ROAD DESIGN NOTE

Accessible tram stops in safety zones

1. Purpose

This Road Design Note (RDN) provides guidelines for the design of road infrastructure associated with accessible tram stops located in safety zones.

Accessible tram stops provide a platform and associated ramps/pedestrian facilities that comply with the requirements of the *Disability Discrimination Act* (1992), *Disability Standards for Accessible Public Transport* (2002) *(DSAPT)* and referenced Australian Standards.

This RDN should be read in conjunction with the Department of Infrastructure (DOI) issued VRIOGS 005.3-200X, which includes the *Client (DOI) Design Requirements for Accessible Tram Stops (*2006).

2. Scope

This RDN is applicable for tram stops in safety zones on arterial and local roads:

- Where posted speed limits are between 60 km/h or less
- At intersections and mid-block between intersections.

This RDN provides guidelines on:

- Road safety barrier requirements.
- Traffic lane realignment, narrowing or removal where the platform cannot be contacined within an existing safety zone.
- Signing, line marking and street lighting requirements.
- Intersection sight line requirements.

3. Road safety barriers

Road safety barrier requirements are dependent on the following factors:

- Posted speed limit.
- Tram stop usage and road conditions.
- Site constraints and/or urban design requirements.

Appendix A provides details of road safety barrier requirements for different speed zones.

Appendix B provides details of acceptable layouts for road safety barriers and platform terminations.

4. Traffic lane width reduction & realignment

Widths required for platforms are provided in the DOI design guidelines referenced in Section 1.

Wherever possible, traffic lanes should be left unaltered with the platform fitted into the available cross section.

Where encroachment of the platform into traffic lanes is necessary, changes to lane arrangements shall consider:

- Traffic lane width requirements. Refer to Section 4.2.5 (Urban Road Widths) of *Austroads Guide to Road Design – Part 3: Geometric Design.*
- Lane alignment. Any lateral shifts in traffic lanes adjacent to platforms shall include appropriate changes to the lane alignment on both the approach and departure sides of the platform. These changes can be achieved by adopting:
  - Horizontal geometry as defined in *Austroads Guide to Road Design – Part 3: Geometric Design* and the associated VicRoads Supplement based on a speed equal to the speed limit plus 10 km/h. based on a speed equal to the speed limit plus 10 km/h.
- Pavement width requirements for turning movements at intersections. Refer *Austroads Design Vehicles and Turning Path Templates* (2006) and applicable VicRoads Region for advice on appropriate design vehicles.
- Method of removal of redundant line marking. The extent and method of redundant line marking removal is subject to the approval of VicRoads. The practices usually adopted for VicRoads projects shall be used. Placement of asphalt overlays for the full width of pavement to cover redundant line marking may be required where substantial shifts in lane lines are required.

Appendix C provides details of the principles to be applied in developing proposals that require changes to traffic lane widths and/or alignments and issues that must be addressed.

Proposals to remove any existing traffic lanes shall be clearly identified at the concept design stage. Approvals

for removal of existing traffic lanes shall be obtained from the Regional Manager of the relevant VicRoads Region.

Proposals for changes to traffic lane widths and/or alignments are subject to the approval of VicRoads.

5. Signing, line marking & street lighting

Signing and line marking shall comply with the requirements of *VicRoads' Traffic Engineering Manual Volume 2 - Signs and Markings.*

Where platforms are within the existing safety zone/cross section, edge lines will usually be required. Where platforms cannot be accommodated within the existing safety zone/cross section, edge lines, diagonal markings and RRPMs may be required.

For the purpose of street lighting, roads adjacent to platform tram stops shall be lit to a minimum of V3 standard. Particular attention should be paid to ensure appropriate lighting of lane re-alignments, the nose of the tram platform, lane narrowings, pedestrian crossings, crash cushions and bollards.

Higher lighting levels may be required by the tram operator for passengers at the tram stop. The lighting design of the platform tram stops should ensure that no one particular feature is grossly over lit in comparison to other tram features or other road features. The lighting of tram facilities shall not be to the detriment of the lighting of the road.

6. Intersection sight line requirements

Sight line requirements at intersections and mid-block locations are defined in:

- Austroads Guide to Road Design
  - Part 3: Geometric Design (midblock)
  - Part 4A: Unsignalised and Signalised Intersections (intersection);
  - Part 4B: Roundabouts (intersection);
  - Part 4C: Interchanges (intersection); and
- VicRoads Supplements to the Austroads Guide to Road Design.

Platform stops and associated pedestrian railing, shelters, etc. shall not reduce sight distances currently available, unless agreed otherwise with VicRoads. Any reduction in sight distances below desirable standards based on an operating speed of 10 km/h above the speed limit shall be subject to the approval of VicRoads.

7. Drainage requirements

The effect of platform tram stops on the existing drainage regime should be checked. For drainage purposes, platform tram stops should be considered as traffic islands and comply with the requirements of *VicRoads Supplement to the Austroads Guide to Road Design – Part 5: Drainage Design and Section 7.4.3 of VicRoads Road Design Guidelines Part 7 – Drainage.*

8. Approval process

The DOI design guidelines referenced in Section 1 include a detailed design workflow. This workflow shall include road safety audit and all changes to road infrastructure associated with each tram stop. Approval of DOI, Yarra Trams and VicRoads is required for concept designs before proceeding to detail design.

VicRoads approvals shall be obtained from the relevant VicRoads Region.

References

Supersedes – RDN 03-33 (July 2007)

VicRoads Standard Drawings for Road Works

Approved by

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Road Design Notes are subject to periodic review and may be superseded.

APPENDIX A: Road safety barrier requirements

APPENDIX B: Layouts for road safety barriers & platform terminations

APPENDIX C: Development of proposals to modify traffic lanes

APPENDIX A

Road safety barrier requirements

Road safety barrier requirements will vary depending on site conditions and the design of the platform. The situations described in Appendix A and B only covers crash protection for traffic travelling in the same direction as the tram using the platform. Equivalent crash protection should be installed on the departure end of the platform to cater for traffic travelling on the tram tracks in the opposing direction (other than right turn traffic). Three categories of road safety barrier treatment are possible. These are:

Category 1 - Full length vertical concrete barrier & crash cushion [1]

This category requires an 800mm high vertical concrete barrier for the full length of the platform plus crash cushion protection of the platform end facing approaching traffic. Refer to Appendix B for design details of concrete barriers. Refer to Section A2 below for details of crash cushion requirements.

Category 2 – Crash cushion[1] at approach end only

This category requires crash cushion protection for the end of the platform facing approaching traffic. Refer to Section A2 below for details of crash cushion requirements.

Category 3 – Crashworthy[2] array at approach end only

This category requires protection of the platform end facing approaching traffic by an array of crashworthy bollards. An alternative to a bollard array may be considered for sites where bollards are inconsistent with urban design objectives, and these objectives warrant the omission of bollards. Refer Section A3 for details.

Platforms shall be designed with Category 1 barriers where the following conditions apply:

- The speed limit at the site is 60 km/h.
- Stop usage and road conditions warrant Category 1 barriers – refer Section A1 below.

Category 2 barriers shall be adopted for all other sites, except where Category 3 barriers are acceptable as described in Section A3 below.

A1. Stop usage & road conditions warranting category 1 barriers

Some stops typically attract high numbers of waiting passengers. Examples of these stops are near schools, universities, retail centres and near interchanging train, tram and Principal Public Transport Network bus services. The road alignment and cross section at these sites and on their approaches should be designed to minimise the vulnerability of the platform to errant vehicles.

Category 1 barriers shall be adopted if the stop is one typically attracting high passenger numbers, and any of the following road conditions apply:

- Any traffic lane realignment, width reduction or removal required to accommodate the platform does not meet desirable standards defined in Section 4.
- The platform is located on the outside of a curve of radius less than 200m.

A2. Crash cushion requirements

The length and width of crash cushions can vary to account for variations in the design impact speed and the width of hazard requiring protection. Crash cushions shall be selected based on the following criteria:

- Design impact speed. Where site constraints permit, crash cushions shall provide for a design impact speed equal to the speed limit plus 10 km/h. Where the site is constrained and the length required to meet this requirement is not available, a design impact speed equal to the speed limit may be adopted.
- Width of Hazard Protected. Where the non-access end of the platform faces approaching traffic, a crash cushion that maximises the width of platform protected shall be adopted. Where the platform access ramp faces approaching traffic and site constraints permit the use of a crash cushion that maximises the width of platform protected, then such a crash cushion shall be adopted. Where the platform access ramp faces approaching traffic and site constraints are not compatible with the use of a wide crash cushion, a narrow crash cushion located at the foot of the ramp may be selected.

A minimum 1.2m clearance shall be provided between crash cushions and adjacent tram lines to ensure that pedestrians cannot be trapped between a tram and the crash cushion.

Refer to Appendix B for diagrams of acceptable crash cushion installations.

A3. Site conditions where category 3 barriers may be acceptable

Crashworthy bollards shall not be used in lieu of an accepted crash cushion except where all of the following conditions are met:

- The speed limit is 50 km/h or less at all times.
- Actual traffic operating speeds at the platform site are consistent with the applicable speed limit.
- The site is constrained and/or urban design considerations are of such high priority that an accepted crash cushion cannot be accommodated or is not considered appropriate.

An example of an acceptable crashworthy bollard is the “Omni Stop” bollard (code 2211), supplied by Saferoads Pty Ltd. This is a proprietary product. The foundations of these rigid steel bollards include a cartridge which allows the bollard to partially deflect on impact which makes them less hazardous to errant vehicles than simple rigid bollards. While these bollards have been successfully crash tested, their crash performance both from a vehicle

1 Accepted crash cushions are shown in Road Design Note 06-04

occupant and vehicle damage point of view is inferior to that of accepted crash cushions.

Alternatives to "Omni Stop" bollards may be considered where these alternatives have been successfully crash tested to at least Test Level 1 as defined in AS 3845:1999.

Acceptable configurations of crashworthy bollards for the protection of platform ends are shown in Appendix B.

Bollard alternative

At sites that would otherwise be suitable for Category 3 barriers, where bollards are undesirable due to urban design objectives, replacement of bollards with a raised traffic island located between the platform and approaching traffic may be considered. The minimum requirements for the traffic island are as follows:

- The width of the island is no less than the maximum width of the platform.
- The length of island where the width requirement of point (i) is met is no less than 10m.
- Barrier kerb as shown on standard drawing SD 2001 (latest version), or accepted equivalent, shall be used. Mountable or semi mountable kerb is not acceptable.
- Offsets to traffic lanes shall be as per normal traffic island requirements defined in *Austroads Guide to Road Design Part 4C* and *VicRoads Supplement*.

When considering this alternative, it must be recognised that a traffic island will not provide the same level of protection from errant vehicle impacts as the bollard arrays shown in Appendix B. The approval process for such a proposal must consider the risks associated with omission of bollards and conclude that the treatment proposed is appropriate for the site.

Appendix B

Layouts for road safety barriers and platform terminations

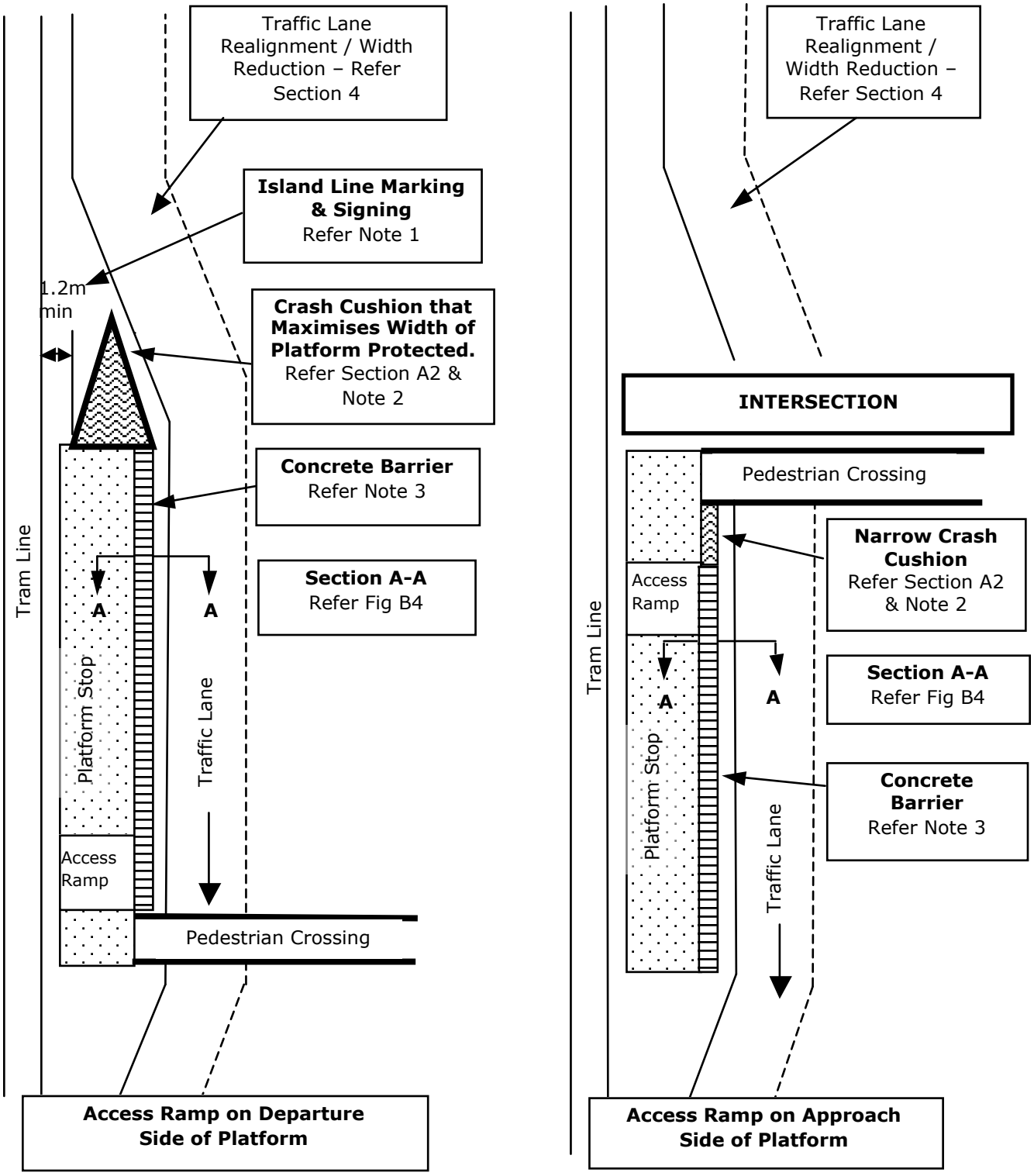

Fig B1 – Tram Stops with Category 1 Barriers

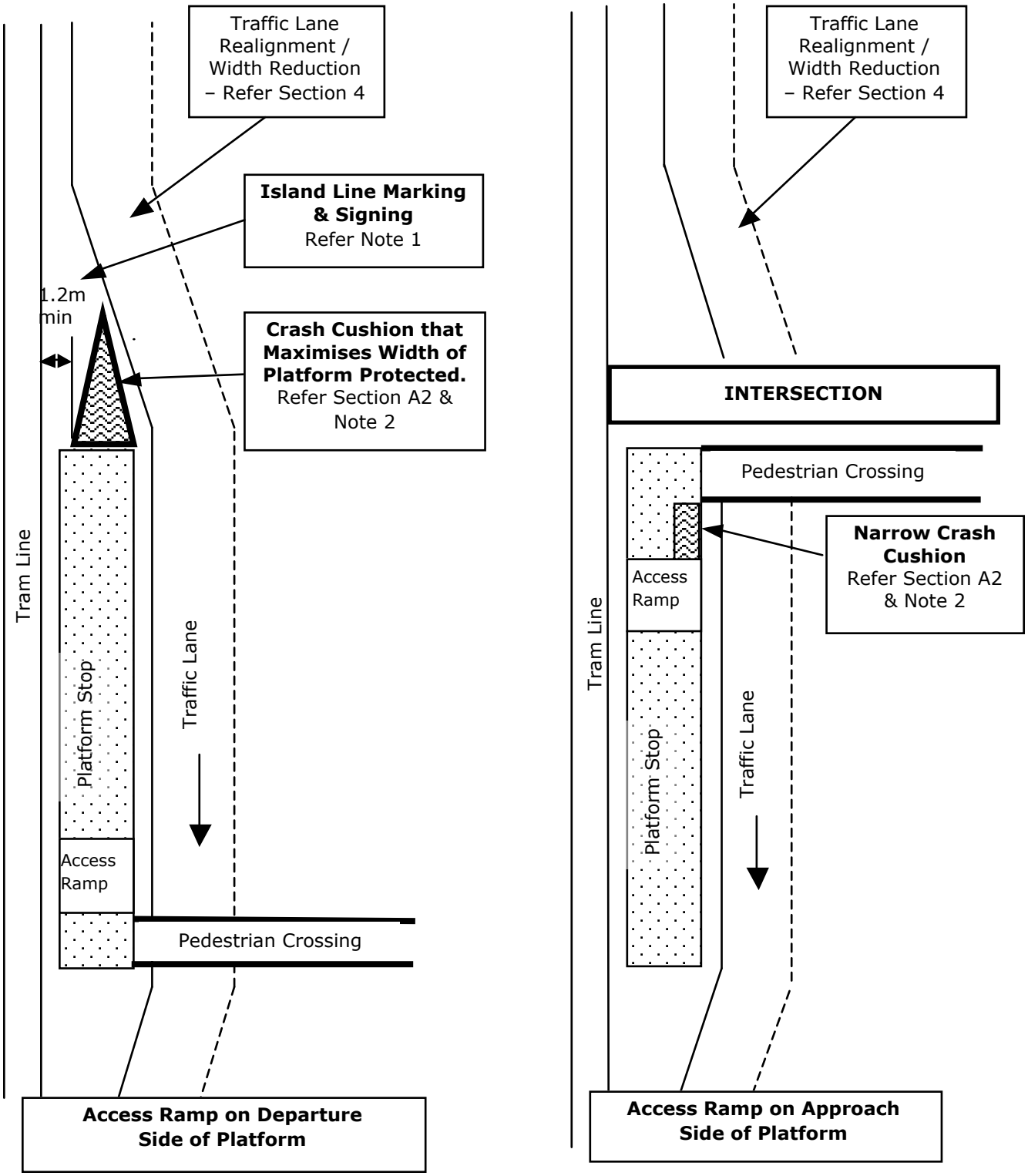

Fig B2 – Tram Stops with Category 2 Barriers

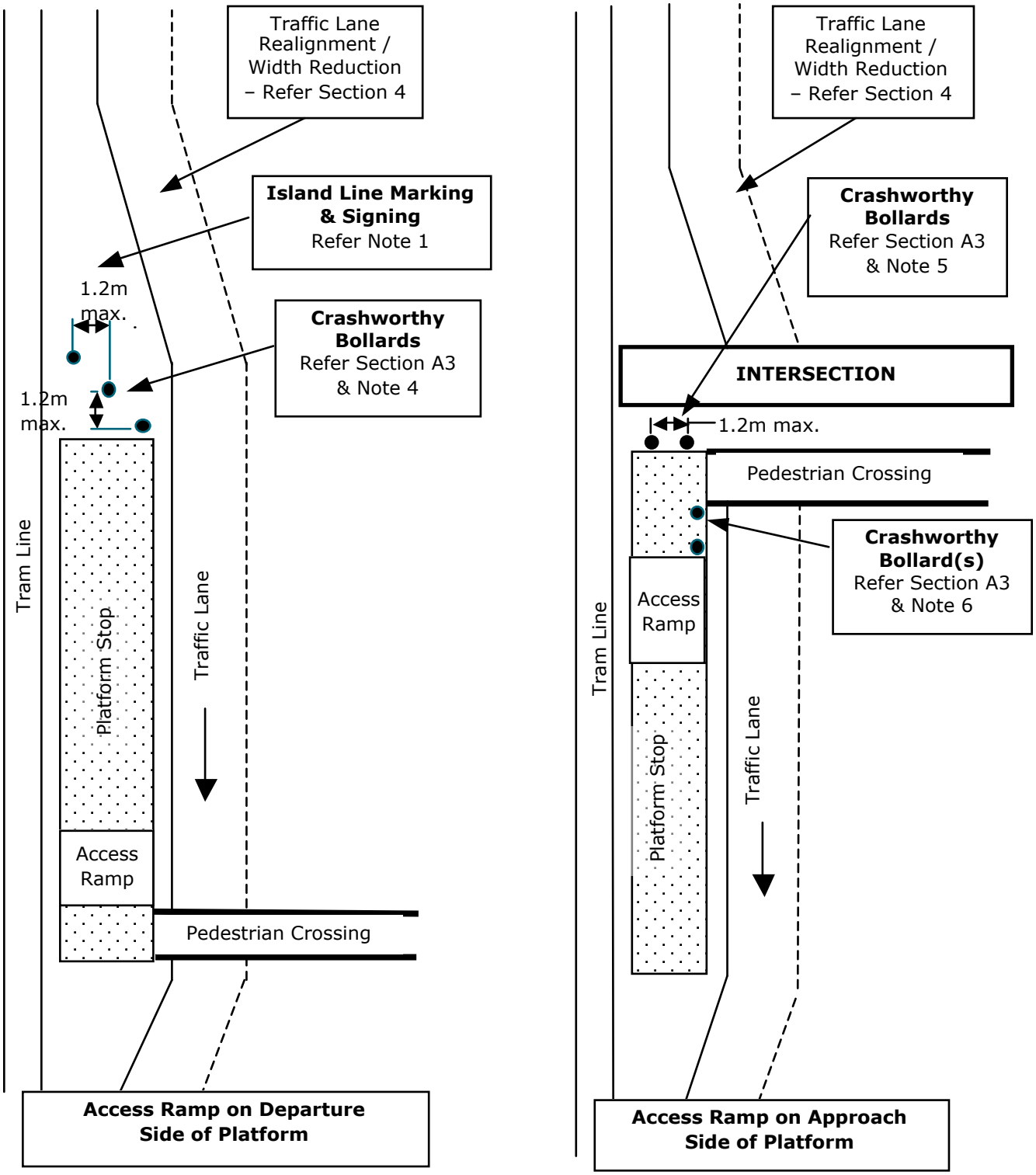

Fig B3 – Tram Stops with Category 3 Barriers

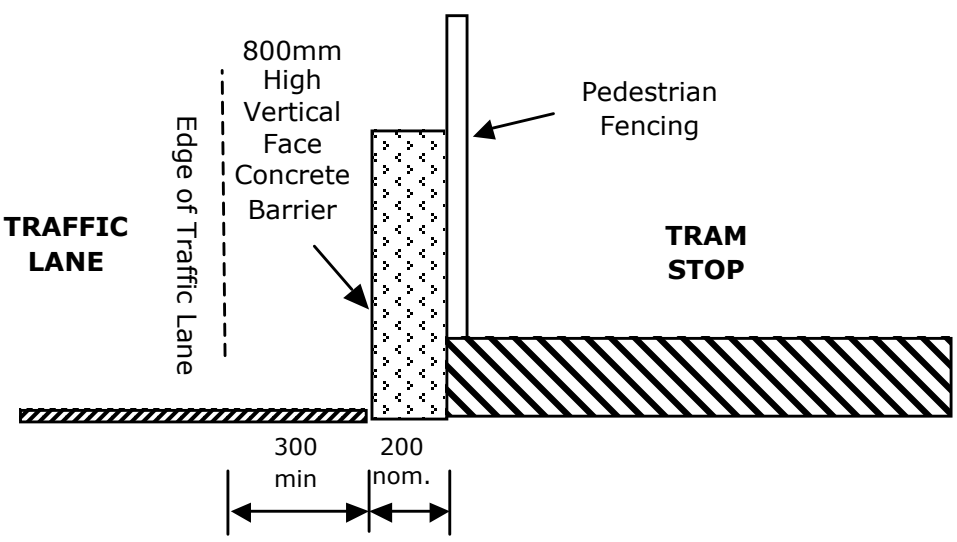

Fig B4 - Platforms with Vertical Face Concrete Barrier

Notes to Figures B1 to B4 – Layouts for road safety barriers and platform terminations

1. Island line marking and signing as per Section 18.2 and Figure 18.26 of *VicRoads Traffic Engineering Manual Volume 2 – Signs and Markings* shall be provided on approaches, except for departure side stops at intersections.
2. Acceptable crash cushions, or impact attenuators are listed in Road Design Note 06-04.
3. Vertical face concrete barriers shall be designed to satisfy a low performance level as defined in AS5100 –Bridge Design, or better. Concrete barriers with a Type F profile as shown on standard drawing SD3901 (latest version) are an acceptable alternative to vertical face profiles.
4. Bollards should be aligned to maximise the width of platform protected. An angled array of bollards as shown in Fig. B3 is preferred to minimise the likelihood of striking more than one bollard simultaneously.
5. A line of bollards perpendicular to the direction of approaching traffic is only acceptable where site constraints prevent the use of an angled array as described in Note 4 above. Bollards should be aligned to maximise the width of platform protected.
6. Where the access ramp is located on the approach side of the platform and the ramp is separated from the pedestrian crossing such that it is not shielded by bollards at the intersection or signal poles, then bollards should be provided between the crossing and the access ramp railing to maximise the protection provided to the platform.
7. Bollards should be a conspicuous colour to ensure they are highly visible to motorists and include a delineator as defined in Section 23.2.1 of *VicRoads Traffic Engineering Manual Volume 2 – Signs and Markings.*

Appendix C

Development of proposals to modify traffic lanes

Most existing safety zones will not be wide enough to accommodate a platform stop without encroaching on the adjacent traffic lane(s). Where encroachment is necessary there are basically three options available. These are:

Option 1. Maintain the existing lane configuration and reduce the width of one or more lanes.

Option 2. Remove one lane and modify the width of the remaining lane(s).

Option 3. Widen the pavement on the outside of the carriageway and realign lanes around the platform stop.

Proposals for individual sites may combine two or more of these options. As each site may have unique constraints, it is not possible to be prescriptive in this design note about which option should be adopted, however principles which should be applied in developing proposals are as follows:

1. Lane widths

Minimum lane widths are as follows:

Through Lanes: 3.0m

Turning Lanes: 2.8m

Bicycle Lanes: 1.2m

Desirable traffic lane widths as shown in Section 4.2.5 (Urban Road Widths) of *Austroads Guide to Road Design – Part 3: Geometric Design*, or widths as close to these as possible should be adopted in preference to minimum widths where feasible.

Lane widths less than shown above, or greater than shown in Section 4.2.5 (Urban Road Widths) of *Austroads Guide to Road Design – Part 3: Geometric Design* may be considered where the widths proposed are consistent with those on the existing road either side of the stop. Lane width proposals shall consider the proportion of commercial vehicles in the existing traffic mix and ensure that lane widths are appropriate.

Where a single traffic lane is provided past a platform stop, the minimum pavement width required between the platform and the outer face of kerb is 3.6m, except where additional pavement width is required to meet the requirements of cyclists as described in Section 3 below.

2. Alignment shifts/lane merges

Changes in lane alignments based on diverge tapers with a rate of lateral shift of 1.0m/s is generally acceptable.

Where lane merges are required, merge tapers based on a rate of lateral shift of 0.6m/s are required.

Taper details, including sight distance requirements are defined in *Austroads Guide to Road Design Part 4C and VicRoads Supplement.*

For platforms at intersections, it is not acceptable to shift the alignment of lanes on one side of an intersection without either:

(a) Providing the same shift in alignment on the other side of the intersection before transitioning back to the original alignment, or

(b) Providing clear delineation of lane alignments through the intersection.

Option (a) is generally preferable to Option (b). Approach sight distance appropriate to the speed limit is essential for either option.

3. Providing for cyclists

The safety of cyclists travelling past platform stops is a key issue that must be considered in developing proposals that require reductions in lane widths or changes in lane configuration. Short sections of roadway with reduced cross section width can be potentially hazardous for cyclists by creating "squeeze points" when the road space available to them is significantly less than that on the adjoining sections of road.

Platform proposals that require changes to lane widths/ configurations must ensure that provision for cyclists appropriate to the route is included. On routes that are likely to be popular with cyclists, consideration should be given to providing an on-road bicycle lane or a wide kerbside lane. Refer to *VicRoads Cycle Notes No. 7,* (August 2000) *and No.13* (July 2004) for further guidance on this issue.

Provision for cyclists must consider not only the cross section width available but the suitability of the pavement surface for bicycles. Examples of pavement surfaces that may not be suitable for cyclists may include bluestone kerb and channel with wide bluestone channels or depressed grated pits.

Where the platform proposal will effectively force cyclists to traverse unsuitable pavement surfaces they were previously able to avoid, modification of this unsuitable surface to make it traversable for cyclists shall be included in the platform works.

4. Lane removal – assessment of proposals

The retention of the existing lane configuration is a highly desirable objective, even if lane widths need to be reduced. Where this is not possible, VicRoads should be advised prior to concept designs being submitted for approval to enable an assessment of the effect of changing the lane configuration on the operation of the affected road(s) to be carried out. VicRoads may conduct its own assessment of traffic impacts and/or provide direction on the traffic assessment required to be carried out by others prior to submission of concept designs for approval.

Where a number of stops are expected to have a similar effect on lane configurations along a route these should all be advised to VicRoads at the same time to enable the route effects and individual site effects to be considered concurrently.

The feasibility of relocating stops to avoid changes to lane configurations at critical intersections or mid-block locations should be investigated to enable an assessment of all available options to be completed.

5. Parking

Where lane realignment or removal impacts on existing parking capacity, the number of parking spaces affected should be identified and shown on any proposals submitted to the relevant municipality for approval. The relevant municipality shall be consulted on the feasibility of modifying existing parking arrangements before any proposals are submitted for approval. Where changes to the road layout will have an impact on existing parking arrangements, the relevant municipality should be invited to submit proposals for mitigation measures, including the feasibility of modifying adjacent parking areas for additional capacity, which would be included in the platform works.

The number of parking spaces affected should be minimised subject to the lane width and realignment provisions of this design note being satisfied.

6. Local Access

The effects of any changes to existing traffic lanes on points of access to adjoining properties shall be identified and shown on any proposals submitted to the responsible road authority for approval. Changes to existing traffic lanes may affect local access in a number of ways, examples of which include the following:

- Commercial vehicle access. Reduced lane widths may force larger vehicles to occupy more than one lane in order to turn into or from a point of access. Proposals must demonstrate that existing access conditions can be maintained – i.e. design vehicles currently able to access a property must continue to have viable access.
- Access in merge areas. If lane merges are required, points of access within merge areas may be more hazardous than those within single or dual lane sections of road due to the increased demands on drivers in these areas. Merge areas should be located clear of points of local access if possible.
- Sight Lines to Access Points. Changes to lane alignments may change sight lines available to vehicles exiting points of local access, particularly if parking is permitted near the approach side of the access point. Sight lines available to points of local access must be appropriate to the speed environment.

7. Bus Stops

Any bus stops located within sections of road where lanes will be modified or removed should be identified and shown on any proposals submitted to the responsible road authority. The effect of buses stopping within the modified section on traffic operation and safety should be considered as part of the assessment of the proposal.

Bus service operators and the responsible road authority shall be consulted on all proposals where existing bus stops may be affected by tram platforms and associated roadwork to ensure that bus operations are not adversely affected.