AN EVALUATION OF THE RANDOM BREATHE TESTING INITIATIVE IN VICTORIA 1989-1990

QUASI-EXPERIMENTAL TIME SERIES APPROACH

by

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AN EVALUATION OF THE RANDOM BREATH TESTING INITIATIVE IN VICTORIA 1989-1990 QUASI-EXPERIMENTAL TIME SERIES APPROACH.

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Abstract:
This report presents the findings of a quasi-experimental evaluation of the impact of the Random Breath Testing (RBT) initiative in Victoria on fatal and serious casualty crashes during high alcohol times of the week in 1990. Bus-based RBT stations using highly visible "Booze Buses" largely replaced car-based stations. This was combined with a multi-million dollar, Statewide anti-drink driving publicity campaign using all mass media, which was launched in mid December 1989, reinforced throughout 1990 and applied intermittently in subsequent periods.

It was found the initiative reduced fatal crashes during high alcohol times of the week in Melbourne by 19%, relative to what was expected. However, there was no statistically significant effect on serious casualty crashes during high alcohol times in Melbourne.

Serious casualty crashes during high alcohol times in a part of rural Victoria (generally closest to Melbourne) also dropped by 15%, although the apparent absence of an effect on rural fatal crashes linked this drop more tentatively to the initiative.

Key Words:
evaluation (assessment), collision, road trauma, publicity, enforcement, Blood Alcohol Content, alcohol*, drink driving*, Random Breath Testing*

Disclaimer:
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BACKGROUND

Since its introduction in Victoria in 1976, Random Breath Testing (RBT) activity has progressively increased from 19,006 tests conducted in 1977 to 520,723 by 1989. Short periods of intensified RBT in selected areas of Melbourne were also carried out between 1977 and 1983 according to predetermined experimental designs. Evaluations of these 'blitzes' found that intensified RBT is an effective measure for reducing night-time, serious casualty crashes.

In September 1989 an initiative was introduced which substantially altered the method of RBT enforcement compared with past operations. Bus-based RBT stations using highly visible "Booze Buses" largely replaced car-based stations. A multi-million dollar, Statewide anti-drink driving publicity campaign through mass media, was launched in mid December 1989, and reinforced throughout 1990 and in subsequent periods. This campaign was the cornerstone of public perceptions of the program, designed to both heighten perceptions of extended enforcement and sensitize the public to the consequences of drink driving.

In brief, the key aspects of the initiative were:

- A major multi-million dollar, multi-media publicity campaign with most advertisements depicting emotive post-crash scenarios, and some publicity of bus-based RBT enforcement
- Thirteen new, high profile 'Booze Buses', largely replacing car-based testing, especially in Melbourne
- A strike force using 'Probationary Constables In Training' (PCIT's) on monthly roster to operate buses
- More than doubling the number of drivers tested, mostly in Melbourne, gradual but smaller increases in session hours, and no change in the number of sessions conducted in Melbourne. The total number of RBT tests in rural areas remained relatively constant.

This study examines the characteristics of the new RBT operations and evaluates its effects on severe crashes in high alcohol hours of week. The results are summarised below.
CHARACTERISTICS OF RBT OPERATIONS

Statewide RBT Operations:

The initiative almost doubled the total number of RBT tests conducted yearly in Victoria from around ½ million in 1989 to over 900,000 in 1990. Bus-based RBT operations more than doubled the testing rate (per hour) of car-based operations.

Overall, this resulted in a substantial increase in the number of RBT tests for relatively small changes in the total time of operation of testing stations. Similarly, the number of person hours spent testing also increased substantially. Changes in RBT operations varied across different parts of the State.

Metropolitan RBT Operations:

Bus-based RBT replaced most car-based RBT in all Police districts of Melbourne. Bus-based RBT became the primary form of RBT operation from November 1989, both in terms of hours of testing and the number of tests conducted.

The substitution of cars with buses led to a substantially higher number of RBT tests and gradual, smaller increases in the total number of hours of RBT operations and session duration. The number of sessions conducted remained relatively constant.

Rural RBT Operations:

The introduction of bus-based RBT in rural Police Districts was much slower and less uniform across Districts than in metropolitan areas.

A minor shift to the use of buses was observed between October 1989 and October 1990, with greater use of bus-based RBT after October 1990.

Whilst the total number of RBT tests conducted remained relatively constant, the duration of RBT sessions and operating hours decreased throughout 1990 (although increases were observed for the first half of 1991).

The number of RBT sessions decreased over time.
METHODS OF RBT OPERATION

Three different types or methods of RBT operated in different parts of Victoria from late 1989 to the end of 1990. These are described below.

Metropolitan RBT Method:

RBT operations were conducted primarily through bus stations resulting in large increases in the number of drivers tested and gradual increases in hours spent testing.

Inner Rural RBT Method:

In the rural Police Districts around Melbourne, bus-based RBT was used at low levels whilst car-based RBT decreased gradually for the period late 1989 to 1990.

The number of RBT tests conducted overall did not change over this time (apart from increased activity in the last quarter of 1990) but there was some decrease in the number of operating hours compared with 1989.

Outer Rural RBT Method:

In the rural Police Districts furthest from Melbourne, bus-based RBT was not obvious until late 1990 and early 1991.

There was little change in the number of RBT tests conducted and the number of operating hours, apart for some decrease in both hours and tests in the latter half of 1990.

This area was least changed by the new (bus-based) RBT method for the period to late 1990.

DESCRIPTIVE ANALYSIS OF EVIDENTIAL BREATH TESTS AND CRASH DATA

Evidential breath tests and crash data were analysed to provide an indication of changes and trends in drink driving and high alcohol hour crashes.

Crashes which occur in "high alcohol hours" of the week refer to those crashes between Monday-Thursday 6pm to 6am, Friday 4pm to 8am Saturday, Saturday 2pm to 10am Sunday, and Sunday 4pm to 6am Monday. Low alcohol hours relate to the complementary times of the week. Serious casualty crashes in high alcohol hours (mainly night-time) are most likely to be affected by RBT because 38% of these crashes have been shown to involve drivers with Blood Alcohol
Concentrations (BACs) over 0.05%, while during low alcohol hours the corresponding percentage is 4% (Harrison, 1990). In addition, past experience suggests that RBT can affect other types of high alcohol hour crashes other than those which are alcohol related (Homel, 1981; Cameron & Strang, 1982). Both serious casualty crashes and fatal crashes (which are more likely to involve alcohol) during high alcohol times were examined.

**Evidential Tests:**

There were no significant changes in the number of drivers charged with exceeding 0.0% or 0.05%, nor in the personal characteristics of these offenders over the period from January 1989 to June 1991, apart from a reduction in the proportion of younger drivers charged with exceeding 0.0% through both non-crash and non-fatl crash evidential breath tests. There was some suggestion that there was a decrease in drinking at hotels and an increase in drinking at home for crash-involved offenders.

**Fatal BAC Readings:**

The proportion of drivers/riders killed with BACs between 0.011-0.15% decreased in 1989 and 1990, whilst the proportion of sober drivers/riders killed has correspondingly increased. The proportion of those killed in high alcohol hours with BACs between 0.05-0.15% also decreased in 1989 and 1990. The proportion of drivers/riders killed with higher BACs (greater than 0.15%) has remained relatively constant. As a result, this group now makes up a greater proportion of "drink drivers" killed.

**Trends in Crashes:**

Twelve monthly moving totals of serious casualty crashes in Victoria since 1983 show that crashes began increasing some time in 1986 and continued increasing throughout 1987. For most of 1988 and early 1989, the total had stabilized and began to decrease steadily from mid 1989.

The 12 month moving total of fatal crashes had increased slightly up to the end of 1989 and since December 1989 there have been dramatic reductions in the number of fatal crashes. This reduction was more pronounced in high alcohol hours.

**RESEARCH DESIGN & STATISTICAL ANALYSIS**

A quasi-experimental research design was developed to structure the crash data. A forecasting model was used to estimate the changes in two treated areas, Melbourne and Rural 1, taking into account changes in the same crash types in two respective comparison areas, Sydney and Rural 2. As all Police Districts in Melbourne, over all days of the week, were exposed to the new bus-based method,
internal untreated 'control' or comparison areas were not available. Additionally, the operation of a Speed Camera Program further eliminated other possible comparative analyses. Statewide intensive publicity also diminished the differences between 'treated' and 'untreated' areas. Therefore, the pattern of results across Melbourne, Sydney, Rural 1 and Rural 2 was used to aid interpretation of measured effects and attribution of these to the treatment.

Controlling for changes in these comparison areas (quasi-experimental control) increases the likelihood that net measured effects in the treatment areas can be more validly ascribed to the initiative. This quasi-experimental design was used in the absence of a full experimental design (which provides the most rigorous assessment), and in preference to the use of statistical control (which attempts to directly allow for the effect of other factors). Statistical controls were not used in this study because technical support for their incorporation was considered to be insufficient.

The statistical analysis involved predicting expected crash numbers for each area, using time series modelling of data between 1983 and 1989, and comparing predicted and actual crash frequencies to determine whether there had been changes. The changes at each area were then compared and net percentage changes calculated to reflect the effect of the initiative.

**Within Group Differences:**

A large statistically significant reduction in fatal crashes in high alcohol hours was found in Melbourne, but not in the rural Victorian areas or the Sydney metropolitan area.

A large statistically significant reduction in serious casualty crashes in high alcohol hours was found in Rural 1, but no statistically significant change in Melbourne, Sydney or the Rural 2 area was detected.

**Between Group Differences:**

A large reduction in fatal crashes in Melbourne relative to Sydney (and both rural Victorian areas) was found.

A larger reduction in serious casualty crashes in Rural 1 was found when compared to Rural 2 (and Melbourne). There was no significant difference in the reduction in serious casualty crashes between Melbourne and Sydney.
Statistical testing of differences between treatment and comparison areas, controlling for location, found evidence of significant crash reductions for:

- **the Melbourne metropolitan area** (relative to Sydney) for **fatal crashes** in high alcohol hours of week only

- **Rural 1** (relative to Rural 2) for **serious casualty crashes** in high alcohol hours of week only

**CONCLUSIONS**

On balance, it appears reasonable to conclude the following from the results of this study:

**Melbourne Metropolitan region:**

The effects of the RBT initiative in Melbourne were restricted primarily to fatal crashes in high alcohol hours. This reduction of 33% was more than twice that found for the Sydney metropolitan area (14%) for the same period.

On the assumption that the reduction in high alcohol hour fatal crashes in Sydney was not due to road safety interventions in that period, and that any "other" factors applied to the same extent in Melbourne as in Sydney, a reduction of the order of 19% in fatal crashes in high alcohol hours in Melbourne could be reasonably attributed to the RBT initiative.

No statistically significant change was found in high alcohol hour serious casualty crashes; however, the estimated change was associated with a wide prediction interval for this series, reflecting the greater difficulty of providing relatively precise forecasts.

**Rural 1 region:**

The greater (statistically significant) reduction in high alcohol hour serious casualty crashes at Rural 1 (26%) compared with Rural 2 (11%) suggests a 15% reduction due to the initiative on these crashes.

However, given the imbalance of this pattern compared with that for fatal crashes, and that fatal crashes at Rural 1 have not changed over time, the attribution of the effect on serious casualty crashes to the initiative is more tentative. This is because fatal crashes are more likely to be alcohol related and although it is probable that the presence of police undertaking RBT also affects non-alcohol related crashes, it seems unlikely that it would affect the latter only and not the former.
It must be acknowledged however, that the estimated effects for fatal crashes in rural areas are associated with much wider confidence intervals, and thus the likelihood of being able to detect a statistically significant difference is low for fatal crashes, particularly in R1.

**Rural 2 region:**

The results for Rural comparisons were more difficult to interpret, mainly because there are no truly "untreated" areas. Although the Rural 2 region was the least changed in terms of quantifiable RBT operations, it was exposed to the related publicity and potentially received qualitative changes in treatment. The absence of a comparison area for the Rural 2 region means that the proportion of the non-statistically significant 11% reduction in high alcohol hour serious casualty crashes due to the RBT initiative cannot be determined.

However, the similarity of serious casualty crash reductions between Rural 2 and both the Sydney and Melbourne metropolitan areas (notwithstanding the confounding of locations with treatments in making this comparison) makes it difficult to ascribe much, if any, of this reduction in Rural 2 to the treatment.

**Extraneous factors:**

Ambient factors in Victoria (eg. speed camera enforcement) have been, as far as possible, controlled for by structuring crash data by time of day periods (crashes in high alcohol hours) which best correspond to the intervention's target and exclude other interventions. Speed camera enforcement was a concurrent road safety intervention, but such enforcement was conducted mainly in low alcohol hours of week.

To the extent that the effect, if any, of speed camera enforcement had generalised to high alcohol hours, the proportional reduction attributed to RBT may be overstated. On balance, the net reduction observed in high alcohol hour crashes noted above has been ascribed to the RBT initiative.

An additional evaluation study of the RBT initiative using an alternative methodology has also been undertaken.
1.0 INTRODUCTION

Random Breath Testing (RBT) was introduced in Victoria in July 1976 and allows police to breath test drivers at random at designated roadside preliminary breath testing stations. Motorists passing the stations are stopped at random by police officers and required to take a preliminary breath test. If the test indicates a driver has a Blood Alcohol Concentration (BAC) above 0.05g/100ml, or above 0.0% if the Zero BAC requirement applies to the driver, an evidential test is given, the result of which can be used to charge the driver with exceeding the prescribed Concentration of Alcohol.

RBT is not strictly random, as times and places of operation are chosen primarily to deter potential drink-drive offenders as the means of reducing alcohol related crashes, and to a lesser extent to detect drinking drivers (Cameron & Strang, 1982; Monk, 1985; Armour, Harrison & South, 1986). Since its introduction, RBT activity has gradually increased, with some periods of intensified RBT being carried out. Tests have increased from 19,006 in 1977 to 520,723 by 1989 (South, 1991).

Evaluations in New South Wales and South Australia have demonstrated a road safety benefit as a result of the introduction of RBT in those States (McLean, Clark, Dorsch, Holubowycz & McCaul, 1984; Kearns & Goldsmith, 1984). Evaluations of RBT in Victorian studies have assessed the effects of specific periods of increased RBT activity supported by extensive publicity, and found that intensified RBT is an effective measure for reducing night-time, serious casualty crashes (Cameron, Strang & Vulcan, 1980; Cameron & Strang, 1982; Armour, Monk, South & Chomiak, 1985). Nevertheless, alcohol-related crashes still account for a significant proportion of driver/riding fatalities; in 1989, it is estimated that one third of drivers and riders killed had a BAC reading over 0.05, and in previous years the proportion has been even greater (South, 1991).

Despite Victoria having pioneered RBT, it has been noted that the level of RBT activity in Victoria has been relatively low since its introduction (Homel, 1990). Several years after the NSW experience of sustained, intensive RBT and publicity, a new RBT initiative was introduced in Victoria in 1989.

In September 1989, a new method of conducting RBT was gradually introduced. Unlike past RBT operations which largely relied on car-based stations, bus-based operations became the primary form of RBT enforcement. This was accomplished with the gradual introduction of 13 new, custom-built, high visibility Booze Buses, which replaced four existing buses. A greater number of police officers can conduct tests in any one bus operation compared to a car-based operation. A breath-testing task force utilising teams of Probationary Constables In Training (PCITs) on monthly deployment enabled higher levels of RBT activity to be achieved. The aim of this change was to increase significantly the number of
drivers who are random breath tested and enhance the visibility of RBT operations, thus more directly exposing a greater number of drivers to RBT in an attempt to increase general deterrence to drink driving.

A State-wide, multi-million dollar publicity campaign was launched on 12 December 1989 to support the initiative and has been presented through all types of media (television, print and radio). Graphic post-crash scenarios are presented in which vehicle passengers are severely injured and the driver has a positive BAC reading. The television advertisements are particularly emotive, showing scenes of distressed relatives and hospital staff and the severity of the personal injuries resulting from the crash. A media launch and publicity for the introduction of the new booze buses, including a considerable number of media articles about the initiative, occurred in April and September 1990.

This evaluation of the RBT initiative involved two main stages. Firstly, an analysis of operational data was undertaken to describe the changes in the characteristics of RBT and its operation before and after the initiative for different areas in Victoria. Secondly, a quasi-experimental research design was developed and crash data, evidential breath tests and fatal BAC data analysed to assess the road safety effect of the initiative. The design was derived solely from operational data; these data were used to define (apparently) different forms of RBT treatment; crash outcomes in the different treatment areas were contrasted with crash outcomes in comparison areas to establish the relative road safety effects of the RBT treatment.

2.0 DIFFICULTIES WITH QUASI-EXPERIMENTAL EVALUATIONS OF COUNTERMEASURES

Experimental evaluations provide the most rigorous test of the effectiveness of programs. They ensure that observed effects are attributable to the treatment rather than other extraneous influences, through the use of appropriate control or untreated groups. Treatment and control groups are obtained through either random allocation or by matching groupings according to important criteria. However, given that countermeasures are usually not implemented according to pre-determined experimental designs (eg. apply RBT and publicity to only a portion of the State), post hoc or quasi-experimental evaluations have to be used. Suitable 'control' groups need to be identified for a quasi-experimental evaluation to be undertaken.

The advantage of using 'control' groups is that the effects of extraneous factors are automatically allowed for, without having to identify or, more likely, to assume what these factors might be, and then subsequently trying to measure them in order to use them as statistical controls. Identifying and measuring all important factors is difficult to do for complex events such as road crashes, which are influenced by many factors and for which all the factors are not yet fully understood.
For this reason, the use of statistical control in the evaluation of a drink-driving initiative through multivariate analysis techniques (in order to directly control for the effect of any "other" effects on crashes), does not have sufficient technical justification and is not used in this study.

The disadvantage of the quasi-experimental approach is that 'control' groups which are unaffected by the program may not be available or identifiable. This is the case if other countermeasures are introduced at the same time, or if there is reason to expect that the effects of the treatment have influenced "untreated" groups indirectly (often referred to as 'spill over' effects). This is exacerbated when the mechanisms by which a countermeasure exerts its effects are not well understood, making 'treated' and 'untreated' groups more difficult to define and identify. In these situations it is not possible to attribute measured effects to a program with certainty; it can always be argued that observed effects could be accounted for by other factors.

A detailed discussion of the evaluation issues pertaining to this program is covered in sections 5.2.2 & 5.2.3 of this report.

3.0 ANALYSIS OF OPERATIONAL DATA

An examination of the changes in the characteristics of RBT and a description of its operation before and after the initiative for different areas in Victoria was undertaken.

Characteristics examined included:

- the number of hours of testing;
- the number of tests conducted;
- the use of bus-based and car-based RBT;
- number of sessions and session duration;
- time of day and day of week of operation; and
- the number of drivers detected with a positive reading.

3.1 RBT Operations Statewide

The number of RBT tests conducted in Victoria since 1977 progressively increased over time (refer Figure 1), with a substantial increase from around ½ million tests in 1989 to over 900,000 in 1990 as a result of the initiative.
Information regarding RBT and preliminary breath testing (PBT) operations in each Police District in Victoria was obtained for the two year period from July 1989 to June 1991. PBT operations involve mobile intercepts and tests of drivers involved in crashes.

Over the two years there were:

- 17,625 RBT sessions conducted in Victoria;
- 23,000 hours of RBT testing;
- almost 1.8 million RBT tests in total;

Changes in the number of hours' and tests over the two year period were examined. Figure 2 shows, on a quarterly basis, the number of hours of RBT testing over the two year period. Hours of testing overall remained relatively constant, apart from increases when the RBT initiative was first introduced in the last quarter 1989 and again at the beginning of 1991.

* Note: throughout this report "hours"or "hours of testing" means hours of operation of RBT stations and not number of person hours spent testing.
The number of RBT tests increased steadily over the two years, while PBT testing appears to have decreased somewhat after 1989 (Figure 3).
These overall changes, however, mask differing changes across metropolitan and rural areas.

3.2 RBT in Metropolitan and Rural Victoria

In this study, the metropolitan area is defined as police districts A - J, whilst remaining police districts (K - Q) constitute rural areas (refer Appendix A).

3.2.1 Hours of RBT testing

Overall, the total number of hours of RBT testing was greater in rural Victoria (14,000) than in the Melbourne metropolitan area (9,000) over the two years. However, in the metropolitan area, hours of testing gradually increased to a steady level of around 480 hours per month by 1991 (Figure 4), whilst in the rural area, the number of hours spent testing was more variable, decreasing throughout most of 1990. However, there were intensified efforts in rural Victoria in January and March 1991.
Analysis by six-monthly time blocks shows that the number of hours of testing in
the metropolitan area increased by 75% from the last half of 1989 to the first half
of 1991 (Figure 5). In the rural area, the hours dropped mainly throughout 1990
(Figure 5).

**FIGURE 5**

**HOURS OF RBT TESTING IN METROPOLITAN
AND RURAL AREAS, SIX-MONTHLY BLOCKS**

3.2.2 *Number of RBT tests*

Overall, the metropolitan area had a much greater number of tests (1.2 million
tests) than the rural area (½ million tests). As shown in Figure 6, the numbers of
persons tested in the metropolitan area generally increased (to about 70,000 tests
per month) while the numbers tested in the rural area fluctuated around an average
of 20,000 tests per month.
3.2.3 Testing capacity of car and bus-based RBT operations

In late 1989, new buses were purchased and fitted for the purpose of conducting RBT tests. The main difference between bus and car-based RBT testing is that there are more police personnel operating each bus and the capacity for RBT testing is therefore increased. Calculations for the two year period show that bus-based RBT operations more than doubled the testing rate of car-based RBT operations in both the metropolitan (154 tests per hour from buses and 70 tests per hour from cars) and rural areas (89 tests per hour from buses and 31 tests per hour from cars).

Over the two year period there was a steady increase in both the proportion of RBT tests conducted and hours spent testing out of buses. RBT testing in the metropolitan area shifted from being primarily car-based (80 to 90% of hours between July-September 1989) to almost completely bus-based (with cars accounting for less than 10% of hours) by September 1990, as shown in Figures 7 and 8. In the metropolitan area, bus-based RBT was the primary form of RBT operation since November 1989 in terms of both hours of testing and number of tests conducted.
FIGURE 7

PROPORTION OF RBT TESTS BY CAR/BUS, METROPOLITAN AREA

FIGURE 8

PROPORTION OF RBT HOURS BY CAR/BUS, METROPOLITAN AREA
In contrast, RBT testing in the rural area as a whole changed from being almost completely car-based to a level in which cars accounted for approximately 60% of RBT hours by June 1991 (Figures 9 and 10). A minor shift to buses was observed between October 1989 and October 1990, with greater use of bus-based RBT apparent from November 1990. The trend of shifting towards buses in the rural area was still continuing at the end of this two year period.

**FIGURE 9**

PROPORTION OF RBT TESTS BY CAR/BUS, RURAL AREAS

**FIGURE 10**

PROPORTION OF RBT HOURS BY CAR/BUS, RURAL AREAS
3.2.4 Number of RBT sessions

As shown in Figure 11, the number of RBT sessions in the metropolitan area decreased somewhat in the first half of 1990, but otherwise remained relatively stable over time.

FIGURE 11

NUMBER OF RBT SESSIONS IN METROPOLITAN AREA IN SIX-MONTHLY PERIODS

In contrast, the number of RBT sessions conducted in the rural area consistently decreased over time (Figure 12).
3.2.5 RBT session duration

There was a gradual increase in average session duration in the metropolitan area over the two year time period (Figure 13). In the period from July to December 1989 the average session duration was around 1 hour and 40 minutes. The average session duration increased by 1 hour and 15 minutes by 1991, to just under three hours.

This trend is congruent with the gradual increase in hours spent testing while the number of RBT sessions has remained relatively constant (refer Figure 11).
The average session duration in rural areas decreased slightly (by around 10 minutes) in 1990, but increased in 1991 (Figure 14), following a similar pattern to the hours of testing. The vast majority of sessions in rural Victoria have been less than 1 hour in duration, although, in the first half of 1991, there was an increase in the number of sessions greater than five hours in duration.
The duration of bus sessions in the metropolitan area did not change over the two year period with a mean duration of over 3 hours. Whilst the average session duration of buses operating in the rural area has remained at around two hours, the distribution has changed over time with an increase in the number of bus sessions less than one hour and also greater than five hours.

Car session durations have also been steady over the period in both the metropolitan and rural areas with the majority of sessions being under 1 hour in duration.

In summary, the increase in session duration (and therefore hours of testing) in the metropolitan area, appears to be the result of the shift from car-based operations to bus-based operations, for which sessions are typically 3 times longer in duration. Since the shift towards buses has been slower in the rural area, the introduction of the buses had relatively little effect on session duration in these areas until the first half of 1991.

3.2.6 Start/end times of RBT sessions

The start times in the metropolitan area did not change greatly in the two years with a median start time between 7pm and 8pm. Over that time period the RBT operations tended to finish later with the median finish time shifting from about 9pm in the last six months of 1989 to 11pm in the first six months of 1991 (see Figures 15 to 18). It appears that the increase observed in session duration in the metropolitan area is the result of the sessions running later. Over the two year period there was a reduction in the level of testing during late morning and early afternoon.
FIGURES 15 - 18
RBT SESSION START/END TIMES IN METROPOLITAN AREA IN SIX-MONTHLY PERIODS

July to December 1989

January to June 1990
In the rural area, the start and end times of RBT sessions did not change over the two year period (see Figures 19 to 22).
FIGURES 19 - 22
RBT SESSION START/END TIMES IN RURAL AREAS IN SIX-MONTHLY PERIODS

July to December 1989

January to June 1990
3.2.7 *RBT by day of week*

In the metropolitan area, Thursday, Friday and Saturday are the days with the highest number of hours of RBT testing. Over the two year period RBT operations became even more concentrated on these days as compared to the earlier part of the week (Figure 23) although RBT increased over all days of the week with substantial periods of time spent testing on each day.
The emphasis of time spent in rural RBT testing shifted from Friday, Saturday and Sunday to be more in line with the metropolitan area pattern (refer Figure 24).

**FIGURE 23**

METROPOLITAN RBT HOURS OF TESTING BY DAY OF WEEK

**FIGURE 24**

RURAL RBT HOURS OF TESTING BY DAY OF WEEK
3.2.8 Hit rates

The RBT hit rate (the percentage of positive and illegal tests) in the metropolitan area over the two year period ranged between 0.25 to 0.40%. This was consistently higher than the hit rate in rural Victoria (0.10 to 0.15%), as shown in Figure 25. For both areas, the hit rate varied somewhat over this period with no clear upward or downward trend. The hit rate for PBT (3 to 4%) is much higher than for RBT but, as with RBT, there is no obvious trend (Figure 26).

FIGURE 25

RBT HIT RATE (POSITIVE BAC) IN THE METROPOLITAN AREA AND REST OF STATE, JULY 1989 - JUNE 1991
3.3 RBT in Police Districts

3.3.1 Hours spent RBT testing and numbers of tests conducted

Figures 27 and 28 shows the number of hours of testing and number of RBT tests conducted within each police district over the two year period.
FIGURE 27
TOTAL RBT HOURS OF TESTING BY POLICE DISTRICT, JULY 1989 TO JUNE 1991

FIGURE 28
TOTAL RBT TESTS BY POLICE DISTRICT, JULY 1989 TO JUNE 1991
Districts in the metropolitan area spent similar amounts of time RBT testing and conducted similar numbers of tests per hour (Figure 29). In districts A, B and C there were more tests conducted each hour, in comparison to other districts. This could be explained by the higher traffic volumes in these districts which are located in and around the inner metropolitan area. Districts D, E and F recorded the lowest number of tests per hour.

**FIGURE 29**

**AVERAGE RBT TESTS PER HOUR BY POLICE DISTRICT,**
**JULY 1989 TO JUNE 1991**

In the different rural Police Districts, there was marked variation in the number of hours spent testing and the number of tests conducted. When broken down into the different divisions, it can be seen that the majority of RBT in some rural districts were concentrated mainly in one of the divisions (generally the one closer to Melbourne). This is most evident in districts M and O, the two districts northwest of the metropolitan area.

3.3.2 **Introduction of bus-based operations**

Bus operations were introduced and used consistently across all metropolitan Police Districts from late 1989.
In contrast, the introduction of buses occurred at varying times across the rural Police Districts, with some introducing buses early in 1990 while other districts first began to use them in late 1990/early 1991.

3.4 Different RBT methods operating in Victoria

Different types of RBT methods operated across the various Police Districts in the State from late 1989 to late 1990, particularly with regard to the different mix of car and bus-based operations. Districts with similar characteristics in terms of use of car and bus-based RBT were grouped together into three regions (Appendix A shows these three areas on a map of Victoria). These three regions were:

1. Melbourne Metropolitan Region

In the Melbourne metropolitan region (Police Districts A to J), the shift from car to bus-based RBT commenced in September 1989 and continued through 1990. In this period RBT operations changed from almost completely car-based to almost completely bus-based.

The total number of RBT tests consequently increased dramatically over time. Hours of RBT activity also gradually increased to a small extent as did session duration, whilst the number of sessions remained constant.

2. Inner Rural Region (Rural 1)

In the region identified as Rural 1 (Police Districts K, M1, O1, P2 & Q), bus-based RBT was introduced late in 1989. It was used (at a relatively low level) throughout 1990, with use increasing into 1991. Car-based RBT also continued over this time, but its use decreased gradually. Overall, the total number of RBT tests remained relatively constant until late 1990 (in September, November and December 1989 activity was more intensive).

The number of hours spent testing decreased compared to 1989, but remained constant throughout most of 1990. Therefore this area represents a mix of the old car-based RBT method and some exposure to the new bus-based method.

3. Outer Rural Region (Rural 2)

The remaining rural areas were identified as Rural 2 (Police Districts L, M2, N, O2 & P1), use of bus-based RBT was very
low, both in terms of number of hours of testing and number of tests conducted, until late in 1990 and early 1991.

In 1990, bus activity in the Rural 1 area was 4.6 times greater in terms of tests and 3.4 times greater in terms of hours of testing than in Rural 2 (see Table 1), indicating substantial differences in the operation of buses in the two areas. Car-based RBT gradually decreased over this time both in the number of RBT tests conducted and hours spent testing. In terms of total use of RBT, the number of tests and hours remained quite stable over time, apart from a small decrease in both tests and hours in the latter half of 1990. This area therefore represents more or less the status quo in terms of RBT method over time.

It should be noted that these three regions were distinguished in relation to the level of change from car to bus-based RBT operations that occurred within each of them, rather than just the global changes in the total number of RBT tests which occurred in each region. This is because bus operations are more visible than those using cars, and so the deterrent effects from each method may not necessarily be comparable; it may not, therefore, be appropriate to use total RBT tests (simply adding the number of car and bus-based tests conducted together) to determine whether there has been a change in the quality of RBT operations.

Table 1 shows the number of hours and number of tests conducted at each of the three different regions through car and bus-based RBT activity for six monthly intervals from June 1989 to July 1991.
Table 1

Car and bus-based RBT activity for different RBT methods operating in Victoria

<table>
<thead>
<tr>
<th>TIME PERIOD</th>
<th>METRO RBT METHOD</th>
<th>RURAL 1 RBT METHOD</th>
<th>RURAL 2 RBT METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HOURS</td>
<td>TESTS</td>
<td>HOURS</td>
</tr>
<tr>
<td></td>
<td>Cars  Buses  Total</td>
<td>Cars  Buses  Total</td>
<td>Cars  Buses  Total</td>
</tr>
<tr>
<td>June-Dec 1989</td>
<td>990  663  1,653</td>
<td>77,483  108,361 185,844</td>
<td>2,708  79  2,787</td>
</tr>
<tr>
<td>Jan-June 1990</td>
<td>451  1,491  1,942</td>
<td>27,144  228,581 255,725</td>
<td>1,779  155  1,934</td>
</tr>
<tr>
<td>July-Dec 1990</td>
<td>186  2,317  2,503</td>
<td>11,941  368,905 380,846</td>
<td>1,474  413  1,887</td>
</tr>
<tr>
<td>Jan-June 1991</td>
<td>96  2,791  2,887</td>
<td>4,701  409,226 413,927</td>
<td>1,500  565  2,065</td>
</tr>
</tbody>
</table>
For each of these three areas, Figures 30 and 31 show the monthly number of hours and tests conducted through bus-based RBT, Figures 32 and 33 show the monthly number of hours and tests conducted through car-based operations, and Figures 34 and 35 show the monthly number of all RBT hours and tests conducted.

**FIGURE 30**


**FIGURE 31**

FIGURE 32

COMPARISON OF MONTHLY HOURS OF CAR-BASED TESTING
FOR EACH RBT METHOD, JULY 1989 - JUNE 1991

FIGURE 33

COMPARISON OF THE MONTHLY NUMBER OF PERSONS TESTED
FROM CARS FOR EACH RBT METHOD, JULY 1989 - JUNE 1991
FIGURE 34
TOTAL MONTHLY HOURS OF RBT TESTING FOR EACH RBT METHOD, JULY 1989 - JUNE 1991

FIGURE 35
TOTAL MONTHLY NUMBER OF RBT TESTS FOR EACH RBT METHOD, JULY 1989 - JUNE 1991
3.5 Summary of the RBT Initiative

In summary, the RBT initiative:

- Built on a history of mainly car-based RBT, related drink driving publicity, and other anti-drink driving countermeasures which have been introduced since the late 1970's.

- More than doubled the number of drivers tested per unit time from the passing traffic stream, thus changing the relative mix of non-tested vs tested motorists in the passing traffic stream. Actually taking a test and/or an awareness that there is a greater chance of being tested when passing a bus-based station, may have an enhanced deterrence value over only seeing the operation and/or perceiving that there is a lower probability of being tested when passing. However, it is not known to what extent drivers are aware of this change, nor what the relative deterrent value is of actually being tested as opposed to seeing the operation.

- Increased the number of drivers exposed to RBT to the maximum potential that can be achieved from:
  
  - increased visibility (for the same number of sessions), and
  - the gradual, but relatively smaller increments in the length of sessions conducted.

- Changed the quality of exposure to RBT by the clearly identifiable and highly visible "Booze Bus" designed solely for that purpose.

- Used an intensive publicity campaign to raise community awareness of drink driving, crash consequences and, to a lesser extent, the introduction and operation of "Booze Buses".

Changes in RBT began in metropolitan Melbourne in late 1989, with a large-scale shift to bus-based RBT operations from the traditional car-based method (buses had been used at a relatively low level over previous years). Existing buses (4 operational Toyota Coaster converted buses) were used initially, being gradually replaced with a fleet of 13 new purpose-built and highly visible "Booze Buses" between April and November 1990. There was a much smaller and delayed use of bus-based RBT in rural Victoria, although rural areas (generally) closer to Melbourne received bus-based testing earlier and more frequently than rural areas farther from Melbourne. This is not surprising given that the initiative and new buses were first obvious in Melbourne, and the deployment of RBT operations was centrally controlled for metropolitan police districts.
Three different types or methods of RBT operated in Victoria from late 1989 to late 1990:

**Metropolitan RBT:**

The shift from car to bus-based RBT commenced in September 1989 and by 1990, RBT operations were conducted primarily through bus stations. This change was associated with a large increase in the number of persons tested and gradual increases in hours spent testing over time.

**Rural 1 RBT:**

In these areas of rural Victoria, bus-based RBT was introduced late in 1989 and used at a relatively low level throughout 1990. The use of car-based RBT continued during this period, decreasing gradually.

**Rural 2 RBT:**

In the remaining rural areas, use of bus-based RBT was not obvious until late 1990 and early 1991. This area was least changed by the new RBT method for the period to late 1990.

4.0 **EFFECTS OF THE RBT INITIATIVE - DESCRIPTIVE ANALYSIS**

Various types of data were considered and selected for descriptive analysis:

- evidential breath analysis data for drivers from non-crash RBT and PBT operations
- evidential breath analysis data for drivers involved in non-fatal crashes
- BAC data for drivers and motorcyclists killed
- fatal crashes and serious casualty crashes (defined as those casualty crashes in which there was at least one person killed, or seriously injured or admitted to hospital) in 'high alcohol times' (times when alcohol is a factor in a significant proportion of crashes) and 'low alcohol times' (these are defined in section 5.2.1).

Statistical analysis of crash data in a quasi-experimental research design was used to examine the effect of the initiative on crashes. This is detailed in Section 5.0.
4.1 Evidential Breath Analysis Data

4.1.1 Evidential tests from non-crash RBT/PBT\(^1\) operations

In the period from January 1989 to June 1991, there were 37,342 evidential tests from non-crash RBT and PBT operations. In 4% of cases, the test resulted in no offence being recorded. Of the offences:

- 76% were exceeding 0.05% offences,
- 21% were exceeding 0.0% offences, and
- 2% were offences for refusing a breath test.

The number of offences in each category remained relatively constant over time (refer Figure 36). A higher number of tests were conducted in the metropolitan area than in rural Victoria. The proportion of offences are similar in both areas, although there was a slightly higher proportion of exceeding 0.0% offences in the metropolitan area.

![Figure 36](image-url)

**FIGURE 36**

NON-CRASH EVIDENTIAL TEST OFFENCES
BY OFFENCE TYPE AND MONTH,
JULY 1989 - JUNE 1991

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\(^1\) Evidential tests resulting from PBT and RBT operations could not be analysed separately.
For drivers charged with exceeding 0.05%:

- the mean BAC was 0.125%, with little change in BAC readings (Figure 39);

- 89% were male and most aged between 21 and 39 years. There was a slight increase in the proportion of females over time (from 10 to 12%), and no change in the age distribution;

- 38% were drinking at a hotel, 12% at a friend's place and 12% at home. There were no significant changes in the type of drinking location since 1989.
For drivers charged with exceeding 0.0%:

- the mean BAC was 0.115%, with little change in the BAC distribution over time (refer Figure 37);
- 94% were male and less than 30 years of age;
- fewer younger drivers (under 21 years) and a higher proportion of older drivers (30 years and older) were charged with this offence over time (refer Figure 38);
- 33% were drinking at a hotel, 17% at a friend's home, and 15% at home. In 1991, drinking at multiple locations was slightly less common, whilst drinking at home was slightly more common.

FIGURE 37

PROPORTION OF NON-CRASH EVIDENTIAL TEST EXCEED 0.00% OFFENCES BY BAC LEVEL AND PERIOD, MID 1989 TO MID 1991
In summary, there appears to be little change in the number of people charged with exceeding 0.0% and the only change in the characteristics of the offenders is a small decrease in the proportion of younger drivers and an increase in the proportion of drivers aged 30 years and older. There appears to be little change either in the number of people charged with the exceeding 0.05% offence, or in the characteristics of these offenders between 1989 and mid-1991.

4.1.2 Evidential tests for drivers involved in non-fatal crashes

Between January 1989 and June 1991, there were 6,566 evidential tests for drivers involved in non-fatal crashes. In 4% of cases, there was no offence. Of the remainder:

- 72% were exceeding 0.05% offences,
- 25% were exceeding 0.0%, and
- 2% were refusals to take the test.

---

2 No information concerning how the sample was obtained, or the severity of the crashes is provided. The number of recorded offences decreased from 3,015 in 1989 to 2,527 in 1990 and 1,024 in the first 6 months of 1991.
There was a slight increase in exceeding 0.0% and a slight decrease in exceeding 0.05% offences (see Figure 40). The vast majority of exceeding 0.0% and 0.05% offences occurred between 9 p.m. and 4 a.m..

**FIGURE 40**

**PROPORTION OF NON-FATAL CRASH EVIDENTIAL TEST OFFENCES BY OFFENCE TYPE AND PERIOD, MID 1989 TO MID 1991**

For drivers charged with exceeding 0.0%:

- the mean BAC of these drivers was 0.125%, with a slight increase in the proportion of drivers in the 0.10-0.15% range over this time period (refer Figure 41);

- the proportions of males (91%) and females (9%) has not changed over time;

- the majority were under 29 years of age. The proportion of drivers under 21 has decreased from 1990 to 1991, while all the other age groups increased (refer Figure 42). Younger drivers tended to have lower BACs than the older drivers;

- 32% were drinking at hotels, 15% at home and 15% at a friend's home. From 1990 to 1991, there was a drop in drinking at hotels and increases in drinking at home and other locations (mainly sporting locations) (refer Figure 43).
FIGURE 41
PROPORTION OF NON-FATAL CRASH EVIDENTIAL TEST
EXCEED 0.00% OFFENCES BY BAC LEVEL AND
PERIOD, MID 1989 TO MID 1991

FIGURE 42
PROPORTION OF NON-FATAL CRASH EVIDENTIAL TEST
EXCEED 0.00% OFFENCES BY AGE GROUP AND
PERIOD, MID 1989 TO MID 1991
For drivers charged with exceeding 0.05%:

- the mean BAC of these drivers was 0.145%. From 1990 to 1991 there was a slight increase in the proportion of lower BACs (refer Figure 44);

- 89% were males, although the proportion of females tested increased from 10% in 1989 to 12% in the last six months of 1991;

- the majority were between 21-29 years of age, although this age group's proportion decreased over the time period. The proportions of under 21 and over 40 year olds slightly increased over the same period. Older drivers (over 30 year olds) tended to have higher BACs than younger drivers;

- hotels (35%) were the most common drinking location followed by at home or a friend's home (both 13%). There was a small drop in the proportion drinking at hotels and increases in the proportions drinking either at home or at a friend's home over the time period (refer Figure 45).
FIGURE 44

PROPORTION OF NON-FATAL CRASH EVIDENTIAL TEST EXCEED 0.05% OFFENCES BY BAC LEVEL AND PERIOD, MID 1989 TO MID 1991

FIGURE 45

PROPORTION OF NON-FATAL CRASH EVIDENTIAL TEST EXCEED 0.05% OFFENCES BY DRINKING LOCATION AND PERIOD, MID 1989 TO MID 1991
In summary, there is little evidence of any substantial changes in the characteristics of the drivers who were charged with exceeding 0.00% or exceeding 0.05% offences after being involved in a crash over the two and a half year period, apart from the reduction in the proportion of younger drivers charged with the exceeding 0.0% offence. There is some suggestion that there was a decrease in the proportion drinking at hotels and an increase in the proportion drinking at home.

4.2 BAC Data for Driver/Rider Fatalities 1986-1990

4.2.1 Distribution of BAC levels

As shown in Figure 46, the overall decrease in the total number of drivers/riders killed in 1990 was evident across all BAC levels; that is, for both drivers who were sober and those with positive readings.

FIGURE 46

NUMBER OF DRIVERS/RIDERS KILLED BY BAC LEVEL AND YEAR, VICTORIA, 1986 - 1990

The proportion of drivers/riders killed across different BAC levels is shown in Figure 47. The proportion of drivers and motorcyclists killed with a BAC under 0.01% (ie. sober drivers) increased slightly in 1989 and 1990. The proportion of drivers/riders killed with higher BACs (above 0.15%) remained constant.
In contrast, the proportion of drivers/riders with BACs between 0.011-0.05% and 0.05-0.15% has been decreasing slightly each year since 1989. The higher proportion of unknown BACs in 1988, makes it difficult to determine whether there was also a decrease in 1988 compared to 1987 for those with BACs between 0.05-0.15%.

4.2.2 BAC level by sex and age

Females comprise less than one quarter of the total number of drivers/riders killed. The BAC distribution for females showed no obvious trends. The proportion of male drivers/riders killed with BACs between 0.011-0.05% and 0.05-0.15% decreased since 1989 (refer Figure 48) reflecting the overall trend. The trend for those with BACs above 0.15% is again reflected in these data. The majority of drivers/riders with BACs between 0.15-0.25% are in the age range 21 to 49.
4.2.3 **BAC level by time of day**

In low alcohol hours of week, approximately 70 to 80% of drivers/riders killed had a BAC below 0.01%. In 1989 and 1990, the proportion of drivers/riders killed in high alcohol hours (ie. when alcohol-involvement in crashes is highest) with BACs below 0.01% increased (refer Figure 49). In 1986 and 1987, this proportion was only 37%, whilst in 1990 46% of drivers/riders killed in high alcohol hours had a BAC level below 0.01%. This increased proportion of "sober" drivers/riders killed is evident in both the metropolitan and rural areas of the State.
The decreasing trend in the proportion of driver/riders killed with BACs between 0.05-0.15% is again reflected here (although not for the 0.011-0.05% group), with the proportion of drivers/riders killed, in high alcohol hours, having a BAC in the range 0.05 to 0.15% having decreased in 1989 and again in 1990 (Figure 49). Again, no change occurred in the proportion of drivers/riders killed with BACs over 0.15%.

4.2.4 Polarisation of BAC levels of drivers/riders killed

For the purposes of this analysis, "drink drivers" refers to those drivers/riders with a BAC level over 0.01%. There is an indication that the BAC distribution of drivers and riders killed is becoming more polarised; that is, drivers/riders killed with higher BACs (greater than 0.15%) account for a much greater proportion of "drink drivers" in 1990 than in previous years, whilst the proportion of "drink drivers" with lower BACs has decreased. In 1989, 66% of drivers with a positive BAC (i.e. greater than 0.01%) exceeded 0.15%; the same proportion for 1990 increased to 76%.

The polarisation of the fatal BAC distribution was more marked in the rest of the State (61% in 1989; 85% in 1990) than in the metropolitan area (50% in 1988; 71% in 1989; 68% in 1990, see Figure 50).
4.2.5 Summary of BAC data for drivers/riders killed

There was a decrease in the proportion of drivers/riders killed with BACs between 0.011-0.15% overall and those with BACs between 0.05-0.15% in high alcohol hours in 1989 and in 1990, whilst the proportion of sober drivers/riders killed correspondingly increased. The proportion of drivers/riders killed with BACs above 0.15% remained unchanged over time. As a result, those killed with higher BACs (greater than 0.15%) made up a greater proportion of "drink drivers", whilst those with lower BACs constituted a smaller proportion of "drink drivers". Drivers with higher BACs constitute around two-thirds of the "drink drivers" killed.

4.3 Serious Casualty and Fatal Crash Data

4.3.1 12 monthly moving totals

Moving totals were used to compare the trends in serious casualty and fatal crashes in high and low alcohol hours. This was done to provide an indication of general changes in crashes over the time period under investigation.

Serious casualty crashes:

The 12 monthly moving totals of serious casualty crashes since December 1983 show that the number of these crashes is similar in both high and low alcohol
hours (refer Figure 51). The moving totals of serious casualty crashes began increasing some time in 1986 and continued increasing throughout 1987. Throughout most of 1988 and early 1989, the totals had stabilized and they began to decrease steadily from mid-1989.

FIGURE 51

SERIOUS CASUALTY CRASHES IN HIGH AND LOW ALCOHOL HOURS OF WEEK (12 MONTHS MOVING TOTALS), VICTORIA, DECEMBER 1983 TO DECEMBER 1990

Fatal crashes:

The 12 month moving totals of fatal crashes show that a higher number of fatal crashes occur in high alcohol hours than in low alcohol hours. Throughout 1990, the gap between the number of fatal crashes in high and low alcohol hours was reduced (refer Figure 52). Fatal crashes in both high and low alcohol hours only slightly increased up to the end of 1989. Since December 1989, there were dramatic reductions in the number of fatal crashes in both high and low alcohol hours. This reduction is more pronounced in high alcohol hours.
4.3.2 Cumulative Sum (CUSUM) charts

Daily fatal and serious casualty crashes in high alcohol hours are set out in cumulative sum (CUSUM) graphs for the 3 methods of RBT operation identified in the operational analysis.

A CUSUM is a series of numbers which represent the sum of the differences between an observed series and the corresponding expected series (Woodward & Goldsmith, 1964). The expected counts for the current evaluation is the mean of the entire series. The CUSUM charts presented here plot the sum of differences between the daily number of serious casualty crashes and the mean daily number of serious casualty crashes between 1983 and mid 1991. It should be noted that the shape of the graph does not depend on the choice of the expected count (in this case, the mean daily number of serious casualty/fatal crashes). The value in using CUSUM graphs is that changes in the series are immediately obvious, and the exact point of the change can be identified.
Statewide high alcohol hour serious casualty crashes:

The CUSUM chart for high alcohol hour serious casualty crashes for the whole of the state (refer Figure 53) shows that the number of these crashes was consistently above the mean from 1987 to mid 1989. The CUSUMs stabilized between the middle and the end of 1989 and, in mid December 1989, the number of these crashes dropped below the mean and remained at that level.

FIGURE 53

DAILY CUSUM OF HIGH ALCOHOL HOUR SERIOUS CASUALTY CRASHES, VICTORIA, JANUARY 1983 - JUNE 1991
High alcohol hour serious casualty crashes for Metro RBT Method:

High alcohol hour serious casualty crashes in the metropolitan area increased relative to the mean from early 1987 and changed direction in September 1989 (refer Figure 54). From mid-December 1989, the CUSUMs decreased, meaning that the daily numbers of these serious casualty crashes were consistently below the mean. From 1987 to 1989, the CUSUMs increased by an average of 1.25 crashes per day in comparison to the drop of approximately 1.5 crashes per day throughout 1990 and 1991. The series, therefore, decreased at a quicker rate than it had previously increased.
High alcohol hour serious casualty crashes for Rural 1 RBT Method:

The CUSUMs for both rural RBT methods (refer Figures 55 & 56) display seasonality effects on the number of high alcohol hour serious casualty crashes. At locations in Rural 1, the CUSUMs begin to rise in September/October and drop throughout the Winter months each year. In late 1987, instead of beginning to drop in the winter months, the CUSUMs continued to increase. Although the series increased from 1987 to 1989 the seasonality of the data is still evident. The CUSUMs reach a peak in mid-1989 and from December 1989 decreased dramatically.

FIGURE 55

DAILY CUSUM OF HIGH ALCOHOL HOUR SERIOUS CASUALTY CRASHES, RURAL 1 RBT METHOD, JANUARY 1983 - JUNE 1991
High alcohol hour serious casualty crashes for Rural 2 RBT Method:

The seasonality of the data is clearly evident throughout the time scale with the series peaking in late March/early April in 1988, 1989 and 1990. As with Rural 1, the CUSUMs increased in 1987 at the time they were due to begin decreasing. However, the increase was smaller than that which occurred for Rural 1 Method. The decreases in late 1990 and 1991 were much less dramatic than the decreases observed for Rural 1 and Melbourne.

FIGURE 56

DAILY CUSUM OF HIGH ALCOHOL HOUR SERIOUS CASUALTY CRASHES, RURAL 2 RBT METHOD, JANUARY 1983 - JUNE 1991
Statewide high alcohol hour fatal crashes:

The CUSUM graph for high alcohol hour fatal crashes (refer Figure 57) shows that the number of fatal crashes was consistently above the mean for most of the period from mid 1987 to mid 1989. The CUSUMs stabilized in the second half of 1989 and then dropped dramatically from the 22nd of December 1989.

FIGURE 57

DAILY CUSUM OF HIGH ALCOHOL HOUR FATAL CRASHES, VICTORIA, JANUARY 1983 - JUNE 1991
High alcohol hour fatal crashes for Metro RBT Method - The CUSUMs for the Metro Method (Figure 58) began to increase in early 1986 and from then generally continued to increase until the end of 1989. From the 22nd December 1989, the CUSUMs dropped at a much quicker rate than at which they rose.

FIGURE 58
DAILY CUSUM OF HIGH ALCOHOL HOUR FATAL CRASHES
METROPOLITAN RBT METHOD,
JANUARY 1983 - JUNE 1991
High alcohol hour fatal crashes for Rural 1 RBT Method:

In the Rural 1 region, the CUSUM (refer Figure 59) exhibited a strong seasonal characteristic. There appeared to be an increase over the period from 1983 to 1989 and a departure from the seasonality in 1990/1991 when the CUSUM dropped quite dramatically.

**FIGURE 59**

**DAILY CUSUM OF HIGH ALCOHOL HOUR FATAL CRASHES, RURAL 1 RBT METHOD, JANUARY 1983 - JUNE 1991**
High alcohol hour fatal crashes for Rural 2 RBT Method:

In Rural 2, there was once again a distinct seasonal pattern in the CUSUM graph (refer Figure 60). In 1987, the pattern was broken and there was an increase in the second part of the year. In 1990, the CUSUM dropped back to be roughly in line with pre-1987 levels.

FIGURE 60

DAILY CUSUM OF HIGH ALCOHOL HOUR FATAL CRASHES, RURAL 2 RBT METHOD, JANUARY 1983 - JUNE 1991
Summary of CUSUM charts:

CUSUM charts were used to determine the point at which a significant change in the number of crashes in high alcohol hours took place. Upon examining the CUSUM charts, it appears that the main points of change occurred in mid 1989 (where the increase in CUSUMs stabilized) and late December 1989 (where the CUSUMs began to drop). However, this change occurred later for high alcohol hour serious casualty crashes in Rural Method 2 and for fatal high alcohol hour crashes in both Rural 1 and Rural 2 regions. There is also some suggestion that the decreases were more pronounced for Melbourne and Rural 1 than for Rural 2.

4.4 Summary of Descriptive Analysis

Evidential Tests:

Non-crash RBT/PBT evidential breath analysis data showed little change in the number of people charged with exceeding 0.0% or 0.05% offences over the period from January 1989 to June 1991. The only change in the characteristics of the offenders over this period was a small decrease in the proportion of younger drivers (<21 years) and increase in the proportion of drivers aged 30 years and older charged with an exceed 0.0% offence.

Evidential tests for drivers involved in non-fatal crashes showed little evidence of any substantial changes in the characteristics of the drivers charged with exceeding 0.0% or exceeding 0.05% offences, over the two and a half year period, apart from the reduction in the proportion of younger drivers among the exceed 0.0% offences. There was some suggestion that drinking at hotels had decreased whilst drinking at home had increased.

Fatal BAC Readings:

The proportion of drivers/riders killed with BACs between 0.011-0.15% overall and those between 0.05-0.15% in high alcohol hours decreased in 1989 and 1990, whilst the proportion of sober drivers/riders killed correspondingly increased. As a result, those killed with higher BACs (greater than 0.15%) make up a greater proportion of the "drink drivers". This group also remained relatively stable as a proportion of all drivers/riders killed and makes up around two-thirds of the "drink drivers" killed.

Crash Data - Moving Totals:

The 12 monthly moving totals of serious casualty crashes in high and low alcohol hours showed that crashes began increasing some time in 1986 and continued increasing throughout 1987. Throughout most of 1988 and early 1989, the totals stabilized and then began to decrease steadily from mid-1989. The 12 month moving totals of fatal crashes in high and low alcohol hours only slightly increased up to the end of 1989 and, since December 1989, there were
dramatic reductions in the number of fatal crashes in both high and low alcohol hours. This reduction is more pronounced in high alcohol hours.

**Crash Data - CUSUMs:**

CUSUM charts were used to determine the precise point at which there was a significant change in the number of crashes in high alcohol hours. The main points of change occurred in mid 1989 (when the increase in CUSUMs stabilized) and late December 1989 (when the CUSUMs began to drop). However, this change occurred later for serious casualty crashes in the Rural 2 region and for fatal high alcohol hour crashes in both Rural regions. There was also some suggestion that the decreases were more pronounced in Melbourne and Rural 1 than in Rural 2.

The results of descriptive analyses provide a very useful starting point for the formal evaluative analysis phase using inferential statistical techniques. As such, descriptive analysis assists with, but does not represent, an evaluation of the RBT initiative.

### 5.0 STATISTICAL ANALYSIS & EVALUATION

#### 5.1 Previous Evaluations

Some level of regular RBT has been carried out since its introduction, with increased levels of operation being associated with particular periods or campaigns. The methods and results of previous evaluations of these campaigns are outlined below to provide relevant background information.

#### 5.1.1 1978 Campaign

In October and November 1978, a campaign was conducted which involved intensified RBT, in turn, at four selected regions of Melbourne, on every Thursday, Friday and Saturday night for seven weeks. An average of 100 hours of RBT was conducted per week. Extensive Melbourne-wide publicity also supported the campaign.

The campaign was evaluated by Cameron *et al.* (1980) in terms of night-time fatalities, serious casualty and alcohol-involved crashes during and shortly after the periods of increased activity, comparing the number of crashes with those in control periods in previous months and in previous years.

The campaign was also evaluated by comparing night-time serious casualty crashes with daytime crashes for the whole of Melbourne during the treatment period. This was done because daytime serious casualty crashes are less likely to involve alcohol and therefore their change provides a control for the reductions in night-time serious casualty crashes (Cameron *et al.*, 1980).

Night-time serious casualty crashes were used because it is known that most alcohol related crashes occur at night (Johnston, 1981) and that alcohol
involvement in crashes is higher at night than during the day (Cameron & Strang, 1982; Sloane & South, 1985). In addition, there were difficulties in directly measuring the effect of intensified RBT on alcohol-involved crashes because of deficiencies in the matching of BAC readings with the police reports of casualty crashes (for example, not all drivers involved in casualty crashes were tested).

The evaluation found a 25% net reduction in night-time serious casualty crashes during the campaign whilst daytime serious casualty crashes were reduced by 5%, and a large, significant reduction in fatalities in the areas treated (Cameron et al., 1980).

5.1.2 1979 Campaigns

Two further periods of increased RBT operations occurred in March/April and September-December 1979. The results of these campaigns were combined with the results from the 1978 campaign and reanalysed. The combined results indicated that the campaigns reduced the risk of night-time serious casualty crashes by 24% and the effect of RBT was maintained for at least two weeks after the operations ceased (Cameron & Strang, 1982). There was a similar trend for fatal crashes, however insufficient numbers meant that a meaningful statistical test could not be applied to these data. It should be noted that the 1978 and 1979 campaigns involved localised and short-term duration of RBT operations in Melbourne.

Similar methods of analysis and methodology were used in this evaluation, with the primary outcome measure being the change (compared to the same period in previous years) in night-time serious casualty crashes corrected for the change in daytime serious casualty crashes. The use of daytime crashes as a control for other factors operating at the time (which could influence crash occurrence quite independently from RBT operation) had also been used in many other overseas evaluations of drink driving countermeasures in the 1970's (Ross, 1973; Chambers, Roberts & Voelker, 1976; NHTSA, 1979).

5.1.3 1983 Campaign

An RBT campaign was also conducted in October to December 1983, which compared the effects of using RBT at times when it was seen by the highest number of drivers with use at times when more drivers would be expected to be alcohol affected. That is, it compared the effects on crashes of increasing public perception of the likelihood of detection with the effects when the probability is actually increased. The previous campaigns had concentrated on Thursday, Friday and Saturday nights when drink driving was most frequent; that is, only at times with the highest probability of detection of alcohol affected drivers.

The evaluation found that both testing strategies had some potential for reducing crashes (Armour et al., 1985). During the campaign period, night-time serious casualty crashes in Melbourne were 18% below their expected value
and 23% below their expected value on Thursday, Friday and Saturday nights (Armour et al, 1985). Again, the change in night-time serious casualty crashes compared to the change in these crashes in the daytime during the campaign was taken as a measure of the effect of the campaign. Changes in crashes were determined by comparing the number of crashes in the campaign period with those for the same periods in the two previous years, 1981 and 1982.

5.2 Evaluation Design for 1989/1990 RBT Initiative: Analysis of Effects and Controlling for Other Factors

5.2.1 Evaluation criteria

As in previous evaluations, it was expected that the RBT initiative would affect alcohol-related crashes. Serious casualty crashes during 'high alcohol hours' were used as a surrogate for alcohol related crashes; this approach serves three purposes:

(1) In high alcohol hours, a driver admitted to hospital or killed as a result of a crash is 9.5 times more likely to have a BAC over 0.05 g/100ml than a driver admitted or killed as a result of a crash in low alcohol hours (the complement of high alcohol hours). Only 4% of driver serious casualties in low alcohol hours have illegal BACs whilst in high alcohol hours, 38% are over 0.05% (Harrison, 1990). This provides a strong separation between time periods which are most likely and least likely to be drink driving times and, consequently, involve alcohol related crashes;

(2) As most RBT operations have been undertaken in high alcohol hours (or just before them), it is possible that RBT also affects non-alcohol related crashes which occur in high alcohol hours (Homel, 1981; Cameron & Strang, 1982), and thus crashes occurring in high alcohol times provide an appropriate target measure.

(3) Larger sample sizes are available for statistical analysis.

High alcohol hours are defined as:

- Monday - Thursday 6pm to 6am
- Friday 4pm to Saturday 8am
- Saturday 2pm to Sunday 10am
- Sunday 4pm to Monday 6am

These hours were determined by Harrison (1990) in a refinement of South's original definition (in Haque & Cameron, 1987).

5.2.2 Controlling for the Effect of Other Factors on Crashes

In order to provide an estimate of the change associated solely with the treatment, the change in the number of crashes needs to be "corrected" for
changes in a 'control' group to account for the effects of other influences at the same time. There were several reasons why valid resolution of issues on the type and methods of control was essential for the conduct of this evaluation. Briefly, these were:

(1) The initiative was not implemented according to a pre-determined experimental design

(2) A major Speed Camera Program was launched in April 1990, which involved intensive publicity and significant increases in the number of speed offences from July 1990 onwards, as can be seen in the graph presented in Appendix B. Speed cameras have been used mostly in daytime hours and throughout the Melbourne metropolitan area (refer Appendix B). This means that daytime serious casualty crashes cannot be used as a 'control' or comparison group for night-time serious casualty crashes as has been done in previous evaluations of RBT.

(3) The Victorian economy has been in a state of recession, and it is not known to what extent this has affected the number of people drinking in licensed premises (South, 1991), and the amount or type of vehicle travel, and therefore the extent to which it has altered crash risk, if at all, particularly in high alcohol hours. 'Controlling' for these possible changes by using a suitable 'control' group or area is essential if the RBT initiative is to be assessed separately from other factors which are present at the same time.

(4) Intensive publicity accompanying the change in RBT operations was exposed Statewide and therefore over all areas regardless of whether or not RBT operations changed. A high level of recall was associated with the publicity. Publicity focused primarily on changing public attitudes to drink driving and to a lesser extent increasing public perceptions of the chance of being caught and the associated penalties. The effect of publicity cannot be partialled out from the effect of RBT operations only, that is, the initiative as a whole can only be evaluated.

An additional concern is whether or not speed cameras might reduce the occurrence of night-time crashes and therefore whether the frequency of such crashes provide a good measure of the effects of RBT activity only. Given that there is no evidence for this possible generalised effect of speed cameras it could be assumed that their effect would be largely restricted to daytime hours. However, if there were speed camera effects in high alcohol hours, the use of intra-State comparison groups should provide a "control" for these effects. This is particularly important because there is some overlap in high alcohol hours on weekends and possible time of speed camera operation (ie. Friday, Saturday and Sunday afternoons and evenings).
5.2.3 Quasi-experimental analysis

The essence of designing an evaluation is to increase the likelihood that measured effects are validly derived and can be attributed to the "treatment", rather than the effect of any other factors. The issue of control (experimental, quasi-experimental and statistical) is central to the achievement of this objective. This evaluation relied solely on quasi-experimental control for the following reasons:

- full experimental control was not available
- it was considered more appropriate to rely on quasi-experimental control (a "passive" approach) than to actively influence analysis outcomes through the incorporation of statistical controls (measuring the effect of other factors directly) for which there is insufficient technical justification. The use of statistical control is considered acceptable in some circumstances, but will always be less desirable than experimental control. Ross (1982) has also argued that the quasi-experimental approach is the most appropriate in evaluating legal deterrence programs aimed at the drinking driver for similar reasons.

- a review of available evidence indicated that the use of statistical control(s), particularly of economic indicators, could not be justified in this evaluation as:
  
a. this evidence is correlational in nature
  
b. the actual shape of the unemployment-crash frequency relationship is unclear. The question as to whether any difference in unemployment rate differentially affects crash frequency or whether certain threshold differences need to be exceeded is yet to be resolved - that is, in terms of crash frequency, are unemployment rates of 10.8% and 11.3% significantly different? Does this difference need to be larger or can it be smaller?
  
c. the (indirect) mechanism by which unemployment rate is thought to influence crash frequency (through reduced high alcohol hour exposure) is speculative, and may mask a possible RBT mechanism
  
d. there is evidence (Hakim, Shefer, Hakkert & Hocherman, 1991) that changes in general measures of total vehicle travel and unemployment, do not reflect changes in more specific types of vehicle travel (ie. day vs. night time travel) amongst various driver groups (ie. young vs. older drivers). Only general measures (such as trends in total vehicle travel overall estimated from fuel sales, unemployment level) are available and such measures may not reflect specific travel patterns.
As revealed in the operational analysis, the use of bus-based RBT operations was consistent across all areas (police districts) in metropolitan Melbourne over time and used across all days of the week at significant levels. Therefore neither 'untreated' areas nor 'untreated' days of the week in Melbourne were available to provide some form of "control" group. In addition, day time or low alcohol hour crashes do not constitute a satisfactory control group for this period, for reasons previously discussed.

Variations in the change to bus-based RBT did occur in the rural areas of Victoria during 1990, with the Rural 1 area experiencing some change from cars to buses whilst the Rural 2 area experienced negligible bus use but continued use of car-based RBT in 1990. In terms of bus-based RBT operations, they provide a group with partial treatment and a group with almost no treatment.

However, rural areas are different in many respects to the metropolitan area, and to use them as "control" groups would assume that economic factors, RBT publicity, and any other factors have similar effects in the rural areas and the metropolitan area, particularly in relation to high alcohol times of the week. More importantly, such a comparison makes the assumption that the treatment would be expected to have similar (sized) proportional effects across rural and metropolitan areas. The potential for change and amenability to effects of the program may well differ across locational settings. The confounding of locational differences makes these groupings unsuitable as direct "control" groups (in its strict technical sense) for the metropolitan treatment.

The comparisons undertaken, therefore, were basically between Melbourne and Sydney, and between the two areas of rural Victoria (Rural 1 and Rural 2), providing a relative comparison in the rural area. The pattern of results across Melbourne, Rural 1 and Rural 2 was also used to aid interpretation of measured effects and attribution of these to the treatment.

Whilst interstate comparisons cannot provide perfect control since economic and other factors are not identical in both areas, and each State has conducted some type of drink driving countermeasure over previous years, this is the best way of controlling for threats to internal validity, because other methods involve more and less defensible assumptions to be made.

5.2.4 Interstate comparisons

Interstate comparisons were used to provide an indication of the net effects of the RBT initiative in Victoria. To complement Victorian data, NSW serious casualty and fatal crashes in high alcohol hours were modelled using time series analysis for the same time period and the percentage change between observed and expected crashes determined. It was decided that NSW provided the most similar state to Victoria in terms of urbanisation, economic activity, population and other characteristics than the other Australian states. Only comparisons of the Sydney metropolitan and Melbourne metropolitan areas were considered.
appropriate given that rural Victoria and NSW are quite different in terms of their areas and road environments, and that the Victorian rural area was split into two regions. Given the possibility that factors other than RBT were having differential effects in rural Victoria, it would not have been possible to partition NSW rural areas in a comparable fashion.

In making interstate comparisons, however, it was necessary to assume that the trends or changes in NSW crashes act as a "control" for global influences on crashes over time (for example, economic activity) and that these changes can be used to filter out any reductions due to possible other factors in Victoria. It should be noted that this analysis would only add explanatory power if the forecast figure was within chance variation of the actual figure. This would indicate that any economic influences were manifested as longer term trends (and were therefore controlled in the modelling) and that no effective, specific high alcohol hour countermeasures were applied during 1990.

On the other hand, if there were significant reductions in high alcohol hour serious casualty and fatal crashes in metropolitan Sydney (when comparing expected and observed numbers) it would be difficult to know whether they are attributable to road safety programs or to other influences such as changes in economic activity or travel, unless a detailed study were undertaken to examine these issues. Thus the certainty of having an adequate interstate comparison group is greatly eroded.

5.2.5 Measuring the change in crash frequency - time series analysis

To measure the change in crash frequency, the expected number of crashes that would have occurred in the absence of the RBT initiative (ie. maintenance of previous RBT program) need to be estimated for comparison with the number of crashes that actually occurred when RBT was operating. In order to do this accurately, the use of time series analysis or data modelling over a large number of years prior to the period of the RBT initiative was undertaken to provide forecasts.

It is well recognised that this provides a better estimation of expected crashes than simply using the number of crashes for the previous year or two (Ross, 1981; Cameron & Strang, 1982; Armour et al, 1985). This is particularly important if the number of crashes occurring in the preceding year are higher than the number reflected in the longer term trend because the effect attributable to the program may be inflated (or vice versa).

A period of 12 months after the introduction of the initiative was considered an appropriate post intervention period as it provided an indication of the longer term effects of the RBT initiative, which unlike previous campaigns, has been sustained for a significant period. Whilst a longer study period provides an indication of longer term effects, it also needs to remain as close as possible to the start date of the initiative so as to ensure that the effects observed are due to the program rather than a result of new or different factors, or that they not diluted by opposing influences.
In addition, beyond 1990 the different Rural 1 and Rural 2 RBT methods of operation no longer existed, given the steady increase in bus-based operations in these areas from late 1990 and 1991 onwards. Further, the accuracy of forecasting decreases as one attempts to forecast further ahead from the date from which the forecast is made (in this case the intervention date). A 12 month post intervention period provided the best balance between the need to assess 'real' longer term effects, sufficient data to permit reliable statistical data analysis and acceptable accuracy in forecasting.

5.2.6 Intervention date

The analysis of the operational RBT data provided no obvious single intervention date. Buses started to appear in September 1989 in the metropolitan area but did not appear in the rural areas until much later. The level of bus-based RBT in the metropolitan area was also quite variable in the period from September to December 1989. The publicity campaign was launched on the 12th December 1989 which provided another possible intervention date.

The date of mid December corresponds to the introduction of publicity and bus-based RBT reaching high levels in some areas. The week starting 16th December 1989, the closest week after the formal launch of the initiative, was chosen as the intervention date for the RBT initiative.

5.2.7 Hypotheses to be tested

After homogenous treatment groups (MM & R1) and comparison groups (metropolitan Sydney (MS) & R2, respectively) were identified, changes in each comparison group were used to account for the changes in crash frequency due to the influence of 'other factors' (for example, abrupt changes in road use) which coincided with the timing of the initiative, for the respective treatment groups. Sydney was used as a comparison group for Melbourne, to avoid locational confounding between urban and rural areas for which there may be different effects of the program.

The relative changes in serious casualty crashes and fatal crashes in high alcohol hours for Melbourne and Sydney, and for Rural 1 and Rural 2, were compared for 1990. The large difference in crash frequency in these areas means that differences between observed and expected crashes in terms of actual numbers are not comparable. Percentage changes in number of crashes were compared to determine relative differences.
The following hypotheses were tested using statistical analysis.

\[ H_0: \text{Melbourne \% change (observed - expected) = Sydney \% change (observed - expected)} \]

\[ H_1: \text{Melbourne \% change (observed - expected) greater than Sydney \% change (observed - expected)} \]

\[ H_0: \text{Rural 1 \% change (observed - expected) = Rural 2 \% change (observed - expected)} \]

\[ H_1: \text{Rural 1 \% change (observed - expected) greater than Rural 2 \% change (observed - expected)} \]

5.3 Data Analysis

5.3.1 Time series methodology - estimating expected numbers of crashes

Statistical analysis was undertaken comparing the relative changes in serious casualty and fatal crashes, during high alcohol hours, for each of the treatment and comparison areas. This involved predicting expected crash numbers for each area, using time series modelling of data between December 1982 and December 1989 (8 full seasonal cycles), and comparing predicted and actual crash frequencies to determine whether there had been changes. The changes at each area were then compared to provide an estimated net percent change at the treatment areas.

Both exponential and Auto Regressive Integrated Moving Average (ARIMA) forecasting models were developed for each area to provide the best prediction, on the basis of pre-intervention trends and also taking into account seasonal fluctuations and longer term trends in the series, of the incidence of crashes that would have occurred post-intervention. This was compared to the actual number of crashes in the post-intervention period to determine whether there have been changes in each group. Forecasting methods allow predictions up to 12 months ahead, and do not apply a pre-determined framework to the distribution of effects post-intervention. Weekly rather than monthly historical data were used because they provided a greater number of data points and thus a better estimate of the variance associated with crashes.

The forecasts obtained using the two family of time series models were virtually identical. However, the ARIMA models were adopted because they provided forecasts with smaller mean square errors and hence narrower prediction limits. The ARIMA models were based on 52 week moving totals for each series more appropriately giving forecasts and forecast variances for the 52 weeks of 1990, and eliminating seasonal effects. Thus, using ARIMA models made it easier to calculate prediction intervals of total target crashes during 1990. A Sensitivity Analysis (Appendix C) was also undertaken to ascertain the stability of the predictions by using alternative intervention dates from which to predict. Predictions were found to be stable regardless of the date used around the one selected as best representing the beginning of the initiative (16 December 1989 coinciding with the launch of the initiative and the changeover to buses in the Melbourne metropolitan area), thus providing further confidence regarding the results from the models adopted.
A summary of the final models fitted and the various statistics used to assess the models, as well as the results of each analysis, is presented in Appendix D.

5.4 Results

Each series and the predicted number of crashes and prediction intervals are illustrated in Figures 61 and 62. Results of the statistical analyses are shown in Tables 2 and 3.

Table 2

Estimated percentage changes (and 95% confidence intervals) in high alcohol hour serious casualty crashes and fatal crashes in Melbourne, Sydney, R1 and R2 areas

<table>
<thead>
<tr>
<th>Crash Series</th>
<th>1990 Actual (O)</th>
<th>1990 Predicted (E)</th>
<th>Percent Change (P)</th>
<th>95% Confidence Interval</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM serious</td>
<td>2128</td>
<td>2275</td>
<td>-6.5%</td>
<td>(-30%, 17%)</td>
<td>0.122</td>
</tr>
<tr>
<td>MM fatal</td>
<td>152</td>
<td>227</td>
<td>-33.0%*</td>
<td>(-49%, -17%)</td>
<td>0.081</td>
</tr>
<tr>
<td>SM serious</td>
<td>1555</td>
<td>1730</td>
<td>-10.1%</td>
<td>(-22%, 2%)</td>
<td>0.060</td>
</tr>
<tr>
<td>SM fatal</td>
<td>178</td>
<td>207</td>
<td>-14.0%</td>
<td>(-37%, 9%)</td>
<td>0.116</td>
</tr>
<tr>
<td>R1 serious</td>
<td>580</td>
<td>785</td>
<td>-26.1%*</td>
<td>(-38%, -15%)</td>
<td>0.059</td>
</tr>
<tr>
<td>R1 fatal</td>
<td>83</td>
<td>102</td>
<td>-18.6%</td>
<td>(-43%, 6%)</td>
<td>0.125</td>
</tr>
<tr>
<td>R2 serious</td>
<td>415</td>
<td>466</td>
<td>-10.9%</td>
<td>(-23%, 2%)</td>
<td>0.064</td>
</tr>
<tr>
<td>R2 fatal</td>
<td>51</td>
<td>65</td>
<td>-21.5%</td>
<td>(-55%, 12%)</td>
<td>0.173</td>
</tr>
</tbody>
</table>

*statistically significant at p<0.05 level, two-tailed

As can be seen from the standard error terms and 95% confidence interval for the post-intervention percentage changes for each series (Table 2 and Figure 61), the percentage change in Melbourne serious casualty crashes had much wider confidence intervals than that for Sydney (double) reflecting that the expected post-intervention trend for this series was much more difficult to predict. Inspection of the pre-intervention trend shows that this is because of the large variation in trend in the series, changing from a general upward trend in 1988, to a stable trend until mid 1989 when a decreasing trend begins. These changes, particularly in the immediate pre-intervention trend, meant that the model was unable to provide a narrower forecast interval.

Similarly, all models for fatal crashes had wider ranges for predictions, relative to serious casualty crashes, particularly for the Victorian rural areas and R2 (around 2 to 3 times that for serious casualty crashes). This is due in part to the greater variance in fatal crashes than serious casualty crashes.

The results in Table 2 indicate that in all areas and for both crash types there was a reduction in target crashes, but only for Melbourne fatal crashes and
Rural 1 serious casualty crashes were the reductions statistically significant (at the 5% level).

Table 3 shows that there was a statistically significant 19% net reduction in fatal crashes (in high alcohol hours) in Melbourne in 1990 (there is a 9% chance that this reduction is due to chance). There was a statistically significant 15% net reduction in serious casualty crashes (in high alcohol hours) in R1 in 1990 (there is a 4% chance that this reduction is due to chance).

Table 3

Estimated net percentage changes, reflecting RBT effect, for Melbourne and R1 high alcohol hour serious casualty and fatal crashes during 1990 & associated 90% confidence intervals and one-tailed level of statistical significance

<table>
<thead>
<tr>
<th>Crash Series</th>
<th>Percent Change</th>
<th>RBT Effect</th>
<th>Standard Error</th>
<th>90% Confidence Interval</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM serious</td>
<td>-6.5%</td>
<td>3.6%</td>
<td>13.6%</td>
<td>(-18.7, 25.9)</td>
<td>0.60</td>
</tr>
<tr>
<td>MM fatal</td>
<td>-33.0%</td>
<td>-19.0%*</td>
<td>14.1%</td>
<td>(-42.1, 4.1)</td>
<td>0.09</td>
</tr>
<tr>
<td>R1 serious</td>
<td>-26.1%</td>
<td>-15.2%**</td>
<td>8.7%</td>
<td>(-29.5, -0.9)</td>
<td>0.04</td>
</tr>
<tr>
<td>R1 fatal</td>
<td>-18.6%</td>
<td>-2.9%</td>
<td>21.3%</td>
<td>(-37.8, 32.0)</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**statistically significant at p<0.05 level, one-tailed; *statistically significant at p<0.1 level, one-tailed

Again, the large standard errors associated with the estimated percent changes for fatal crashes at both R1 and R2, and particularly the net change (RBT effect) for fatal crashes at R1 (21.3%) should be noted when interpreting these results. Only extremely large changes would be detectable (statistically), making it difficult to determine what the effects were of RBT on fatal crashes at R1.

The lack of statistical power may have been partially overcome if Rural 1 and Rural 2 fatal crashes were combined. However, this is not considered appropriate for two reasons;

(1) it contradicts the conceptual framework derived from the operational data on RBT and used to structure the crash data analysis; this saw an a priori distinction made between Rural 1 and Rural 2 areas,

(2) while it may be argued that the absolute level of bus-based testing is small in Rural areas (especially when compared to metropolitan levels), the relative (R1 to R2) difference indicates that consistent with a conservative evaluation approach, this distinction should be maintained.

The interpretation of these results is given in Section 6.0
Figure 61
Actual and predicted weekly frequencies and prediction intervals for Melbourne and Sydney high alcohol hour serious casualty crashes and fatal crashes.
Figure 62
Actual and predicted weekly frequencies and prediction intervals for Rural 1 and Rural 2 high alcohol hour serious casualty crashes and fatal crashes
6.0 INTERPRETATION & DISCUSSION OF RESULTS

6.1 Overview of Outcomes

When interpreting the results from the formal data analysis, it is important to emphasise the relative assessment of outcomes required by this evaluation design. This form of assessment has direct implications for interpretation of results.

Relative assessment provides a measure of control (which would otherwise not be available), but it is by no means a perfect solution. Thus, as will be found in this section, the pattern of outcomes has meant that attribution of cause to effect must be equivocal.

The incremental nature of the comparisons can be summarised in a number of ways (each requiring a (slightly) different view of RBT 'treatment' and the initiative) as follows:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Proportion of RBT in buses</th>
<th>Hours of bus RBT</th>
<th>Bus-based tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro</td>
<td>Most</td>
<td>Very high</td>
<td>High</td>
</tr>
<tr>
<td>Rural 1</td>
<td>Some</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Rural 2</td>
<td>Almost none</td>
<td>Very Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

The above classification already involves some assumptions, even though, at one level, it receives support from data presented in Table 1. Nevertheless, the differences in baseline levels, probable differences in generating additional general deterrence, the RBT 'history' on which the initiative was building, the differences in absolute levels required to increase RBT effectiveness (especially in rural areas), drinking and driving patterns across regions and a host of other factors indicate that such relative assessments are not as powerful, nor as 'clean', as they might be. However, this was all that was available for this evaluation.

A fourth location, Sydney, could be added to the above table with the entry in any column (encompassing other safety and economic factors as well) being "unchanged". This was to be assessed post-hoc: that is, rather than establishing in advance that no substantive countermeasures and economic changes were implemented/occurring in the Sydney metropolitan area during 1990, this would be assessed through analysis outcomes. For this evaluation, the utility of incorporating Sydney data was partly contingent upon the actual 1990 figure(s) being within chance variation of the forecast value.
The statistically significant comparisons were that:

- the reduction in serious casualty crashes in the Rural 1 region was significantly greater than for the Rural 2 region; and

- the reduction in fatal crashes in Melbourne area was greater than for the Sydney area.

However, interpretation of these outcomes is not necessarily as straightforward, nor as limited, as this.

There are two possible methods of interpreting the results found for the three different areas and treatment regimes, vis, within and between groups interpretation. From the perspective of a conservative, data-driven evaluation, the interpretation of results is derived on a between-groups, empirical basis. This is the stance adopted by the authors of this report. However, if certain assumptions are made explicitly (and can thus be potentially defended), alternative explanations can be entertained. These distinctions are elaborated below.

### 6.2 Within Groups Interpretation

The results demonstrate that a statistically significant 33% reduction in fatal crashes was found for the Melbourne metropolitan area. There are a number of correlates which could be advanced to apparently strengthen the connection between this measured effect and RBT treatment. There is co-incidence in time and space between effect and suggested "cause"; such an outcome pattern could be expected on the basis of previous evaluations and there was a range of (metropolitan) factors at work to strengthen the treatment effect (eg. media discussion etc.).

However, given that a satisfactory control group could not be defined, this reduction supports the impact of the initiative at a non-evaluative (in a strict technical sense) level only. Given the lack of control over extraneous variables, there is little certainty in the connection between the treatment and the observed reduction. The impact of other variables accounts for an unknown proportion of this result (which could be as high as 100% of the reduction).

### 6.3 Between Groups Interpretation

The between groups approach is consistent with the quasi-experimental design but, again, there is some flexibility of interpretation available if (defensible) assumptions are made. In the same way as within group interpretations could be made, the between-group results could be interpreted in ways which are potentially more favourable to the initiative if supplemented by other, non-evaluation information. This is not the role of the formal evaluation report.
The preferred approach in this report, between-groups and data driven, must by necessity be equivocal given the pattern of results obtained. These results demonstrate:

- a large reduction in fatal crashes during high alcohol hours in the Melbourne metropolitan area relative to both rural Victoria comparisons and the Sydney metropolitan area

- a larger reduction in serious casualty crashes during high alcohol hours in Rural 1 when compared to the Rural 2 area, and the Melbourne and Sydney metropolitan areas

However, there is a potential confounding of geographical effects with treatment effects in some of the above comparisons. Controlling for location, there was evidence of an incremental benefit for:

- the Melbourne metropolitan area (relative to Sydney) for fatal crashes in high alcohol hours only, and

- Rural 1 (relative to Rural 2) for serious casualty crashes in high alcohol hours only.

7.0 CONCLUSION

The previous section presented the different possible interpretations of the results of this study, and their inherent weaknesses. The following section outlines the interpretation which appears most reasonable, on the basis of the available evidence. In general, comparisons controlling for location were considered most valid. It is acknowledged that some readers of this report may find alternative interpretations more reasonable.

Melbourne Metropolitan region- The effects of the RBT initiative in the Melbourne Metropolitan area were restricted primarily to fatal crashes in high alcohol hours. This reduction, 33%, was more than twice that found for the Sydney metropolitan area (14%) for the same period. On the assumption that the reduction in high alcohol hour fatal crashes in Sydney was not due to road safety interventions in that period, and that any "other" factors applied to the same extent* in Melbourne as in Sydney, a reduction of the order of 19% in fatal crashes during high alcohol hours in Melbourne could be reasonably attributed to the RBT initiative. No statistically significant change was found in relation to serious casualty crashes; however, the estimated change was associated with a wide

* Direct quantitative comparisons and differences between Melbourne and Sydney on safety related and non-safety related factors do not provide sufficient evidence for them to serve as explanations for differences in crash frequency percentage reductions. A detailed evaluation study would need to be undertaken to determine the relevance and effect size of apparent quantitative differences.
prediction interval for this series reflecting the greater difficulty in providing forecasts with greater precision.

**Rural 1 region** - The greater (statistically significant) reduction in high alcohol hour serious casualty crashes at Rural 1 (26%) compared with Rural 2 (11%) suggests a 15% reduction due to the initiative on these crashes. However, given the imbalance of this pattern compared with that for fatal crashes, and that fatal crashes at Rural 1 have not changed over time, the attribution of the effect on serious casualty crashes to the initiative is more tentative. This is because fatal crashes are more likely to be alcohol related and, although it is probable that the presence of police undertaking RBT also affects non-alcohol related crashes, it seems unlikely that it would affect the latter only and not the former. It must be acknowledged however, that the estimated effects for fatal crashes in rural areas are associated with much wider confidence intervals as highlighted previously, and thus the likelihood of being able to detect a statistically significant difference is low for fatal crashes, particularly in R1.

**Rural 2 region** - The results for Rural comparisons were more difficult to interpret, mainly because there are no truly "untreated" areas. Although the Rural 2 region was the least changed in terms of quantifiable RBT operations, it was exposed to the related publicity and potentially received qualitative changes in treatment. The absence of a comparison area for the Rural 2 region means that the proportion of the non-statistically significant 11% reduction in high alcohol hour serious casualty crashes which is due to the RBT initiative cannot be determined. However, the similarity of serious casualty crash reductions between Rural 2 and both the Sydney and Melbourne metropolitan areas (notwithstanding the confounding of locations with treatments in making this comparison) makes it difficult to ascribe much, if any, of this reduction in Rural 2 to the treatment.

**Extraneous factors** - Ambient factors in Victoria such as speed camera enforcement have been, as far as possible, controlled for by structuring crash data by time of day periods (crashes in high alcohol hours) which best correspond to the intervention's target and exclude other interventions. For instance, speed camera enforcement has been used mainly in low alcohol hours. To the extent that the effect, if any, of speed camera enforcement generalised to high alcohol hours, the proportional reduction attributed to RBT may be overstated. On balance, the net reduction observed in high alcohol hour crashes noted above has been ascribed to the RBT initiative.

8.0 **FURTHER RESEARCH**

Although the evaluation of this program suggests that it has been effective in reducing target crashes, many questions remain regarding the processes and factors involved in the achievement of crash reductions through RBT enforcement. Such questions include:
• are crash reductions derived from the real changes in particular aspects of enforcement, and/or the influence of publicity, either on its own, or in conjunction with the changes in enforcement?

• what are drivers' perception about the changes in RBT enforcement and how do perceived changes in enforcement correspond to reality?

• do drivers have exaggerated perceptions of the likelihood of being tested?

• what is the relative and/or combined value of varying number of hours of operation, tests conducted, frequency of sessions, duration of sessions, distributions of operations over geographical locations and times of day, different levels of RBT conspicuity, and the presence/absence of publicity?

In short, what is the optimal RBT deterrence "cocktail"?
REFERENCES


APPENDIX A

MAP 1: METROPOLITAN POLICE DISTRICTS

MAP 2: COUNTRY POLICE DISTRICTS
APPENDIX B

SELECTED CHARACTERISTICS OF
SPEED CAMERA OPERATION
Monthly number of Traffic Infringement Notices Issued
for Speeding Offences Detected by Speed Cameras
Victoria 1989-1991
Number of speed camera sessions by location
June 1990 - January 1992

Metropolitan
Rural
Start/End times of metropolitan speed camera sessions, July - December 1990

- Start Hour
- End Hour
Start/End times of metropolitan speed camera sessions, January - June 1991

- Start Hour
- End Hour

Sessions

Hour Beginning

0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23
Start/End times of metropolitan speed camera sessions, July - December 1991

Legend:
- ■ Start Hour
-   End Hour

Hour Beginning

Sessions

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Start/End times of rural speed camera sessions, July - December 1990

- Start Hour
- End Hour
Start/End times of rural speed camera sessions, January - June 1991
Start/End times of rural speed camera sessions, July - December 1991

Start Hour  | End Hour
---|---
0 | 180
160 | 160
140 | 140
120 | 120
100 | 100
80 | 80
60 | 60
40 | 40
20 | 20
0 | 0

Hour Beginning

Sessions
APPENDIX C

SENSITIVITY ANALYSIS
Appendix C

Sensitivity Analysis

Predictions for 1990 were calculated based on different "intervention" dates in 1989, in order to test the stability of the predictions and outcomes provided by the time series models selected for statistical analysis. The outcomes are shown in the six tables below for each treatment area, and fatal and serious casualty crashes.

It should be noted that these results do not constitute the "uncorrected" outcome of the initiative if the intervention date is varied, since this would require calculations and comparisons based on the 52 week period from the chosen intervention date.

Metro area, high alcohol hour serious casualty crashes: Predicted and actual numbers in 1990 based on varying intervention dates.

<table>
<thead>
<tr>
<th>Intervention Date</th>
<th>Actual number of crashes in 1990</th>
<th>Predicted number of crashes in 1990</th>
<th>Percentage change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Nov 1989</td>
<td>2156</td>
<td>2447</td>
<td>-11.9</td>
</tr>
<tr>
<td>1 Dec 1989</td>
<td>2156</td>
<td>2435</td>
<td>-11.5</td>
</tr>
<tr>
<td>16 Dec 1989</td>
<td>2156</td>
<td>2428</td>
<td>-11.2</td>
</tr>
<tr>
<td>1 Jan 1990</td>
<td>2156</td>
<td>2526</td>
<td>-14.7</td>
</tr>
</tbody>
</table>

Rural 1 area, high alcohol hour serious casualty crashes: Predicted and actual numbers in 1990 based on varying intervention dates.

<table>
<thead>
<tr>
<th>Intervention Date</th>
<th>Actual number of crashes in 1990</th>
<th>Predicted number of crashes in 1990</th>
<th>Percentage change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Nov 1989</td>
<td>590</td>
<td>756</td>
<td>-21.9</td>
</tr>
<tr>
<td>1 Dec 1989</td>
<td>590</td>
<td>756</td>
<td>-21.9</td>
</tr>
<tr>
<td>16 Dec 1989</td>
<td>590</td>
<td>755</td>
<td>-21.9</td>
</tr>
<tr>
<td>1 Jan 1990</td>
<td>590</td>
<td>805</td>
<td>-26.7</td>
</tr>
</tbody>
</table>
Rural 2 area, high alcohol hour serious casualty crashes: Predicted and actual numbers in 1990 based on varying intervention dates.

<table>
<thead>
<tr>
<th>Intervention Date</th>
<th>Actual number of crashes in 1990</th>
<th>Predicted number of crashes in 1990</th>
<th>Percentage change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sept 1989</td>
<td>422</td>
<td>487</td>
<td>-13.4</td>
</tr>
<tr>
<td>1 Nov 1989</td>
<td>422</td>
<td>487</td>
<td>-13.4</td>
</tr>
<tr>
<td>1 Dec 1989</td>
<td>422</td>
<td>487</td>
<td>-13.4</td>
</tr>
<tr>
<td>16 Dec 1989</td>
<td>422</td>
<td>487</td>
<td>-13.4</td>
</tr>
<tr>
<td>1 Jan 1990</td>
<td>422</td>
<td>497</td>
<td>-15.1</td>
</tr>
</tbody>
</table>

Metro area, high alcohol hour fatal crashes: Predicted and actual numbers in 1990 based on varying intervention dates.

<table>
<thead>
<tr>
<th>Intervention Date</th>
<th>Actual number of crashes in 1990</th>
<th>Predicted number of crashes in 1990</th>
<th>Percentage change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Nov 1989</td>
<td>155</td>
<td>229</td>
<td>-32.3</td>
</tr>
<tr>
<td>1 Dec 1989</td>
<td>155</td>
<td>229</td>
<td>-32.3</td>
</tr>
<tr>
<td>16 Dec 1989</td>
<td>155</td>
<td>229</td>
<td>-32.3</td>
</tr>
<tr>
<td>1 Jan 1990</td>
<td>155</td>
<td>218</td>
<td>-28.9</td>
</tr>
</tbody>
</table>

Rural 1 area, high alcohol hour fatal crashes: Predicted and actual numbers in 1990 based on varying intervention dates.

<table>
<thead>
<tr>
<th>Intervention Date</th>
<th>Actual number of crashes in 1990</th>
<th>Predicted number of crashes in 1990</th>
<th>Percentage change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Nov 1989</td>
<td>83</td>
<td>94</td>
<td>-11.4</td>
</tr>
<tr>
<td>1 Dec 1989</td>
<td>83</td>
<td>94</td>
<td>-11.4</td>
</tr>
<tr>
<td>16 Dec 1989</td>
<td>83</td>
<td>94</td>
<td>-11.4</td>
</tr>
<tr>
<td>1 Jan 1990</td>
<td>83</td>
<td>95</td>
<td>-12.6</td>
</tr>
</tbody>
</table>
### Rural 2 area, high alcohol hour fatal crashes: Predicted and actual numbers in 1990 based on varying intervention dates.

<table>
<thead>
<tr>
<th>Intervention Date</th>
<th>Actual number of crashes in 1990</th>
<th>Predicted number of crashes in 1990</th>
<th>Percentage change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sept 1989</td>
<td>51</td>
<td>60</td>
<td>-15.2</td>
</tr>
<tr>
<td>1 Nov 1989</td>
<td>51</td>
<td>60</td>
<td>-15.2</td>
</tr>
<tr>
<td>1 Dec 1989</td>
<td>51</td>
<td>60</td>
<td>-15.2</td>
</tr>
<tr>
<td>16 Dec 1989</td>
<td>51</td>
<td>60</td>
<td>-15.2</td>
</tr>
<tr>
<td>1 Jan 1990</td>
<td>51</td>
<td>71</td>
<td>-28.2</td>
</tr>
</tbody>
</table>
APPENDIX D

SUMMARY OF TIME SERIES MODELS
Let \( \{X_t\} \) denote the differenced data and \( \{\epsilon_t\} \) denote a sequence of independent and normally distributed random variable with mean zero and equal variances. The following table gives the models used in terms of \( X_t \) and \( \epsilon_t \) along with some residual diagnostics measuring goodness-of-fit.

<table>
<thead>
<tr>
<th>Series</th>
<th>Model</th>
<th>Model Parameters</th>
<th>Root MSE</th>
<th>Durbin-Watson</th>
<th>Ljung-Box</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM serious</td>
<td>ARIMA (0,2,1)</td>
<td>( X_t = -0.940\epsilon_{t-1} + \epsilon_t )</td>
<td>12.91</td>
<td>2.11</td>
<td>25.80</td>
</tr>
<tr>
<td>MM fatal</td>
<td>ARIMA (0,1,2)</td>
<td>( X_t = -0.149\epsilon_{t-2} + 0.011\epsilon_{t-1} + \epsilon_t )</td>
<td>2.92</td>
<td>1.99</td>
<td>24.43</td>
</tr>
<tr>
<td>SM serious</td>
<td>ARIMA (1,1,1)</td>
<td>( X_t = 0.840X_{t-1} - 0.745\epsilon_{t-1} + \epsilon_t )</td>
<td>9.33</td>
<td>1.94</td>
<td>28.04</td>
</tr>
<tr>
<td>SM fatal</td>
<td>ARIMA (1,1,0)</td>
<td>( X_t = 0.138X_{t-1} + \epsilon_t )</td>
<td>2.86</td>
<td>2.00</td>
<td>22.65</td>
</tr>
<tr>
<td>R1 serious</td>
<td>ARIMA (0,1,2)</td>
<td>( X_t = 0.164\epsilon_{t-2} - 0.053\epsilon_{t-1} + \epsilon_t )</td>
<td>5.63</td>
<td>1.98</td>
<td>13.28</td>
</tr>
<tr>
<td>R1 fatal</td>
<td>ARIMA (0,1,0)</td>
<td>( X_t = \epsilon_t )</td>
<td>1.75</td>
<td>1.86</td>
<td>22.55</td>
</tr>
<tr>
<td>R2 serious</td>
<td>ARIMA (0,1,0)</td>
<td>( X_t = \epsilon_t )</td>
<td>3.97</td>
<td>1.91</td>
<td>26.25</td>
</tr>
<tr>
<td>R2 fatal</td>
<td>ARIMA (0,1,0)</td>
<td>( X_t = \epsilon_t )</td>
<td>1.52</td>
<td>1.86</td>
<td>32.93</td>
</tr>
</tbody>
</table>