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Western Australia.*

## **Main Roads Supplement to the Austroads Guide to Traffic Management**

### **Part 6: Intersections, Interchanges and Crossing Management**

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## PURPOSE

The purpose of this document is to detail Main Roads' standards for traffic management at all type of road intersections, including grade-separated interchanges, as well as rail crossings and pedestrian and cyclist crossings of roads, and bicycle paths and shared paths.

This Supplement has been developed to be read in conjunction with the Austroads Guide to Traffic Management (AGTM) Part 6: Intersections, Interchanges and Crossings Management (2020), a copy of which can be obtained via the [Austroads](#) website.

In Western Australia, Main Roads' policies, guidelines and standards take precedence over Austroads Guides and Standards Australia Standards. National Guides and Standards take precedence over International Guides and Standards, unless specifically stated otherwise.

This Supplement has the same structure as the equivalent Austroads Guide and only additional requirements, clarifications, or practices different from Austroads appear. Where appropriate, this Supplement may also contain additional sections and figures not covered by Austroads, but the numbering sequence found in the Austroads Guide remains. Figures and tables in this Supplement replace those with the same figure or table number in the equivalent Austroads Guide.

Where a reference has been made to a particular Main Roads WA document or drawing within this supplement, the reference provided can be used in the search facility on the Main Roads WA website to locate the current version.

## 1 INTRODUCTION

Main Roads has no supplementary comments for this section.

## 2 SAFETY AND TRANSPORT MANAGEMENT OBJECTIVES

### 2.1 Safety Objectives

Main Roads has implemented the [Road Safety Management System \(ROSMA\)](#) based on Safe System principles.

### 2.2 Traffic Management Objectives

The Department of Transport provides advice on the application of [Inter-Modal Hierarchical Prioritisation](#) (I'M-HiP for short) to active transport infrastructure, such as footpaths, shared paths, and bicycle paths where these intersect with minor roads.

## 3 SELECTION OF INTERSECTION TYPE

### 3.1 General

Main Roads WA has Supplements to the Austroads Guide to Road Design Parts 4, 4A, 4B and 4C.

### 3.2 Types of Intersections

#### 3.2.2 Simple and Basic Turn Treatments (Type S / BA)

##### 3.2.2.1 Simple Turn Treatments – Rural Roads (Type S)

The Simple Left (SL) and Simple Right (SR) turn treatments are applicable to rural roads and in situations where the turning traffic is less than or equal to 5 vehicles per hour. This treatment differs from Type BA in that there is no widening of the pavement at the turning point at the intersection.

Refer to Main Roads WA Intersections at Grade Guideline drawing [202231-0008](#) and Pavement Marking Standard drawing [200331-0182](#).

### **3.2.2.2 Basic Turn Treatments (Type BA)**

Refer to Main Roads WA Intersections at Grade Guideline drawings [200131-0081](#) and [202231-0009](#) and Pavement Marking Standard drawing [200331-0182](#).

### **3.2.3 Auxiliary Lane Turn Treatments (Type AU)**

Refer to Main Roads WA Intersections at Grade Guideline drawing [200131-0083](#) and Pavement Marking Standard drawing [200331-0182](#).

Main Roads does not support the use of lane marking at a rural AUR right turn treatment shown in Figures 3.5 and 3.6. Further details on this type of treatment can be found in Appendix A of Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4](#)".

### **3.2.4 Channelised Turn Treatments (Type CH)**

Refer to Main Roads WA Intersections at Grade Guideline drawings [200131-0084](#), [200131-0085](#), Kerbing Guideline drawing [200231-0053](#) and Pavement Marking Standard drawing [200331-0183](#). For road trains, refer to Main Roads WA Intersection at Grade Guideline drawings [201431-0001](#) and [201431-0002](#).

Main Roads prefers to use the AUR treatment instead of the type CHR(S) on two-lane roads. A type CHR(S) treatment may only be considered on dual carriageways to provide access to minor local roads and driveways. A typical type AUR treatment is shown in Appendix A of Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4](#)".

### **3.2.5 Intersection Treatments – Rural Divided Roads**

Refer to Main Roads WA Standard drawing [201131-0072](#) for signs and pavement marking details of a minor intersection in a rural area on a dual carriageway with a wide median.

### **3.2.7 Staggered T-intersections**

Main Roads does not support the use of the two-lane two-way road right-left staggered treatment shown in Figure 3.16(a).

For signs and pavement markings at staggered T-intersections, refer to Main Roads WA Guideline drawings [201631-0001](#) and [201631-0002](#).

### **3.2.8 Seagull Treatments**

Refer to Main Roads WA Intersections at Grade Guideline drawings [200131-0085](#), kerb treatments Guideline drawing [200231-0053](#) and Pavement Marking Standard drawings [201031-0022](#) and [201031-0023](#).

### **3.2.9 Wide Median Treatments**

Refer to Main Roads WA Pavement Marking Standard Drawing [201031-0021](#).

### **3.2.10 Channelised Intersections with Right-turn Restrictions**

Refer to Main Roads WA Signs and Pavement Marking Local Area Traffic Management Guideline drawings [200331-0142](#), [200331-0136](#), [200331-0137](#) and [200631-0002](#).

### 3.3 Intersection Selection

#### 3.3.2 Selection Process

[Road Safety Management System \(ROSMA\)](#) system based on Safe System principles can be used for intersection selection.

Main Roads WA "[Supplement to Austroads Guide to Traffic Management Part 3](#)" describes Main Roads approach to modelling and intersection analysis.

#### 3.3.3 Assessment of Intersection Control Options

Main Roads is committed to providing the safest practical intersection control treatment that also provides an acceptable level of mobility, i.e. seeking to maximise safe mobility.

Main Roads' process to determine the most suitable intersection treatment on major roads is described in Main Roads WA "[Roundabouts and Traffic Signals – Guidelines for the Selection of Intersection Control](#)".

The Main Roads WA "[Traffic Signals Approval Policy – Network Operations Directorate](#)" outlines the factors that Main Roads takes into account when considering approval of modifications to existing traffic signals and the provision of new traffic signals.

#### 3.3.6 Warrants for S, BA, AU and CH Turn Treatments

This section replaces Section 3.3.6 from the Austroads Guide to Traffic Management Part 6.

The type CHR(S) treatment is not a preferred Main Roads treatment. Main Roads prefers to use the AUR treatment as an alternative to the type CHR(S). For dual carriageways a CHR treatment should be adopted in place of an AUR treatment.

Due to the high percentage of heavy vehicles on Western Australian roads, Main Roads uses the equation below for warrants for turn treatment in place of Austroads Guide to Traffic Management, Part 6 (2020), Figure 3.25. Note that this equation will match the warrants in Austroads graphs when the %HV equals 7.725%.

The following equation is used to determine the turning treatment warranted.

$$x = \frac{1}{471.5} \times Q_M^{0.912} \times Q_i^{1/2.46} \times (1 + 0.75 \times \%HV / 100)$$

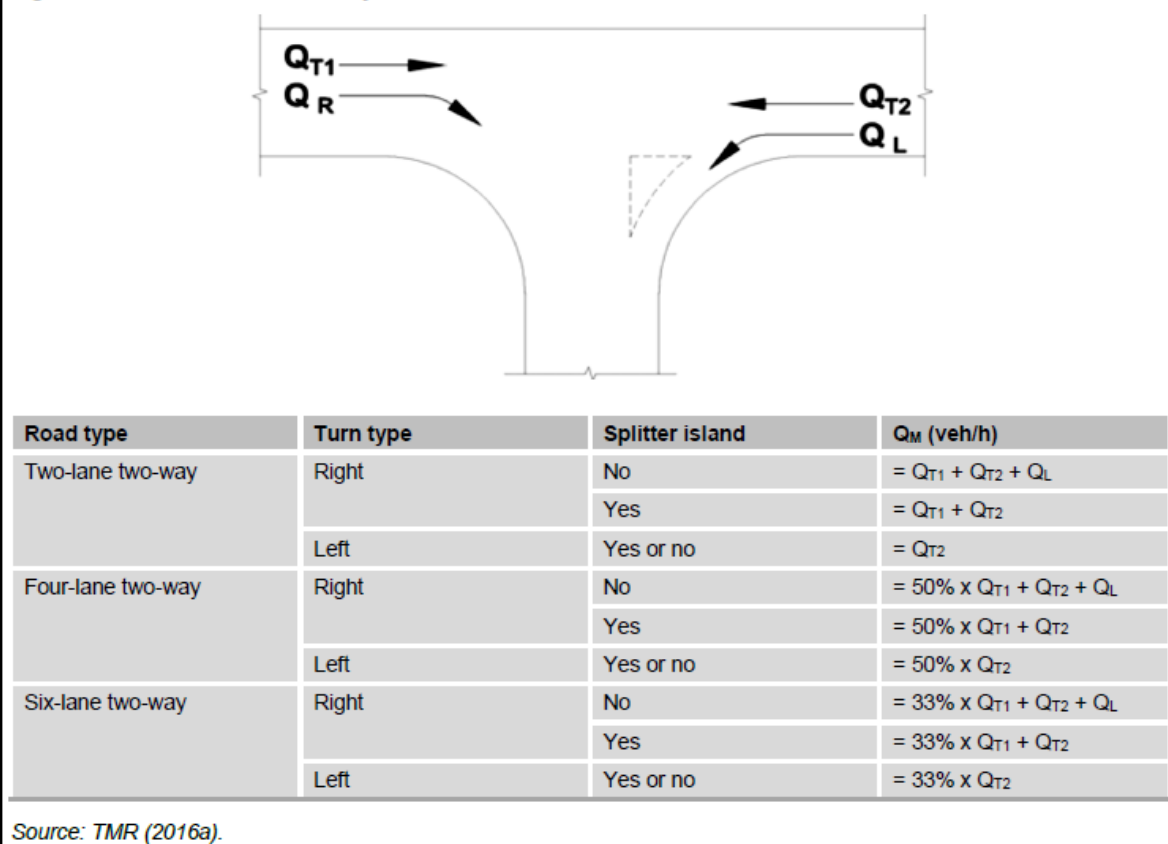
To use the above equation, substitute in values for  $Q_M$ ,  $Q_i$  and %HV

#### Notes

1.  $Q_M$  is calculated based on Austroads Guide to Traffic Management Part 6 (2020), Figure 3.26 shown below.
2. %HV, calculated as the weighted average % heavy vehicles for  $Q_M$ .
3.  $Q_i$  is either  $Q_R$  or  $Q_L$ .
4. If  $Q_i$  is less than or equal to 5, only a Simple Left (SL) or Simple Right (SR) is warranted.
5. For four lane and six lane single carriageways refer to Austroads Guide to Traffic Management Part 6 (2020), Figure 3.26, for adjustments to  $Q_M$ .

6. If the treatment is found to be of type CHL, perform an additional check to determine if an offset turn is required. See section 3.3.6.1 *Warrants for Offset Turn Treatments on Rural Roads* in this supplement for guidance on performing this check.

Figure 3.26: Calculation of the major road traffic volume  $Q_M$



For Design Speeds  $\geq 100$  km/h and  $Q_i > 5$

- If  $x < 1$ , only a BAR / BAL treatment is warranted
- If  $1 \leq x < 2.1$ , an AUR / AUL(S) treatment is warranted
- If  $x \geq 2.1$ , a CHR / (AUL or CHL) treatment is warranted

For  $70$  km/h  $\leq$  Design Speeds  $< 100$  km/h and  $Q_i > 5$

- If  $x < 1.5$ , only a BAR / BAL treatment is warranted
- If  $1.5 \leq x < 3.3$ , an AUR / AUL(S) treatment is warranted
- If  $x \geq 3.3$ , a CHR / (AUL or CHL) treatment is warranted

For Design Speeds  $< 70$  km/h and  $Q_i > 5$

- If  $x < 2.3$ , only a BAR / BAL treatment is warranted
- If  $2.3 \leq x < 5$ , an AUR / AUL(S) treatment is warranted
- If  $x \geq 5$ , a CHR / (AUL or CHL) treatment is warranted



**Example:**

Major Road: Two lane single carriageway with a design speed of 80 km/h

Minor Road: Splitter Island included.

$$Q_{T1} = 250 \text{ (15\%)}$$

$$Q_R = 35 \text{ (20\%)}$$

$$Q_{T2} = 300 \text{ (15\%)}$$

$$Q_L = 155 \text{ (12\%)}$$

Note above values are peak hour flows with % heavy vehicles.

$$x = \frac{1}{471.5} \times Q_M^{0.912} \times Q_i^{1/2.46} \times (1 + 0.75 \times \%HV / 100)$$

Right Turn Assessment:

$$Q_M = 550$$

$$x = 3.16$$

Treatment = AUR

Left Turn Assessment:

$$Q_M = 300$$

$$x = 3.33$$

Treatment = AUL or CHL

**3.3.6.1 Warrants for Offset Turn Treatments on Rural Roads**

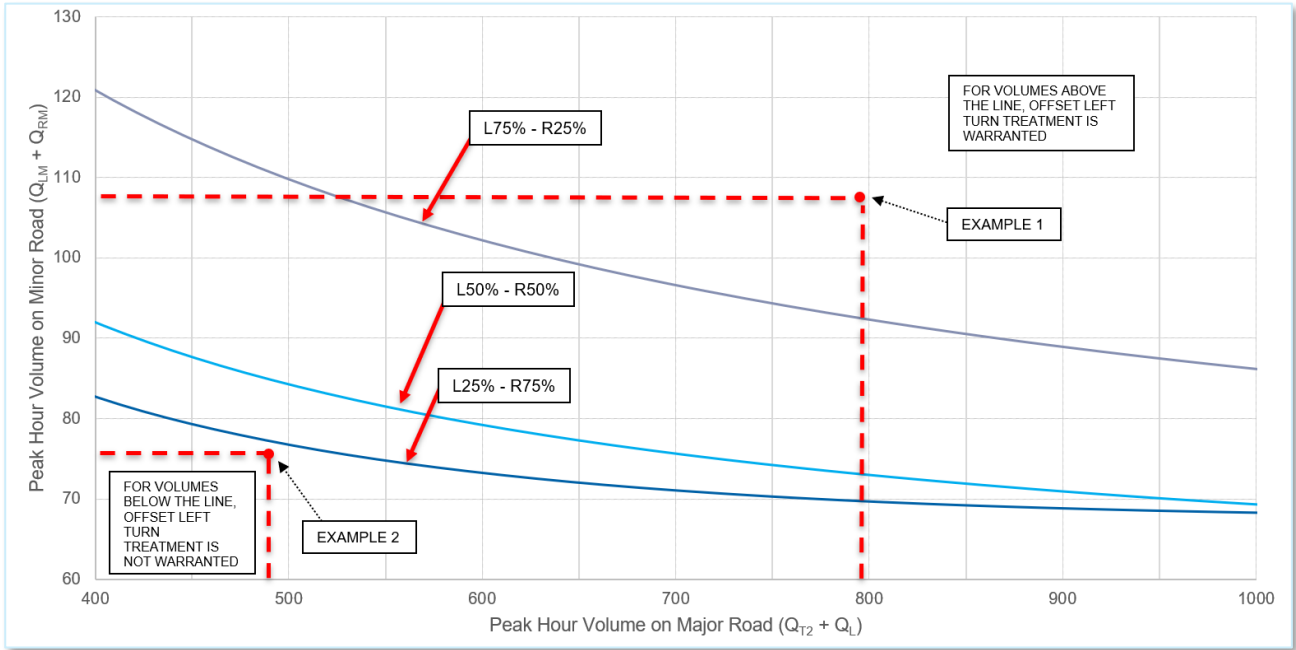
Offset turn treatments are proposed to eliminate masking of vehicles at intersections with limited sight distance. The warrants for offset left turns are based on the probability of one crash occurring every 50 years as a result of the offset left turn treatment not being installed.

The graph in Figure 3.26A below was produced using a frequency of one KSI crash (KSI = Killed or Seriously Injured) in 50 years, for a range of traffic flow split on the minor road and the corresponding allowable major road traffic volumes. The following two examples have been plotted onto the graph in Figure 3.26A as an illustration.

Example 1: The peak hourly traffic volume on the major road is 795 veh/hr. The peak hourly traffic volume on the minor road is 108 veh/hr. The right and left turn out from the minor road is split evenly – 50% right and 50% left. Since the plotted point is above the L50%-R50% curve, an offset left-turn pocket is required.

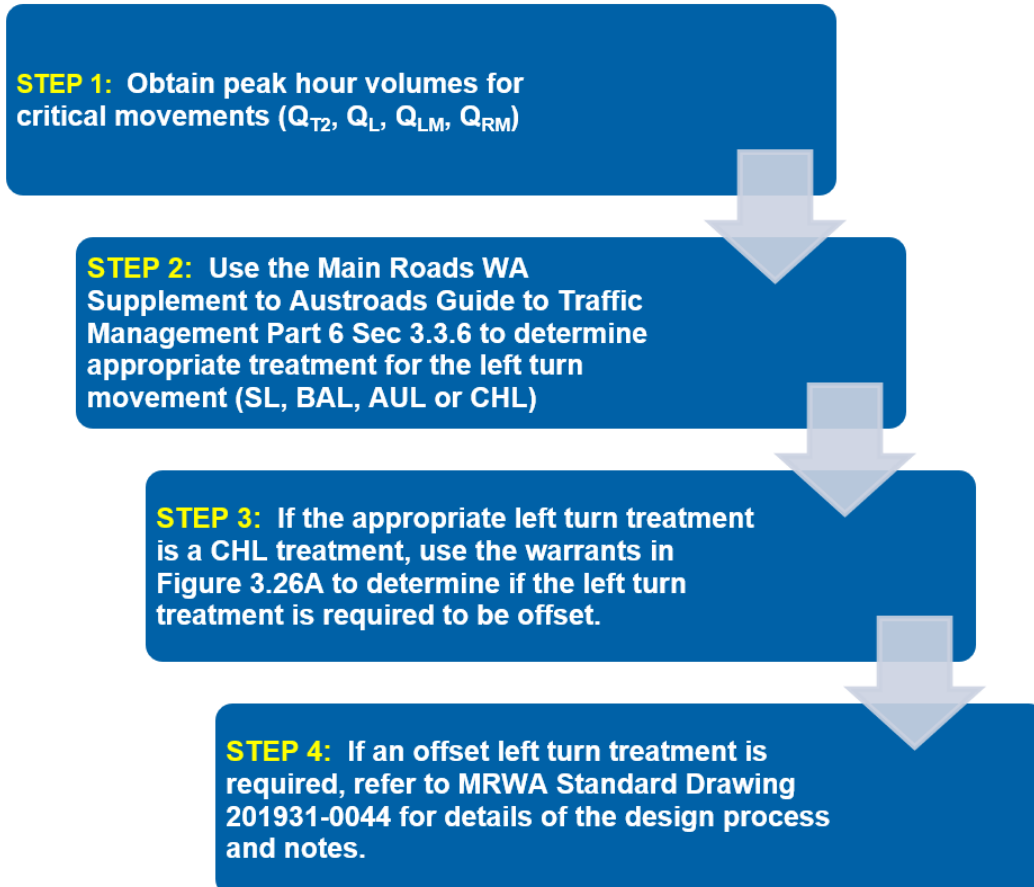
Example 2: The peak hourly traffic volume on the major road is 490 veh/hr. The peak hourly traffic volume on the minor road is 76 veh/hr. 25% of vehicles from the minor road turn left, and 75% turn right. Since the plotted point is below the L25%-R75% curve, an offset left-turn pocket is not warranted.

**Figure 3.26A:** Warrants for Offset Left Turn Treatments at Rural Intersections



A step-by-step process to determine whether an offset left turn is warranted is shown in Figure 3.26B.

**Figure 3.26B:** Flow Chart to Determine Offset Left Turn Treatment at Rural Intersections



A spreadsheet using the equation and conditions in the supplementary section 3.3.6, and offset warrants in supplementary section 3.3.6.1 is available from the following link:

[MRWA Intersection Warrants Spreadsheet](#)

If the above link doesn't work, please search for "MRWA Intersection Warrants" in the Technical Library on the Main Roads website ([www.mainroads.wa.gov.au/technical-commercial/technical-library](http://www.mainroads.wa.gov.au/technical-commercial/technical-library)).

Spreadsheet Example 1:

Major Road: Two lane single carriageway with a design speed of 80 km/h

Minor Road: Splitter Island included.

$$Q_{T1} = 182 \text{ (12\%)}$$

$$Q_R = 12 \text{ (10\%)}$$

$$Q_{T2} = 750 \text{ (15\%)}$$

$$Q_L = 45 \text{ (9\%)}$$

$$Q_{LM} = 54 \text{ (10\%)}$$

$$Q_{RM} = 54 \text{ (10\%)}$$

Note: above values are peak hour flows with % heavy vehicles.

Spreadsheet output:

<b>INTERSECTION WARRANTS</b>		
Main Roads WA Supplement to Austroads Guide to Road Design - Part 4 A.8		
DESIGN SPEED =	80km/h	
SPLITTER ISLAND YES / NO =	Yes	
DUAL CARRIAGEWAY YES / NO =	No	
	<b>COUNT</b>	<b>HV</b>
<b>MOVEMENT</b>	<b>(v/h)</b>	<b>(%)</b>
Q <sub>T1</sub> =	182	12
Q <sub>R</sub> =	12	10
Q <sub>T2</sub> =	750	15
Q <sub>L</sub> =	45	9
Q <sub>LM</sub> =	54	10
Q <sub>RM</sub> =	54	10
<b>RIGHT TURN ASSESSMENT</b>		
Q <sub>m</sub> =	932	
% HV =	14.414	
x =	3.30	
TREATMENT =	AUR	
<b>LEFT TURN ASSESSMENT</b>		
Q <sub>m</sub> =	750	
% HV =	15.000	
x =	4.64	
TREATMENT =	CHL	
OFFSET?	YES	

Spreadsheet Example 2:

Major Road: Two lane single carriageway with a design speed of 80 km/h

Minor Road: Splitter Island included.

$$Q_{T1} = 170 \text{ (12\%)}$$

$$Q_R = 22 \text{ (10\%)}$$

$$Q_{T2} = 460 \text{ (15\%)}$$

$$Q_L = 30 \text{ (9\%)}$$

$$Q_{LM} = 19 \text{ (10\%)}$$

$$Q_{RM} = 57 \text{ (10\%)}$$

Note: above values are peak hour flows with % heavy vehicles.

Spreadsheet output:

<b>INTERSECTION WARRANTS</b>		
Main Roads WA Supplement to Austroads Guide to Road Design - Part 4 A.8		
DESIGN SPEED =	80km/h	
SPLITTER ISLAND YES / NO =	Yes	
DUAL CARRIAGEWAY YES / NO =	No	
	<b>COUNT</b>	<b>HV</b>
<b>MOVEMENT</b>	<b>(v/h)</b>	<b>(%)</b>
Q <sub>T1</sub> =	170	12
Q <sub>R</sub> =	22	10
Q <sub>T2</sub> =	460	15
Q <sub>L</sub> =	30	9
Q <sub>LM</sub> =	19	10
Q <sub>RM</sub> =	57	10
<b>RIGHT TURN ASSESSMENT</b>		
Q <sub>m</sub> =	630	
% HV =	14.190	
x =	2.95	
TREATMENT =	AUR	
<b>LEFT TURN ASSESSMENT</b>		
Q <sub>m</sub> =	460	
% HV =	15.000	
x =	2.52	
TREATMENT =	AUL(S)	
OFFSET?	NO	

MRWA Guideline drawings for the different turn treatments are listed under the relevant sections in this supplement (Sections 3.2.2 – 3.2.4).

## 3.5 Intersection Performance

### 3.5.1 Safety

#### ***Ensuring adequate visibility***

For Main Roads' variation to the Austroads Guideline requirement for ASG refer to Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4A](#)".

For Main Roads' variation to the Austroads Guideline requirement for Minimum Gap Sight Distance (MGSD) refer to Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4A](#)".

### 3.5.4 Road Lighting

For Main Roads variations to Australian Standards and Austroads Guidelines, refer to "[Lighting Design Guideline for Roadway and Public Spaces](#)" and Main Roads WA "[Supplement to Austroads Guide to Road Design Part 6B](#)".

## 4 ROUNDABOUTS

### 4.1 General

Refer to Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4B](#)" for the preferred practice for the design of roundabouts in Western Australia.

### 4.4 Road Space Allocation and Lane Management

#### 4.4.2 Cyclists

Main Roads' practice is to provide an off-road bicycle path at multi-lane roundabouts. The preferred practice is to allow for cyclists to exit the roadway prior to entering the roundabout using off-road cycle paths located outside the circulating carriageway as shown in Main Roads WA Guideline drawings [200331-0196](#) and [200331-0202](#).

### 4.5 Functional Design

#### 4.5.4 Entry Curvature and Deflection

Refer to Section 4.5.2 of the Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4B](#)".

#### 4.5.7 Signs and Line Marking

For roundabout pavement marking and signing refer to the following Main Roads WA drawings:

Single Lane Roundabouts	<a href="#">200331-0197</a>
Dual lane Roundabouts – Single lane approach	<a href="#">200331-0198</a>
Dual lane Roundabouts	<a href="#">200331-0202</a>
Single Lane Roundabout – On low speed roads (Posted speed limit < 60 km/h)	<a href="#">200831-0016</a>
Roundabout metering	<a href="#">201031-0171</a>
Roundabouts - Multi combination vehicles	<a href="#">201231-0014</a>
Dual lane Roundabouts – With single lane exits – Spiral Line Marking	<a href="#">201831-0002</a>
Three lane roundabout with double right turn - Spiral line marking	<a href="#">201831-0031</a>

#### 4.5.9 Lighting

For Main Roads variations to Australian Standards and Austroads Guidelines, refer to "[Lighting Design Guideline for Roadway and Public Spaces](#)" and Main Roads WA "[Supplement to Austroads Guide to Road Design Part 6B](#)".

### 4.6 Signalised Roundabouts

#### 4.6.1 General

Main Roads WA "[Guidelines for the Analysis of Roundabout Metering Signals](#)" have been developed by Main Roads to assess whether an existing roundabout is suitable for the installation of traffic signals on any particular leg (or legs) of a roundabout in order to increase overall capacity.

## 4.6.2 Metering in Advance of Roundabouts

Refer to Main Roads WA Standard drawing [201131-0048](#) for more detailed information on the traffic signal layout and Standard drawing [201031-0171](#) for the signs and pavement markings used at metered roundabouts in Western Australia.

# 5 SIGNALISED INTERSECTIONS

## 5.1 Introduction

Main Roads WA "[Traffic Signals Approval Policy – Network Operations Directorate](#)" sets out the circumstances under which Main Roads will consider approving the modifications of existing traffic signals and the providing new traffic signals.

## 5.3 Road Space Allocation

A typical arrangement for a signalised Intersection with double left turn lanes and a right turn acceleration lane on a divided road is given in Main Roads WA Guideline drawing [200431-0065](#).

Swept path clearances at a signalised intersection with double and single right turn lanes on a divided road are given in Main Roads WA Guideline drawing [200431-0066](#).

Main Roads WA Standard drawings [200531-0006](#) and [200531-0007](#) provide advance stop line details on the approaches to traffic signals.

## 5.6 Signs and Road Markings

Main Roads may install U-turn permitted signs on an approach to intersection traffic control signals where U-turning will not compromise safety or interfere with the efficiency of the traffic signal operations in accordance with the Main Roads WA "[Policy and Application for 'U-turn Permitted' Signs at Traffic Controlled Intersections](#)".

Advance signs with flashing signals and the message "Prepare To Stop" may be used to warn motorists that they will be required to stop at a signalised intersection. The appropriate locations and types of signs are described in Main Roads WA guideline on "[Advance Warning Flashing Signals](#)".

## 5.7 Road Lighting

For Main Roads variations to Australian Standards and Austroads Guidelines, refer to "[Lighting Design Guideline for Roadway and Public Spaces](#)" and Main Roads WA "[Supplement to Austroads Guide to Road Design Part 6B](#)".

# 6 UNSIGNALISED INTERSECTIONS

## 6.2 Traffic Controls

### 6.2.2 Stop Signs and Give Way Signs

Further information on the application of Stop and Give Way controls is described in the Main Roads Guideline "[Stop, Give Way, Keep Left, Keep Right and Divisional Marker Signs in WA](#)".

## 7 ROAD INTERCHANGES

### 7.3 Route Considerations

#### 7.3.1 Spacing of Interchanges

For closely spaced interchanges on urban freeways, the distance between consecutive decision-making points (eg. merge from two lanes to one after an intersection, lane changes after an intersection, a merge followed by a diverge) is to be at least equivalent to 4 seconds of travel time at the respective design speed. Refer to Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4C](#)".

### 7.4 Road Space Allocation and Lane Management

#### 7.4.4 Pedestrians and Cyclists

Pedestrians and cyclists are prohibited from travelling along freeways in Western Australia. Main Roads WA "[Policy for Cycling Infrastructure](#)" requires a Principal Shared Path to be provided adjacent to one side of a freeway and allowance made in land and structural designs for the future installation of a shared path along the other side of a freeway. At interchanges, Main Roads will provide grade separation for Principal Shared Paths.

### 7.6 Ramp Layouts

#### 7.6.4 Access Control

On freeways and major roads planned to be upgraded to a freeway standard, control of access shall be enforced over the full length of the road including the interchange ramps. Special cases for direct access may exist to accommodate Freeway Service Centres, public transport facilities, enforcement sites or in extenuating circumstances where alternative access is unavailable. Refer to Main Roads WA "[Supplement to Austroads Guide to Road Design Part 4C](#)".

### 7.9 Ramp Metering

In Western Australia Managed Motorways are identified as Managed Freeways or Smart Freeways and reference should be made to Main Roads WA [Smart Freeways Policy & Guidelines Overview](#). Main Roads WA has developed a "[Supplement to Victoria's Managed Motorway Design Guide, Volume 2: Design Practice, Parts 2 and 3](#)".

## 8 RAIL CROSSINGS

Main Roads WA "[Railway Crossing Control in Western Australia Policy and Guidelines](#)" provides direction and guidance on the management, design and operation of railway crossings in Western Australia.

## 9 PEDESTRIAN AND CYCLIST CROSSINGS

### 9.1 Introduction

The criteria for different types of parallel pedestrian crossings and exclusive pedestrian phase crossings at signalised crossings are outlined in Main Roads WA guidelines for "[Pedestrian Crossing Facilities at Signalised Intersections](#)".

Main Roads WA "[Policy for Cycling Infrastructure](#)" makes the following references to crossings used by pedestrians and cyclists:



- Grade separation of freeway interchanges will incorporate grade separated crossing facilities for pedestrians and cyclists.
- Where required to prohibit vehicular traffic, bollards should be placed on local access paths and not on the through path. Bollard design details and pavement markings are shown in Main Roads Standard drawing [200531-0008](#).
- Grab rails will only be installed on shared paths near road crossings that are frequently used by aged or disabled pedestrians and alongside median openings. Where installed, grab rails are to be fabricated and positioned in accordance with Main Roads Standard drawing [9831-5649](#).

Main Roads WA “Guidelines on Pedestrians Crossing Slip Lanes” have been developed for locations where pedestrians are required to cross slip lanes which are not controlled by traffic signals. These guidelines describe appropriate crossing treatments based on the pedestrian usage and traffic volumes. (Note: This document is subject to review).

Pedestrian kerb ramps at intersections are to be designed as shown in Main Roads WA Standard drawing [9831-5649](#) and have an absolute maximum grade of 1:10. Positions of Tactile Ground Surface Indicators on ramps and cut throughs are shown in Main Roads WA Standard drawings [200931-0089](#), [200931-0090](#) and [200931-0091](#).

## 9.2 Mid-block Crossings

Pedestrian zebra crossing details are shown in Main Roads WA Standard drawing [200331-0164](#). Puffin and Pelican crossing details are shown in Main Roads Guideline drawing [200431-0116](#).

The Main Roads WA document “[Traffic Warden Controlled Children's Crossing](#)” contains variations and additions to AS 1742.10 Clause 7.2 and Figures 3 and 4. The layout for a children’s crossing with static signs is shown in Main Roads WA Standard drawing [9120-0174](#) and with advance warning flashing signals in Standard drawing [9531-2169](#).

## 9.3 Bicycle Treatments at Intersections

Cyclist advance stop cycling facilities are detailed on Main Roads WA Standard drawings [200531-0006](#) and [200531-0007](#).

# APPENDIX A SIGNALISED INTERSECTION GUIDANCE

Main Roads has no supplementary comments for this section.

# APPENDIX B SAFE SYSTEM ASSESSMENT FRAMEWORK SUMMARY

The Safe Systems Assessment Framework is a methodology that may be applied within the [Road Safety Management \(ROSMA\)](#) process.

## COMMENTARY 1 – 26

Main Roads has no supplementary comments for these sections.