Midlands Highway Safety Improvements Programme 2014-2024

Highway Cross Section Selection and Justification

Objective: To deliver a minimum AUSRAP 3 star rating for the entire length of the Midland Highway in Tasmania.

Strategy: Using the Safe Systems approach apply safety countermeasures not limited to the following elements:

1. Central median barrier
2. Roadside barriers
3. Shoulder rumble strips
4. Skid resistance
5. Protected turned lanes
6. Additional lane

Background: In 2013 RACT arranged an AUSRAP survey of the Midland Highway between Mangalore and Breadalbane. State Growth has reviewed the survey results and found that the star rating along the highway typically ranges between 1 and 2 with some section marginally better or worse. The table below shows typically what elements have been present for the AUSRAP star rating achieved on the sections of the Midlands Highway that have been surveyed. The majority of the road scores a rating of 2 stars or less.

	Treatments Present					
AUSRAP Star Rating	***Audio Tactile Markings (Edge & Centre)***	***Protected Turn Lanes***	***Roadside hazard protection or clear zone provision***	***Additional Lanes***	***Median Barrier***	***Skid Resistance***
3	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
2.5	**Y**	**Y**	**Y**	**Y**	**N**	**Unable to quantify**
2	**Y**	**Y**	**Some**	**Some**	**N**	
1.5	**Y**	**Y**	**Minimal**	**N**	**N**	
1	**Y**	**Some**	**N**	**N**	**N**	
<1	**Y**	**N**	**N**	**N**	**N**	

This table indicates that all six elements must be present in some form to achieve an AUSRAP 3 Star rating.

Element 1 - Central Median Barrier (CMB)

Swedish Story (Carlsson 2009) – with 1.75m wide CMB, 110kph and 0.75m shoulders

- *Head on collisions almost disappear*
- *76% reduction in fatalities*
- *Up to 50% reduction in fatalities and serious casualty crashes in total*
- *Increase in property damage and slight injury crashes. Collisions with median barrier are very frequent and equate to 2 crashes per year per km, with 65% in the one lane sections. Cable repair costs per km for AADTs ranging between 7,500and 10,000 vpd works out at $11,500 per km per year.*
- *Towing rate – 20-25% of all barrier crashes will require towing.*
- *In 2009 the Swedes were looking at various alternative barrier reflectors, edge line designs and median widths to reduce the crash rate .Increasing the median widths and lane widths was expected to reduce crash rates.*
- *Corben (2003) concluded the Swedish success was largely due to the wide scale implementation of flexible barrier rather than the 2+1 layout*

Irish pilot scheme – with 2 m wide CMB and 1m sealed shoulders

- *50-60% reduction in in fatalities and serious casualty crashes in total*
- *No reported problem with hit fence rate*

Wire Rope Safety Barrier research and investigations for the Pacific Highway and RTA (Nilsson & Prior) – 2m wide CMB and 2m sealed shoulders

- *35-50% reduction in fatalities*
- *30-45% reduction in fatalities and serious casualty crashes*
- *30%increase in vehicle damage / non injury accidents*
- *Most appropriate type of median safety barrier was wire rope*
- *Wire rope safety barrier has design deflection of 1.5m at 110kph*
- *Central location within the median for flexible wire rope barrier*
    - *Debris from damaged barrier does not encroach into carriageway (the posts are 900mm)*
    - *Sight distance past barrier is maintained*
    - *Sustain less impacts than a median offset to one side*
    - *Deflection into opposing carriageway is due to an incident is less*

Fatality rate per 100,000 of population across the world

- *Sweden – 4.9*
- *UK – 5.5*
- *Germany – 6.5*
- *Ireland – 9.6*
- *Victoria – 6.6*
- *Queensland – 8.3*
- *Tasmania – 11.2*

Factors to consider in case for narrow medians e.g 1.6m CMB

- Impact on hit fence crash rate
- Impact on life cycle and ongoing maintenance requirements
- Half median width needs to be sufficient to contain dislodged elements of fence
- Very efficient incident clearance procedures are required
- Impact on sight distance
- Provisions for motorcycle riders
- Maintenance worker safety
- Overlaps at joins narrow the effective clearance also errors in fence , line marking and overlap setout can result in very little or no clearance at overlaps

CMB selection for the Midlands Highway

- Swedish roads (8,000-10,000 vpd) typically have double the traffic on the Midlands highway (4,000 – 7,000 vpd)
- Midlands Highway crash rate is double the Swedish crash rate as evidenced by fatality rates provided above.
- On the above basis the Midland Highway hit barrier rate and wire repair cost could be similar to Sweden at about $10,000 per km per year however this is more likely to be an upper limit.
- The Mangalore to Breadalbane stretch of the Midland Highway is 150km in length.
- In case of narrow medians a higher level of emergency response needs to be factored in.
- Role of shoulder width in run off road (ROR) crash rate is understood. Extra 0.5 to 1.0m of shoulder reduces ROR rate by in the range of 35-50 %. Same principle applies for median shoulders.
- On this basis could say that every 0.1m of shoulder effects crash rate by at least 7%.
- The pavement cost per 0.3m of median is really only the materials cost as all plant and labour capacity is on site for the scale of operations involved. A supplied and placed pavement of 450mm is $55/m2 but really only half this is material cost so say $33/m2 to be conservative i.e $10,000 per km.

The following scenarios are presented to provide an indication of cost effectiveness of various CMB widths on the 150km length of the Midlands Hwy (110kph & 5,000 vpd). No cost has been included for extra emergency response required for the narrow median (1.6m wide) case.

Scenario 1 - $10k per km per year barrier repair cost

- 1.80m CMB – barrier maint.cost - $1.5M/year
- 1.60m CMB – barrier maint.cost - $ 1.7M/year,0.2m pave. saving $1.0 M one off
- 2.10m CMB – barrier maint cost - $ 1.2M/year, 0.3m pave cost $1.5M one off
- Over 10 years total operational cost with o interest:
    - 1.80m CMB – $15.0M
    - 1.60m CMB – $16.0M
    - 2.10m CMB – $13.5M

Scenario 2 - $5k per km per year barrier repair cost

- 1.80m CMB – barrier maint.cost - $0.75M/year
- 1.60m CMB – barrier maint.cost - $ 0.85M/year,0.2m pave. saving $1.0 M one off
- 2.10m CMB – barrier maint cost - $ 0.60M/year, 0.3m pave cost $1.5M one off
- Over 10 years total operational cost with o interest:
    - 1.80m CMB – $7.5M
    - 1.60m CMB – $7.5M
    - 2.10m CMB – $7.5M

Scenario 3 - $2.5k per km per year barrier repair cost

- 1.80m CMB – barrier maint.cost - $0.375M/year
- 1.60m CMB – barrier maint.cost - $ 0.428M/year,0.2m pave. saving $1.0 M one off
- 2.10m CMB – barrier maint cost - $ 0.30M/year, 0.3m pave cost $1.5M one off
- Over 10 years total operational cost with o interest:
    - 1.80m CMB – $3.75M
    - 1.60m CMB – $3.28M
    - 2.10m CMB – $4.50M

In terms of lifecycle cost whether the barrier maintenance cost is $10k, $5k $2.5k per km per year there is very little difference in lifecycle cost.

Tasmanian case histories:

Dilston Bypass - 1.8m CMB offset fence, 100 kph, aadt-4,800vpd

- *Considerable ongoing barrier hit rate 19 hits over 12 months in 2012*
- *Have 12 months (2012) data (Hubble) – $33k over a 13km length I,e $2,500/km. There is a lot of uncertainty with the limited data recovered and insufficient data to draw any conclusions on representative rates for the 100kph and ~ 5,000vpd road scenario.*
- *Complaints from motorcyclists*

Brighton Bypass - highly variable 2 – 4m CMB, 110 kph, aadt – 8,000vpd

- *Not aware of any problems with barrier hit rate*

Bass Hwy – Gannons Hill 1.8m CMB with offset fence, 110kph, aadt- 8,300vpd

The offset barrier in the median was too close to the through lane judging from edge line setout. Hit fence crashes were recorded immediately. From site inspection TEB determined that the median should be widened by 200mm on the shallow side to create more clearance. The width required was taken by reducing the shoulder width by 200mm to 1.8m.

Midlands Hwy - Symmons Plains – 1.8m CMB with offset fence, 110kph, aadt-6,300vpd

From setout markings on site it was clear that the end result was not going to look good or provide much clearance. Contractor and Superintendent asked TEB to review. TEB recommended centralising the fence within the median and widening the median to 2.1m and narrowing each shoulder by in the order of 150mm.

Not aware of any problems with barrier hit rate. Looks good and feels comfortable to drive. TEB is of the view that the revised cross section, in terms of widths works well.

Victoria - Bacchus Marsh Road Cross Section

Vicroads has sent through their design for 2+1 project on Bacchus Marsh Road.

Points of interest of a quick scan of document:

- *The narrow median is considered under EDD (Extended Design Domain)*
- *2.2 metre wide painted median containing WRSB*
    - *1.metre clearance (minimum) between barrier and edge of traffic*
    - *Partial encroachment of the dynamic deflection of the barrier into traffic lane - Maximum allowance of 0.5m*
    - *This means the dynamic deflection of the WRSB must not exceed 1.5metres*
    - *Post cushions (white) to be used on popular motorcycle routes*
    - *WRSB terminals – non-releasing anchors*
    - *WRSB centrally located unless widening on curves to meet sight distance or deflection requirements*
    - *The provision of breaks in the WRSB is to considered on a project-specific basis, given consideration to the location of intersection and property access as well as emergency access requirements.*
- *2.2m not allowed for 110 km/h – must be at least 6.2m wide*
- *3.5m wide traffic lanes*
- *3.m wide shoulder and 0.5 verge*
- *" VicRoads will be refining the cross section to ensure it satisfies the requirements of the Transport Accident Commission (who are funding the project). This may lead to a reduction in the proposed cross section."*
- *Traffic volume is around 5000 vpd*

See Appendix 3 for cross section and location plan.

See Reference 13 for Vicroads Supplement to Austroads Guide to Road Design –Part3 Geometric Design.

South Australian Experience with "Smart "road barriers

SA have been trialling "Smart" road barriers that speed up emergency response times by electronically monitoring the wire rope strain levels and reporting to police and ambulance when intervention level is reached. This trial has been going almost 12 months. It is assumed a narrow median i.e less than 2m has been provided and this is why the "Smart" mitigation is being applied. Waiting to hear back from SA colleague on the trial findings.

Construction scenarios for upgrading the Midlands Highway

In a nut shell very little of the midlands highway is wide enough to retrofit medians. It is just a reality that even with some width compromises on median and shoulder widths there is insufficient sealed width to retrofit without widening.

Accordingly , given widening in the order of 2m will be required either on one or both sides of the road, it is cost effective to ensure a safe 2.1m median is provided.

Operational issues

To facilitate road maintenance eg, reseals, over dimension vehicles and upon input received from the Tasmanian transport industry etc TEB settled on a clearance width requirement of 7.0m on one lane carriageway. With a 3.5m lane, 2.0m shoulder and 0.5m verge this leaves a need for 1.0m in the median to the face of the barrier. On the other side of the fence 1.0m clearance is also needed so incident vehicles do not overly intrude into the oncoming fast lane. At 110kph the design deflection is 1.5m and if a 1m clearance is provided the incident vehicle would only intrude 0.5m into the oncoming lane. With 1.0m clearance either side of the median barrier fence and a 0.1m wide fence the gross median width is 2.1m from centre to centre of the median edge line.

Public Perception

It is anticipated that a safer outcome would be the community preference and result in greater community acceptance than a narrow median with a higher hit barrier rate. Also provides Motorcyclists a more forgiving environment i.e time to correct and avoid the barrier fence.

Conclusion

If the Midland Highway could be retrofitted with median barrier over the majority of its length without widening works a narrow median could be worth considering as substantial civil works costs could be avoided. As it is however, very little of the Midlands Highway can be retrofitted without widening roadworks where the cost of an extra 300mm of pavement is a small/ negligible cost.

Recommendation

For these reasons TEB recommended a 2.1m CMB with centrally mounted flexible barrier.

This was subsequently approved by the Project Executive Group some 3 months ago.

Element 2 – Roadside Barriers

Where topography, roadside hazards or clear zone requirements are uneconomical to achieve, roadside barriers may be provided. Roadside barriers reduce batter slope and width requirements behind the barrier.

Flexible or rigid barriers systems may be used to suit the circumstances however flexible systems are preferred due to their more forgiving nature.

As a guiding principle it is not considered necessary to provide roadside barriers where there are rock or cut batters unless the batter presents as a hazard or there is

a risk of large angle collisions. Rock batters should be cut to a tolerance so that they do not present a hazard.

On the one lane side of the median barrier, to achieve clearance requirements 7m of clear width is required between faces of fences. As per the cross section drawing the 7m clear width between barriers on the one lane side includes a half m width of verge.

On the two lane side of the median barrier the cross section drawing shows a 10.5m clearance where roadside barrier is provided. However in some circumstances it may be acceptable to reduce the shoulder width to 1.0m and /or avoid roadside barriers where:

- Attempting to match in with existing kerb and channel
- Shoulder narrowing is only required over short distances

Element 3 – Shoulder rumble strips (Audio Tactile Line Marking)

Audio tactile line marking (ATLM) is a proven mitigation against run off road crashes and is a standard requirement on Category 1 roads (National Road) in the Tasmanian State road Hierarchy.

Until now ATLM has been achieved using thermoplastic materials in Australia. Profile thermoplastic typically has a 3-4 year lifecycle on chip sealed flexible pavements. New Zealand have been trialling a Cold applied plastic alternative in the South Island, a similar climate to Tasmania and should be considered.

Element 4 – Skid Resistance

Skid resistance is required to enable the driver to keep control of the vehicle as traffic and road environment conditions vary.

Asset Management maintain skid resistance and should be funded to ensure it is maintained to at least intervention level condition.

Element 5 – Protected turned lanes

Central median barrier fence assists in protecting vehicles in turning lanes on the highway. These lanes also need to comply with Austroads warrants for unsignalised intersections.

Element 6 – Additional lanes (overtaking)

Austroads guidelines for lane widths and State Growths own Professional Services Specification T3 (Road Design Standards) nominates lane and shoulder widths required. For a Category 1 Roads 3.5m lanes and 2 m sealed shoulders are specified.

It is understood that in future PBS Level 3A vehicles e.g. B Triple Combinations in excess of 30m in length may be Permitted on the Bass and Midland Highway.

Review of tracked width requirements have been made verifying that 3.5m lanes are adequate subject to widening on curves requirements that are also outlined in T3.

Summary

This document supports the case for the cross section shown in the appendices, for upgrading the Midlands Highway to AUSRAP 3 star rating with the six elements. For such a major capital investment, the centrepiece of the upgrade, the central median barrier needs to suite the situation for the long term. A 2.1m median is recommended as the best option to improve road safety and meet the states future needs.

Appendices

1. Standard Drawing for Midlands Highway Upgrades – Typical Cross Sections for "2+1" Lane Configuration
2. "Smart " road barriers that will speed up emergency response times to crash sites being trialled in South Australia - Adelaide Advertiser 13th November 2013
3. Bacchus Marsh Road Cross Section and location plan

References

1. Austroads Guidelines
2. State Growth Professional Services Specification T3 – Road Design Standards
3. Austroads Technical Report AP-T153/10 Road Safety Engineering Risk Assessment Part 8: Rural Head on Crashes
4. Austroads Research Report AP – R387/11 Improving Roadside Safety – Stage 2 Interim Report
5. Austroads Research Report AP – R419/12 Improving Roadside Safety – Stage 3 Interim Report
6. Evaluation of 2+1 roads with cable barrier – Final Report – Arne Carlsson(2009)
7. The implementation of 2+1 Road scheme in Ireland: a case for Australia - Elaine Gazzin (2008)
8. Wire Rope Safety Barriers and the Pacific Highway Program: RTA Research and Investigations – K Nilsson and Neville Prior
9. Dilston Barrier fence repair data , East Tamar Highway, 2012-P Hubble
10. AUSRAP Star Rating Survey of Midlands Highway – 2013
11. Star Rating Australia's National Network of Highways 2013 – Australian Automobile Association
12. Midland Highway 10 Year Action Plan – Tasmanian Government 2014
13. Vic Roads Supplement to the Austroads Guide to Road Design- Part 3 Geometric Design

Version

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