

ATTACHMENT G

**PROVISIONAL
DESIGN NOTES**

for

**Transit New Zealand's
Provisional Passing and Overtaking
Guidelines**

**Draft for Consultation
Version 4**

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Record of Amendments

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Preface

This document is a transitional version prepared for Transit staff and Transit's network consultants only. It assumes that the reader has some technical knowledge and experience with development and operation of New Zealand's rural two-lane state highway network. It has not been written with the general public as its target readership.

These provisional notes provide an indication of how Transit's Passing and Overtaking Policy could be implemented for design issues. They are intended to help with the development of projects in 2008/09 and beyond, while we complete consultation on these Guidelines.

As this is a provisional document, we welcome your feedback. Please forward your comments to larry.cameron@transit.govt.nz.

From 1 August 2008, Transit NZ will join with Land Transport New Zealand to become the New Zealand Transport Agency. The final version of the New Zealand Transport Agency's Passing and Overtaking Guidelines may vary from this document.

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G/PART A. INTRODUCTION

Purpose	The purpose of Design Notes is to provide consistency in design practice for Passing and Overtaking treatments and measures.
Layout	<p>Design Notes have been divided into sections that cover various Passing and Overtaking treatments. Within each section, design issues relating to treatment options are discussed. An additional section on special user requirements is included.</p> <p>These Design Notes follow the categories within Table 3. Integration of Treatments and Measures and Table 4. Tool Kit of Options of the Guidelines.</p>
Relevant Documents	<p>General geometric design standards must comply with:</p> <ul style="list-style-type: none"> • AUSTROADS Rural Road Design. • Land Transport NZ's Manual of Traffic Signs and Markings Parts I & II (MOTSAM). • Transit's Draft State Highway Geometric Design Manual. <p>Where standards differ, MOTSAM will take precedence.</p> <p>Eventually, Transit's Draft State Highway Geometric Design Manual may be replaced with a NZ supplement for AUSTROADS Rural Road Design, which itself is planned for update.</p> <p>Until development and release of any updated AUSTROADS publication and subsequent NZ supplement, Design Notes is a useful repository for design matters that affect Passing and Overtaking projects.</p>
Overseas References	Where there is no established practice within New Zealand and Australia, research and practice from other countries is referenced.
Current Versions	For references or publications referred within Design Notes, current versions will apply if more than one version. For overseas publications with a New Zealand supplement, the current New Zealand supplement will apply.
Non-Exclusive Lists	<p>Any lists of treatments, measures and options described within these Design Notes are not exclusive lists.</p> <p>Other influences, such as new products, advances in technology, different management systems and opportunities for network development, may provide further opportunities for implementing Transit's Passing and Overtaking Policy.</p>

G/PART B. OVERTAKING TREATMENTS

Introduction	Overtaking treatments are generally covered within other Transit Manuals. However, guidance is given on flow limits and levels of overtaking in the opposite direction.
Flow Limits on Overtaking	US research showed that overtaking started to decline after about 600-700 vph of one-way traffic travelling in the same direction as the overtaking vehicle (Harwood, St John & Warren, 1985).
Overtaking in Opposite Direction	<p>At passing lanes and slow vehicle bays, consider providing 1.5 m of extra seal width in the untreated direction, if there is adequate sight distance for overtaking in the opposite direction (Luther et al., 2004).</p> <p>When one-way traffic flows in the treated direction are under about 400 vph, US research showed no adverse safety effects from overtaking in the opposite direction (Harwood, St John & Warren, 1985). Safety may not be adversely affected at higher flows but there was insufficient data for statistical proof.</p>

G/PART C. PASSING TREATMENTS

Introduction

Design issues for passing treatments are generally covered within other design documents. Advice is given on 2+1 lane features, particularly within a European context. 2+1 lanes are not covered specifically within AUSTRROADS and Transit documents.

Other passing treatments cater mainly for slow moving vehicles. Design criteria are site-specific to ensure that facilities match the site and traffic conditions.

G/C1.

2+1 Lanes & Passing Lanes

Merge Zones

For passing lane merges, provide:

- A maximum taper length of 160 m, unless surveyed speed data justifies a shorter length between 115-160 m.
- 290 m clear sight distance at 110 km/hour operating speed environment (1.05 m driver eye height to 1.15 m driver eye height measured downstream from the end of merge taper), based on the Draft State Highway Geometric Design Manual (Transit, 2002).

Note: The 290 m distance avoids reduced sight distance downstream of merge tapers. The clear sight distance can be either increased or decreased if the expected speed environment after PL construction is likely to differ from 110 km/hour.

- Sufficient sight distance to see the start of the merge markings from the 'Merge Ahead' signs.
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Diverge Zones

For passing lane diverges, provide:

- A maximum taper length of 100 m, unless surveyed speed data justifies a shorter length between 70-100 m. See AUSTRROADS Part 5 Section 6.8.3 (i) Diverging Tapers for more detail.
- 290 m clear sight distance would be required at 110 km/hour operating speed environment (1.05 m driver eye height to 1.15 m driver eye height measured from upstream to the mid-point of diverge taper), based on the Draft State Highway Geometric Design Manual (Transit, 2002).

Note: The 290 m distance allows following motorists to adjust their speed if vehicles in front pull out into the passing lane at the diverge zone. The clear sight distance can be adjusted if the expected speed environment after PL construction is likely to differ from 110 km/hour.

Operational Effects	See the Background Technical Report (Transit, 2006) for guidance on percentage following and speed compared to other types of passing facility.
Length (Both PLs and 2+1 lanes)	<p>It may not be possible to achieve the recommended Policy length in all situations. To ensure consistency between passing lane lengths, aim to provide lengths within approximately a 20% range (e.g. 1.3-1.5 km passing lane length, excluding transitions).</p> <p>In all cases ensure that the passing length is sufficient to allow for possible future ITS applications at merges, i.e. do not provide under-length passing lanes for projected high volumes.</p>
Length (2+1 lanes)	<p>For relatively flat road gradient;</p> <ul style="list-style-type: none"> • Consider an initial 2 km long passing lane, then alternating passing lanes about 1.5 km long, excluding transition zones. <p>For varying road gradient:</p> <ul style="list-style-type: none"> • Consider locating passing lengths on uphill gradient sections but ensure that the layout is sufficient to allow an even reduction in passing/overtaking demand in both directions.
Transition Zones for 2+ Lanes	<p>To be compatible with passing lane markings in MOTSAM, individual merge lengths will be 115-160 m length in each direction, i.e. a total of 230-320 m. Diverge lengths will be 70-100 m length for each direction, i.e. a total of 140-200 m.</p> <p>Note: Unless speed conditions suggest a lower merge and diverge taper length, use the higher value.</p> <p>Overseas research shows reduced transition zone lengths on European 2+1 lanes (Potts & Harwood, 2003). Any future drafting of New Zealand requirements for 2+1 lanes should consider revised transition zone lengths for 2+1 lanes based on European experience.</p>
Additional Information	<p>In the absence of any AUSTROADS document or New Zealand supplement on 2+1 lanes:</p> <ul style="list-style-type: none"> • Consider revisions to Swedish guidelines based on experience and observed results (Bergh & Carlsson, 2000). • See the Swedish guidelines for new constructions, as opposed to retrofits, (Potts & Harwood, 2003). • For layouts of intersections at major crossroads consider German experience with 2+1 lanes (Durth, 1995).

G/C2. Other Passing Treatments

Surveyed Speeds Speed surveys should be undertaken when developing shoulder widening, slow vehicle bays and crawler lanes/shoulders.

Shoulder Widening Table G1 outlines recommended shoulder lengths. **Note:** Table G1 is based on Table 4.6 Recommended Minimum Slow Vehicle Bay Lengths from Koorey & Gu, 2001.

With no paint markings, the sealed shoulder width should be 2.0-2.4 m. If the shoulder widening is expected to have high HCV use a wider shoulder widening up to 3.5 m seal width may be appropriate.

Use projected flows when determining the typical average number of following vehicles in platoons. Assume that the difference in desired speed of the platoon leader and following traffic is at least 10 km/hour.

Mean Traffic Speed (km/hour)	Minimum Length (m)	
	Followed by One Veh	Followed by Two Veh
30	90	120
40	140	195
50	200	285
60	275	395
70	360	520
80	455	660
90	560	815

Slow Vehicle Bays Use MOTSAM for slow vehicle bay length, diverge and merge taper lengths.

Note: NZ safety audits of slow vehicle bays in the Kaimai Ranges suggest clear sight distances at both merge and diverge areas (Nicholson, Brough & Meister, 2,000).

Therefore, aim for:

- For both merge and diverge areas, consider the same sight distance provided for merge sight distance, as shown in Table 13.4 (b) Merge Sight Distance at end of Climbing Lane for Cars Overtaking MCV's (AUSTROADS, 2003).
- For clear merge sight distance, measure downstream from the end of the merge taper. This distance may partly include yellow line markings at the end of visibility length. For clear diverge sight distance, measure upstream from the mid-point of diverge taper.

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Slow Vehicle Bays
continued

Note: Clear sight distances at the end of taper and mid-point of diverge taper are taken at 1.05 m driver eye height to 1.15m driver eye height. (based on Draft State Highway Geometric Design Manual).

**Crawler Lanes &
Crawler Shoulders**

AUSTROADS Rural Road Design, Section 13.4.2 Climbing Lanes and Section 13.5.1 Partial Climbing Lanes outlines criteria for the operation of partial crawler lanes (where Transit may use shoulders instead rather than passing lanes or crawler lanes) and crawler lanes.

AUSTROADS Rural Road Design Table 13.4(a) Grade/Distance Warrant (lengths (m) to Reduce Truck Speed to 40 km/h) outlines the minimum length of gradient to reduce a truck speed to 40 km/hour.

If a crawler lane or slow vehicle bay is not feasible and the projected AADT is low and would have 1-2 following vehicles, consider shoulder widening, i.e. crawler shoulders. Use the same lengths outlined in Table G1 above.

G/PART D. CENTRELINE TREATMENTS

Introduction	The centreline treatments of gap separation and central median cables rely on overseas experience to outline best practice.
Gap Separation	<p>The recommended gap separation is 1.75 m but separation width down to 1.2 m minimum can be provided. The total combined seal width should enable the sealed carriageway to be reconfigured for median cables, if required.</p> <p>For passing facilities with a long-term passing strategy, provide for extra seal width during site excavation and carriageway formation (but not necessarily seal) at both the interim and long-term stages.</p>
Restraint Cables (Width for central median)	<p>Provide a 1.75 m total width median. Allow 1.10 m separation between cables and markings on single lane side (centre to centre) and 0.65 m on two-lane side. Provide extra carriageway seal width on curves.</p> <p>Note: See Potts & Harwood, 2003 for Swedish layout. Allow a minimum 4.6 m full lane clearance between central median cables and edge restraints, i.e. kerbs, bridge guard rails (Bergh & Carlsson, 2000).</p>
Restraint Cables (Clearances)	<p>If there is no central median barrier, provide 1.0 m (minimum) - 1.3 m (preferred) clearance between the edgeline marking and roadside restraint cables.</p> <p>Note: Vehicles speed will not be adversely affected by a minimum 1.0 m separation clearance between side restraints and traffic lane edge line (Bergh & Carlsson, 2000).</p> <p>If both central median and roadside cables are provided or proposed, allow 6 m minimum clearance between roadside cables and central median cables to allow traffic to pass a stationary HCV or similar 2.5 m wide vehicle.</p>
Restraint Cables (Support posts)	Place supporting delineator posts at 10 m spacings within the transition zone.

G/PART E. ROADSIDE/EDGE LINE TREATMENTS

Introduction	<p>Clear zoning information is available in AUSTRoads Rural Road Design, Section 17.3 Recovery Area. However, overseas practice is different for 2+1 lanes and hilly/mountainous terrain and should be considered.</p>
Clear zoning (Combined hilly/ mountainous areas)	<p>Refer to AUSTRoads Rural Road Design 2003, Figure 17.2 Clear Zones on Straights & Figure 17.3 Adjustment Factors for Clear Zones on Curves for clear zoning information on straights and curves.</p> <p>Note: In combined hilly and mountainous terrain with lower operating speed, consider a reduced clear zoning requirement. Crashes on low-volume Swedish roads in mountainous terrain typically involved the outside edge of curves. Crashes were uncommon on both straight sections (where overtaking activity generally occurs) and on inside edges of curves (Cited in Larsson, Candappa & Corben, 2003).</p> <p>Refer to AUSTRoads Rural Road Design Figure 17.5 Effective Clear Zone Widths on Batters for information on clear zoning on batters. Refer to AUSTRoads Rural Road Design Figure 17.4 Warrants for Guard Fence on Embankment for information on side restraint cables/guard rails at the top of batters.</p>
Clear Zoning (2+1 lanes)	<p>Consider Swedish approach to clear zoning of 2+1 lanes, where practical remove all hazards in both directions (i.e. trees, existing poles, etc.) within a 9 m width from edgeline.</p> <p>Note: For single lane sections including transitions, consider either a full 1:6 batter run out area or side restraint cables (Bergh & Carlsson, 2000).</p>
Sealed Shoulder (Out of Context Curves)	<p>Consider all curves less than 500 m radius.</p> <p>Transit has a mathematical technique, using RGDAS and High Speed Data to calculate out of context curves (i.e. more than 10 km/hour speed difference), particularly for 4 km downstream (in treated direction) and 2 km upstream (in untreated direction) of the passing lane.</p> <p>If no surveyed data are available, assume an operating speed of 10 km/hour above the posted speed limit at the end of the passing lane.</p>
Sealed Shoulder (2+1 lanes)	<p>A 1.5 m wide sealed shoulder should be considered along the full length of single lane sections of 2+1 lanes and at transition zones (Bergh & Carlsson, 2000).</p> <p>If there are sufficient numbers of cyclists, a 1.5 m wide sealed shoulder is to be provided in both directions, unless separate cyclist or mixed pedestrian and cyclist facilities are provided.</p>

G/PART F. INTERSECTION TREATMENTS

Introduction	Intersection design guidelines relate to AUSTRoads Part 5 Intersections at Grade. A New Zealand supplement applies to right turn bays.
Intersections Requiring Capacity Analysis	<p>See AUSTRoads Part 5 Intersections at Grade Table 4.3 for critical gaps and follow-up headway in traffic flow. However, the AUSTRoads values do not take into account the differences between urban and rural traffic flow conditions.</p> <p>Compared to default values, surveyed data is better with similar rural intersections layouts surveyed under projected flow conditions to determine critical gaps and follow-up headway.</p> <p>See Intersections section under Attachment F Planning Notes for more detail on intersection capacity.</p>
Shoulder Bypass	<p>See MOTSAM for markings layout.</p> <p>See AUSTRoads Part 5 Intersections at Grade Figure 5.23a & 5.23b Warrants for Rural Turn Lanes for threshold criteria on Type BAR <i>basic right</i> turn shoulder bypass.</p> <p>Note: The New Zealand supplement applies (i.e. no Type AU <i>auxiliary lane</i> right turn lanes) for right turn lanes at intersections. A type BAR intersection is required instead.</p>
Right & Left Turn Bays	<p>See MOTSAM for markings layout.</p> <p>See AUSTRoads Part 5 Intersections at Grade Figure 5.23a and 5.23b for threshold criteria on Type CHR <i>channelised right</i> turn right turn bays and Type AUL <i>auxiliary left</i> turn lanes.</p> <p>For some flow conditions, the AUSTRoads threshold criteria may not be appropriate. See Table F4. Modified Harmelink Model within Attachment F Planning Notes (Mutabazi, Russell & Stokes, 1999).</p>
Roundabouts	See AUSTRoads Part 6 Roundabouts for high volume intersections, such as rural roundabouts.
Grade-Separated Intersections	See Transit's guidelines for grade-separated intersections (NAASRA, 1984).

G/PART G. INTELLIGENT TRANSPORT SYSTEM MEASURES

Introduction	There is little design information on Intelligent Transport System (ITS) applications for New Zealand rural state highways. Overseas references are provided instead.
Merging	Late merges are recommended for congested conditions with reduced traffic speeds. See an evaluation of the late merge in Beacher et al, 2004 for configuration of VMS signs. Refer to Transit standard drawings for fixed VMS signs in rural locations.
Additional Information	While not Transit's official reference, information is provided within Colorado Department of Transportation, 2005.

G/PART H. SPECIAL USER REQUIREMENTS

Introduction	Special use requirements would generally be required where there are an expected high number of special users and access controls onto state highway may require either separate facilities or increased seal width.
Pedestrians & Bicyclists	<p>Refer to AUSTROADS Part 14 Bicycles and NZ Supplement regarding path widths for cyclists only and mixed pedestrian and cyclist use.</p> <p>Provision of passing facilities is to be consistent with Transit's Walking and Cycling Policy.</p>
Motorcyclists	<p>When choosing supporting posts for restraining cables on roadside and central median cables, consider if supporting posts would minimise any potential injury to vulnerable users.</p> <p>Note: An Australian study (Larsson, Candappa & Corban, 2003) cited Swedish research that showed no over-representation of injuries from motorcyclists travelling on Swedish 2+1 roads with central median cables.</p>
Equestrians	<p>For specific isolated locations, separate facilities or extra reserve width may be required for equestrians.</p> <p>Refer to AUSTROADS Part 14 Bicycles for mixed-use path widths that also include equestrian activity.</p>
Slow Moving Farm Vehicles	<p>For high numbers of slow moving farm vehicles and if not restricted from the state highway, consider slow vehicle bays in series at about 3-5 km spacings on flat/rolling road gradient.</p> <p>If affected state highways are shorter, shoulder widening may be more effective.</p>

G/PART I. REFERENCES

1. AUSTRROADS, 1993. "Guide to Traffic Engineering Practice - Part 6: Roundabouts," Austrroads Publication No. AP-11.6/93, ISBN 0 85588 425 8, Sydney, Australia, January, 1993.
2. AUSTRROADS, 1998. "Guide to Traffic Engineering Practice Part 14 – Bicycles," Austrroads Publication No. AP-11.4/99, ISBN 0 85588 434 X, Sydney, Australia, January, 1999.
3. AUSTRROADS, 2003. "Rural Road Design: A Guide to the Geometric Design of Rural Roads," ISBN 0 85588 655 2, Eighth Edition, Sydney, Australia, 2003.
4. AUSTRROADS, 2006. "Guide to Traffic Engineering Practice - Part 5: Intersections at Grade," Austrroads Publication No. AP-G11.5/05, ISBN 0 85588 734 6, Sydney, Australia, April, 2006.
5. Beacher A., Fontaine M. & Garber N., 2004. "Evaluation of the Late Merge Zone Traffic Control Strategy". Transportation Research Board. Final Report VTRC 05-R6, Charlottesville, Virginia, USA, August, 2004.
6. Bergh T. & Carlsson A., 2000. "2+1 Roads With and Without Cable Barriers Speed Performance", Proceedings of the Fourth International Symposium on Highway Capacity, Transportation Research Board, Hawaii, USA, June, 2000. pp.118-199.
7. Cenek P.D. & Lester T.J., 2008. "Operational Evaluation of Representative Passing Lanes against Proposed Guidelines", Unpublished report, for Transit NZ, 2008.
8. Colorado Department of Transportation, 1985. "Design Guidelines for Including Intelligent Transportation Systems in Projects", Prepared for Colorado Department of Transportation, ITS Branch, January, 2005.
9. Durth W., 1995. "Implementation of Intermediate Cross Sections", Proceedings of International Symposium on Highway Geometric Design Practices, Transportation Research Board, Boston, USA, August 30-September 1 1995, pp.17-1-12.
10. Harwood D.W., May A.D., Anderson I.B., Leiman L. & Archilla A.R., 1999. "Capacity and Quality of Service of Two-Lane Highways", Final Report 3-55(3), cited in Koorey G.F. & Gu J., 2001, Prepared for National Co-operative Highway Research Program, Transportation Research Board, US National Research Council, 1999.

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11. Harwood D.W., St John A.D. & Warren D.L., 1985. “Operational and Safety Effectiveness of Passing Lanes on Two-Lane Highways”, Transportation Research Board Record 1026, 1985, pp.31-39.
12. Koorey G.F. & Gu J., 2001. “Assessing Passing Opportunities – Stage 3”, Transfund New Zealand Research Report No.220, 2001.
13. Larsson M., Candappa N. & Corben B., 2003. “Flexible Barrier Systems Along High Speed Roads: A Lifesaving Opportunity”, Report, Prepared for VicRoads, Monash University Accident Research Centre, Australia, December, 2003.
14. Luther R.E., Alley B., Charlton S., Wigmore B. & Haas P., 2004. “Impact on Driver Behaviour of Overtaking Lane Design for New Zealand Roads”, Transfund New Zealand Research Report No. 255.
15. Mutabazi, M, Russell E.R. & Stokes R.W., 1999. “Review of Effectiveness, Location, Design and Safety of Passing Lanes in Kansas”, Report No. K-TRAN:KSU-97-1, Prepared for Kansas Department of Transport.
16. NAASRA, 1984. “Grade-Separated Intersections: A Design Guide” NAASRA.
17. Nicholson C., Brough K. & Meister M., 2000. “SH 29 Kaimai Slow Vehicle Bays Safety Review”, Opus International Consultants Report 29A012.00, prepared for Transit New Zealand.
18. Potts I.B. & Harwood D.W., 2003. “Application of European 2+1 Roadway Design” Research Results Digest – Number 275, National Cooperative Highway Research Program, Transportation Research Board, USA, April 2003.
19. Transit New Zealand/Land Transport New Zealand, 1998. Manual of Traffic Signs and Markings Part I Traffic Signs, 4th Edition, Wellington, New Zealand, Passing Lane Traffic Signs updated 1 March 2000, viewed 1 May 2006. <<http://www.transit.govt.nz/technical/manuals/MOTSAM-Part I: TRAFFIC SIGNS>>.
20. Transit New Zealand/Land Transport New Zealand, 2004. Manual of Traffic Signs and Markings Part II Markings, 3rd Edition, Wellington, New Zealand, Passing Lane Markings updated July 2004, viewed 1 May 2006. <<http://www.transit.govt.nz/technical/manuals/MOTSAM-Part II: MARKINGS>>.

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21. Transit New Zealand, 2002. Draft State Highway Geometric Design Manual, April, 2002.
 22. Transit New Zealand, 2006. "Background Technical Report for Passing and Overtaking Policy", Unpublished Report. May, 2006.
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