIAGRAM - PEDESTRIAN CASUALTY CRASHES WITH KNOWN ZERO BAC - 1985 TO 1994 INCLUSIVE

MOONEE PONDS JUNCTION, MOONEE PONDS

KEY

- Pedestrian
- Vehicle
- Tram
- Tram lines
- Stationary vehicle
- Motorbike
- Queued vehicle
- Traffic Signals
- Pedestrian Signals





CASE: MOONEE PONDS JUNCTION -
Mt. Alexander Road, Pascoe Vale Road, Ascot Vale Road, Puckle Street/Dean Street

FACING NORTH-EAST FROM SOUTH-WEST CORNER OF JUNCTION

FACING EAST FROM SOUTH-WEST CORNER OF JUNCTION

FACING NORTH-WEST

FACING NORTH-WEST FROM SOUTH-WEST CORNER

APPENDIX 2

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES AT MAROONDAH HIGHWAY, CROYDON

Location: Maroondah Highway, east of Murray Road,

CROYDON

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES - 1985 to 1994

Location: *Maroondah Highway, east of Murray Road, Croydon*

Date of Inspection: **February 1996**

1. Details of "BAC > 0.01 g/100 ml" Crashes

Number of Alcohol-Related Pedestrian Crashes:

Fatal - 1
Serious Injury - 4
Other Injury - 1
Total - 6

Number of Crashes by Vehicle Type:

Car - 5
Taxi - 1

Predominant Alcohol-Related Pedestrian Crash Types (DCA)[1]:

Near Side (100) - 1
Far Side (102) - 4
Walking with Traffic (104) - 1

Pedestrian Blood Alcohol Levels:

0.010 to 0.050 g/100 ml: 1
0.051 to 0.150 g/100 ml: 1
0.151 to 0.250 g/100 ml: 2
0.251 to 0.350 g/100 ml: 2

Pedestrian Age:

0 to 17 years: 0
18 to 25 years: 4
26 to 35 years: 1
36 to 45 years: 0
46 to 55 years: 0
56 years and over: 0
unknown: 1

Pedestrian Gender:

Male: 6
Female: 0

[1] Classified according to the VicRoads' definitions for classifying accidents or DCAs.

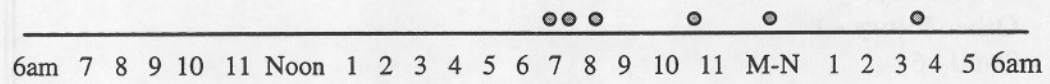
Driver Age:

0 to 17 years: 0
18 to 25 years: 2
26 to 35 years: 1
36 to 45 years: 0
46 to 55 years: 1
56 years and over: 0
unknown: 2

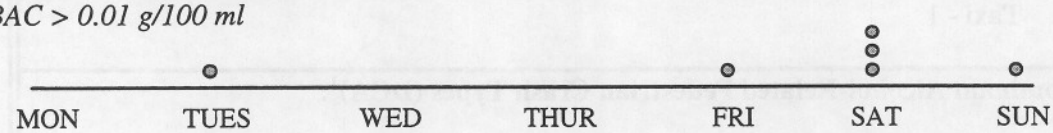
Driver Gender:

Male: 5
Female: 0
Unknown: 1

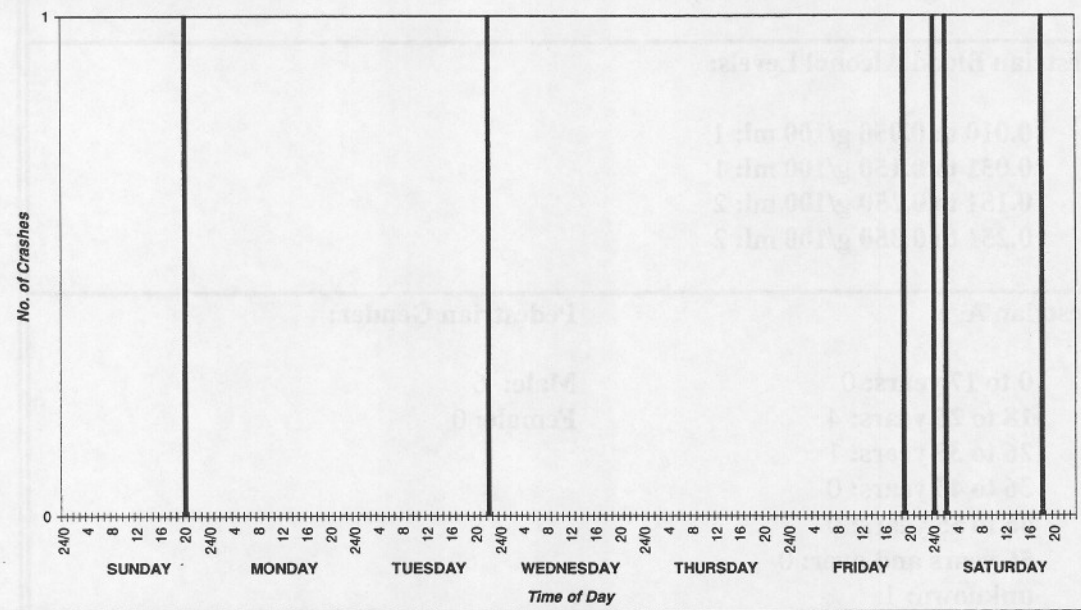
Time of Day Crash Patterns:
BAC > 0.01 g/100 ml



Day of Week Crash Patterns:
BAC > 0.01 g/100 ml



Time of Week:



Light Condition:

Dark (street lights on): 6
Other: 0

Atmospheric Conditions:
All crashes occurred in clear conditions.

Road Conditions:
All crashes occurred on dry road surfaces.

Month of Year:
Half of the crashes occurred in March/April, otherwise crashes were scattered throughout the year.

Initial Direction of Travel Crash Patterns

Vehicles	Pedestrians
westbound: 5	**southbound:** 4
eastbound: 1	**northbound:** 1
	eastbound: 1

Other Patterns/Comments:
Most crashes involved pedestrians being struck on the westbound carriageway, after safely clearing the eastbound carriageway.

2. Location Details

Street Names: Maroondah Highway, east of Murray Road
Suburb and Local Government Area: Croydon, City of Maroondah
Melway Map Reference: 50 E2
Road Functional Classification: Primary arterial road.
Alignment/Topography: Generally flat with a minor uphill grade and left hand curve for westbound traffic.
Intersection Geometry (if applicable): Cross intersection (including hotel entrance), incorporating truncated service roads.
Traffic Control Type: None applicable to pedestrians.
Surrounding Land Use: Residential, except for Croydon Hotel and a caravan display centre to the east.
Divided/Undivided Roadway: Maroondah Highway divided.
Speed Zone: Maroondah Highway: 80 km/h.
Number of Traffic Lanes: Three lanes both directions and an exclusive right-turn lane for westbound traffic.
Pedestrian (or other vulnerable road user) Activity: Generally low pedestrian volumes.
Characteristics of Traffic (Control) Operation: Vehicle volumes and speeds along Maroondah Highway are generally high, with traffic flowing freely at night and in the early morning when most crashes occurred.

3. Factors Contributing to Crash Occurrence

This section describes the factors which may have contributed to the occurrence of the alcohol-related pedestrian crashes.

Alignment/Topography: *Probably* - the particular situation of pedestrians crossing from north to south across the path of motorists approaching around a left hand curve may lead to a potentially dangerous under-estimation by the pedestrian of the time available to clear the path of the vehicle by the time it arrives. If pedestrians adopt a crossing strategy that involves judging whether an approaching vehicle will pass behind them, then the alignment of a vehicle approaching around a left hand curve may well mislead pedestrians (intoxicated pedestrians in particular) into believing that a safe gap is available. However as the vehicle gets closer, its alignment moves progressively towards the pedestrian and away from what initially seemed a "safe" path that would pass behind the pedestrian (refer Attachment 3). Furthermore, westbound drivers approaching the main crash site will tend to focus attention on proximal cues until the curve has been successfully negotiated, with attention then returning to distal cues. A curved approach, therefore, may result in later recognition by drivers of pedestrians ahead than if the road were straight.
Intersection Geometry (if applicable): *Unlikely.*
Intersection Control (if applicable): *Unlikely.*
Road Surface (friction and roughness): *Unlikely.*
Roadside Features/Hazards: *Unlikely* - guardrail on the median tends to channel pedestrians to cross at the intersection rather than at random locations along the roadway.
Land Use: *Highly likely* - the fact that most pedestrians struck appeared to be leaving the Croydon Hotel suggests that pedestrians may have become intoxicated there.
Traffic Operation: *Possibly* - vehicle flow is expected to have been light at the time of most crashes - a situation which may place higher demands on alcohol-affected pedestrians to select a safe gap in randomly arriving vehicles.
Delineation: *Unlikely.*

Street lighting:
Potentially - while street lighting appears to meet normal standards this may be insufficient, given the presence of highly intoxicated pedestrians during periods of darkness and other prevailing circumstances described above. Night-time visibility of pedestrians for drivers relies on there being adequate contrast between the pedestrian and the level of background illumination. The presence of the curve, together with the median immediately east (and beyond) the site of the crashes, reduces the contrast between the pedestrian and their background illumination (at the time of inspection two luminaires on the north side were not functioning).

Sight Distance:
Potentially - while sight distances are generally good, the presence of shrubs in the outer separator on the westbound approach reduces sight distances between approaching drivers and pedestrians crossing from south to north (one crash only).

Road Divided/Undivided:
Unlikely - however, the narrowness and unfavourable slope of the median where pedestrians are directed to cross provides neither a secure nor comfortable location for waiting pedestrians.

Lane Configuration (e.g. lane drop/merge, etc.):
Unlikely.

Lane Provision for Turning:
Potentially - southbound pedestrians crossing from the median may not correctly distinguish between westbound through vehicles and vehicles entering the exclusive right turn lane to turn into the hotel car park/drive-through bottle shop.

Road works:
Unlikely.

Shoulder Condition:
No.

Speed:
Probably - the above circumstances, together with low traffic volumes late at night and the 80 km/h speed zone, suggest vehicle speeds tend to be high. Successfully avoiding a collision with an intoxicated pedestrian crossing in darkness in this relatively high speed environment presents difficulties for motorists.

Other:
Night-time crash risks are accentuated by headlight glare from eastbound traffic, which can affect the conspicuity of pedestrians crossing the westbound carriageway.

Comparison with "Known Zero BAC" Pedestrian Crashes
No pedestrian crashes with "known zero BAC's" were reported in the study period.

4. Summary of Main Crash Circumstances

The main circumstances for alcohol-related pedestrian crashes are summarised below:

Pedestrians:

- all males, with most pedestrians being aged between 18 and 25 years
- generally high BAC's, with most above 0.20 g/100 ml
- received mainly serious or fatal injuries

Drivers:

- mainly males, aged between 18 and 35 years, with two unknown drivers
- several crashes involved drivers being unable to stop in time to avoid collisions with pedestrians unexpectedly stepping into their paths

Vehicles:

- all cars, including a taxi

Road Environment:

- crashes clustered in the near vicinity of the Croydon Hotel, with crash circumstances being consistent with pedestrians having been drinking there
- all crashes occurred away from any form of traffic facility for pedestrians, and generally involved *pedestrians crossing four lanes of high speed traffic*
- all crashes occurred in darkness (street lights on)
- the curved alignment for approaching westbound drivers may have exacerbated difficulties for intoxicated pedestrians in selecting safe gaps and also lead drivers to concentrate on the immediate roadway ahead, rather than looking further ahead. Such risks may be heightened in 80+ km/h speed zones, by the light condition and by occasional headlight glare from eastbound traffic.
- while street lighting appears to meet the relevant standards, this may not be adequate for the circumstances

Situational:

- all crashes occurred at night or early morning
- crashes occurred mainly during "high-alcohol periods" (Friday to Sunday)
- most crashes involved pedestrians being struck from the left (or far-side)
- traffic arriving randomly and at high speed make gap selection difficult.

5. Countermeasure Options for Alcohol-Related Pedestrian Crashes

Pedestrians:

- reduce the levels of drinking and intoxication by assisting with the introduction of (more effective) alcohol intervention programs for patrons and install coin-in-the-slot breath testing machines so patrons can monitor their blood alcohol levels
- place signs or posters in the hotel warning pedestrians and drivers of the hazardous pedestrian environment in Maroondah Highway, especially at night
- educate local residents about the pedestrian risks near the Croydon Hotel. Traffic safety pamphlets could be distributed to local businesses and residences.

Drivers:

- place signs or posters in hotels and other licensed premises as described above

Vehicles:

None

Road Environment:

- install pedestrian signals and erect fencing or other barriers within and outside the hotel grounds to strongly channel alcohol-affected pedestrians to the signals
- encourage greater use of pedestrian signals by intoxicated pedestrians by ensuring that, during the high risk times (late night and early morning), the signals are made *highly responsive* to pedestrian calls and that an extended walk time is provided (this could involve use of new technology designed to sense walking speeds and adjust times accordingly)
- upgrade street lighting to "above standard" levels of illumination
- install symbolic "pedestrians ahead" signs on both approaches to the site
- remove or trim shrubs on the westbound approach to provide improved sight distances for both pedestrians and drivers
- provide improved median storage conditions for pedestrians waiting to cross
- provide "above standard" skid resistant pavements, possibly incorporating measures to influence driver sensory perception (e.g. tactile and/or audible stimuli) to reduce vehicle speeds and alert drivers to the heightened crash risks.

Situational/Other:

- undertake Police enforcement of vehicle speeds, and safe pedestrian crossing behaviour during high risk periods/conditions

6. Summary of Conclusions and Countermeasure Recommendations

Alcohol-related pedestrian crashes are considered to be primarily due to the presence and very high levels of alcohol in most pedestrians struck. At high BAC's, the abilities of pedestrians to judge speed and distance of approaching vehicles are severely affected. However, there are additional factors which, in combination with the intoxicated state of pedestrians, contribute to crash risk. These factors include:

- the absence of a suitable pedestrian crossing facility at the main crash location, where four lanes of 80+ km/h traffic must be safely negotiated. Randomly arriving vehicles, at relatively high speeds, make gap selection difficult;
- the adverse effect of the nearby curve on safe gap selection decisions by pedestrians and on an approaching driver's preview of the road ahead;
- the high speed environment presenting difficulties for motorists in successfully avoiding a collision with an intoxicated pedestrian, especially in darkness;
- restricted sight distances between drivers and pedestrians, due to roadside vegetation, and potentially inadequate street lighting for the circumstances.

A number of countermeasure options have been proposed to address these factors, **with the following countermeasures recommended for particular attention:**

- introduce targeted local education/publicity and alcohol intervention programs;
- install pedestrian signals and erect fencing/barriers to strongly channel alcohol-affected pedestrians to the signals. During high risk/non-peak times, ensure that the pedestrian signals are highly responsive to pedestrian calls and that an extended walk time is provided;
- upgrade street lighting to "above standard" levels of illumination;
- provide "above standard" pavement skid resistance, possibly incorporating measures to influence driver sensory perception, and erect symbolic "pedestrians ahead" warning signs on the approaches to the main crash location;
- enforce safe vehicle speeds and pedestrian behaviour during high risk periods.

ATTACHMENT 1

Maroondah Highway (east of Murray Road), Croydon

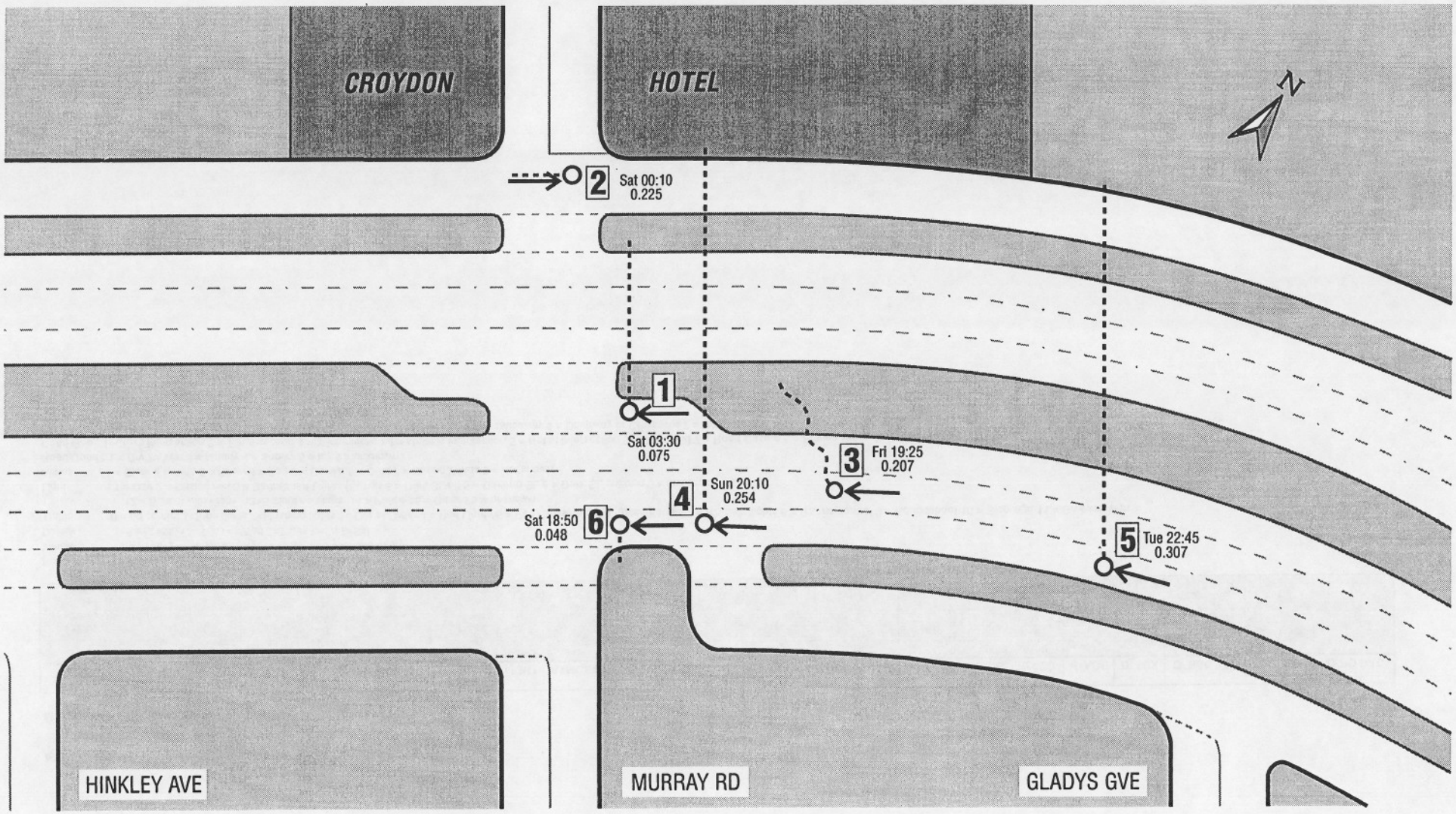
ACCID	INJNEW	DAY	MONTH	YEAR	DAYWK	TRAFFIC	BAC	LIGHT	ATMOS1	RDCOND1	GEOLOC	ROADCHR1	ROADCHR2	AGE	SEX	DCA	TMACC	d_AGE	D_SEX	D_BAC	VT	POS BAC	ZERO BAC
F93013406	2	24	4	1993	7	0	48	3	1	2	2	1	n/a	53	M	100	1650	20	M	999	1	6	
Y86008912	2	22	3	1986	7	0	75	3	1	1	1	1	n/a	20	M	100	330	31	M	999	3	1	
Y87012469	2	11	4	1987	7	0	225	3	1	1	2	1	n/a	26	M	104	10	999	M	999	1	2	
Y87025043	2	17	7	1987	6	0	207	3	1	1	1	1	3	18	M	102	1925	53	M	999	1	3	
Y88004814	1	26	1	1988	3	0	307	3	1	1	2	1	n/a	23	M	102	2245	20	M	999	1	6	
Y88051804	3	4	9	1988	1	0	254	3	1	1	9	9	n/a	25	M	102	2010	999	U	999	1	4	

Road user : 1 = Pedestrian
Injnew : 1 = Fatal 2 = Serious Injury 3 = Other Injury 4 = No Injury
Daywk : 1=Sun 2=Mon 3=Tues 4=Wed 5=Thurs 6=Fri 7=Sat
Traffic : 0 = no control 1=Stop lights 2=Flashing lights 3= Out of Order 4 = Ped Lights 5 = Ped Crossing 6=RX gates/Booms 7 = RX bells/lights 8 = RX no control 9 = Roundabout 10 = Stop sign 11 = Giveway sign
12 = School with Flags 13=School no Flags 14 = Police 15 = Other 99 = unknown
Light : 1 = Day 2 = Dusk/dawn 3 = Dark Street Lights (SL) on 4 = Dark SL off 5 = Dark no SL 6 = Dark SL unkown 9 = unknown
Atmos : 1 = Clear 2 = Rain 3 = Snow 4 = Fog 5 = Smoke 6 = Dust 7 = Strong Winds 9 = not known
Road Cond : 1 = Dry 2= Wet 3 = Muddy 4 = Snowy 5 = Icy 9 = unknown
Road Geo : 1=Cross intersection 2 = T intersection 3 = Y intersection 4 = Multiple intersection 5 = Not at intersection 6 = Dead end 7 = Road closure 8 = Private Property 9 = unknown
Road Char : 1 = Straight 2 = Curved 3 = Divided 4 = Median opening 5 = Bridge, culvert or causeway 6 = Driveway or Crossover 7 = Roadworks 9 = unknown

CASE	CASE DETAILS
C-2	***ATTACHMENT 2: COLLISION DIAGRAM*** **- PEDESTRIAN CASUALTY CRASHES WITH KNOWN BAC > 0.01 - 1985 TO 1994 INCLUSIVE DAY OF WEEK, TIME OF DAY & BAC SHOWN FOR EACH CRASH** **MAROONDAH HIGHWAY CROYDON**

KEY

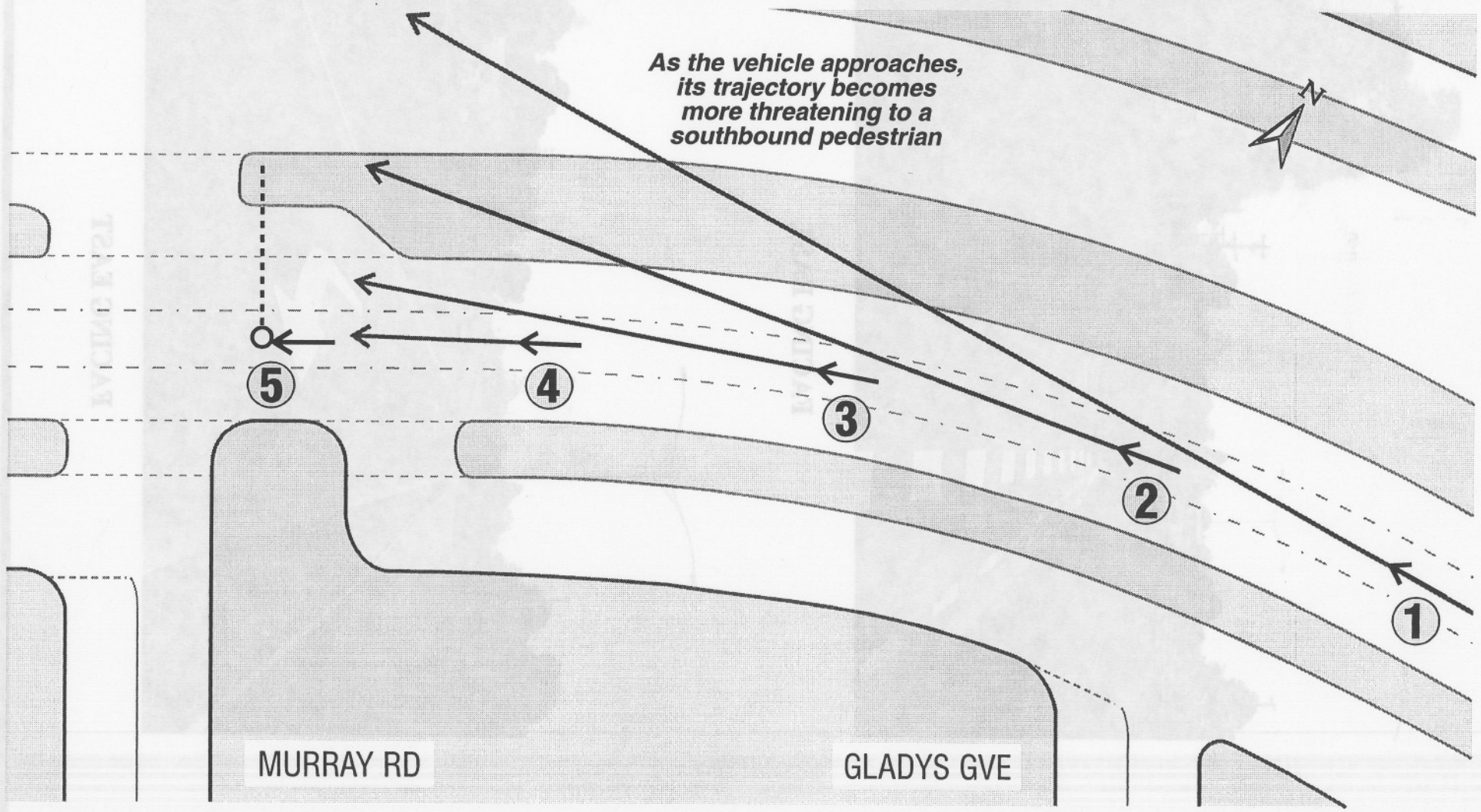
Pedestrian	Motorbike
Vehicle	Queued vehicle
Tram	Traffic Signals
Tram lines	Pedestrian Signals
Stationary vehicle	



CASE	CASE DETAILS
C-2	*ATTACHMENT* 3: DIAGRAM SHOWING CHANGING VEHICLE ORIENTATION THROUGH CURVE AND PEDESTRIAN PERCEPTION OF TRAJECTORY **MAROONDAH HIGHWAY CROYDON**

KEY

- Pedestrian
- Vehicle
- Tram
- Tram lines
- Stationary vehicle
- Motorbike
- Queued vehicle
- Traffic Signals
- Pedestrian Signals



CASE: MAROONDAH HIGHWAY, EAST OF MURRAY ROAD, CROYDON

FACING EAST

FACING EAST

CASE: MAROONDAH HIGHWAY, EAST OF MURRAY ROAD, CROYDON

FACING SOUTH

FACING SOUTH

APPENDIX 3

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES AT RACECOURSE ROAD, FLEMINGTON

Location: Racecourse Road, between Stubbs Street

and Clarence Street/Smithfield Road,

FLEMINGTON

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES - 1985 to 1994

Location: ***Racecourse Road between Stubbs Street and Clarence Street/Smithfield Road, Flemington***

Date of Inspection: **March 1996**

1. Details of Crashes

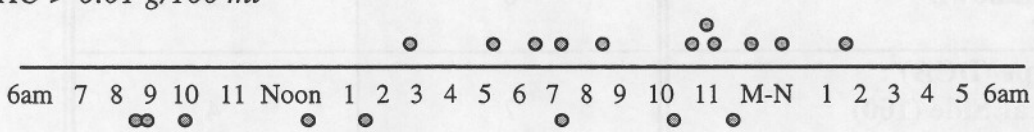
CATEGORIES	*NUMBER OF CRASHES*	
	"BAC > 0.01 g/100 ml" Crashes	**"Zero BAC"[1] Crashes**
Injury Level		
Fatal	1	0
Serious Injury	10	5
Other Injury	0	4
Total	**11**	**9**
Vehicle Type:		
Car	11	7
Truck	0	1
Unknown	0	1
Crash Type (DCA)[2]:		
Near Side (100)	7	4
Emerging (101)	0	2
Far Side (102)	2	2
Playing/working/lying/ standing on c'way (103)	2	0
Struck while boarding/ alighting vehicle (108)	0	1
Pedestrian Blood Alcohol Levels:		
0.010 to 0.050 g/100 ml	2	All zero
0.051 to 0.150 g/100 ml	1	
0.151 to 0.250 g/100 ml	7	
0.251 to 0.350 g/100 ml	1	
Pedestrian Gender:		
Male	10	5
Female	1	4

[1] Zero BAC is defined as ranging from 0.000 g/100 ml to 0.010g/100 ml.
[2] Classified according to the VicRoads' definitions for classifying accidents or DCAs.

Pedestrian Age:		
0 to 17 years	0	0
18 to 25 years	3	3
26 to 35 years	2	1
36 to 45 years	2	2
46 to 55 years	3	2
56 years and over	1	0
unknown	0	1
Driver Age:		
0 to 17 years	0	0
18 to 25 years	3	1
26 to 35 years	3	3
36 to 45 years	3	2
46 to 55 years	1	0
56 years and over	0	2
unknown	1	1
Driver Gender:		
Male	8	7
Female	1	1
Unknown	2	1

Time of Day:

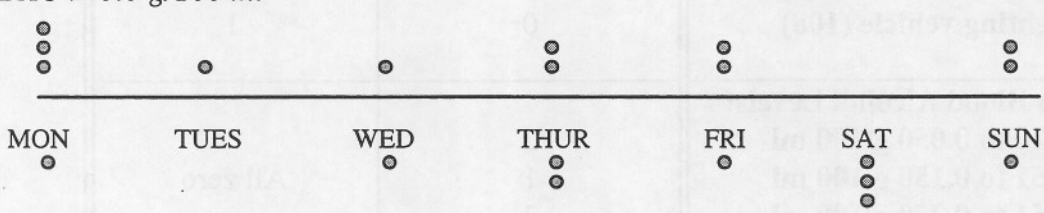
BAC > 0.01 g/100 ml



Zero BAC

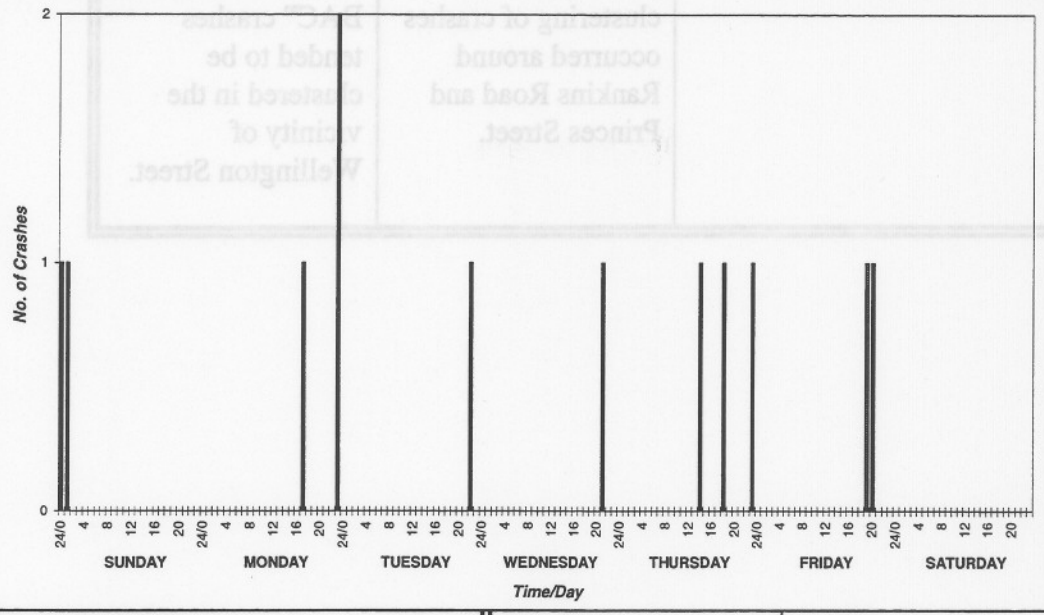
Day of Week:

BAC > 0.0 g/100 ml



Zero BAC

Time of Week:



Light Condition:		
Day light	2	5
Dusk/Dawn	0	1
Dark (street lights on)	9	3
Atmospheric Conditions:		
Clear	11	7
Rain	0	2
Road Conditions:		
Dry	10	7
Wet	1	2
Month of Year:		
December-February	2	2
March-May	2	2
June-August	5	2
September-November	2	3
Initial Direction of Vehicles		
westbound	3	4
eastbound	8	4
northbound		1
Pedestrians		
southbound	5	5
northbound	4	2
other/unknown	2	2

Other Patterns/Comments:	The highest level of clustering of crashes occurred around Rankins Road and Princes Street.	The "known zero BAC" crashes tended to be clustered in the vicinity of Wellington Street.

2. Location Details

Street Names:
Racecourse Road between Stubbs Street and Clarence Street/Smithfield Road.

Suburb and Local Government Area:
Flemington, City of Melbourne.

Melway Map Reference:
2AC2 to 2AA1 and 42K1 to 42J1.

Road Functional Classification:
Primary arterial road.

Alignment/Topography:
Uphill grade and left and right hand curves for westbound vehicles, with a crest situated at the pedestrian signals, just west of Wellington Street.

Intersection Geometry (if applicable):
Several minor T- and cross-intersections are situated along the route.

Traffic Control Type:
Pedestrian operated signals are positioned just west of Wellington Street and intersection signals are located at Pin Oak Street.

Surrounding Land Use:
Mixture of commercial (approx. 45%) and residential (approx. 55%)

Commercial:

- Shops - mainly food shops such as green-grocers, supermarkets, milk-bars, take-away food, liquor shops, chemists;
- Vietnamese and other Asian grocers;
- Restaurant/cafes - only one or two;
- Few clothing, shoe or specialty shops;
- Car workshops; garages; small car-yards;
- Hotels/Pubs on Racecourse Road - Palace Hotel at Rankins Road, Sydney Liars' Club between Eastwood and Pridham Streets; Newmarket Hotel between Bellair and Newmarket Streets (no longer trades - being redeveloped);
- McDonald's Restaurant - corner of Princes Street/Racecourse Road.

Residential:

- Housing Commission Flats - between Victoria and Stubbs Streets, northern side;
- New townhouses/units between Clarence and Bellair Streets, southern side.

Divided/Undivided Roadway:
Racecourse Road is undivided, but tram safety zones east and west of the shopping centre tend to provide localised separation of vehicles in opposing directions.

Speed Zone:
Racecourse Road: 60 km/h.

Number of Traffic Lanes:
The number of lanes vary from three on the approaches to the main shopping area, reducing to two lanes in each direction, including the lane within which the tram tracks are located. The other travelling lane, between the tram tracks and the parking lane, is unusually wide.

Pedestrian (or other vulnerable road user) Activity:
High pedestrian volumes, reducing to medium to low volumes late at night and in the early morning.

Characteristics of Traffic (Control) Operation:
Vehicle volumes and speeds along Racecourse Road are generally high, with traffic flowing freely late at night and in the early morning when most of the alcohol-related crashes occurred.

Other Observations/Comments:
The route has a poor record for pedestrian safety in general and for alcohol-related pedestrian crashes, in particular.

Depending on vehicle arrivals/congestion, traffic entering the shopping centre from the east may be required to merge from three to two lanes on the approach to the area where alcohol-related pedestrian crashes tend to cluster.

3. Factors Contributing to Alcohol-Related Pedestrian Crashes

This section describes the factors which may have contributed to the occurrence of the alcohol-related pedestrian crashes. Where applicable, distinctions are drawn between the crashes with BAC's > 0.01 g/100 ml and those reported to be zero.

Road Width:
Probably - pedestrians must cross a roadway of approximately 25 m, which can make gap selection demanding for pedestrians in general and for alcohol-affected pedestrians in particular. The latter category of pedestrians appears to take erratic paths, often exposing themselves to high risk for much more time than is necessary.

Alignment/Topography:
Probably - westbound drivers approaching the main crash site near Rankins Road during darkness, experience low contrast between pedestrians and their background. The uphill grade results in pedestrians being silhouetted against the night sky, rather than an illuminated area of roadway. This situation is exacerbated for westbound drivers who may also be subjected to headlight glare from eastbound vehicles.

The particular situation of alcohol-affected pedestrians crossing from south to north across the path of motorists approaching around a left hand curve may lead to a potentially dangerous under-estimation by the pedestrian of the time available to clear the path of the vehicle by the time it arrives. If pedestrians adopt a crossing strategy that involves judging whether or not an approaching vehicle will pass behind them as they cross, then the early alignment of a vehicle approaching around a left hand curve may well mislead pedestrians (intoxicated pedestrians in particular) into thinking that a safe gap exists. However, as the vehicle gets closer, its alignment progressively moves more towards the pedestrian and less along a "safe" path that would pass behind the pedestrian.

Furthermore, eastbound motorists approaching the site of the crashes will tend to focus attention more on proximal cues until they have successfully negotiated the curve, with attention then being directed to distal cues. The presence of the curve therefore may result in later recognition by motorists of pedestrians ahead than if the road were straight. Added to the above are the problems of restricted sight distances between drivers and pedestrians, due to the curve in the road, immediately east of Wellington Street. Pedestrians positioned in this area are particularly at risk.

Most "zero BAC" crashes occurred within a straight, generally flat road section.

Intersection Geometry (if applicable):
Unlikely.

Intersection Control (if applicable):
Unlikely.

Road Surface (friction and roughness):
Possibly - Racecourse Road is a primary arterial road carrying high volumes of traffic including large numbers of heavy vehicles. It is therefore more likely to have deficiencies in pavement condition and skid resistance as a result of heavy vehicle use of the route. These deficiencies may be more critical for vehicles travelling at higher speeds, as is expected to be the case in the alcohol-related pedestrian crashes.

Roadside Features/Hazards:
Possibly - the presence of shop front veranda posts, parking sign poles and a tree, all located on the northern footpath immediately east of Wellington Street, collectively interfere with the ability of motorists and pedestrians to see each other around the curve in Racecourse Road. The presence of parked vehicles exacerbates this effect. Similar obstructions exist on the south side of Racecourse Road, adjacent to the hotel on the corner of Rankins Road.

Roadside features did not appear to play a part in the "zero BAC" crashes.

Land Use:
Highly likely - there appears to be a strong association between crash location and the presence of hotels, e.g. the hotel on the south-east corner of Racecourse Road/Rankins Road, another hotel on the south-east corner of Racecourse Road/Eastwood Street and a third hotel formerly located west of Bellair Street. The direction of travel by pedestrians immediately before their crashes suggests that at least five of the eleven pedestrians struck were leaving a hotel and may have become intoxicated there.

Traffic Operation:
Possibly - vehicle flows were probably light at the time of the alcohol-related pedestrian crashes - a situation which may place higher demands on alcohol-affected pedestrians to select a safe gap in randomly arriving vehicles. The need for westbound vehicles to merge from three to two lanes when entering the shopping centre acts as to reduce driver attention to pedestrians who may be crossing ahead. In contrast, vehicle flows generally appear to have been high at the time of the "zero BAC" crashes, causing vehicle queuing and the characteristic crash circumstance of pedestrians being struck while crossing between queued vehicles.

Delineation:
Possibly - lane-markings are faded throughout Racecourse Road, especially near the Pin Oak Crescent/Eastwood Street intersection, leading to reduced lane discipline by drivers and hence greater uncertainty for pedestrians about the vehicle paths. This problem is accentuated near Rankins Road, where alcohol-affected pedestrians seem more likely to cross and where vehicles often need to merge.

Street lighting:
Potentially - while street lighting appears to meet normal standards, this may be insufficient, given the presence of highly intoxicated pedestrians during periods of darkness and other prevailing circumstances described above. Night-time visibility of pedestrians for drivers relies on there being adequate contrast between the pedestrian and the level of background illumination. The presence of both the uphill gradient for westbound drivers and the curve, reduces the contrast between pedestrians and their background illumination.

It is noteworthy that an external light fixed to the wall of the hotel at Rankins Road, together with nearby street lighting, helps to illuminate the footpath where pedestrians may walk when leaving the hotel.

The majority of "zero BAC" crashes occur during daylight hours, although three of these nine crashes actually occurred in darkness, with street lights on.

Sight Distance:
Potentially - while sight distances are generally good, the presence of a tree, roadside objects and the curve in Racecourse Road reduced the view drivers and alcohol-affected pedestrians had of each other in some of the crashes.

Road Divided/Undivided:
Possibly - there is no central storage area for pedestrians to wait in safety to stage their crossing movement (Racecourse Road is wide throughout). This is of particular concern near Rankins Road where merging vehicles tend to encroach onto tram tracks. The absence of a central refuge (e.g. a median) is more critical for the "zero BAC" crashes, as traffic volumes are higher and safe gaps fewer during daytime.

Lane Configuration (e.g. lane drop/merge, etc.):
Possibly - see above.

Lane Provision for Turning:
Potentially - pedestrians waiting in the centre of the road are at risk from vehicles being positioned near the centre line in readiness to turn into side streets (e.g. Wellington Street).

Speed:
Probably - low traffic volumes late at night suggest that vehicle speeds are generally 60+ km/h (this inference is supported by corresponding site observations). Given the crash and location circumstances described in Section 3 of this report, many drivers would have difficulty successfully avoiding a collision with an alcohol-affected pedestrian crossing in darkness when approaching at 60 km/h or higher.

4. Summary of Main Crash Circumstances

The main circumstances for alcohol-related pedestrian crashes are summarised below:

Pedestrians:

- predominantly males, with ages scattered between 18 and 55 years
- typically with high BAC's, mostly above 0.150 g/100 ml
- received either serious or fatal injuries

Drivers:

- predominantly males, with ages scattered between 18 and 55 years

Vehicles:

- predominantly cars

Road Environment:

- crashes clustered in the near vicinity of hotels, on wide carriageways, with no pedestrian refuge or median to assist pedestrians
- crashes mainly occurred away from traffic signals or other pedestrian facilities
- poor night-time visibility of pedestrians near Rankins Road, due to the uphill gradient and resultant lack of contrast between pedestrians and their background.
- the presence of curves, together with poorly maintained or non-existent line markings, increase the risks to pedestrians
- vehicle merging arrangements, together with changes in vertical and horizontal alignment, potentially distract drivers
- changes in horizontal alignment, in combination with roadside objects, limit driver and pedestrian sight distances
- deficiencies in pavement condition/skid resistance increase crash risks.

Situational:

- most crashes occurred at night or early morning, in darkness (street lights on)
- crashes occurred throughout the week but more so between the "higher alcohol periods" of Thursday to Sunday
- most crashes involved pedestrians being struck from the right (or near-side)
- for most crashes, vehicle flows were probably low and vehicle speeds relatively high, making gap selection among randomly arriving vehicles more difficult.

5. Countermeasure Options for Alcohol-Related Pedestrian Crashes

Pedestrians:

- target hotels in the area to introduce (more effective) alcohol intervention programs for patrons and to install coin-in-the-slot breath testing machines;
- place signs or posters in hotels in the area warning pedestrians and drivers of the hazardous pedestrian environment of Racecourse Road;
- educate residents of Flemington about the high pedestrian risk of Racecourse Road. Traffic safety pamphlets could be distributed to shops and would be written in both English and other languages of the area

Drivers:

None

Vehicles:

None

Road Environment:

- install pedestrian signals adjacent to the hotel near Rankins Road. These signals should be made highly responsive to pedestrian calls during the late night and early morning. Also erect fencing to direct alcohol-affected pedestrians to preferred crossing points;
- if the problem continues or worsens, the proposed pedestrian signals could, during periods of light traffic flow, rest in red to drivers and pedestrians, changing to green for drivers only when a vehicle activates the detection loop;
- upgrade street lighting to "above standard" levels of illumination;
- install symbolic "pedestrians ahead" signs on both approaches to the site;
- remove or minimise the number of obstructions on the curves immediately east of Wellington Street (north side) and immediately east of Rankins Road (south side), to improve sight distances for both pedestrians and drivers;
- install pedestrian signals adjacent to the hotel near Rankins Road. These signals should be made highly responsive to pedestrian calls during the late night and early morning. Also erect fencing to direct alcohol-affected pedestrians to preferred crossing points;
- if the problem continues or worsens, the proposed pedestrian signals could, during periods of light traffic flow, rest in red to drivers and pedestrians, changing to green for drivers only when a vehicle activates the detection loop;

Road Environment:

- install pedestrian signals adjacent to the hotel near Rankins Road. These signals should be made highly responsive to pedestrian calls during the late night and early morning. Also erect fencing to direct alcohol-affected pedestrians to preferred crossing points;
- if the problem continues or worsens, the proposed pedestrian signals could, during periods of light traffic flow, rest in red to drivers and pedestrians, changing to green for drivers only when a vehicle activates the detection loop;
- upgrade street lighting to "above standard" levels of illumination;
- install symbolic "pedestrians ahead" signs on both approaches to the site;
- remove or minimise the number of obstructions on the curves immediately east of Wellington Street (north side) and immediately east of Rankins Road (south side), to improve sight distances for both pedestrians and drivers;
- widen footpaths on the eastern approach to and departure from the curve, occupying space not required for parking nor vehicle movement, and hence improve sight distances between pedestrians and drivers, and reduce the width of road to be crossed;
- modify lane line markings to ensure westbound vehicles merge well in advance of the first curve rather than at or within the curve where risk of pedestrian collisions appear greatest;
- provide a median in the form of a textured or painted strip between the tram tracks throughout the length of the shopping centre;
- provide "above standard" skid resistant pavement surfacing, possibly incorporating measures which influence driver sensory perception, such as providing a tactile and/or audible stimulus, to reduce vehicle speeds and to alert drivers to the heightened risks of pedestrian crashes.

Situational/Other:

- undertake Police enforcement of vehicle speeds, and safe and legal pedestrian crossing behaviour during high risk periods/conditions

6. Summary of Conclusions and Countermeasure Recommendations

Alcohol-related pedestrian crashes are considered to be primarily due to the presence and very high levels of alcohol in many pedestrians struck. At high BAC's, the abilities of pedestrians to judge speed and distance of approaching vehicles are severely affected. However, there are additional factors which, in combination with the intoxicated state of pedestrians, contribute to crash risk. These factors include:

- the absence of a suitable pedestrian crossing facility at the main crash location, where the equivalent of six lanes of traffic must be safely negotiated. Randomly arriving vehicles, at relatively high speeds, make gap selection difficult;
- the adverse effect of the nearby curve on safe gap selection decisions by pedestrians and on an approaching driver's preview of the road ahead;
- vehicles merging where pedestrian crash risk is high, together with poorly maintained or non-existent lane markings;
- restricted sight distances between drivers and pedestrians, due to roadside objects, and potentially inadequate street lighting for the circumstances.
- possible deficiencies in pavement skid resistance.

A number of countermeasure options have been proposed to address these factors, **with the following countermeasures recommended for particular attention:**

- introduce targeted local education/publicity and alcohol intervention programs;
- install pedestrian signals and erect fencing/barriers to strongly channel alcohol-affected pedestrians to the signals. During high risk/non-peak times, ensure that the pedestrian signals are highly responsive to pedestrian calls and that an extended walk time is provided;
- during the late night and early morning, operate intersection signals to display red to *all* drivers and green to pedestrians when there are no approaching vehicles;
- upgrade street lighting to "above standard" levels of illumination;
- provide "above standard" pavement skid resistance, possibly incorporating measures to influence driver sensory perception, and erect symbolic "pedestrians ahead" warning signs on the approaches to the main crash location;
- provide a textured "median" to enable pedestrians to cross in stages, widen footpaths and provide indented parking bays where lane widths exceed needs;
- enforce safe vehicle speeds and pedestrian behaviour during high risk periods.

ATTACHMENT 1

Racecourse Road (between Stubbs Street and Clarence Street/Smithfield Road), Flemington

ACCID	INJNEW	DAY	MONTH	YEAR	DAYWK	TRAFFIC	PEDMOVE	BAC	LIGHT	ATMOS1	RDCOND1	GEOLOC	ROADCHR1	AGE	SEX	DCA	TMACC	D_AGE	D_SEX	D_BAC	VT	POS BAC	ZERO BAC	
B87029358	2	13	8	1987	5	0	1	30	3	1	1	1	1	54	M	102	1830	29	M	999	5	1		
B89033114	2	5	6	1989	6	0	1	34	3	1	1	2	1	38	M	100	2030	999	U	999	1	2		
B89001674	2	2	1	1989	2	0	1	59	1	1	1	5	1	28	M	100	1710	42	M	999	1	3		
B85027737	2	12	8	1985	2	1	1	175	3	1	1	1	1	65	M	100	2310	999	U	999	2	4		
B89016205	2	14	4	1989	6	0	1	178	3	1	1	1	1	21	M	100	1910	22	M	999	1	5		
I90020802	2	4	6	1990	2	0	2	184	3	1	1	2	1	22	F	103	2345	30	M	999	1	6		
I90008374	2	22	2	1990	5	0	1	196	1	1	1	2	1	47	M	100	1450	30	F	999	1	7		
B85022886	2	7	7	1985	1	0	1	225	3	1	2	2	1	58	M	102	10	20	M	999	1	8		
B86036426	2	4	11	1986	3	0	1	225	3	1	1	1	1	22	M	100	2245	37	M	999	2	9		
B85036206	2	13	10	1985	1	0	2	250	3	1	1	2	2	31	M	103	130	44	M	999	1	10		
B89025066	1	15	6	1989	5	0	1	263	3	1	1	2	1	39	M	100	2300	48	M	999	1	11		
B85002073	3	23	1	1985	4	0	1	250	3	1	1	5	1	68	M	102	2130	20	M	999	1	missing		
B89013445	3	31	3	1989	6	0	1	0	3	2	2	2	1	22	M	102	2320	33	M	999	1		1	
B89035490	2	20	8	1989	1	0	7	0	2	1	1	1	1	21	M	108	9999	38	M	215	1		2	
B87038847	2	28	10	1987	4	0	1	5	1	1	1	1	1	48	F	100	850	26	F	999	1		3	
B88011747	3	7	3	1988	2	1	1	5	1	1	1	1	1	21	F	100	830	999	U	999	99		4	
B87031480	2	5	9	1987	7	4	1	5	1	1	1	5	1	52	M	101	1000	26	M	999	7		5	
B87033090	3	12	9	1987	7	0	1	5	1	1	1	5	1	40	M	100	1215	24	M	999	1		6	
B87044277	3	5	12	1987	7	0	1	5	1	1	1	5	1	999	F	101	1325	78	M	999	1		7	
B89051579	2	14	12	1989	5	0	1	0	3	2	2	5	1	27	M	102	2210	39	M	999	1		8	
B88028382	2	30	6	1988	5	4	1	5	3	1	1	2	1	38	F	100	1915	70	M	999	1		9	

Road user : 1 = Pedestrian
Injnew : 1 = Fatal 2 = Serious Injury 3 = Other Injury 4 = No Injury
Daywk : 1=Sun 2=Mon 3=Tues 4=Wed 5=Thurs 6=Fri 7=Sat
Traffic : 0 = no control 1=Stop lights 2=Flashing lights 3= Out of Order 4 = Ped Lights 5 = Ped Crossing 6=RX gates/Booms 7 = RX bells/lights 8 = RX no control 9 = Roundabout 10 = Stop sign 11 = Giveway sign
12 = School with Flags 13=School no Flags 14 = Police 15 = Other 99 = unknown
Light : 1 = Day 2 = Dusk/dawn 3 = Dark Street Lights (SL) on 4 = Dark SL off 5 = Dark no SL 6 = Dark SL unkown 9 = unknown
Atmos : 1 = Clear 2 = Rain 3 = Snow 4 = Fog 5 = Smoke 6 = Dust 7 = Strong Winds 9 = not known
Road Cond : 1 = Dry 2= Wet 3 = Muddy 4 = Snowy 5 = Icy 9 = unknown
Road Geo : 1=Cross intersection 2 = T intersection 3 = Y intersection 4 = Multiple intersection 5 = Not at intersection 6 = Dead end 7 = Road closure 8 = Private Property 9 = unknown
Road Char : 1 = Straight 2 = Curved 3 = Divided 4 = Median opening 5 = Bridge, culvert or causeway 6 = Driveway or Crossover 7 = Roadworks 9 = unknown

CASE

C-3

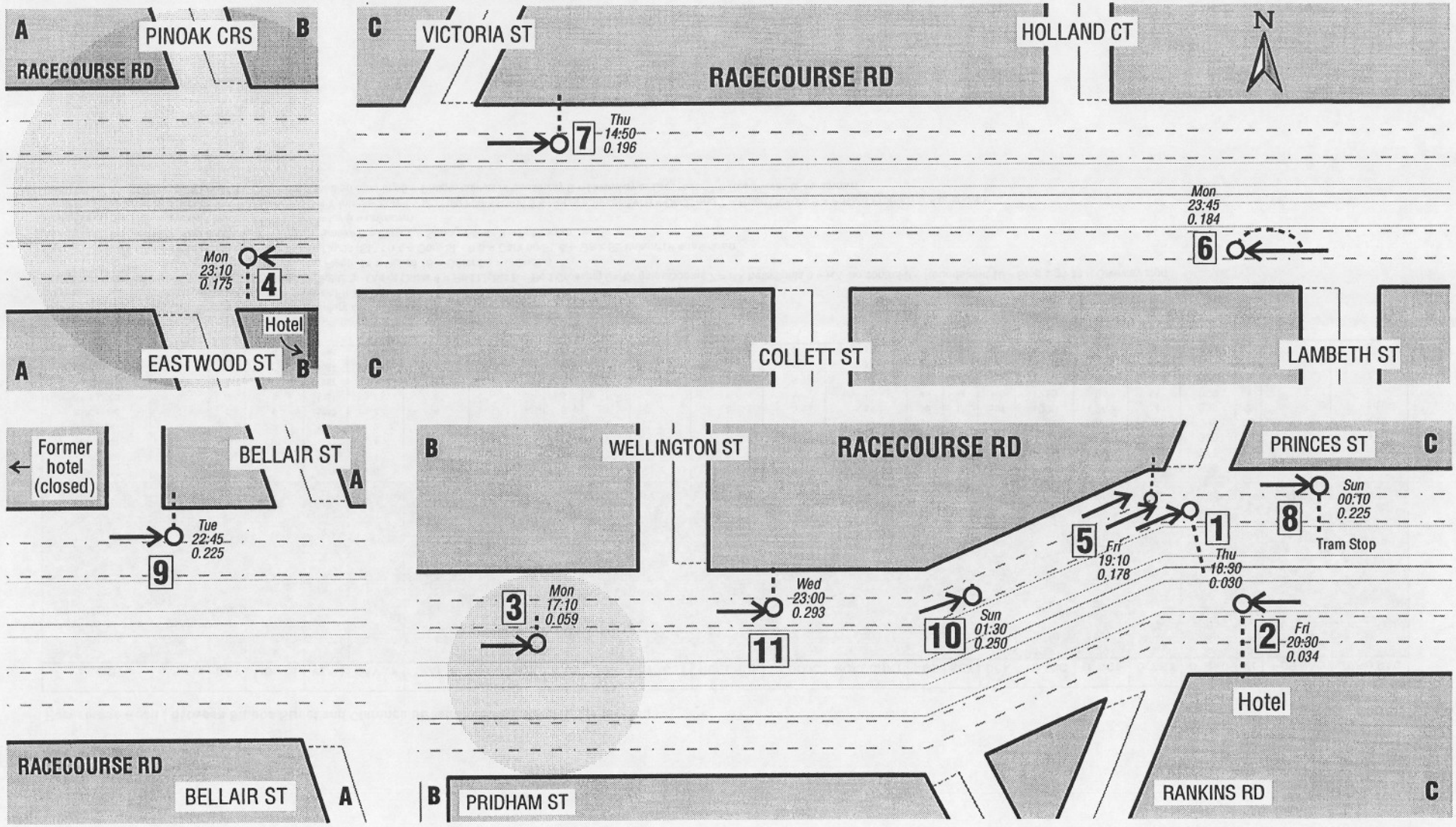
CASE DETAILS

ATTACHMENT 2: COLLISION DIAGRAM - PEDESTRIAN CASUALTY CRASHES
WITH KNOWN BAC > 0.01 - 1985 TO 1994 INCLUSIVE
DAY OF WEEK, TIME OF DAY & BAC SHOWN FOR EACH CRASH

RACECOURSE RD BETWEEN PINOAK ST AND PRINCES ST

KEY

Pedestrian
Vehicle
Tram
Tram lines
Stationary vehicle
Motorbike
Queued vehicle
Traffic Signals
Pedestrian Signals



CASE

C-3

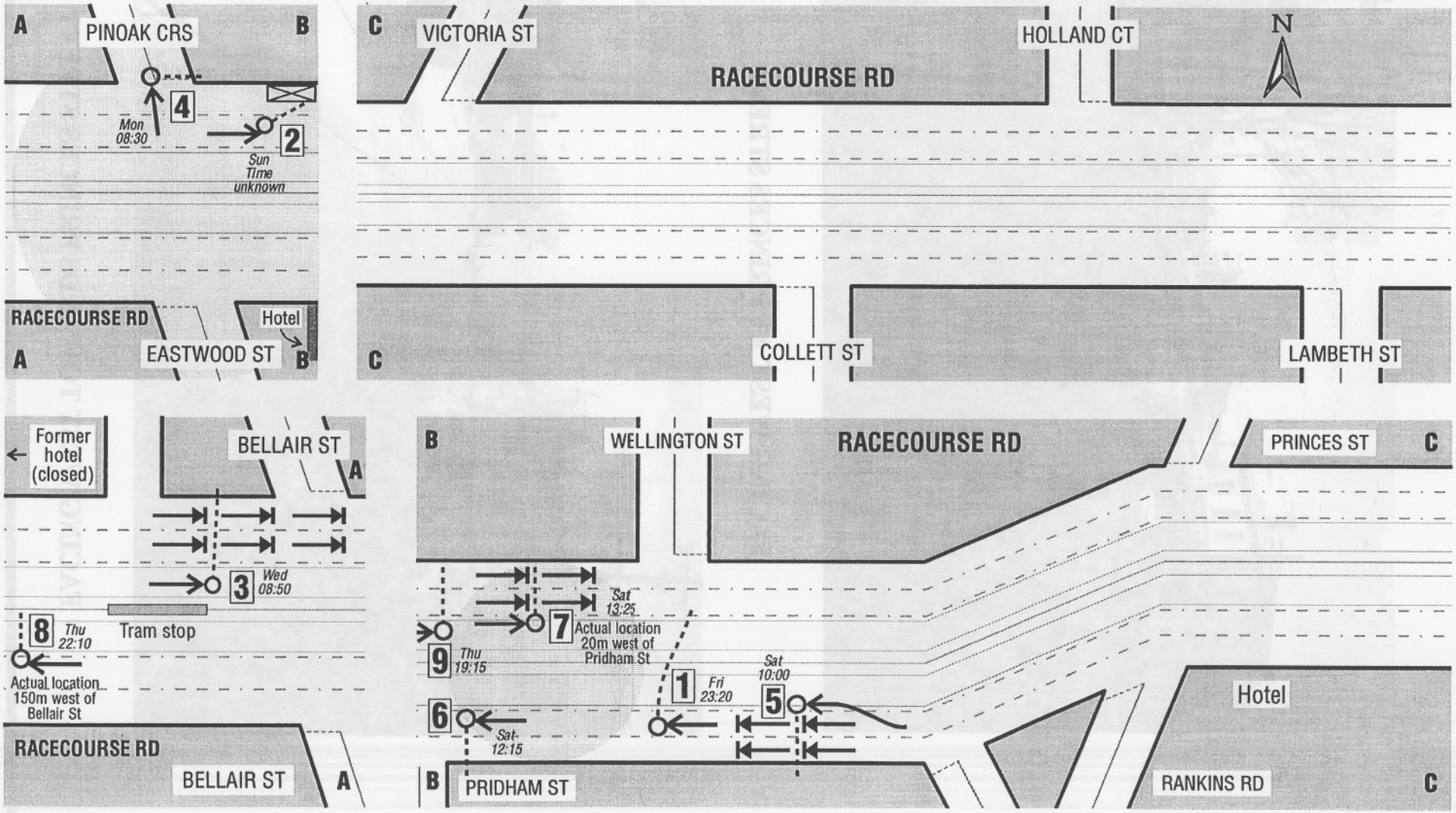
CASE DETAILS

ATTACHMENT 2: COLLISION DIAGRAM - PEDESTRIAN CASUALTY CRASHES WITH KNOWN ZERO BAC - 1985 TO 1994 INCLUSIVE

RACECOURSE RD BETWEEN PINOAK ST AND PRINCES ST

KEY

Pedestrian
Vehicle
Tram
Tram lines
Stationary vehicle
Motorbike
Queued vehicle
Traffic Signals
Pedestrian Signals



RACECOURSE ROAD, BETWEEN STUBBS STREET AND SMITHFIELD ROAD, FLEMINGTON

FACING WEST AT PRINCES STREET

FACING WEST TOWARDS PRINCES STREET

RACECOURSE ROAD, BETWEEN STUBBS STREET AND SMITHFIELD ROAD, FLEMINGTON

FACING EAST, WEST OF WELLINGTON STREET

FACING EAST TOWARDS BELLAIR STREET

APPENDIX 4

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES AT BRUNSWICK STREET, FITZROY

Location: Brunswick Street,

between Johnston Street and Victoria Parade,

FITZROY

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES - 1985 to 1994

Location: ***Brunswick Street between Victoria Parade and Johnston Street, Fitzroy***

Date of Inspection: **March 1996**

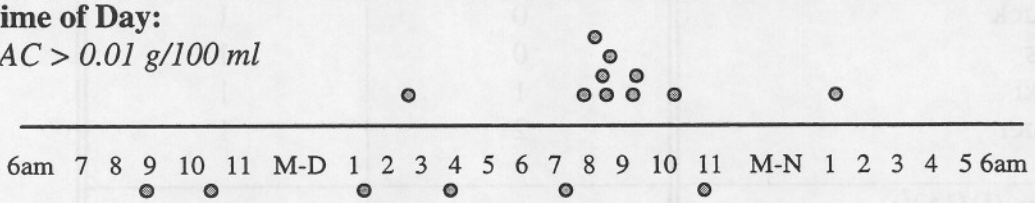
1. Details of Crashes

CATEGORIES	*NUMBER OF CRASHES*	
	"BAC > 0.01 g/100 ml" Crashes	"Zero BAC"[1] Crashes
Injury Level		
Fatal	1	0
Serious Injury	6	4
Other Injury	3	2
Total	**10**	**6**
Vehicle Type		
Car	7	3
Truck	0	1
Bus	0	1
Taxi	1	1
Other	2	1
Crash Type (DCA)[2]:		
Near Side (100)	7	4
Emerging (101)	2	1
Far Side (102)	1	0
Other (109)	0	1
Pedestrian Blood Alcohol Levels:		
0.010 to 0.050 g/100 ml	2	
0.051 to 0.150 g/100 ml	5	
0.151 to 0.250 g/100 ml	1	All zero
0.251 to 0.350 g/100 ml	3	
Pedestrian Gender:		
Male	8	2
Female	3	4

[1] Zero BAC is defined as ranging from 0.000 g/100 ml to 0.010g/100 ml.
[2] Classified according to the VicRoads' definitions for classifying accidents or DCAs.

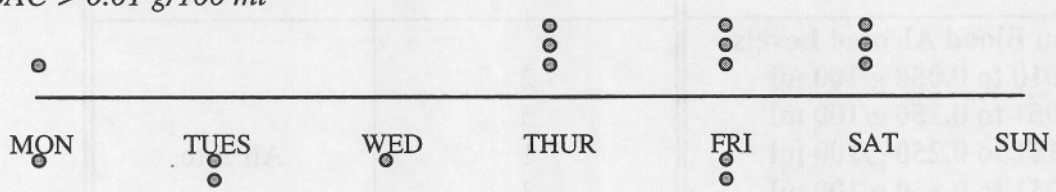
Pedestrian Age:		
0 to 17 years	0	0
18 to 25 years	2	1
26 to 35 years	2	3
36 to 45 years	3	1
46 to 55 years	1	1
56 years and over	2	0
unknown	1	0
Driver Age:		
0 to 17 years	0	0
18 to 25 years	4	3
26 to 35 years	1	1
36 to 45 years	2	1
46 to 55 years	0	0
56 years and over	0	0
unknown	3	1
Driver Gender:		
Male	5	6
Female	2	0
Unknown	3	0

Time of Day:
BAC > 0.01 g/100 ml



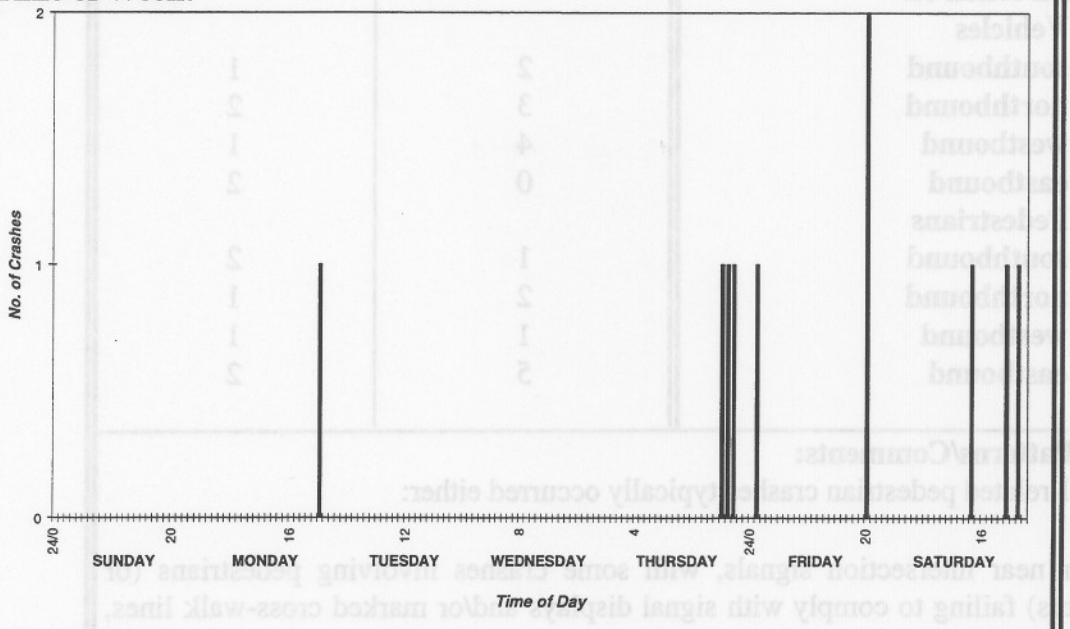
Zero BAC

Day of Week:
BAC > 0.01 g/100 ml



Zero BAC

Time of Week:



Light Condition:		
Day light	1	4
Dusk/Dawn	1	0
Dark (street lights on)	7	2
Dark (street lights off)	1	0
Atmospheric Conditions:		
Clear	8	5
Rain	1	1
Unknown	1	0
Road Conditions:		
Dry	7	4
Wet	2	2
Unknown	1	0
Month of Year:		
December-February	0	1
March-May	4	1
June-August	3	4
September-November	3	0

Initial Direction of:		
Vehicles		
southbound	2	1
northbound	3	2
westbound	4	1
eastbound	0	2
Pedestrians		
southbound	1	2
northbound	2	1
westbound	1	1
eastbound	5	2

Other Patterns/Comments:
Alcohol-related pedestrian crashes typically occurred either:

- at or near intersection signals, with some crashes involving pedestrians (or drivers) failing to comply with signal displays and/or marked cross-walk lines, or

- at mid-block locations with pedestrians emerging from between parked cars.

2. Location Details

Street Names:
Brunswick Street, between Victoria Parade and Johnston Street, Fitzroy.

Suburb and Local Government Area:
Fitzroy, City of Yarra

Melway Map Reference:
2CA12 to 2CB7

Road Functional Classification:
Secondary arterial road and tram route

Alignment/Topography:
Generally flat and straight throughout

Intersection Geometry (if applicable):
Numerous cross and T-intersections along Brunswick Street. Many side streets have been narrowed on their approaches to Brunswick Street

Traffic Control Type:
Traffic signals at Victoria Parade, Gertrude Street, and Johnston Street, with stop or give way signs controlling side street traffic

Surrounding Land Use:
Mixture of Commercial (approx. 70%) and Residential (approx. 30%)

Commercial:

- Hotels/Pubs - at Gertrude Street/Brunswick Street; at Moor Street/Brunswick Street and on Brunswick Street between James and Hanover Streets
- Cafes/restaurants - mainly towards the Johnston Street end of Brunswick Street
- Shops - clothing stores; second-hand/antique stores; book stores
- Workshops - mechanical; dress-design factory
- Community Health Centre and other medical centres.

Residential:

- Housing Commission Flats - on eastern side of Brunswick Street between Gertrude and King William Streets.
- De Paul House for Alcoholics - south of Gertrude Street.
- Brotherhood of St Lawrence and other accommodation for homeless people.
- Catholic Church Missions.
- Terrace-houses - eastern side of Brunswick Street near Gertrude Street.

Divided/Undivided Roadway:
Undivided

Speed Zone:
60 km/h

Number of Traffic Lanes:
Two in each direction, including tram tracks and parking lanes

Pedestrian (or other vulnerable road user) Activity:
Consistently high to medium level of pedestrian activity

Characteristics of Traffic (Control) Operation:
The Brunswick Street/Johnston Street intersection caters for consistently high vehicle and pedestrian volumes throughout the day and night, while Brunswick Street/Gertrude Street meets a much lower pedestrian and vehicle demand. Vehicles flow freely along Brunswick Street during night-time when most crashes occurred. Vehicle movements and speeds fluctuate between free flowing conditions at, and sometimes above, the speed limit, to highly congested conditions, especially near and north of Johnston Street when the many pubs, restaurants and other licensed premises are well attended.

Other Observations/Comments:
The nature of pedestrian and vehicle activity varies markedly from the southern to the northern end of the route being investigated. Numerous intoxicated pedestrians can be observed emerging from the pub on the corner of Gertrude Street or sitting in shop doorways or tram shelters, drinking from bottles. This type of activity characterises Brunswick Street from around Gertrude Street to Moor Street. Further north, land use changes and pedestrian activity is associated more with the many cafes, restaurants and pubs concentrated along the length of Brunswick Street to Johnston Street and beyond. Pedestrian activity at the Brunswick Street/Johnston Street intersection is particularly high at night, on the later days of the week.

3. Factors Contributing to Alcohol-Related Pedestrian Crashes

This section describes the factors which may have contributed to the occurrence of the alcohol-related pedestrian crashes. Where applicable, distinctions are drawn between the crashes with BAC's > 0.01 g/100 ml and those reported to be zero.

Alignment/Topography: *Unlikely* - Brunswick Street is generally flat and straight throughout.
Intersection Geometry (if applicable): *Unlikely.*
Intersection Control (if applicable): *Probably* - the nature of intersection signal operations is such that many pedestrians don't comply fully with the signals, in terms of observing the signal displays and/or crossing between the marked cross-walks. This failure to comply appears to be due in part to the impatience of pedestrians, in combination with the often lengthy delays pedestrians experience when they comply with signals.
Road Surface (friction and roughness): *Possibly* - Brunswick Street is a busy arterial road carrying high volumes of traffic, including trams. The high volumes make it more likely to have deficiencies in pavement skid resistance. These deficiencies may be more critical for vehicles travelling at higher speeds, as may be the case in the alcohol-related pedestrian crashes which tend to occur outside of peak traffic periods. Site observations suggest that the road surface of Brunswick Street has not recently been resurfaced or otherwise maintained.
Roadside Features/Hazards: *Unlikely.*
Land Use: *Highly likely* - there appears to be a strong association between crash location and the presence of pubs and other licensed premises in the area, e.g. pubs on the corner of Gertrude Street and Johnston Street and at two other pubs at locations in between. The direction of travel by a number of pedestrians at the time of their crashes is consistent with them leaving one of the local pubs.
Traffic Operation: *Possibly* - for the majority of crashes, vehicle flows were probably light at the time - a situation which may place higher demands on alcohol-affected pedestrians crossing at mid-block locations to select a safe gap in randomly arriving vehicles.

Delineation:
Possibly - in general, stop lines and pedestrian cross-walk markings are well worn and of limited effectiveness. Motorists approaching a red light at Brunswick Street/Gertrude Street tend to pull up over the stop line causing safety problems for pedestrians. Trams and other large vehicles, by stopping beyond the stop line obstruct the pedestrian's view of the pedestrian signal lantern. Pedestrians may therefore not know when it is safe to cross the road and may be forced to walk around vehicles which are stopped beyond the stop line, placing them in or near the parallel but conflicting vehicle flow.

Further, the poorly maintained state of the line markings at intersection signals, cross walk markings in particular, could imply to both pedestrians and drivers that they are not particularly important elements for controlling traffic, hence leading to poor compliance by both road user types, in circumstances where high compliance is highly desirable to reduce already elevated risks.

Street lighting:
Potentially - while street lighting may meet normal standards, this appears insufficient for the circumstances, i.e. the presence of highly intoxicated pedestrians during periods of darkness and other prevailing circumstances described above. Night-time visibility of pedestrians for drivers relies on there being adequate contrast between the pedestrian and the level of background illumination. The relatively low levels of illumination compared to other nearby routes, such as Lygon Street, combined with headlight glare from approaching vehicles, makes pedestrians more difficult to see for drivers.

Half of the "zero BAC" crashes occurred during daylight hours, although three of these ten crashes occurred in darkness, with street lights on.

Sight Distance:
Potentially - while sight distances are generally good, the presence of parked vehicles in the section of Brunswick Street between James Street and Moor Street may have reduced the view drivers and alcohol-affected pedestrians had of each other in some of the crashes.

Road Divided/Undivided:
Possibly - there is no storage area for pedestrians to wait in safety in the middle of the road to stage their crossing movement. This is especially true between James Street and Moor Street where most mid-block crashes occurred.

Lane Configuration (e.g. lane drop/merge, etc.):
Unlikely.

Lane Provision for Turning:
Unlikely.

Speed:
Probably - low traffic volumes late at night suggest that vehicle speeds often reach 60+ km/h (this inference is supported by corresponding site observations). Given the crash and location circumstances described in Section 3 of this report, many drivers would have difficulty successfully avoiding a collision with an alcohol-affected pedestrian crossing in darkness when approaching at 60 km/h, or higher.

Other:
The very high BAC's of most pedestrians and their erratic crossing behaviour make avoiding collisions difficult for drivers travelling at or near the speed limit.

4. Summary of Main Crash Circumstances

The main circumstances for alcohol-related pedestrian crashes are summarised below:

Pedestrians:

- predominantly males (in contrast with the "zero BAC" crashes which involved female pedestrians in two thirds of cases), with most pedestrians being aged between 18 and 55 years
- generally high BAC's, with most above 0.10 g/100 ml
- received mainly serious or fatal injuries

Drivers:

- predominantly males, aged between 18 and 25 years
- several crashes involved drivers failing to give way to pedestrians at intersection signals, while in other cases being unable to stop in time to avoid collisions with pedestrians unexpectedly stepping on to the roadway
- three unknown drivers (in eleven cases) who failed to stop after their crashes

Vehicles:

- predominantly cars (for both alcohol-related and "zero BAC" crashes)

Road Environment:

- crashes clustered in the near vicinity of hotels and, to a lesser extent, near other licensed premises. Other activities potentially associated with some alcohol-related crashes include De Paul House for Alcoholics - south of Gertrude Street, the Brotherhood of St Lawrence and other accommodation for homeless people, and the Catholic Church Missions

- a majority of crashes occurred near intersection signals, with pedestrians failing in some cases either to comply with signal displays or to use marked cross-walks. There was also evidence of at least one driver failing to comply with traffic signal displays and others failing to give way to pedestrians while turning

- a sizeable minority of crashes occurred away from traffic signals, with pedestrians crossing a wide carriageway, typically from between parked vehicles, with no pedestrian refuge or median to assist them. The poorly maintained or non-existent line markings increase the risks to pedestrians

- probable deficiencies in pavement skid resistance may contribute to pedestrian (and other) crash risks

- most alcohol related pedestrian crashes occurred in darkness (street lights on). Compared to other nearby or similar routes with less pedestrian activity, street lighting standards in Brunswick Street may be inadequate for the conditions

Situational:

- most alcohol-related pedestrian crashes occurred in darkness, between 7 and 10 p.m. and during the "higher alcohol periods" of Thursday to Saturday

- most crashes involved pedestrians being struck from the right (or near-side)

- for most crashes, vehicle flows were expected to have been low and, consequently, vehicle speeds higher, making gap selection more difficult due to randomly arriving vehicles. For the crashes which occurred at traffic signals, vehicle speeds may have been relatively high in the case of motorists arriving during or at the conclusion of a green signal

5. Countermeasure Options for Alcohol-Related Pedestrian Crashes

Pedestrians:

- target hotels in the area to introduce (more effective) alcohol intervention programs for patrons and to install coin-in-the-slot breath testing machines so that patrons can monitor their blood alcohol levels

- place signs or posters in hotels and other licensed premises in the area warning pedestrians and drivers of the hazardous pedestrian environment in Brunswick Street, especially at night

- educate residents of Fitzroy about the high pedestrian risks in Brunswick Street. Traffic safety pamphlets could be distributed to local businesses, private residences, Housing Commission Flats, and organisations which care for the numerous alcoholics and homeless people of the area. Pamphlets would be written in both English and other major languages of the area

- improve the night-time conspicuity of intoxicated pedestrians in the area, where practicable, by issuing to pedestrians in the high risk categories, clothing which incorporates highly reflective markers, such as sports-style shoes. Local welfare organisations, such as the De Paul House for Alcoholics, the Brotherhood of St. Lawrence and the Catholic Church Mission, may be well placed to assist with the targeted distribution of such clothing or footwear to those most in need.

Drivers:

- place signs or posters in hotels and other licensed premises as described above

Vehicles:

None

Road Environment:

- erect fencing to direct alcohol-affected pedestrians to preferred crossing points

- automatically introduce pedestrian phases at all intersection signals during the high risk times of late night and early morning, (e.g. between 7 p.m. and 2 a.m.) throughout the route. Short signal cycle lengths and longer walk times would also help intoxicated pedestrians to cross in greater safety

- during the late night and early morning, operate intersection signals to display red to *all* drivers and green to pedestrians when there are no approaching vehicles. The green signals for drivers would be introduced upon detection of an arriving vehicle. The safety advantages of this form of operation include reduced average speeds for vehicles approaching high risk intersections, while disbenefits for traffic operation would be minor.

- to encourage greater use of pedestrian signals by intoxicated pedestrians, ensure that, during the high risk times referred to above, the signals are made highly responsive to pedestrian calls and that an extended walk time is provided (this could involve use of new technology designed to sense walking speeds and adjust times accordingly)

- upgrade street lighting to "above standard" levels of illumination

- erect symbolic "pedestrians ahead" signs on approaches to the three main locations in Brunswick Street where pedestrian crashes tend to cluster

- widen footpaths and/or provide indented parking bays where lane widths are excessive to needs (e.g between Gertrude Street and Moor Street) and hence reduce the width of road to be crossed

- upgrade maintenance of intersection signal and lane line markings to improve driver and pedestrian compliance and to also improve predictability of pedestrian and vehicles paths

- provide a median in the form of a textured or painted strip between the tram tracks throughout the length of Brunswick Street to enable pedestrians to stage their crossing manoeuvre

- provide skid resistant pavement surfacing, possibly incorporating measures which influence driver sensory perception, such as providing a tactile and/or audible stimulus, to reduce vehicle speeds and to alert drivers to the heightened risks of pedestrian crashes.

Situational/Other:

- undertake Police enforcement of vehicle speeds, and safe and legal pedestrian crossing behaviour during high risk periods/conditions, especially between 7 and 10 p.m. on Thursdays, Fridays and Saturdays

- examine the possibility of extending the activities of "soup van" volunteers to patrol selected sections of Brunswick Street to help intoxicated pedestrians to cross safely

6. Summary of Conclusions and Countermeasure Recommendations

Alcohol-related pedestrian crashes are considered to be primarily due to the presence and very high levels of alcohol in many pedestrians struck. At high BAC's, the abilities of pedestrians to judge speed and distance of approaching vehicles are severely affected. However, there are additional factors which, in combination with the intoxicated state of pedestrians, contribute to crash risk. These factors include:

- the failure by pedestrians to use traffic signals or to comply with signal displays;
- restricted sight distances between drivers and pedestrians, due to parked vehicles, and potentially inadequate street lighting for the circumstances;
- deficiencies in pavement skid resistance and standards of line marking;
- potential difficulties for approaching motorists in seeing/responding to pedestrians soon enough to avoid a collision;
- continual, high traffic volumes using this busy arterial route, together with high exposure to crash risk of (homeless) people attending local welfare agencies;

A number of countermeasure options have been proposed to address these factors, **with the following countermeasures recommended for particular attention:**

- introduce targeted local education/publicity and alcohol intervention programs, and work with local welfare agencies to make pedestrians conspicuous at night;
- erect fencing at high risk locations to direct pedestrians to safer crossing points;
- during high risk/non-peak times, automatically introduce pedestrian phases, shorten signal cycle lengths and lengthen walk times at signalised intersections and ensure that pedestrian signals are highly responsive to pedestrian calls;
- during the late night and early morning, operate intersection signals to display red to *all* drivers and green to pedestrians when there are no approaching vehicles;
- upgrade street lighting to "above standard" levels of illumination;
- improve pavement skid resistance in the vicinity key locations;
- provide a textured "median" to enable pedestrians to cross in stages, widen footpaths and provide indented parking bays where lane widths exceed needs;
- erect symbolic "pedestrians ahead" warning signs at high risk locations and upgrade line marking maintenance throughout Brunswick Street;
- enforce safe vehicle speeds and pedestrian behaviour during high risk periods.

ATTACHMENT 1

Brunswick Street (between Johnston Street and Victoria Parade), Fitzroy

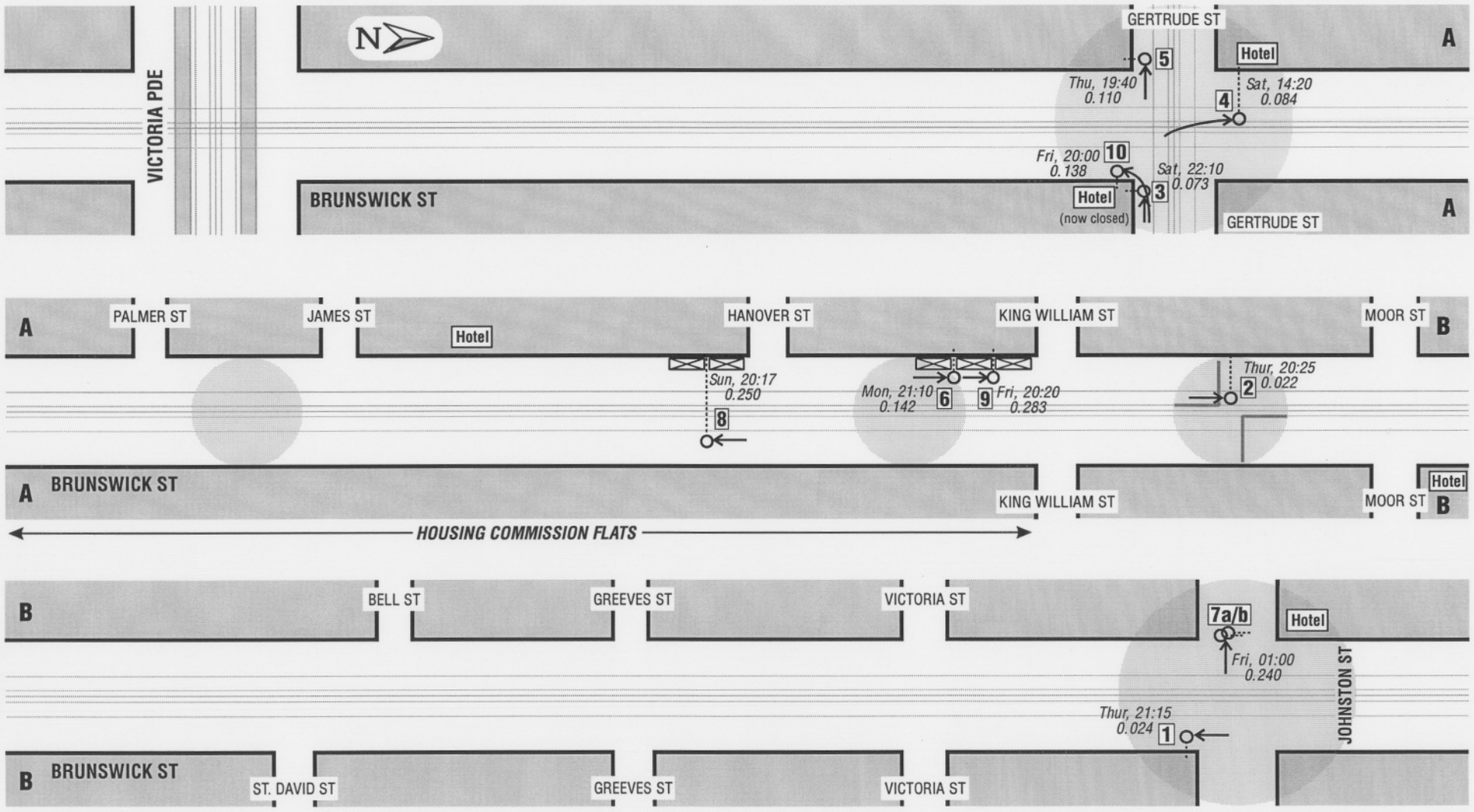
ACCID	INJNEW	DAY	MONTH	YEAR	DAYWK	TRAFFIC	BAC	LIGHT	ATMOS1	RDCOND1	GEOLOC	ROADCHR1	ROADCHR2	AGE	SEX	DCA	TMACC	D_age	D_sex	D_bac	Vehtype	Alc Ref	NonAlc Ref
A89045149	3	27	4	1989	5	1	24	3	1	1	1	1	0	22	M	100	2115	999	U	999	1	1	
A89017816	2	27	4	1889	5	4	22	3	2	2	5	1	0	58	M	100	2025	39	M	999	3	2	
A87036729	2	17	10	1987	7	0	73	4	1	1	1	1	0	27	M	100	2210	24	F	999	1	3	
A89023757	2	20	5	1989	7	1	84	1	1	1	1	1	0	61	F	100	1420	22	M	999	1	4	
A88042648	3	29	9	1988	5	0	110	2	1	1	1	1	0	46	M	100	1940	999	U	999	99	5	
A89035042	1	14	8	1989	2	0	142	3	1	1	1	1	0	36	M	101	2110	24	M	999	1	6	
A87036956	1	10	10	1987	7	0	250	3	1	1	5	1	0	45	F	102	2017	40	F	150	4	8	
A88033633	2	29	7	1988	6	0	283	3	1	2	1	1	0	42	M	101	2020	29	M	999	1	9	
A93022243	2	28	5	1993	6	1	138	3	9	9	1	1	0	32	M	100	2000	999	U	999	1	10	
A89031672	2	2	6	1989	6	1	240	3	1	1	1	1	0	999	M	100	100	25	M	85	1	7a	
A89031672	2	2	6	1989	6	1	240	3	1	1	1	1	0	24	F	100	100	25	M	85	1	7b	
A88017238	2	10	2	1988	4	1	5	1	1	1	1	1	0	30	M	100	1300	999	M	999	1		1
A88027196	3	7	6	1988	3	1	5	3	2	2	1	1	0	26	F	100	2240	24	M	999	1		2
A87029272	3	17	8	1987	2	0	5	1	1	1	1	1	0	47	F	100	1020	45	M	999	8		3
A93020538	2	22	6	1993	3	0	0	1	1	1	1	1	0	45	M	109	857	29	M	999	7		4
A88015037	2	8	4	1988	6	0	5	1	1	1	1	1	0	30	F	101	1535	20	M	999	3		5
A88033756	2	29	7	1988	6	0	5	3	1	2	1	1	0	23	F	100	1900	24	M	999	1		6
A89001115	3	30	12	1988	6	1	0	2	1	1	1	1	0	30	F	100	1910	21	F	999	1		7
A89049569	2	23	11	1989	5	1	0	2	1	1	1	1	3	46	M	100	1930	22	M	999	1		8
A91023044	3	4	7	1991	5	99	0	3	1	1	1	1	0	19	M	102	1900	999	U	999	99		9
I86022486	3	15	7	1986	3	0	5	1	1	2	2	1	0	23	F	101	818	47	M	999	1		10

Road user : 1 = Pedestrian
Injnew : 1 = Fatal 2 = Serious Injury 3 = Other Injury 4 = No Injury
Daywk : 1=Sun 2=Mon 3=Tues 4=Wed 5=Thurs 6=Fri 7=Sat
Traffic : 0 = no control 1=Stop lights 2=Flashing lights 3= Out of Order 4 = Ped Lights 5 = Ped Crossing 6=RX gates/Booms 7 = RX bells/lights 8 = RX no control 9 = Roundabout 10 = Stop sign 11 = Giveway sign
12 = School with Flags 13=School no Flags 14 = Police 15 = Other 99 = unknown
Light : 1 = Day 2 = Dusk/dawn 3 = Dark Street Lights (SL) on 4 = Dark SL off 5 = Dark no SL 6 = Dark SL unkown 9 = unknown
Atmos : 1 = Clear 2 = Rain 3 = Snow 4 = Fog 5 = Smoke 6 = Dust 7 = Strong Winds 9 = not known
Road Cond : 1 = Dry 2= Wet 3 = Muddy 4 = Snowy 5 = Icy 9 = unknown
Road Geo : 1=Cross intersection 2 = T intersection 3 = Y intersection 4 = Multiple intersection 5 = Not at intersection 6 = Dead end 7 = Road closure 8 = Private Property 9 = unknown
Road Char : 1 = Straight 2 = Curved 3 = Divided 4 = Median opening 5 = Bridge, culvert or causeway 6 = Driveway or Crossover 7 = Roadworks 9 = unknown

CASE	CASE DETAILS
C-4	***ATTACHMENT 2: COLLISION DIAGRAM*** **- PEDESTRIAN CASUALTY CRASHES WITH KNOWN BAC > 0.01 - 1985 TO 1994 INCLUSIVE DAY OF WEEK, TIME OF DAY & BAC SHOWN FOR EACH CRASH** **BRUNSWICK ST BETWEEN VICTORIA PDE AND JOHNSTON ST**

KEY

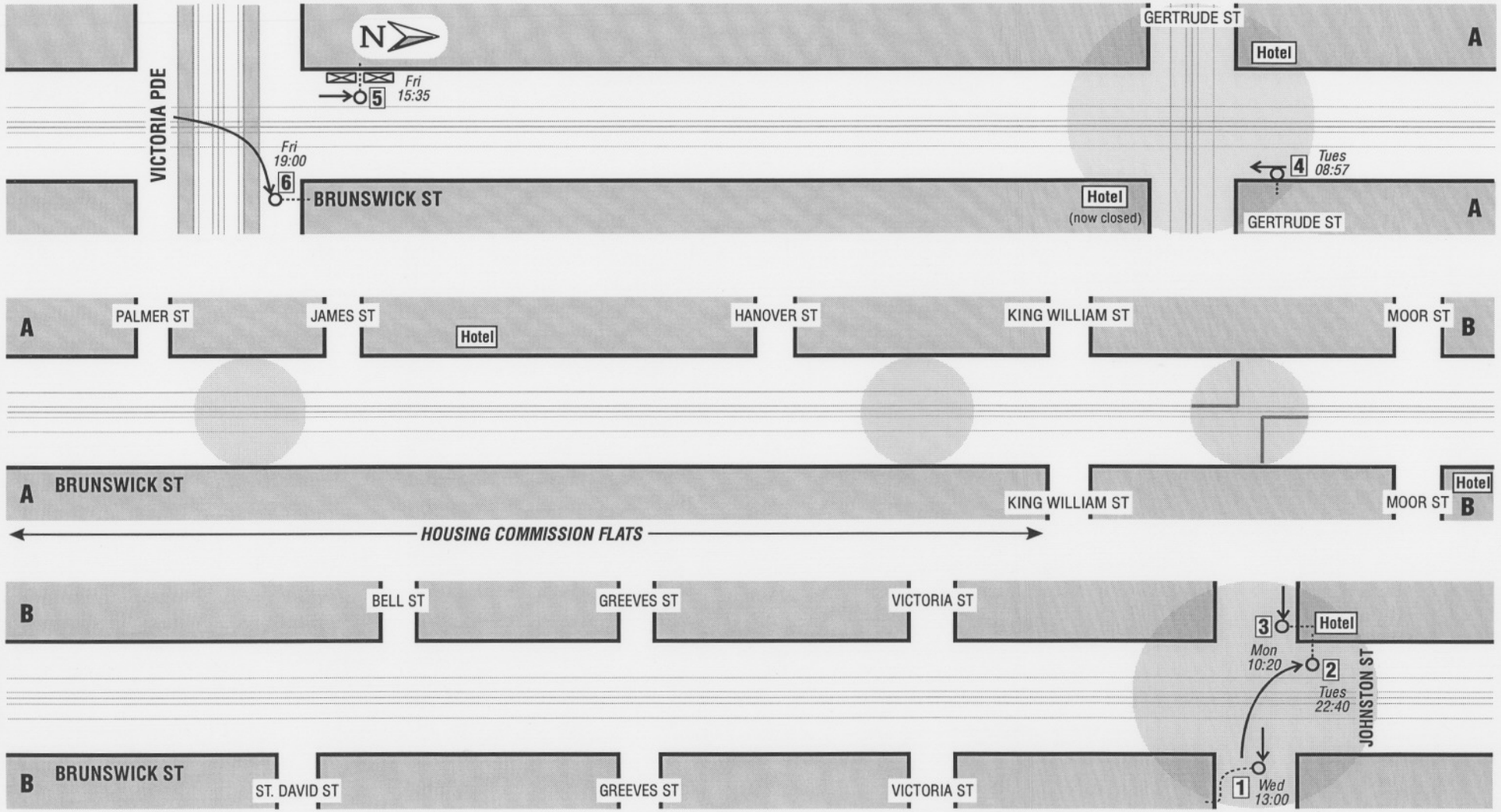
Pedestrian · Vehicle · Tram · Tram lines · Stationary vehicle · Reversing vehicle · Queued vehicle · Traffic Signals · Pedestrian Signals



CASE	CASE DETAILS
C-4	**ATTACHMENT 2: COLLISION DIAGRAM - PEDESTRIAN CASUALTY CRASHES WITH KNOWN ZERO BAC - 1985 TO 1994 INCLUSIVE** **BRUNSWICK ST BETWEEN VICTORIA PDE AND JOHNSTON ST**

KEY

Pedestrian
Vehicle
Tram
Tram lines
Stationary vehicle
Reversing vehicle
Queued vehicle
Traffic Signals
Pedestrian Signals



BRUNSWICK STREET, BETWEEN VICTORIA PARADE AND JOHNSTON STREET, FITZROY

FACING NORTH AT PALMER STREET

BRUNSWICK STREET, BETWEEN VICTORIA PARADE AND JOHNSTON STREET, FITZROY

FACING NORTH NEAR MOORE STREET

FACING WEST AT GERTRUDE STREET

APPENDIX 5

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES AT FLEMINGTON ROAD, NORTH MELBOURNE

Location: Flemington Road,

between Curran Street and Gatehouse Street,

NORTH MELBOURNE

REPORT ON INVESTIGATION OF ALCOHOL-RELATED PEDESTRIAN CRASHES - 1985 to 1994

Location: *Flemington Road, between Curran Street and Gatehouse Street, North Melbourne*

Date of Inspection: 2 May 1996

1. Details of Crashes

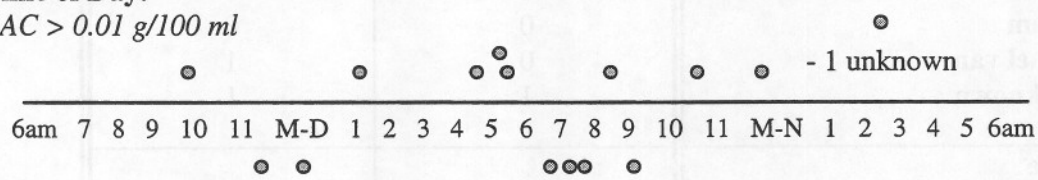
CATEGORIES	*NUMBER OF CRASHES*	
	"BAC > 0.01 g/100 ml" Crashes	"Zero BAC"[1] Crashes
Injury Level		
Fatal	0	0
Serious Injury	7	5
Other Injury	2	1
Total	**9**	**6**
Vehicle Type		
Car	6	4
Truck	1	0
Taxi	1	0
Tram	0	0
Panel van	0	1
Unknown	1	1
Crash Type[2]		
Near Side (100)	5	2
Emerging (101)	1	0
Far Side (102)	3	3
Playing/working/lying/ standing, on c'way (103)	0	1
Pedestrian Blood Alcohol Levels:		
0.010 to 0.050 g/100 ml	1	
0.051 to 0.150 g/100 ml	1	All zero
0.151 to 0.250 g/100 ml	6	
0.251 to 0.350 g/100 ml	1	
Pedestrian Gender:		
Male	8	4
Female	1	2

[1] Zero BAC is defined as ranging from 0.000 g/100 ml to 0.010g/100 ml.
[2] Classified according to the VicRoads' definitions for classifying accidents or DCAs.

Pedestrian Age:		
0 to 17 years	1	1
18 to 25 years	1	3
26 to 35 years	1	1
36 to 45 years	1	0
46 to 55 years	2	1
56 years and over	0	0
unknown	3	0
Driver Age:		
0 to 17 years	0	0
18 to 25 years	5	2
26 to 35 years	0	1
36 to 45 years	0	2
46 to 55 years	2	0
56 years and over	0	1
unknown	1	0
missing	1	0
Driver Gender:		
Male	3	2
Female	4	3
Unknown	1	1
Missing	1	0

Time of Day:

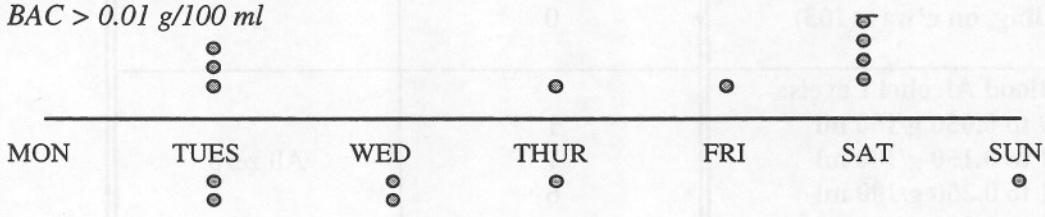
BAC > 0.01 g/100 ml



Zero BAC

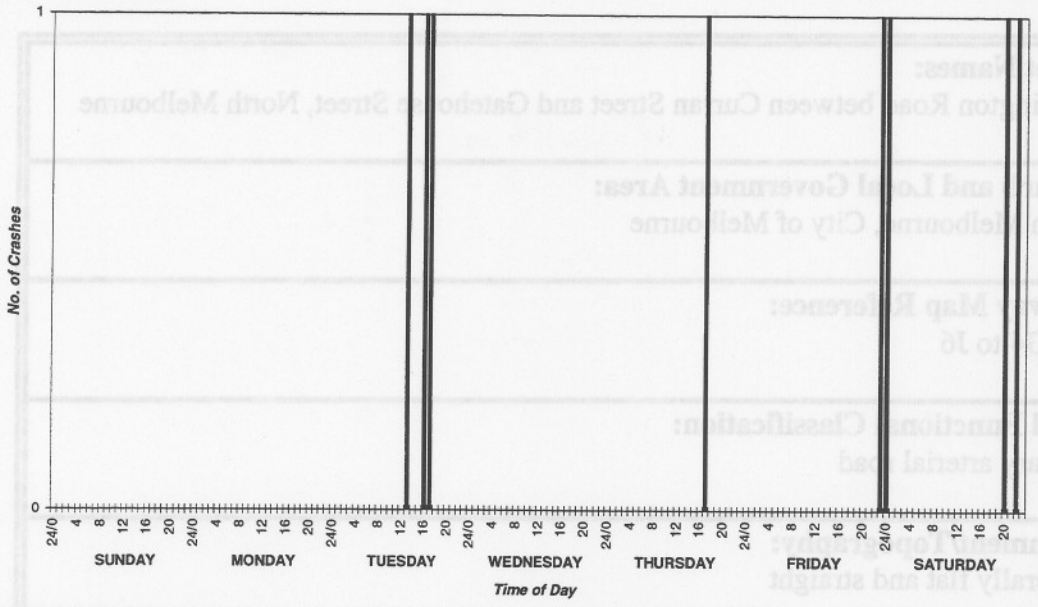
Day of Week:

BAC > 0.01 g/100 ml



Zero BAC

Time of Week:



Light Condition:		
Day light	4	2
Dusk/Dawn	1	2
Dark (street lights on)	3	1
Dark (strt lights unknown)		
Unknown	0	1
	1	0
Atmospheric Conditions:		
Clear	8	6
Unknown	1	0
Road Conditions:		
Dry	9	6
Other	0	0
Month of Year:		
December-February	3	2
March-May	0	1
June-August	3	1
September-November	3	2
Initial Direction of:		
Vehicles		
westbound	4	5
eastbound	3	1
northbound	1	0
unknown	1	0
Pedestrians		
southbound	4	1
northbound	4	4
other/unknown	1	1

2. Location Details

Street Names:
Flemington Road between Curran Street and Gatehouse Street, North Melbourne

Suburb and Local Government Area:
North Melbourne, City of Melbourne

Melway Map Reference:
2A, G4 to J6

Road Functional Classification:
Primary arterial road

Alignment/Topography:
Generally flat and straight

Intersection Geometry (if applicable):
There are two main cross-intersections and several breaks in the outer separators permitting traffic to move between the centre and side carriageways.

Traffic Control Type:
Intersection signals at Abbotsford St and Gatehouse St, and pedestrian operated signals opposite the Royal Children's Hospital.

Surrounding Land Use:
Residential/Parkland/Public Hospital:

- All residential on south-west side of Flemington Road.
- Hotel nearby between Buncle and Melrose Streets.
- Mainly newly-constructed townhouses/apartments.
- Housing Commission Flats nearby on Melrose Street.
- Possible housing accommodation for nurses and other hospital employees.
- St. Vincent de Paul's 'Ozanam House' - provides shelter and meals for homeless people or vagrants; situated opposite The Royal Children's Hospital (this establishment has recently moved location to Arden Street).
- St. Vincent de Paul's 'Bailly House', located nearby, off Flemington Road.
- Majority of north-west side of Flemington Road is taken up by Royal Park South.
- The Royal Children's Hospital - corner of Gatehouse Street/Flemington Road.

Divided/Undivided Roadway:
Flemington Road essentially comprises four separate carriageways, each two lanes wide. For both south-east bound traffic and north-west bound traffic, the two centre carriageways are separated from the two inner carriageways by tree plantations, while tram tracks form an effective barrier between the two inner carriageways.

Speed Zone:
60 km/h throughout Flemington Road.

Number of Traffic Lanes:
Four lanes in each direction for motor traffic, with a further lane in each direction, for use by trams.

Pedestrian (or other vulnerable road user) Activity:
Pedestrian activity is consistently medium to high, due largely to:

- use of tram services
- attendance at Royal Children's Hospital
- use of Royal Park and the presence of major welfare agencies located in Flemington Road.

Characteristics of Traffic (Control) Operation:
The heavy and often congested traffic flows prevailing in Flemington Road, as well as the high numbers of trams and other heavy vehicles, create hazardous conditions for pedestrians in general and intoxicated pedestrians in particular. A number of alcohol -related pedestrian crashes occurred on weekday afternoons, including some during peak-period times.

Photographs Attached:
Yes

Other Observations/Comments:
The high traffic volumes, wide multi-lane carriageways and the relatively high vehicle speeds along this major Melbourne arterial road present a serious risk to pedestrians attempting to cross without the assistance of traffic control signals. The crash risks are increased dramatically for intoxicated pedestrians.

3. Factors Contributing to Alcohol-Related Pedestrian Crashes

This section describes the factors which may have contributed to the occurrence of the alcohol-related pedestrian crashes. Where applicable, distinctions are drawn between the crashes with BAC's > 0.01 g/100 ml and those reported to be zero.

Alignment/Topography:
Unlikely - Flemington Road is generally flat and straight throughout.

Intersection Geometry:
Unlikely.

Intersection Control:
Possibly - the nature of intersection signal operations is such that many pedestrians don't comply fully with the signals, in terms of observing the signal displays and/or crossing between the marked cross-walks. Failure by intoxicated pedestrians to comply with signals was a dominant feature of the alcohol-related pedestrian crashes and may be due, in part, to the impatience of pedestrians, in combination with the often lengthy delays pedestrians experience when they *do* comply with signals.

Further, drivers approaching signals are required to share their attention between the general driving task and monitoring traffic signal displays for possible changes. As such, drivers have a reduced capacity to detect and respond appropriately to pedestrians crossing at unexpected times or in unexpected locations, as was generally the case with the alcohol-affected pedestrians struck in Flemington Road.

Road Surface (friction and roughness):
Possibly - Flemington Road is a very busy arterial road carrying high volumes of traffic, including trams. The worn surface, due to high vehicle volumes, contributes to deficiencies in skid resistance.

Roadside Features/Hazards:
Unlikely.

Land Use:
Highly likely - there appears to be a strong association between crash occurrence in Flemington Road and the presence of welfare agencies such as St. Vincent de Paul's 'Ozanam House', which provides shelter and meals for homeless and other needy people. This property is situated opposite The Royal Children's Hospital and is the address given by *five* of the nine pedestrians whose BAC's exceeded 0.01 g/100 ml (of these five pedestrians, all had BAC's of at least 0.150 g/100 ml, with two exceeding 0.22 g/100 ml)). Further, it is understood that 'Ozanam House' is currently undergoing renovation and that the welfare service has been temporarily relocated to nearby Arden Street).

While there is a pub situated on the corner of Buncle Street, there is no obvious association between it and the known alcohol-related pedestrian crashes reported along this section of Flemington Road.

Traffic Operation:
Possibly - for the majority of crashes, traffic congestion was probably high at the time, suggesting few gaps in the traffic flow would have existed, underlining the importance of making the proper use of pedestrian facilities for safe crossing.

An earlier study of pedestrian safety in Flemington Road (and other similar locations) concluded that many pedestrians don't comply with traffic signals because of the poor level-of-service provided to them (i.e. long cycle times and short crossing times).

Delineation:
Unlikely - linemarking standards are generally quite high along Flemington Road.

Street lighting:
Potentially - while street lighting may meet normal standards for roads of this type, this may be inadequate for the circumstances, i.e. highly intoxicated pedestrians crossing during periods of darkness (and other circumstances described above).

Over half of the "BAC > 0.01 g/100 ml" and "zero BAC" crashes occurred during either darkness or dusk/dawn lighting conditions.

Sight Distance:
Potentially - while sight distances are generally good, the presence of parked vehicles in some sections of Flemington Road may have reduced the view drivers and alcohol-affected pedestrians had of each other in some of the crashes.

Road Divided/Undivided:
Possibly - most alcohol -related pedestrian crashes occurred in the side carriageways. While pedestrians crossing the side carriageways need cross only one direction of traffic at a time, the width of the side carriageways (effectively three lanes, one being a parking lane) may present additional difficulties for intoxicated pedestrians.

Lane Configuration (e.g. lane drop/merge, etc.):
Unlikely.

Lane Provision for Turning:
Unlikely.

Speed:
Probably - traffic volumes are consistently high (even late at night) and vehicle speeds often reach 60+ km/h (this inference is supported by corresponding site observations), . Given the crash and location circumstances described above, many drivers approaching at 60+ km/h would experience difficulty in avoiding an alcohol-affected pedestrian crossing in an erratic manner.

Other:
The very high BAC's of most pedestrians and there erratic crossing behaviour make avoiding collisions difficult for drivers travelling at or near the speed limit.

4. Summary of Main Crash Circumstances

The main circumstances for alcohol-related pedestrian crashes are summarised below:

Pedestrians:

- predominantly males (for "zero BAC" crashes also), with most pedestrians aged between 18 and 55 years (in three cases, the age of the pedestrian was unknown);
- generally high BAC's - most > 0.15 g/100 ml - and erratic crossing behaviour;
- most received serious injuries;
- in most cases, failed to comply either with pedestrian signal displays or the use of marked cross-walks.

Drivers:

- predominantly aged between 18 and 25 years;
- given the need to share their attention between the general driving task and monitoring traffic signal displays for possible changes, have a reduced capacity to detect and respond appropriately to pedestrians crossing at unexpected times or in unexpected locations;
- crashes involved drivers being unable to stop in time to avoid collisions with pedestrians unexpectedly stepping on to the roadway;

Vehicles:

- predominantly cars (for both alcohol-related and "zero BAC" crashes)

Road Environment:

- crashes occurred in the near vicinity of St. Vincent de Paul's 'Ozanam House' and the Royal Children's Hospital. 'Ozanam House' was the address of five of the nine crash-involved pedestrians whose BAC's exceeded 0.01 g/100 ml;
- a majority of crashes occurred at or in the vicinity of intersection or pedestrian signals, with pedestrians failing in some cases to comply either with signal displays or the use of marked cross-walks. There was also evidence of at least one left-turning driver failing to give way to a crossing pedestrian;
- most pedestrians were struck crossing Flemington Road's side carriageways;
- probable deficiencies in pavement skid resistance may contribute to pedestrian (and other) crash risks
- approximately half of all pedestrian crashes occurred in darkness or dawn/dusk conditions.

Situational:

- most alcohol-related pedestrian crashes occurred during the afternoon peak period or at night, in darkness
- crashes occurred predominantly on Saturdays and Tuesdays
- for most crashes, vehicle flows were expected to have been relatively high, highlighting the importance of intoxicated pedestrians using pedestrian crossing facilities.

5. Countermeasure Options for Alcohol-Related Pedestrian Crashes

Pedestrians:

- target hotels and licensed premises in the area to introduce (more effective) alcohol intervention programs for patrons and to install coin-in-the-slot breath testing machines so that patrons can monitor their blood alcohol levels. This option should be considered even though there is no clear link between alcohol-related pedestrian crashes and hotels and other licensed premises in the area. Place signs or posters in these premises warning pedestrians and drivers of the hazardous pedestrian environment in Flemington Road, especially at night;

- educate local residents about the high pedestrian risks in Flemington Road. Traffic safety pamphlets could be distributed to the Royal Children's Hospital, local businesses, private residences, nearby Housing Commission Flats, and organisations which care for the alcoholics and homeless people of the area. Pamphlets would be written in English and other major languages of the area;

- improve the night-time conspicuity of intoxicated pedestrians in the area, where practicable, by issuing to pedestrians in high risk categories, clothing which incorporates highly reflective markers, such as sports-style shoes. Local welfare organisations (e.g. St. Vincent de Paul's Ozanam House) may be well placed to assist with targeted distribution of clothing or footwear to those most in need.

Road Environment:

- erect fencing to more effectively direct alcohol-affected pedestrians to preferred crossing points;

- automatically introduce pedestrian signal phases at the intersections of Flemington Road with Abbotsford Street and Gatehouse Street, outside peak traffic periods, during the high risk times of late night and early morning (e.g. between 8 p.m. and midnight.). The optimum periods for this form of operation may be best determined after discussion with staff of welfare agencies, who can advise on the scheduling of their services. Short signal cycle lengths and longer walk times would also help intoxicated pedestrians to cross in greater safety;

- to encourage greater use of pedestrian signals by intoxicated pedestrians during the high risk times, ensure that signals are made highly responsive to pedestrian calls and that an extended walk time is provided (this could involve use of new technology designed to sense walking speeds and adjust times accordingly);

- upgrade street lighting to "above standard" levels of illumination;

- provide skid resistant pavement surfacing, possibly incorporating measures which influence driver sensory perception (e.g. providing a tactile/audible stimulus) to reduce vehicle speeds and alert drivers to heightened pedestrian crash risks. Such measures could be targeted at the approaches to and departures from signals, and/or in the vicinity of tram stops and safety zones.

Situational/Other:

- undertake Police enforcement of vehicle speeds, and safe and legal pedestrian crossing behaviour during high risk periods/conditions, particularly on Friday and Saturday nights and early mornings;
- examine the possibility of extending the activities of welfare agencies to patrol selected sections of Flemington Road to help intoxicated pedestrians to cross safely.

6. Summary of Conclusions and Countermeasure Recommendations

Alcohol-related pedestrian crashes at this location are considered to be primarily due to the presence and very high levels of alcohol in many of the pedestrians struck. At high BAC's, the abilities of pedestrians to judge speed and distance of approaching vehicles are severely affected. However, there are additional factors which, in combination with the intoxicated state of pedestrians, contribute to crash risk. These factors include:

- continual, very high traffic volumes using this major Melbourne arterial route;
- the wide, multi-lane cross-section of Flemington Road and the complex nature of the crossing task for pedestrians;
- potential difficulties for motorists in seeing and responding to pedestrians soon enough to avoid a collision, due to the need for drivers to also monitor traffic signal displays and other potential traffic conflicts closely (i.e. attention sharing in a very complex traffic environment on the approaches to signals), the presence of parked vehicles and/or inadequate street lighting for the circumstances;
- the failure of pedestrians to use traffic signals or to comply with signal displays;
- high levels of exposure to crash risk of people who attended Ozanam House when it was operating in Flemington Road (currently closed for renovations).

A number of countermeasure options have been proposed to address these factors, **with the following countermeasures recommended for particular attention:**

- work with local welfare organisations (e.g. St. Vincent de Paul's 'Ozanam House') to improve the night-time conspicuity of intoxicated pedestrians;
- erect fencing to more effectively direct alcohol-affected pedestrians to preferred crossing points;
- automatically introduce pedestrian phases at the intersections of Flemington Road with Abbotsford and Gatehouse Streets, outside peak traffic periods, during the high risk times (e.g. between 8 p.m. and midnight). Short cycle lengths and longer walk times are favoured during these times;
- to encourage greater use of signals by intoxicated pedestrians during high risk times, ensure that the signals are highly responsive to pedestrian calls;
- upgrade street lighting to "above standard" levels of illumination;
- provide skid resistant pavement surfacing on the approaches to and departures from traffic signals, and/or in the vicinity of tram stops and safety zones.

ATTACHMENT 1

Flemington Road (between Curran Street and Gatehouse Street), North Melbourne

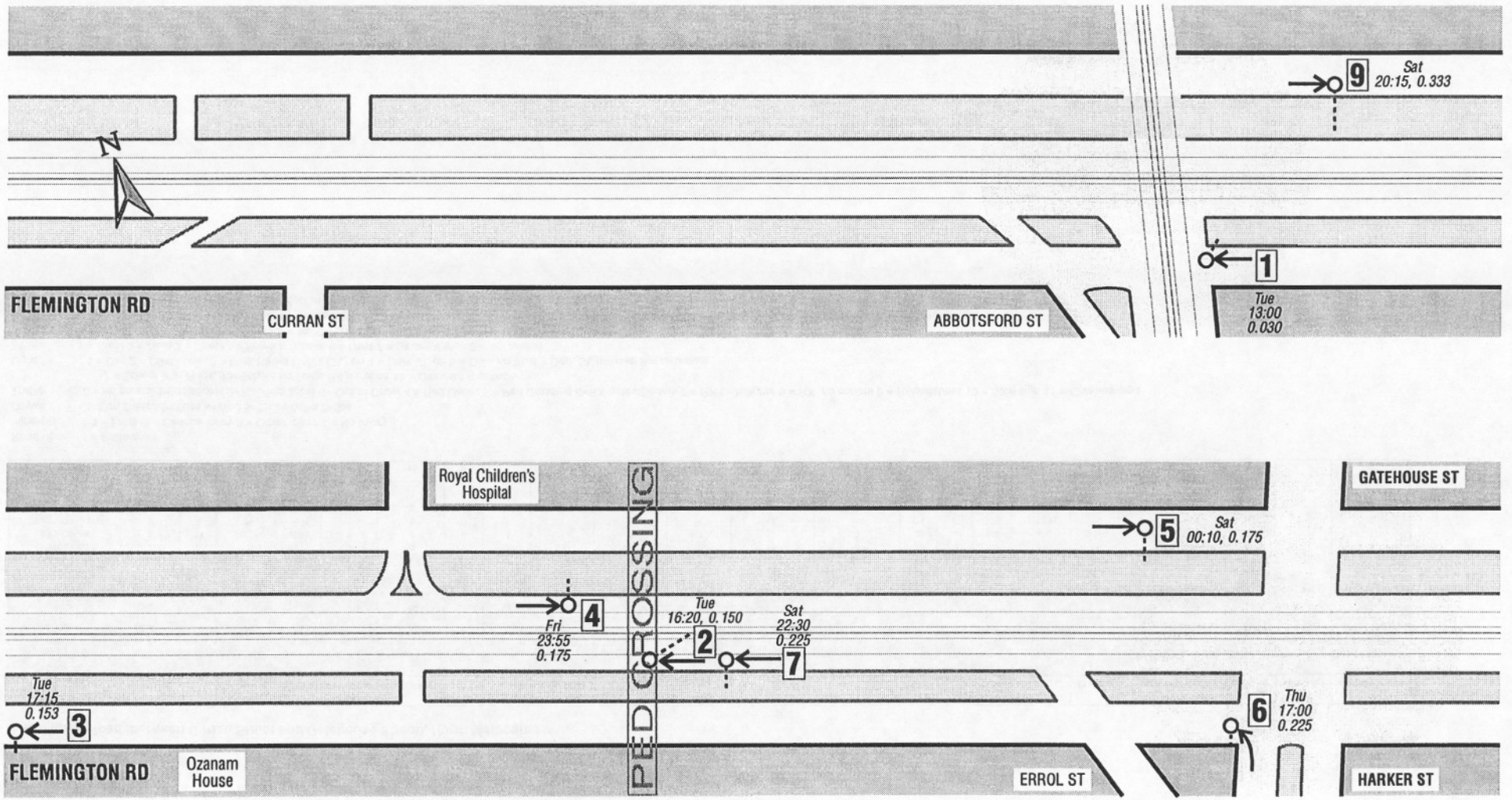
ACCID	INJNEW	DAY	MONTH	YEAR	DAYWK	TRAFFIC	BAC	LIGHT	ATMOS1	RDCOND1	GEOLOC	ROADCHR1	ROADCHR2	AGE	SEX	DCA	TMACC	D_age	D_sex	D_bac	Vehtype	Alc Ref	NonAlc Ref
Y85031746	3	10	9	1985	3	1	30	1	1	1	1	1	3	999	M	101	1300	50	F	999	1	1	
A87025389	2	21	7	1987	3	1	150	1	1	1	5	1	3	999	M	100	1620	47	M	999	3	2	
A89048548	3	14	11	1989	3	0	153	1	1	1	5	1	n/a	25	M	100	1715	21	M	999	7	3	
A86005816	2	28	2	1986	6	4	175	3	1	1	5	1	n/a	48	M	100	2355	24	F	999	1	4	
A86025647	2	9	6	1986	7	0	175	3	1	1	5	1	3	14	F	102	10	23	M	999	1	5	
A85034681	2	3	10	1985	5	1	225	2	1	1	1	1	3	999	M	100	1700	999	U	999	1	6	
A86024098	2	26	7	1986	7	0	225	3	1	1	5	1	n/a	62	M	102	2230	18	F	999	1	7	
A88003175	2	16	1	1988	7	0	333	1	1	1	1	1	3	32	M	102	2015	22	F	999	1	9	
A88006234	2	12	12	1987	7	0	239	9	9	1	5	1	n/a	43	M	100	9999	MIS	MIS	MIS	MIS	missing	
A90039661	2	6	11	1990	3	0	0	2	1	1	5	1	3	23	M	102	1936	44	M	999	1		1
A91004634	3	31	1	1991	5	0	0	1	1	1	1	1	3	23	M	100	1200	999	U	999	99		2
A91023103	2	3	7	1991	4	1	0	1	1	1	1	1	n/a	21	F	100	1130	18	F	999	1		3
A85003351	2	5	2	1985	3	0	5	6	1	1	4	1	3	47	M	103	2100	24	F	999	5		4
A85014017	2	1	5	1985	4	1	5	2	1	1	2	1	3	3	M	102	1830	38	M	999	1		5
A88041498	2	4	9	1988	1	5	5	3	1	1	5	1	3	32	F	102	1900	28	F	999	1		6
A91035406	1	16	10	1991	4	15	0	1	2	2	2	1	3	79	F	100	930	39	M	999	15		7

Road user : 1 = Pedestrian
Injnew : 1 = Fatal 2 = Serious Injury 3 = Other Injury 4 = No Injury
Daywk : 1=Sun 2=Mon 3=Tues 4=Wed 5=Thurs 6=Fri 7=Sat
Traffic : 0 = no control 1=Stop lights 2=Flashing lights 3= Out of Order 4 = Ped Lights 5 = Ped Crossing 6=RX gates/Booms 7 = RX bells/lights 8 = RX no control 9 = Roundabout 10 = Stop sign 11 = Giveway sign 12 = School with Flags 13=School no Flags 14 = Police 15 = Other 99 = unknown
Light : 1 = Day 2 = Dusk/dawn 3 = Dark Street Lights (SL) on 4 = Dark SL off 5 = Dark no SL 6 = Dark SL unkown 9 = unknown
Atmos : 1 = Clear 2 = Rain 3 = Snow 4 = Fog 5 = Smoke 6 = Dust 7 = Strong Winds 9 = not known
Road Cond : 1 = Dry 2= Wet 3 = Muddy 4 = Snowy 5 = Icy 9 = unknown
Road Geo : 1=Cross intersection 2 = T intersection 3 = Y intersection 4 = Multiple intersection 5 = Not at intersection 6 = Dead end 7 = Road closure 8 = Private Property 9 = unknown
Road Char : 1 = Straight 2 = Curved 3 = Divided 4 = Median opening 5 = Bridge, culvert or causeway 6 = Driveway or Crossover 7 = Roadworks 9 = unknown

CASE	CASE DETAILS
C-5	***ATTACHMENT 2: COLLISION DIAGRAM*** **- PEDESTRIAN CASUALTY CRASHES** **WITH KNOWN BAC > 0.01 - 1985 TO 1994 INCLUSIVE** **DAY OF WEEK, TIME OF DAY & BAC SHOWN FOR EACH CRASH** **FLEMINGTON RD BETWEEN CURRAN ST AND GATEHOUSE ST**

KEY

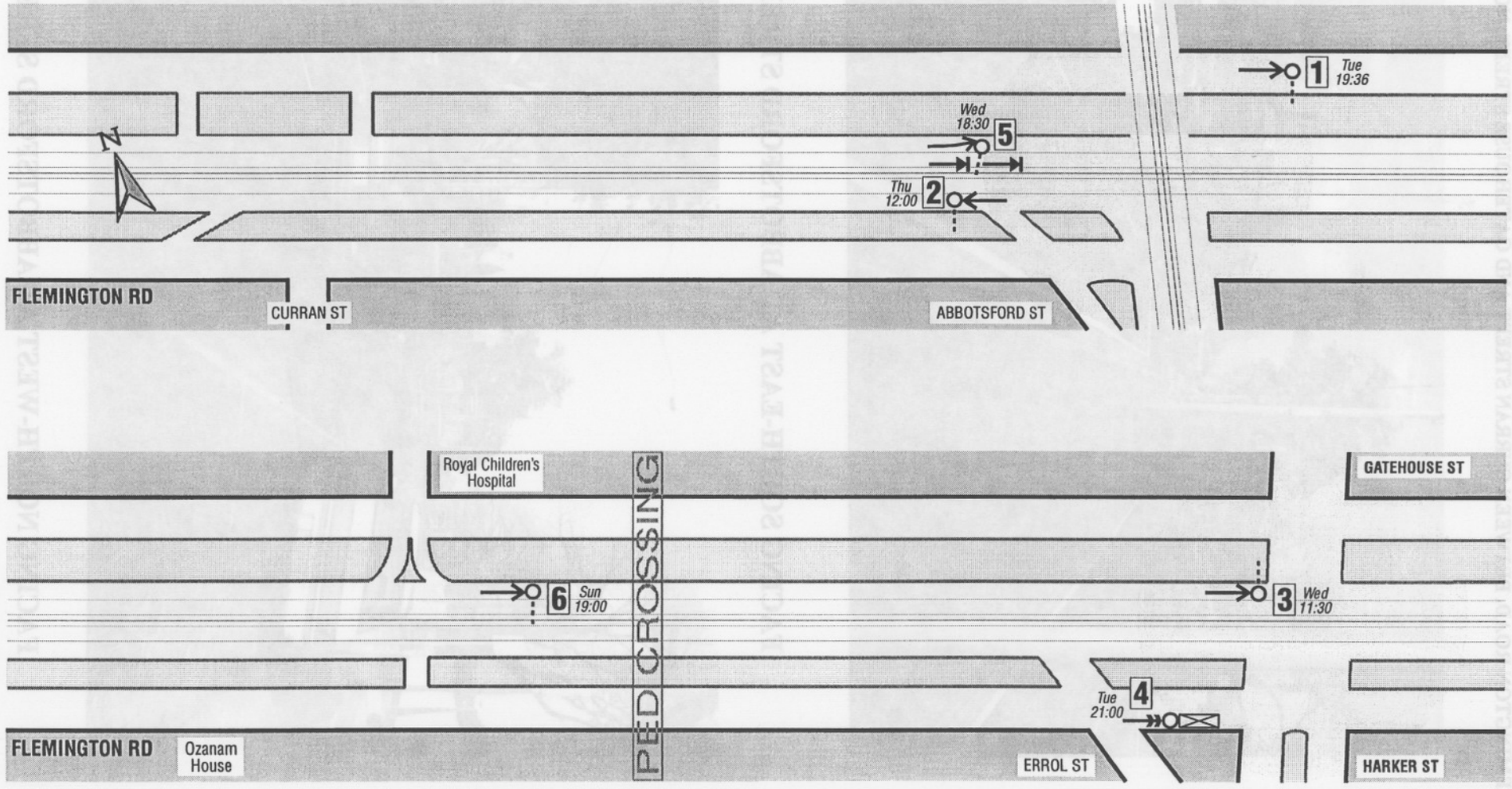
Pedestrian	Reversing vehicle
Vehicle	Queued vehicle
Tram	Traffic Signals
Tram lines	Pedestrian Signals
Stationary vehicle	



CASE	CASE DETAILS
C-5	***ATTACHMENT 2: COLLISION DIAGRAM*** **- PEDESTRIAN CASUALTY CRASHES WITH KNOWN ZERO BAC - 1985 TO 1994 INCLUSIVE** **FLEMINGTON RD BETWEEN CURRAN ST AND GATEHOUSE ST**

KEY

Pedestrian	Reversing vehicle
Vehicle	Queued vehicle
Tram	Traffic Signals
Tram lines	Pedestrian Signals
Stationary vehicle	



FLEMINGTON ROAD, BETWEEN CURRAN STREET AND GATEHOUSE STREET, NORTH MELBOURNE

FACING SOUTH-EAST AT ABBOTSFORD STREET

FACING NORTH-WEST AT ABBOTSFORD STREET

FLEMINGTON ROAD, BETWEEN CURRAN STREET AND GATEHOUSE STREET, NORTH MELBOURNE

FACING SOUTH-EAST NEAR ROYAL CHILDREN'S HOSPITAL

FACING SOUTH-EAST NEAR ROYAL CHILDREN'S HOSPITAL