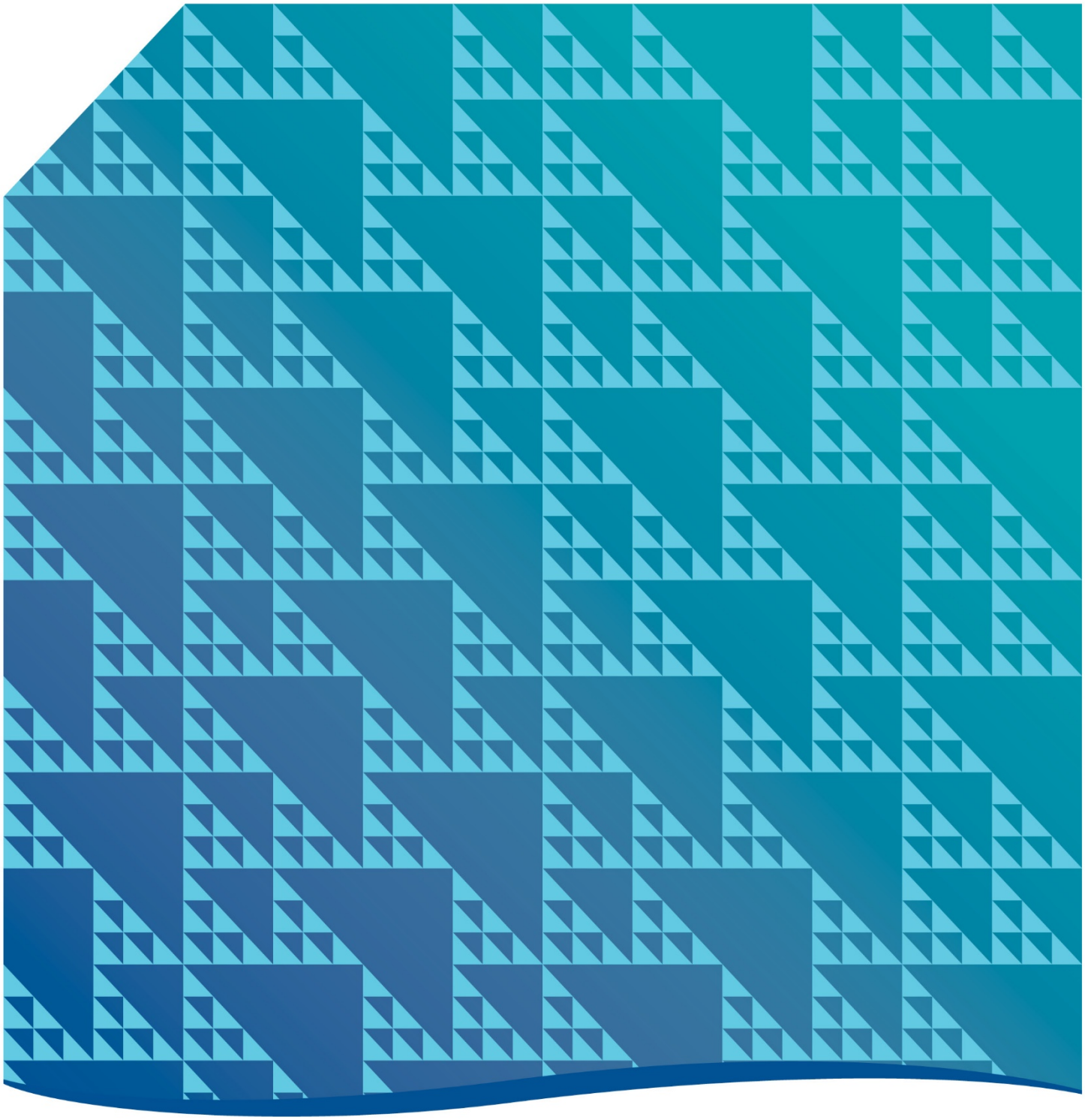
Design Guidelines for Category One Roads

Edition 5 – 3rd December 2015

Design Guidelines



Department of State Growth

Tasmanian Government

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Objective

This document is to provide guidance on how the Department of State Growth can upgrade Category One roads cost effectively in Tasmania, to reduce the casualty crash rate and improve road safety and efficiency.

Traffic Safety Strategy

Consistent with the Safe Systems approach, deliver a minimum AusRap 3 Star rating by introducing the following mass action road safety countermeasures -

- **Lane separation** with flexible safety barriers can achieve a 90% reduction in serious road trauma caused by head-on and run-off road crashes. Involves provision of flexible safety barrier within central medians to reduce head on crashes and on outside shoulders where required to reduce run off road crashes.
- **Audible edge lines** to alert drivers if they drift towards the edge or centre of the road to provide time to correct.
- **External sealed shoulders** to allow drivers to recover and prevent loss of control if a vehicle crosses the audible edge line.
- **Removing roadside hazards** or providing roadside barriers where hazards cannot be removed.
- **Improving skid resistance** of road surfaces.
- **Improving junctions** by providing protected turning lanes.
- **Alignment improvements** to smooth out tight corners and reduce blind spots.
- **Alternating 2+1 lane arrangements** at regular intervals to provide safe overtaking opportunities and avoid driver frustration.

1. Design Cross Section Selection

The design cross section is to be selected by considering the design traffic volume. The design traffic volume is calculated by using the estimated annual compound growth rate for 20 years.

Lane and median widths may vary with sight distance requirements on horizontal curves.

Where Design Traffic Volumes < 15,000 vpd

- Treat links with 2+1 cross section with 2.1m median for Flexible Safety Barrier (FSB).
- Where there are intersections use 1+1 cross section with 2.1m median for FSB.

Where Design Traffic Volumes >= 15,000 vpd

- Treat links with 2+2 cross section with 2.1m median for FSB.
- Where the highway is approaching a built up area, and design traffic volumes are in excess of 15,000 vpd, widening of the median to 3.0m should be considered to mitigate the likely higher hit FSB rate.

Note that the median width of 2.1m was selected, and this falls under Extended Design Domain (EDD) criteria. No other EDD criteria can be applied for horizontal and vertical alignments.

Side Roads

- Design cross section for side roads should match with existing.

See Appendices 1, 3.1, 3.2, 4.1 and 4.2.

2. Design Vehicles

General Access - Semi Trailers

PBS L2A - B Double

PBS L3A - B Triple

Urban areas with residential land use - state road intersections should be designed for General Access. PBS L2A access should be provided where there is industrial land use.

Rural (non-urban) areas the following default design vehicles should be provided:

For movements on Category 1 road links

- Provide for PBS L3A vehicles between the major freight portals for the State, Burnie Port, Bell Bay Port and the Brighton Transport Hub.
- The design cross section developed for the Midland Highway Safety Upgrade Programme provides for PBS L3A through movements.
- PBS L2A access is to be provided on links not associated with major freight portals.

For movements where there is grade separation between State Roads

- Provide for PBS L3A where each road is a route to a major freight portal, design for access e.g. Midland Hwy / Illawarra MR.
- PBS L2A is to be provided on links not associated with major freight portals.

For movements where there is grade separation between a State and Local road

- High productivity vehicle function to be ascertained to inform design vehicle standard.

For at grade intersections movements to a major freight portal

- Provide for PBS L3A access.

For at grade intersections movements not involving a major freight portal

- Provide major and minor junctions with PBS L2A access.
- Design property accesses to cater for the design vehicle whatever it may be in each case, determined from property owner / operator.

3. Design Speed, Vertical and Horizontal Alignment

3.1 Design Speed

For "Greenfield" sites Austroads guidelines suggest adopting design speed of 110 km/h.

For Existing roads, "Brownfield" sites, the operating speed of the existing road should be used where known. In the absence of the operating speed, values of 110 km/h to 120 km/h are recommended.

Adoption of a blanket design speed does not necessarily provide value for money. Design speed of individual sections can be varied to match the existing topography.

Design speeds as low as 90 km/h to 100 km/h may be considered acceptable as long as appropriate mitigation is provided.

With Brownfield sites, apply vertical and horizontal alignment parameters to deliver cost effective outcomes.

3.2 Stopping sight distance (SSD)

The design speed (horizontal and vertical curve design parameters) will be guided by assessing SSD criteria.

SSD for existing and the proposed designs are to be identified where less than 260m. Designers are to indicate sections of the highway where:

- SSD is between 209m and 244m
- SSD is less than 209m

Absolute Minimum SSD = 209m at 110 km/h with 2.5 sec reaction time and d=0.36
Desirable Minimum SSD = 244m at 110 km/h with 2.0 sec reaction time and d=0.26
Desirable SSD = 260m at 110 km/h with 2.5 sec reaction time and d=0.26

When assessing SSD on proposed design, any central FSB needs to be considered.

Quantifying the SSD deficiency, and the cause will enable an appropriate cost effective solution to be determined. This could include:

- Minor improvements to horizontal alignment.
- Minor improvements to vertical alignment.
- A combination of minor horizontal and vertical improvements.
- Additional shoulder widening to provide manoeuvrability if improving SSD is cost prohibitive, particularly if there is no crash history.

3.3 Horizontal Alignment Improvements

Horizontal alignment should match or exceed the operating speed. In general for roads with a 110 km/h speed limit, horizontal design should seek to achieve a 120 km/h design speed where practical.

However, improvements to horizontal curvature need to consider adjacent constraints and effects to heritage, fauna and flora and the vertical alignment.

As a guide, where the existing radius is R:

- R<530m (110 km/h) Improvements up to 120 km/h standard to be considered depending on SSD constraints. If improvement cannot be achieved, provision of additional signage and delineation may be required.
- 530m<R<670m (120 km/h) Improvements could be required depending on SSD constraints.
- R>670m – no improvements needed unless SSD compromised due to other factors.

NOTE: Incremental improvements may be achieved in lieu of full realignment of lengths, particularly where there is no crash history.

3.4 Vertical Alignment Design

In the context of Brownfield sites, major changes to vertical alignments are not considered value for money, but will be considered in the context of available SSD.

Where additional lanes are added there are implications for the vertical profile (i.e. crown line) which can be further complicated by changes needed to superelevation, particularly if combined with pavement strengthening.

Cost effective improvements to vertical alignments can be considered in this context by shaving vertical crests and filling either side of crests.

Cutting of crests is considered to be less cost effective, due to reduced pavement depth and risk of exposing potentially weak subgrades, and management of traffic during construction.

Generally a 110 km/h design speed should be achieved:

- Crest vertical curve K values ranging from 97.3-133 for general and absolute minimums respectively.
- Minimum length of crests between 100 and 150m.
- Sag vertical curve K values ranging between 51 and 112.

Where it is identified that the vertical alignment of the existing road does not meet stopping sight distance requirements for a design speed of 110 km/h the Department of State Growth will assess the situation taking into account:

- That EDD concessions may apply (Brownfield sites).
- Crash history profile.
- Benefit for cost considerations given that vertical alignment improvements will generally yield very low road safety benefits.

This may result in additional shoulder width to be provided to allow for increased manoeuvrability rather than improving the vertical alignment to 110 km/h.

Refer to Appendix 2 for further information on interpretation of Austroads Guidelines to Road Design.

4. Flexible Safety Barrier

Deployment of Flexible Safety Barrier (FSB) is a key element in the strategy to improve traffic safety for two primary reasons:

1. FSB within a centre of the road median is highly effective in reducing head on crashes subject to how many median openings are allowed. The intent is to minimise median openings as far as practical, recognising some loss of direct access for property owners and transport operators will result.
2. FSB placed 0.5m from sealed road shoulders is highly effective in reducing crashes that result from a vehicle leaving the road.

Application:

- Wire rope safety barrier, category TL3, is an acceptable form of FSB.
- FSB should be mounted centrally within the median on straights.
- On curves median widening over the standard may be necessary to offset the FSB to maintain SSD. The width between the FSB and edge line should be not be less than 1.0m.
- Verges with FSB are to be sealed to minimise vegetation management.
- Generally, do not provide FSB on outside edges of roads through cuts that are in the clear zone, unless the cut is a hazard itself. In these cases the situation should be assessed on a case by case basis.

5. Provision for Overtaking

Where FSB is provided in the road median, provision of overtaking lanes is required to maintain highway capacity.

The intention is to alternate positioning of 2+1, 1+1 and 1+2 treatments along the route as regularly as possible to provide equally for each direction. It is anticipated that this will result in:

- 1+1 being used between 2+1 and 1+2 lengths to provide for intersections, median openings with width for turn lanes, property accesses and U turns.
- Provision of a general minimum overtaking lane length of 1.5 km.
- Merge tapers are to be designed for the posted speed limit as per Austroads Guide to Road Design Part 3.0 – Overtaking Lanes with additional shoulder width to be provided in the merge taper as per figure 9.2 (2009) of this reference.
- 2+2 treatments may be considered on climbing lanes or where overlaps are required.
- 2+2 is recommended where the design traffic volume exceeds 15,000 vpd.

6. Median openings and provisions for Access

The objective is to provide median breaks at approximately three kilometre intervals. This has been the position for all projects to date, and was negotiated with emergency services since 2010. Application will depend on the circumstances and some flexibility may be necessary to provide access to properties in some instances.

Coinciding median breaks with high volume accesses and side roads is recommended.

6.1 Intervals between median openings

- Provide formal openings at ~ 3 to 4 km intervals. This spacing works well for contraflow to allow for road maintenance activities like resealing, crash site management, emergency services and minimises impact on property accesses. The openings may or may not coincide with property accesses, if they do, there is potential for right turns into a property access to be permitted. Design for vehicle nominated by property owner within reason.
- Provide U-turn capacity for PBS L2A at major side road junctions by introducing G-turns on the side roads.
- Provide two pairs of P-turns every 10-12 km between side road junctions i.e. provide a pair of P-turns at 3 to 4 km intervals. See Appendix 6.1 and 6.2.

6.2 Management of median openings

- G-turns to cater for PBS L2A vehicles on side roads.
- P-turns to cater for PBS L2A vehicles on the highway.
- Where there are T junctions, provide G-turns on the minor road designed for PBS L2A vehicles at the most suitable/strategic junctions.
- P-turns for turning across 2 oncoming lanes are acceptable subject to sight distance requirements.
- G-turn use on the highway should be minimised as much as possible, and if used, only on 1+1 sections of the highway.
- Where a median opening for property access is allowed within overtaking section, default position should be to facilitate right turn in, but prohibiting right turn out.
- Where distance to next median opening is < 2 km possibly treat property accesses as left in left out only.
- Consider service roads where there is a high access density.
- Consider combining accesses where practical.

6.3 Median opening options

- Cater for junctions with side roads. Reduce highway configuration to 1+1 at junctions.
- Minimise right turn provisions for isolated property accesses.
- Cater for U-turns for PBS L2A vehicles using pairs of P-turns, see Appendix 6.2.
- Where unavoidable, cater for G-turns for PBS L1A vehicles, but only where highway configuration is 1+1.
- See Midland Highway Median Opening Design Drawings for Emergency Vehicles, U-turns, Accesses and Intersections in Appendix 6.1 and 6.2.

7. Street Lighting

Application Principals:

- In the interests of a consistent driving experience for road users, provision of street lighting is to be avoided unless there are identified hazards such as solid islands, bridge structures, solid medians, solid channelization or roundabouts.
- FSB and associated terminations are not considered a hazard requiring street lighting. Sufficient delineation is provided with audio tactile edge lines, RRPMs and barrier fence delineators.
- Where traffic islands are provided on a side road approach to a highway, street lighting should be applied to the island on the minor road approach and impinge as little as possible on the through road.
- Street lighting should be applied to interchange on and off ramps.
- The lighting category to be applied to State Roads is Australian Standard AS1158 – Category V5.

8. Grade Separation of Intersections

Consider road category, crash history, future land use, freight use and cost in determining intersection treatments.

Where Design Traffic Volumes <10,000 vpd

Provide at grade intersection treatments, grade separation is not likely to be required.

Where Design Traffic Volumes 10,000 – 15,000 vpd

- Where speed limit >= 100 km/h consider grade separation with minimum provision of on and off ramps.
- Where speed limit < 100 km/h at grade intersections preferred

Where Design Traffic Volumes >= 15,000 vpd

- Where speed limit > 80 km/h consider grade separation.
- Where speed limit <= 80 km/h at grade intersections preferred.

See Appendix 5.1 and 5.2.

9. Intelligent Transport Systems

There are some situations in which it may be cost effective to provide intelligent transport systems (ITS) including the following:

- Variable Speed Limits to respond to variable weather conditions; or
- "Watch For Entering Traffic" warning signage to cater for large and / or slow moving vehicles entering the highway that could be a hazard to highway traffic.

Factors for consideration when considering candidates for either of the above treatments:

- Intersection layout.
- Major and minor road traffic volumes and growth rates.
- Land use, future development, and % of commercial traffic (PBS L1, 2A, 3A or other large slow moving vehicles).
- Crash History.
- Topography, speed environment and sight distance.
- Weather characteristics e.g. propensity for ice, fog, snow or wet road surface.
- Availability of power supply and communication network.

Drawing T3/2/60 – Appendix 7, is an example of an ITS application on the East Tamar Highway - Dilston Bypass, incorporating the Variable Speed Limit and "Watch For Entering Traffic" treatments. This example is a good guide for how similar treatments where warranted could be implemented on the Midland Highway

Appendices

- A1 - Midland Hwy Cross Section Justification Report – September 14
- A2 - Midland Hwy Projects - Vertical Alignment Design Discussion – May 15
- A3.1 - Midland Hwy (Perth to Breadalbane) Median Width Report – February 15
- A3.2 - Category 1 Road Median Widths - Table 1 – February 15

- A4.1 - Midland Hwy Upgrade "2+1" X section drawing – July 14
- A4.2 - Midland Hwy Upgrade "2+2" X section drawing (to be prepared)
- A5.1 - Midland Hwy – Devon Hills Intersection Options Report – November 14
- A5.2 - British Guidelines on warrants for Compact Grade Separated Junctions
- A6.1 - 2+1 Typical Median Opening Application – Page 1 of 2 - June 15
- A6.2 - 2+1 Typical Median Opening Application – Page 2 of 2 - July 15
- A7 - Drawing T3/2/60 – ITS Example – January 11

Document Control

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