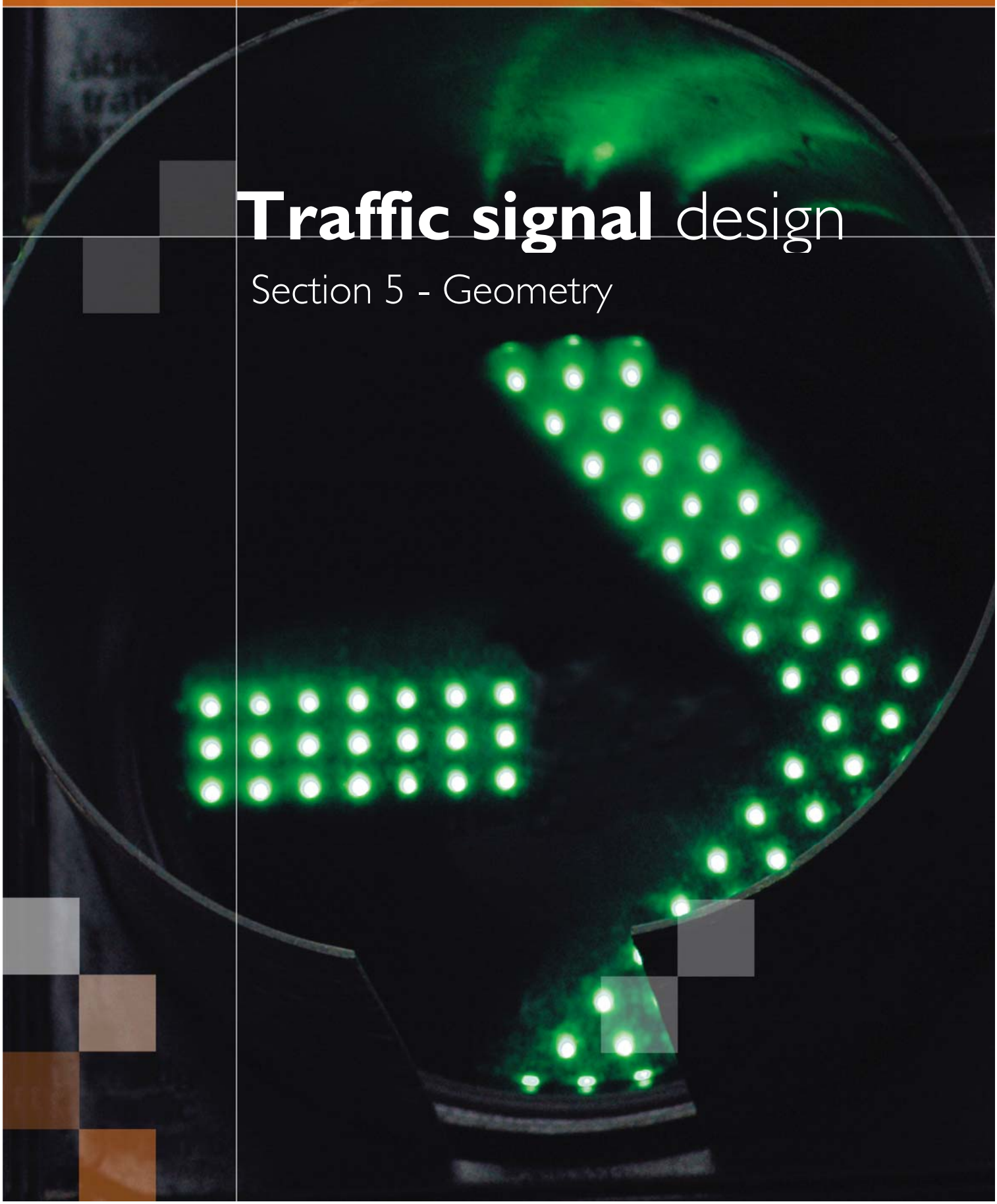
Traffic signal design

Section 5 - Geometry



The traffic signal design guidelines have been developed to assist in designing traffic control signals.

The guidelines are to comprise 16 sections and 5 appendices. These are initially being released individually and in no specific order. The sections which are to be released are as follows:

Part	Title
Section 1	Investigation
Section 2	Warrants
Section 3	Design Process
Section 4	Plan Requirements
Section 5	Geometry
Section 6	Pavement Marking
Section 7	Phasing and Signal Group Display Sequence
Section 8	Lanterns
Section 9	Posts
Section 10	Signs
Section 11	Detectors
Section 12	Controller
Section 13	Provision for Future Facilities
Section 14	Signalised Mid-block Marked Footcrossings
Section 15	Special Situations
Section 16	References
Appendix A	Design Plan Checklist
Appendix B	Traffic Signal Symbols
Appendix C	Location and Function of Lanterns
Appendix D	Location and Dimensions of Components
Appendix E	Left Turn on Red
Appendix F	Level Crossing Interface – Concept of Operations
Appendix G	Level Crossing Interface – Traffic Signal Design Guidance

To determine which sections are currently available go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/trafficsignaldesign_dl1.html

The information contained in the various parts is intended to be used as a guide to good practice. Discretion and judgement should be exercised in the light of the many factors that may influence the design of traffic signals at any particular site. The guidelines make reference, where relevant, to current Australian Standards and are intended to supplement and otherwise assist in their interpretation and application.

Traffic Signal Design

Section 5

GEOMETRY

Special Note:

As of 17 January 2011, the RTA is adopting the Austroads Guides (Guide to Traffic Management) and Australian Standards (AS 1742, 1743 & 2890) as its primary technical references.

An RTA Supplement has been developed for each Part of the Guide to Traffic Management and relevant Australian Standard. The Supplements document any **mandatory** RTA practice and any complementary guidelines which need to be considered.

The RTA Supplements **must** be referred to prior to using any reference material.

This RTA document is a complementary guideline. Therefore if any conflict arises, the RTA Supplements, the Austroads Guides and the Australian Standards are to prevail.

The RTA Supplements are located on the RTA website at www.rta.nsw.gov.au

Roads and Traffic Authority
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VERSION: 1.0
ISSUED: August 2008
AMENDMENTS: Refer to Amendment Record

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To access electronic copies of these and other guidelines go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/technicalmanuals_dl1.html

For the latest amendments (if any) to these guidelines go to:

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ISBN 978-1-921242-95-3 (Electronic only)
RTA/Pub. 08.092

Contents

Amendment record

Please note that the following updates have been made to this document.

Amendment No	Page	Description	Issued	Approved By
1	5-5 5-6	Section 5.7. Reference to User Guide for Pedestrian Facilities deleted Section 5.8 Austroads references updated	December 2010	R O'Keefe Mgr Traffic Policies, Guidelines & Legislation
2	5-2	Amended minimum median widths	August 2012	R O'Keefe Mgr Traffic Policies, Guidelines & Legislation

5.1 INTRODUCTION

When designing traffic signals for an intersection, the opportunity should be taken to identify and rectify any deficiencies in the geometry where necessary, to ensure safe and efficient operation and hence obtain the maximum benefit from the signalisation.

The design of the intersection should provide for:

- location of traffic signal hardware
- clearance to traffic signal hardware
- vehicle turning paths
- clearly defined vehicle paths
- storage requirements
- minimising the distance between stop lines
- pedestrian requirements
- minimising the length of pedestrian crossings
- medians and left-turn islands (where required)
- auxiliary lanes (where required)

Any changes in the geometry should be in accordance with Sections 1 to 4 of the *Road Design Guide,* but care should be taken when applying these principles. The combined effects of horizontal and vertical alignment should be considered at all times.

This section discusses some of the geometric requirements specific to signalised intersections. It is not a replacement for Sections 1 to 4 of the *Road Design Guide*, but merely a supplement. Reference should also be made to Appendix D *Location & Dimension of Components* for positioning and dimensioning of traffic signal components.

5.2 SIGHT DISTANCE REQUIREMENTS

Sight distance requirements for a signalised intersection should be in accordance with the sight distance criteria in Section 4 of the *Road Design Guide*. The combined effects of horizontal and vertical alignment on sight lines and stopping distance must be considered at all times. In addition STOPPING SIGHT DISTANCE (SSD) should be the minimum available to:

- primary, overhead primary, or dual primary lanterns (as applicable)
- the rear end of a stored vehicle or stationary queue

If SSD to primary lanterns is inadequate consideration should be given to the provision of overhead primary, or dual primary lanterns.

If SSD to the rear end of a stored vehicle or stationary queue in insufficient, the probability of a rear end collision is high (refer to Figure 5.1). If vehicle B is a through vehicle, there is no simple solution to the problem other than regrading. If vehicle B is waiting to make a turn, possible solutions to the problem include the provision of an exclusive turn bay, turn ban, split approach phasing, or regrading.

If the road alignment does not provide sufficient sight distance and the existing geometry cannot be adjusted to overcome the problem, consideration should be given to the provision of advance warning signs, W3-3 (refer to the relevant RTA Guidelines for warrants). In extreme circumstances it may be necessary to install advance warning flashing lights (see Section 15.9 in *Special Situations*).

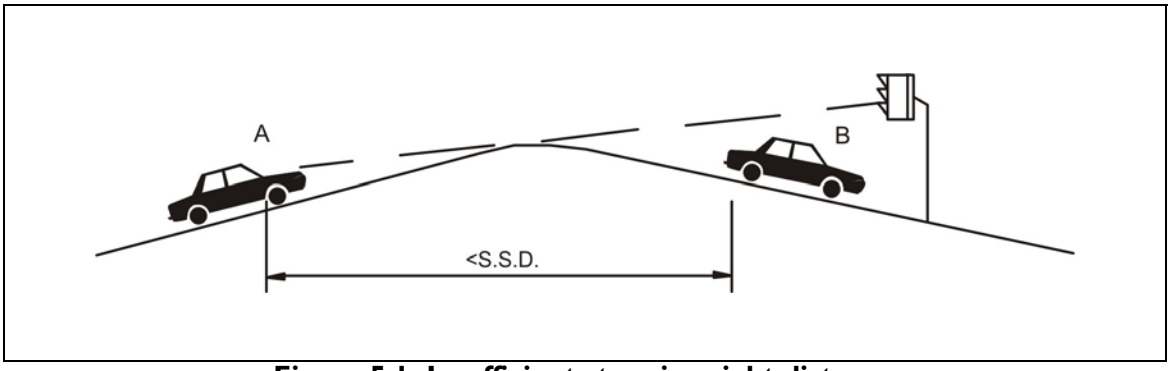

Figure 5.1 Insufficient stopping sight distance

5.3 MEDIANS

If a raised median is used to mount a traffic signal post, the median must be at least wide enough to accommodate the post and its associated lanterns, visors and target boards. The minimum median widths are shown in Table 5.1.

Table 5.1
MINIMUM WIDTHS OF RAISED MEDIAN

Situation	Minimum Width (m)
No posts – Size A signs only	1.2
Any single post with or without 200 mm lanterns. If post is adjacent to narrow or curving lanes, 1.5m to be provided at the nose of the median for a minimum length of 5 m.	1.2
Type 2 post with dual 200 mm lanterns	1.5
Type 2 post with single 300 mm lanterns	1.5
Type 2 post with dual 300 mm lanterns and/or pedestrian repeater lanterns	1.8
Two-stage mid-block pedestrian crossing	2.4

These minimum median widths are in consideration of traffic signal hardware only and do not necessarily reflect the preferred median width of 2.4 m which is required to accommodate signal maintenance, pedestrians and/or cyclists.

The following criteria should be adopted where possible to allow maintenance personnel to erect a maintenance ladder without it straddling the median and having stiles placed in traffic lanes or being improperly balanced:

- the raised median should be no less than 2.4 m wide
- the minimum width of raised median must be maintained for a minimum distance of 1.5 m on both sides of a post

- the crossfall (preferably constant) of the median must not exceed the maximum crossfall of the adjacent carriageway for 1.5 m on both sides of a post
- the grade of the median near the post should be kept as low as practicable

While the minimum width of raised median is stated as 1.2 m (no posts – size A signs) in Table 5.1, lesser widths of raised and painted medians may be used where no signs are required (see Section 4 of the *Road Design Guide)*. The use of back-to-back median kerb or similar treatments is not recommended and should be avoided at intersections as it is:

- not readily observed by approaching drivers, particularly in bad weather conditions
- a hazard which makes recovery difficult for an errant vehicle which straddles it
- not wide enough to provide adequate refuge for pedestrians and can mislead pedestrians who might believe such a refuge is available

Where a marked foot crossing is proposed, a gap is to be provided in any median less than 2.4 m wide. The gap should clear the crossing by 300 mm on both sides and leave a minimum length of 2 m of median beyond the crossing. If this length cannot be achieved, the median should be rounded off and the clearance of 300 mm provided from the side of the crossing nearest the stop line. Further details of median treatments are shown in Appendix D *Location & Dimension of Components*.

Where two-stage signalised marked foot crossings are used, the median must be a minimum of 2.4 m wide to allow for pedestrian storage (see Section 11.4 in *Detectors* & Section 14 *Signalised Mid-block Marked Footcrossings)*.

5.4 CORNER ISLANDS

Corner islands may be used as shown in Figure 5.2 to:

- reduce the distance between stop lines
- reduce the length of marked foot crossings and pedestrian crossings
- enable the free flow of left-turn vehicles where this would benefit capacity without endangering pedestrians

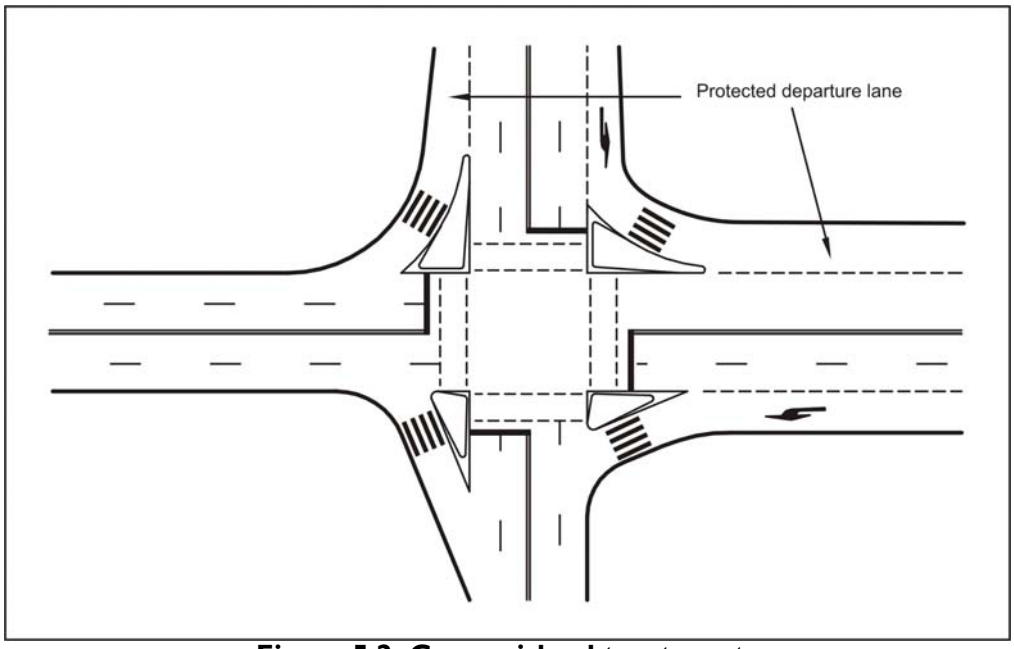

Figure 5.2 Corner island treatments

Corner islands should be designed in accordance with Section 4 of the *Road Design Guide,* to allow installation of traffic signal hardware and to provide a pedestrian refuge area. The minimum area is 8.0 m2 but it should be large enough to adequately accommodate expected pedestrian numbers and be able to keep pedestrian path lines free of obstructions, such as posts/mast arms/signs, especially if the intersection is used frequently by people with disabilities

Any side of an island abutting a pedestrian crossing or marked foot crossing should be a minimum of 6 m long to ensure all pavement marking will terminate at the face of the kerb. If traffic signal posts and mast arms are used on corner islands, the post location must meet the conditions as discussed in Section 9 *Posts* and Appendix D *Location & Dimension of Components*.

Caution needs to be exercised when considering a marked foot crossing across a left turn slip lane where the design speed of the left turn traffic exceeds 30 km/h. Pedestrians are more likely to disobey the pedestrian signal than drivers are the vehicular signal, especially if a further controlled marked foot crossing has to be negotiated in another phase. To minimise the consequences of a possible pedestrian/vehicle conflict, kerb return radii in excess of 20 m should be avoided, thus keeping design speeds to approximately 30 km/h or less (see Section 4 of the *Road Design Guide,* Figure 4.8.8). The preferred treatment is to reduce the left turn speed by redesigning the kerb line as shown in Figure 5.3(b). The C phase pedestrian movement may be protected as described in Section 7 *Phasing & Signal Group Display Sequence*.

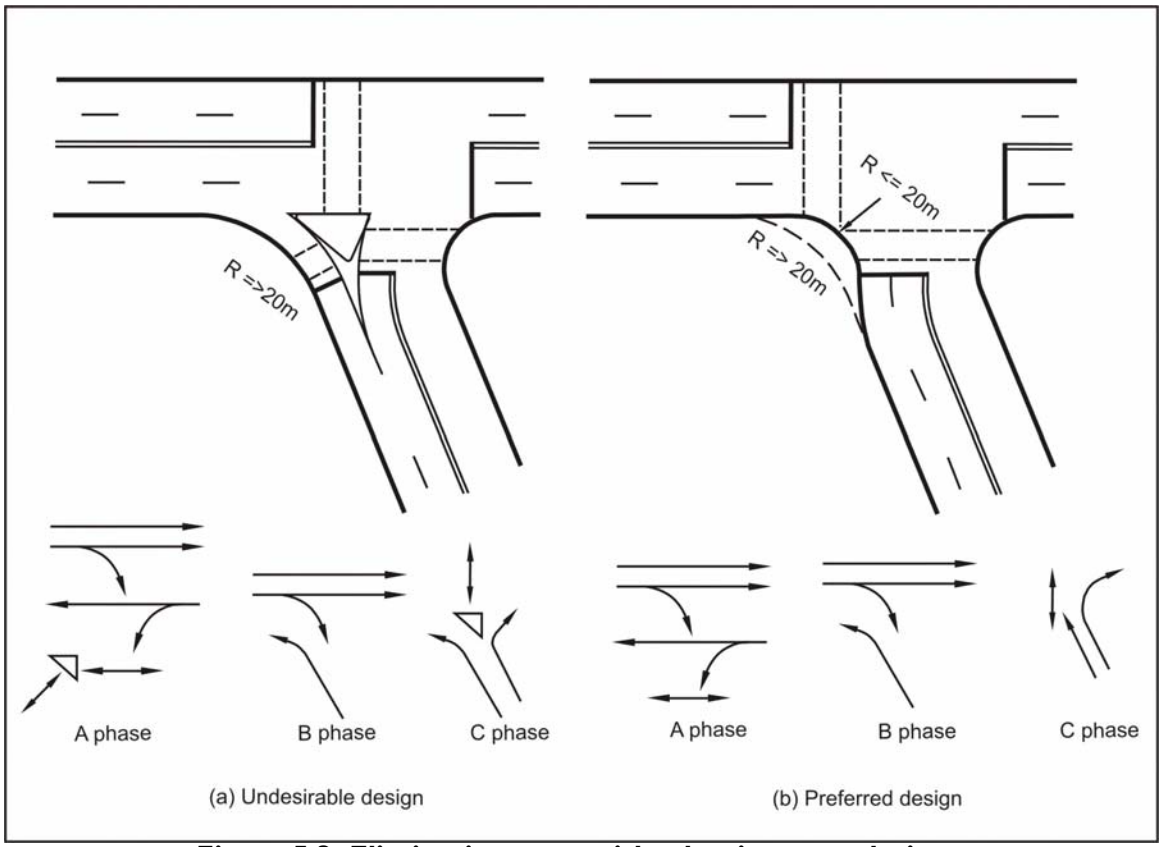

Figure 5.3 Eliminating corner island to improve design

For uncontrolled left turns the kerb return radius must be designed in accordance with requirements set out in Section 4 of the *Road Design Guide*, Part 4.8.7, unless a protected departure lane is provided as shown in Figure 5.2 and Section 4 of the *Road Design Guide*, Figure 4.8.32.

5.5 LENGTH OF RIGHT-TURN BAYS

A correctly designed right-turn bay will provide a deceleration length to allow right-turn vehicles to stop without slowing or obstructing adjacent through traffic and a storage length long enough to accommodate the maximum expected queue of right-turn vehicles. If the deceleration length cannot be achieved (as is often the case in urban areas), the bay should be at least long enough to accommodate the maximum expected queue of right-turn vehicles in the bay. This is so that they do not overflow and block the adjacent through lane. The bay should also be long enough to allow the right-turn vehicles to enter the right-turn bay without being blocked by the queue of vehicles in the adjacent through lane. Hence, the length of the right-turn bay will also depend on the length of the queue of adjacent through vehicles.

The calculation of the expected maximum queue lengths can be carried out analytically using the methods in the *ARRB Research Report, ARR 123 Traffic Signals: Capacity and Timing Analysis (ARRB, fifth reprint, 1993),* or by computer analysis, e.g. SIMSET, SCATES, SIDRA.

5.6 DIAMOND TURNS

The design should provide sufficient clearance for diamond turns (i.e. opposing right turns operating concurrently). Where there is insufficient width for a diamond turn, either one of the turns must be banned or the phasing altered so that the right turns operate during different parts of the cycle, e.g. split-approach phasing. See Section 4 of the *Road Design Guide,* Part 4.8.4.8 and Fig 4.8.21, for clearances.

5.7 KERB RAMPS

Kerb ramps should be provided at all pedestrian crossing points, whether signalised or not. The number and position of ramps is determined by considering the general movement of pedestrians, the location of pedestrian crossing points and in particular any obstacles such as traffic signal posts and utilities. Wherever practical, kerb ramps should be located on the downstream side of adjacent gully pits.

Kerb ramps should be installed so that they guide pedestrians (particularly the visually impaired) across the adjacent roadway by the most direct route i.e. they must be aligned in the direction of travel. Wherever possible, kerb ramps should be located so that they can be used by people with or without disabilities. The edge of the kerb ramp nearest the stop line should be aligned with the outside edge of the marked foot crossing line nearest the stop line. Kerb ramps may vary in width but should be as wide as possible. The absolute minimum width is 1.0 m and the desirable minimum width is 1.2 m. Ideally, they should be the same width as the crossing itself (see Appendix D *Location & Dimension of Components*).

The location of the post carrying the pedestrian push button detector must be such that the footing is clear of the splayed portion of the kerb ramp. The preferred location of this post is 0.5 m beyond the front edge of the stop line and set back 1.0m from the kerb (see Appendix D *Location & Dimension of Components*). This location is in consideration of the needs of people with disabilities to be able to access the push button and the required clearance to the footing. When kerb ramps are adjacent to each other there should be a minimum separation of 1.0 m to avoid unusual footpath and/or kerb shapes.

5.8 BICYCLES

The needs of on-road cyclists should be considered in the design of signalised intersections. Continuity is required for cyclists using bicycle lanes, sharing the kerbside lane or riding along road shoulders, particularly at locations with left-turn slip lanes. Figure 5.4 shows one solution for such a situation. The provision of bicycle lanes is intended to channelise through bicycle traffic and to draw motorists' attention to the presence of cyclists. Short lengths of bicycle lanes are also used in association with advanced stop lines and bicycle storage areas. For additional information on the geometry of bicycle/vehicle mixing, see the *NSW Bicycle Guidelines* and *Austroads* Guide to Traffic Management (Part 6 Section 8) and Austroads Guide to Road Design (Part 4 Section 9).

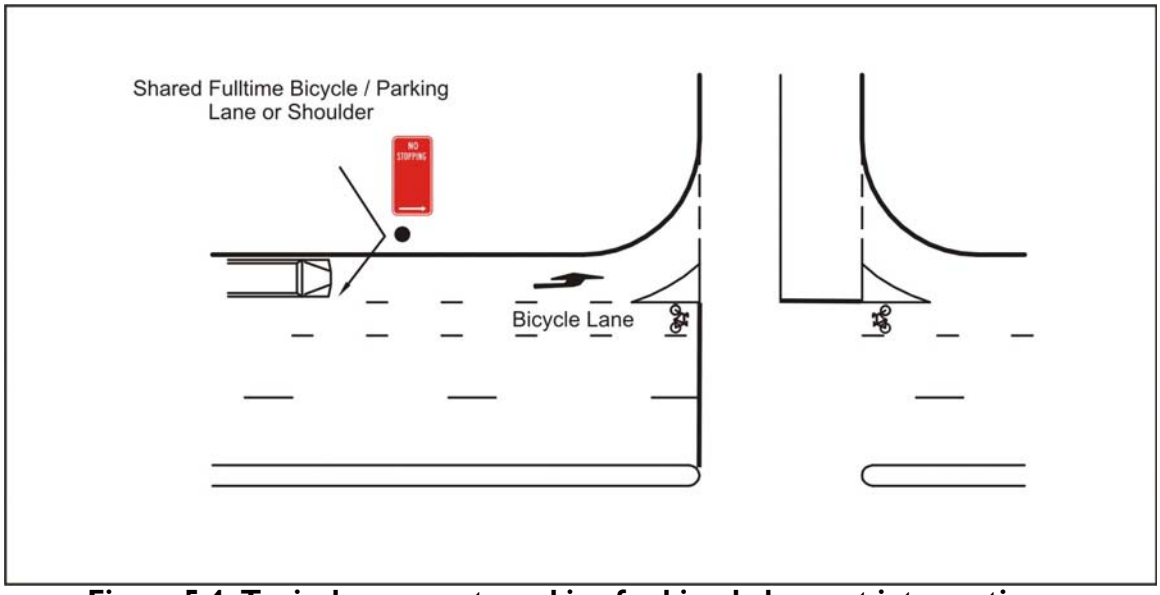

Figure 5.4 Typical pavement marking for bicycle lanes at intersections

At intersections where it is not feasible to provide the recommended pavement markings, provision should be made for the mixing of vehicle and bicycle traffic for at least 50 m on all approaches to an intersection.

Special pavement detection of bicycles is yet to be developed and the safest solution, at present, is a special push-button facility to enable cyclists to register a demand. The button should be mounted differently to the buttons used by pedestrians and it should be clearly marked or identified as being for cyclists' use only.

In view of the costs involved, special bicycle detection should only be provided where there is a risk that bicycles will be left waiting against a red signal for a long period of time. In practice, bicycles are rarely left stranded at the stop line as there are usually sufficient vehicles to lodge the call for the phase.

Where an off-road bicycle route crosses a main road, traffic signals should be provided if warranted in terms of vehicle/bicycle flows and/or safety. However, it is preferable to combine bicycle traffic with pedestrian traffic at a signalised mid-block pedestrian crossing if possible.

From 1 July 2008, bicycle storage areas can be used under the NSW road rules. For further details see Section 15 *Special Situations*.

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March 2008
RTA/Pub. 08.092