RAA Highway Assessment

Sturt Highway

August 2013

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Contents

Executive Summary

The Sturt Highway is 225 km in length, connecting Adelaide with South Australia's Riverland region. Starting at Gawler, it runs in an easterly direction towards the Victorian border passing through the major towns of Nuriootpa, Waikerie, Berri, and Renmark. As the most direct route to the Riverland, the Sturt Highway carries high volumes of a diverse range of traffic. The Sturt Highway is recognised as one of the most hazardous sections of Australia's national highway network so close monitoring of the hazards is important.

At the time of *Towards 2020* (2009) the Sturt Highway carried between 1,700 and 10,000 vehicles per day, up to 33% of which were commercial vehicles. This was forecast to increase as a result of the opening of the Northern Expressway in 2010, providing motorists quicker access to the Sturt Highway from Adelaide. As of 2013, traffic volumes were between 1,700 and 10,800 with up to 35% of these being commercial vehicles. This has risen slightly from 2009, and is a likely result of the new Northern Expressway.

RAA has conducted an audit of the Sturt Highway in 2012 to assess the conditions of the road, what improvements have been made, and what still needs to be done.

The highway review found that while the lane widths throughout the highway were 3.5m which is the minimum desired required for a corridor with such high traffic volumes, the sealed shoulders did not meet the 1.5m desirable width. It was encouraging to note however that some degree of sealed shoulder was provided throughout the highway.

The crash statistics support the concerns that many intersections are high risk with lack of signs, lines and poor geometry that makes turning into the high traffic flow difficult. Better signage and provision of protected turn and merge lanes would benefit many intersections on the highway.

The Paringa Bridge is limiting efficiency on the highway with a 30km/h speed restriction and road closures for periods twice a day to allow boat traffic through. Narrow lanes on the bridge also present a safety issue and there is a need to either upgrade the bridge or provide a new bridge to cope with long term traffic growth.

Currently the section of Sturt Highway between Gawler and Nurioopta is duplicated but an increase in traffic volumes demand that in the long term, the whole highway should be duplicated to reduce the risk of head-on collisions.

Audio Tactile Line Marking has been provided for approximately half the length of the Sturt Highway but like most highways in SA, ATLM should be applied to the entirety of the highway as it has been found to be an effective countermeasure for reducing run-off road crashes.

RAA's highway review included an assessment of the pavement on the Sturt Highway. The assessment found that the ride quality of the Stuart Highway was generally good throughout, offering motorists a smooth and even ride. Approximately 3km of the highway was found to have a poor surface offering a less comfortable ride and should be addressed as part of ongoing maintenance. The levels of rutting along the highway was generally acceptable with rut depths between 5 and 10mm however there were a number of sections that were below average, having rut depths of 10 – 15mm that

should be addressed promptly due to the increased potential for aquaplaning at those sections.

The review identified a number of hazards including varying densities of roadside vegetation. Of particular concern was a section west of Barmera where large gum trees have grown within three meters of the edge of the carriageway. Appropriate steps should be taken to protect motorists from these hazards. The Sturt Highway also has a high number of animal collisions. It is suggested that countermeasures are examined to reduce such instances and may include removal of vegetation from the roadside for a specified distance to improve visibility of animals that encroach on the road.

The review found a total of 10 rest areas along the Sturt Highway, three of which had no facilities provided at the layby. While perhaps not considered high priority due to the number of towns along the route, upgrades to the rest stops should be considered to increase their appeal and encourage motorists to take regular breaks.

The results of RAA's highway review were combined with AusRAP data collected in 2012 and used to form the basis of the RAA's recommendations for investment in the highway. These recommendations include:

- **Installation of roadside barriers (114 km)**
- **Improved skid resistance (4.5 km)**
- **Provision of audio tactile edge of carriageway line marking (39 km)**
- **Provision of a central median barrier (without duplication) (7.5 km)**
- **Upgrade junction treatments (protected turn lanes) (40 Sites)**
- **Shoulder sealing greater than 1m (45 km)**
- **Removal of roadside hazards (7.5 km)**

Table 1 shows the results of the 2012 AusRAP star rating for the Sturt Highway and compares this to the star rating that could be achieved if all of the above recommendations are followed.

	Length (%)		
Star Rating	**2012**	**Post Investment Plan**	**Change**
★★★★★	-	-	-
★★★★	6%	60%	+ 54%
★★★	75%	38%	- 37%
★★	16%	2%	- 14%
★	2%	-	- 2%

Table 1 - AusRAP Star Rating Pre & Post Investment Plan

1 Traffic Volumes

The Sturt Highway is 225 km in length, connecting Adelaide with South Australia's Riverland region. Starting at Gawler, it runs in an easterly direction towards the Victorian border passing through the major towns of Nuriootpa, Waikerie, Berri, and Renmark. As the most direct route to the Riverland, the Sturt Highway carries high volumes of a diverse range of traffic. The Sturt Highway is recognised as one of the most hazardous sections of Australia's national highway network so close monitoring of the hazards is important. The highway has been previously analysed by RAA in Towards 2020 (2009) and Backwater to Benchmark (2005).

Since the Sturt Highway is the most direct route to South Australia's Riverland, it is subject to seasonal increases in traffic volumes as tourists are drawn to the area. Nevertheless, heavy vehicles also account for a large portion of traffic as the highway is also one of the fastest routes to Sydney. The composition of traffic can present risks as traffic often encounters slow moving vehicles and there is a demand for regular overtaking opportunities.

At the time of *Towards 2020* (2009) the Sturt Highway carried between 1,700 and 10,000 vehicles per day, up to 33% of which were commercial vehicles. This was forecast to increase as a result of the opening of the Northern Expressway in 2010, providing motorists quicker access to the Sturt Highway from Adelaide. As of 2013, traffic volumes were between 1,700 and 10,800 with up to 35% of these being commercial vehicles. This has risen slightly from 2009, and is a likely result of the new Northern Expressway.

The Sturt Highway has received much attention in the past, due to its hazardous nature and high traffic volumes. Upgrade works to improve the safety and efficiency of this route include duplication of heavily trafficked sections, such as between Gawler and Nuriootpa, extensive shoulder sealing, improvement to junctions, and an increased number of overtaking opportunities. These previous investments have delivered results, as described in Towards 2020, and as such further investment will continue to show results, decreasing crash rates and improving efficiency.

RAA has conducted an audit of the Sturt Highway in 2012 to assess the conditions of the road, what improvements have been made, and what still needs to be done.

2 Crash Statistics

Between 2007 and 2012, there have been a total of 543 crashes on the Sturt Highway. Of these, 76 crashes have resulted in a serious injury or a fatality. Of the 543 crashes, 23.6% involved hitting a fixed object, 17% were right angle crashes, and 13% involved collisions with animals. The high proportion of hit fixed object crashes reflects the roadside hazards on the Sturt Highway, which was a concern raised in *Towards 2020*.

The frequency of right angle crashes suggests that the rural intersections along this route are high risk and require improvement. The issue of animal hazards had not been previously identified in Towards 2020 but is now the third most common type of crash.

The following image illustrates the number of crashes by location along the Sturt Highway for the five year period, 2008 to 2012.

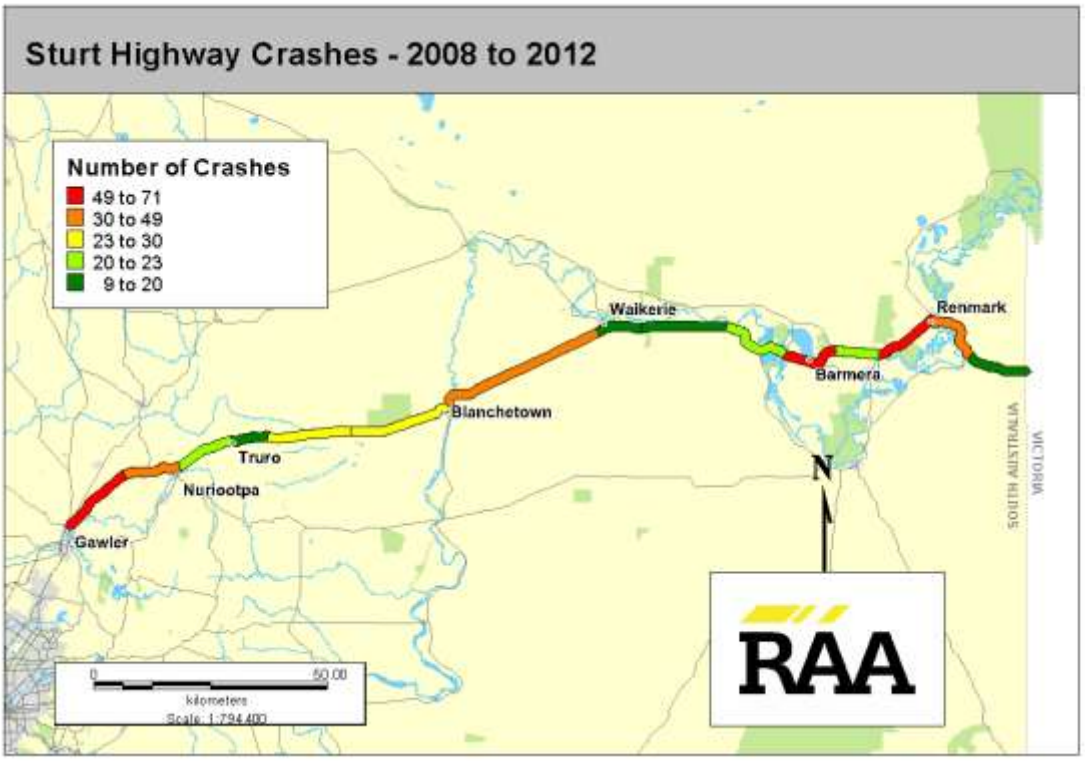

Figure 1 – Crashes Along Sturt Highway, 2008-2012

While the crash totals vary along the Sturt Highway, there appears to be a high frequency of crashes occurring north of Gawler, around Barmera and to the west of Renmark. While the trend has shown a very gradual decline in the number of crashes over the past five years, the figure has remained reasonably constant for the past two years.

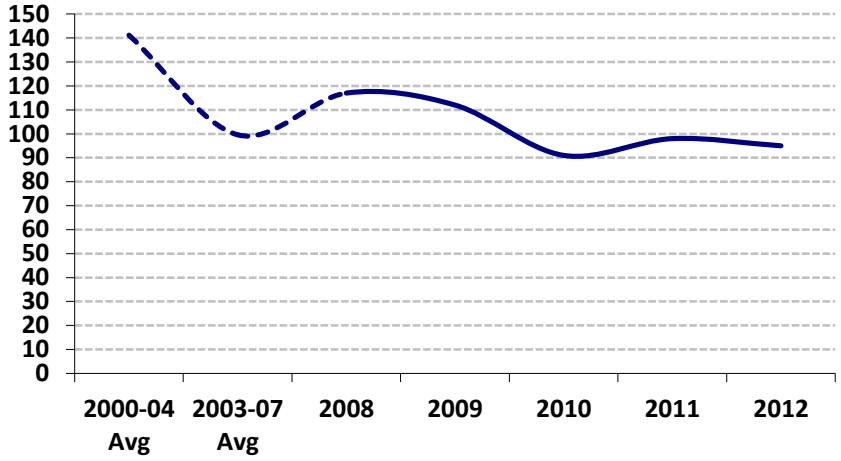

Figure 2 – Crashes On Sturt Highway, 2008-2012

The majority of crashes along the Sturt Highway tend to involve property damage only. During the five year monitoring period there have been 317 property damage only crashes, 124 minor injury crashes, 61 serious injury crashes and 11 fatal crashes.

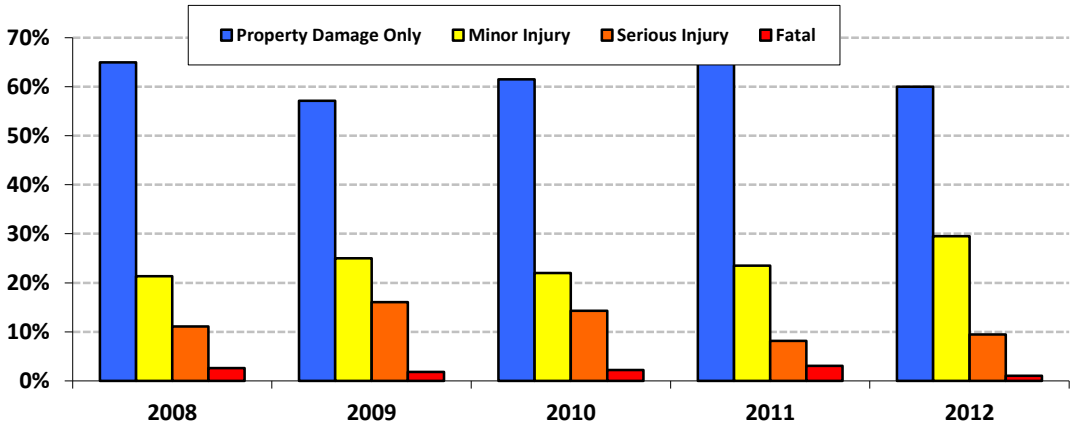

Figure 3 – Crashes By Severity, 2008-2012

Crash Severity	Cost per Crash[1]	Number of crashes	Total Cost (2012 Values)
Property Damage Only	$11,743	317	$3,722,531
Minor Injury	$17,309	124	$2,146,316
Serious Injury	$340,000	61	$20,740,000
Fatal	$7,200,000	11	$79,200,000

Table 2 - Cost of Crashes on Sturt Highway (2012 Values), 2008-2012

Crashes along the Sturt Highway between 2008 and 2012 cost $105,808,847. This figure includes losses to workplace and households as well as a number of medical, insurance, accident investigation, legal and repair costs. The above table breaks down the cost of crashes by severity for the past five years and highlights that each fatality costs over $7M (in 2012), which in turn is over 21 times the cost of a serious injury. Therefore any change in the number of fatalities would have a significant impact on the overall cost for a particular road or area.

3 Highway Geometry

The Sturt Highway is characterised by long straights and wide sweeping curves. There are no tight bends or curves with restricted visibility that pose a risk to motorists and this was confirmed by the 2012 AusRAP data.

3.1 Lane Widths

As with all major freight routes in South Australia, driving lanes should be a minimum of 3.5 metres wide, to allow for large commercial vehicles to maintain a safe distance within the lane. The 2012 review of the Sturt Highway noted that almost the entire highway meets this minimum width requirement. If traffic volumes continue to increase into the future it may be necessary however to provide wider driving lanes to further increase safety, particularly for the sections of the highway that do not have a physical median.

3.2 Sealed Shoulders

Sealed shoulders on the Sturt Highway are not currently meeting the desired minimum width of 1.5 metres. Despite this it is encouraging to note that the entire highway benefits from some degree of sealed shoulder, as these are crucial in reducing run off road crashes.

[1] Property damage only and minor injury costs derived from 'Cost of Crashes in Australia 2006', BITRE Research Report 118; Figures amended to reflect 2012 values. Serious jury and fatal costs derived from AusRAP 2013 'Star Rating Australia's National Roads'. Note that the costs displayed are for each crash type and not for each casualty.

Figure 4 - A typical section of the Sturt Highway with sealed shoulders of approximately 1 metre (Google Street View 2010)

Sealed shoulders on the Sturt Highway are less than 1 metre for approximately 140 km, between 1 metre and 2.4 metres for approximately 60 km, and wider than 2.4 metres for approximately 5 km.

3.3 Intersections

Towards 2020 identified intersections as hazards on Sturt Highway and this is supported by the crash data. Almost one third of all serious injury and fatality crashes have occurred at intersections or junctions on the Sturt Highway. Specifically for fatalities, almost half have occurred at intersections or junctions, with right angle crashes being the second most common crash type on the Sturt Highway. This highlights the need and importance of examining upgrade options for these high risk intersections.

Many intersections on the Sturt Highway are not controlled and do not provide any filter or protected turn lanes, an example of this being the intersection with Germein Road near Barmera. This intersection is typical of many of those along the Sturt Highway; the only warning provided for drivers on the terminating road is a yellow “T-intersection” advisory sign prior to joining with the Sturt Highway. There are no give way signs or lines present on the road.

Figure 5 Intersection with Germein Road. Uncontrolled with no prior warning for drivers on the terminating road (Google Street View 2012)

Figure 5 shows the intersection of Sturt Highway and Germein Road. Drivers might misjudge this intersection as there is no clear stop or give way line and the geometry may make turning into heavy traffic flows difficult. Improvements to an intersection such as this should include advanced warning of the upcoming intersection for drivers on Germein Road, give way signs and lines to help drivers position their vehicles, and filter lanes in and out of the intersection to allow vehicles to accelerate and merge into traffic on the Sturt Highway.

3.4 Paringa Bridge

The Paringa Bridge crosses the River Murray just east of Renmark. It was opened in 1927 and still remains in use as part of the Sturt Highway. The Paringa Bridge is a lock bridge, opening twice daily to allow for boats and watercraft to pass through, at 9:30am and 2:30pm.

As the bridge was designed for use in the 1920's it is incapable of providing efficient traffic flow given the high traffic volumes that the Sturt Highway currently carries. Speed restrictions for the bridge are 30 km/h, and entrance to the bridge is controlled by traffic signals, directing motorists to stop when the bridge is opened for boats to pass through. The driving lane along the bridge is approximately 3.2 metres wide, leaving little room for error when large commercial trucks are passing through.

Figure 6 - The Paringa Bridge open for boats to pass through (Google Image)

If traffic volumes continue to increase on the Sturt Highway, along with the movement of heavy freight vehicles through the area, the Paringa Bridge will require significant upgrades or a new bridge will be required. As the Sturt Highway is a major freight route, it is neither efficient nor acceptable to have a bridge subject to a 30km/h speed restriction and which stops traffic twice daily as the only crossing over the Murray River.

3.5 Duplication

Separating driving lanes in opposite directions through duplication of the road is done to prevent head on collisions due to driver fatigue and inattention. It is suggested in *Towards 2020* that between 90% and 100% of head on collisions can be prevented through duplication of the road, and installing median barriers where required. This highlights the importance of investment in separating driving lanes, as head on collisions often result in fatalities.

Figure 7 - A duplicated section of the Sturt Highway between Nuriootpa and Gawler (Google Street View 2010)

Currently the section of the Sturt Highway between Gawler and Nuriootpa is duplicated. If traffic volumes continue to increase and head on collisions remain an issue of concern, then further duplication of the highway should be considered.

3.6 Audio Tactile Line Markings

Audio-Tactile Line Markings (ATLM) are currently installed on the Sturt Highway. ATLM are a series of raised bars positioned on the edge lines of the highway, 50mm wide, 150mm long and at 200mm spacing. Currently, the Department of Planning, Transport, and Infrastructure (DPTI) use Thermoplastic Rib Profile ATLM on South Australian highways, and it is their policy to install ATLM on key arterial roads which have a high frequency of crashes due to driver fatigue (DPTI 2009).

ATLM reduce crashes resulting from driver fatigue by alerting the driver when they begin to move out of the driving lane. When a wheel passes over the ATLM a noise and vibration alerts the driver to move back into the traffic lane. ATLM also helps to highlight delineation in wet or low visibility situations, such as heavy rain or fog.

ATLM are currently used on more than half of the Sturt Highway, with the sections currently protected thought to be high fatigue zones. As upgrade works continue in the future, RAA wish to see the entire length of the Sturt Highway protected with ATLM. Application of ATLM should also be considered for the centre lines on the Sturt Highway, to reduce head-on collisions, as they are currently only provided for the edge of carriageway lines.

4 Pavement Performance

4.1 Ride Quality

Towards 2020 identifies roughness and rutting as the main pavement concerns on the Sturt Highway. The ride quality results of the pavement survey are shown in Figure 8 and show that for almost the entire length of the highway, the ride quality is above average or good. This was reflected in RAA's highway review which did not identify any significant areas of roughness or rutting. The quality of the pavement was considered good and offered a smooth and even ride to motorists. This may be due to upgrade works which have improved the surface quality since the time of *Towards 2020*. AusRAP data for the Sturt Highway also confirms RAA's observations, showing that approximately 190 km of the highway is in "good" condition, approximately 8 km is of "medium" condition, and approximately 3 km is of "poor" condition. It is important that areas of poor and medium condition such as to the east of Truro be targeted as a priority for upgrade and maintenance work.

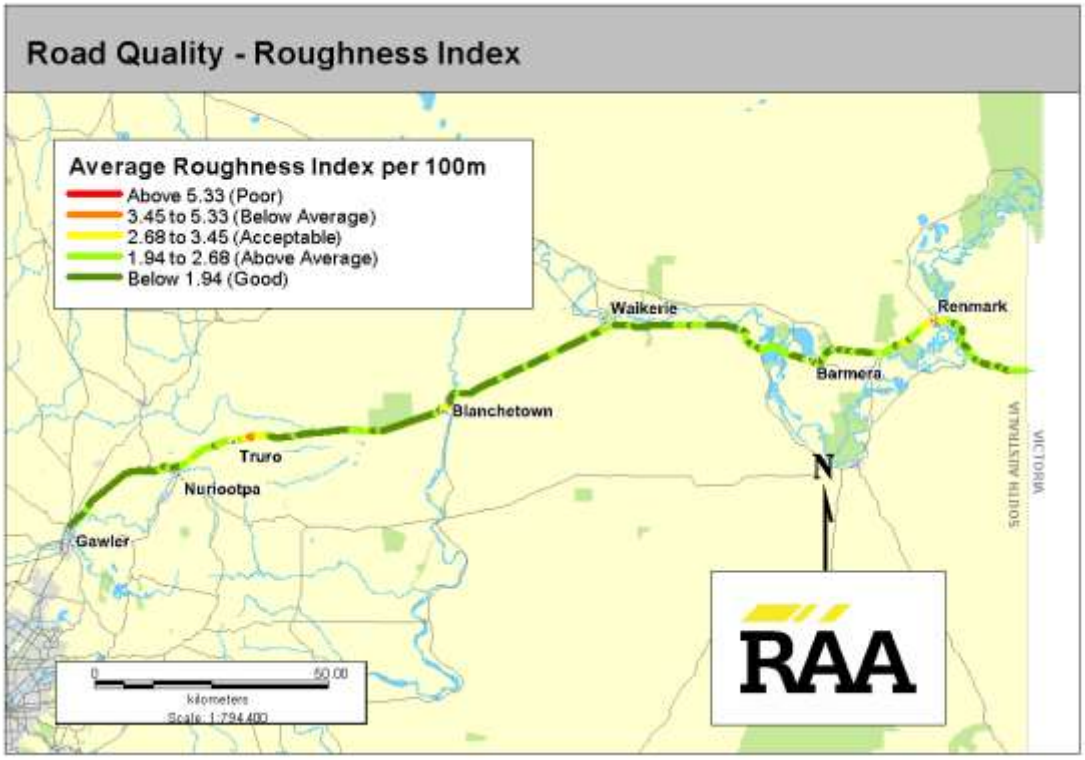

Figure 8 – Ride Quality Map for Sturt Highway

4.2 Rutting

Rutting was identified as a concern in Towards 2020 and can be dangerous as they can trap rainwater, increasing the potential for aquaplaning in wet conditions and resulting in a loss of control of the vehicle. Severe cases of rutting can also act as "guide rails" to the vehicle's tyres, reducing steering performance and creating issues with trailers tracking the vehicle. Rutting throughout the highway was mostly found to be between 5 and

10mm deep which is considered acceptable. There were however a number of sections with rut depths of between 10 and 15mm which is below average and cause for concern as it is thought that the potential for aquaplaning can occur with rut depths greater than 10mm.

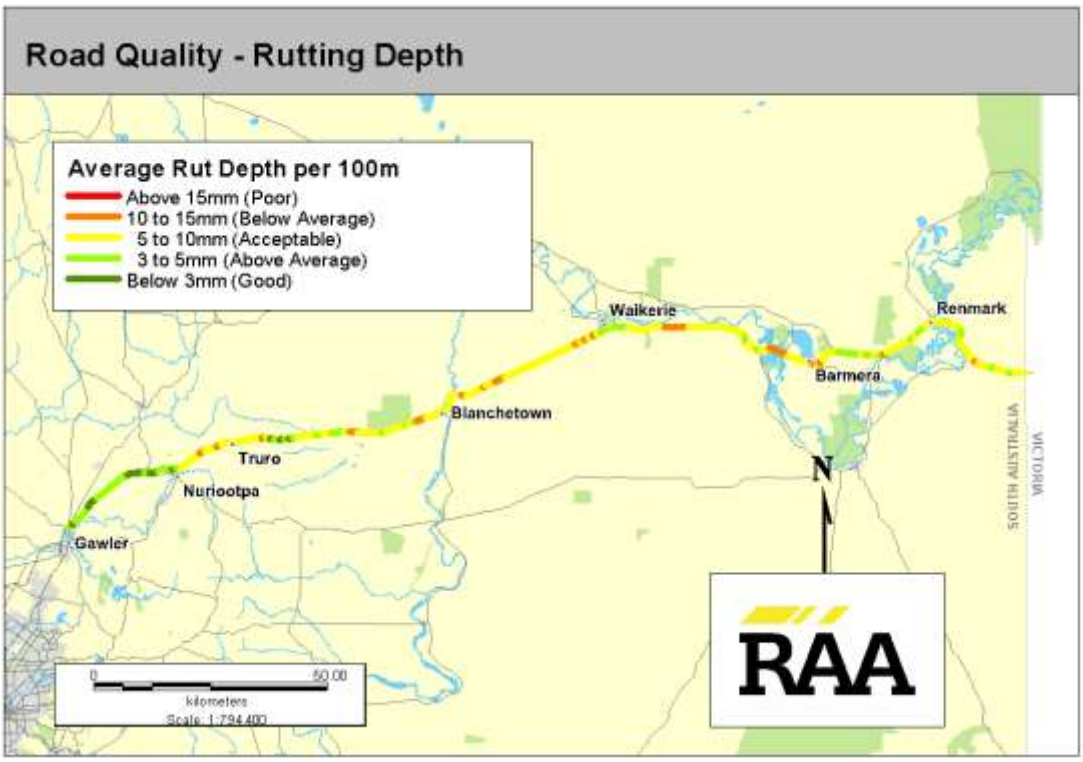

Figure 9 – Rutting Map for Sturt Highway

5 Roadside Hazards

5.1 General Roadside Hazards

Almost a quarter of all crashes on the Sturt Highway are the result of vehicles running off-road and hitting fixed objects. This includes 18 serious injuries and fatalities since 2007. Roadside hazards on the Sturt Highway include vegetation, significant drop-offs, and Stobie Poles. Removal or protection of roadside hazards will help to reduce this number, limiting the consequences of run-off the road incidents.

Vegetation density along the Sturt Highway varies from sparse between Nuriootpa and Blanchetown, to dense in areas between Barmera and Renmark. However most of the highway is lined with low levels of shrubs and trees, posing a minimal to moderate level of risk to motorists.

There are some areas of concern, such as the section just west of Barmera. In this area very large Gum Trees are only approximately 3 metres from the driving lane, as shown in Figure 10.

Figure 10 - Roadside hazards on the Sturt Highway (Google Street View 2010)

Significant embankments were noted many times throughout the 2012 highway review and these were also discussed in *Towards 2020* as a major concern. Due to their frequency, providing protection from all embankment hazards would be costly and impractical. Further work should therefore be undertaken to identify and prioritise the protection for embankments.

AusRAP data shows that there is approximately 15 km of rigid safety barrier, and 5 km of wire rope safety barrier already offering protection from hazards on the Sturt Highway. While RAA welcome these measures, we wish to see protection provided for all significant hazards that are located within 10 metres of the shoulder.

5.2 Animal Hazards

Animal hazards were not previously identified as an issue in *Towards 2020*, however current crash data has revealed that collisions with animals is the third most frequent crash type on the Sturt Highway. The 2012 highway review encountered road kill at the side of the road on two occasions, and a live Emu on the road just east of Blanchetown.

Low level shrubbery can conceal animals which may suddenly stray onto the road, and as such an effective mitigation technique would be to removal of vegetation for a specified distance from the roadside which could make animals more visible before entering the path of a vehicle. Other mitigation techniques involve driver education, installation of warning signs, and timely removal of carcasses from the road.

6 Rest Areas

Good quality rest areas are important to prevent driver fatigue, as they encourage drivers to stop and take regular breaks. It is important that the rest areas on the Sturt Highway accommodate both commercial and private vehicles, since a diverse mix of traffic uses this route.

The 2012 review noted 10 rest areas along the Sturt Highway, three of which had no facilities at all. The remaining rest stops typically had shelter, a table and chairs, and bins. Although upgrading rest areas on the Sturt Highway may not been viewed high priority due to the short distances between towns, they should still be maintained and upgraded where possible. Upgrades would include provision of full facilities at all rest stops, including shelter, tables, bins, lighting, drinking water, and toilets.

7 AusRAP

The AusRAP star ratings for Sturt Highway are shown in Table 3 below. Since 2005, there has been a reduction in sections awarded a 3-star rating due to new stringent assessment criteria which has resulted in a number of sections downgraded to 1-star or 2-star. Nevertheless, improvements since 2007 have resulted in 6% of the Sturt Highway rated as 4-star.

	Length (%)		
Star Rating	**2005**	**2007**	**2012**
★★★★★	-	-	-
★★★★	-	-	6%
★★★	86%	80.5%	75%
★★	14%	19.5%	16%
★	-	-	2%

Table 3 - AusRAP Star Rating 2005 - 2012

The AusRAP program develops a series of highway safety improvements, based on the star ratings. A schedule of highway upgrades is included in Appendix B. Table 4 below shows a comparison of the current star rating and the potential star rating awarded to Sturt Highway if all the proposed improvements were implemented.

	Length (%)		
Star Rating	**2012**	**Post Investment Plan**	**Change**
★★★★★	-	-	-
★★★★	6%	60%	+ 54%
★★★	75%	38%	- 37%
★★	16%	2%	- 14%
★	2%	-	- 2%

Table 4 - AusRAP Star Rating Pre & Post Investment Plan

8 Recommendations

RAA has analysed the AusRAP assessment and recommend the following treatments to improve the safety performance of the Sturt Highway:

- **Installation of roadside barriers (114 km)**
- **Improved skid resistance (4.5 km)**
- **Provision of audio tactile edge of carriageway line marking (39 km)**
- **Provision of a central median barrier (without duplication) (7.5 km)**
- **Upgrade junction treatments (protected turn lanes) (40 Sites)**
- **Shoulder sealing greater than 1m (45 km)**
- **Removal of roadside hazards (7.5 km)**

These recommendations would significantly increase the length of highway rated 4-star while upgrading 1-star and 2-star sections to a 3-star rating.

9 References

Clark, S 2009, *Audio-Tactile Line Marking*, Department of Planning, Transport and Infrastructure (DPTI), Government of South Australia, Adelaide.

Principal Road Designer 2002, *Guide to the Selection of Safety Barriers – GD100*, Department of Planning, Transport and Infrastructure (DPTI), Government of South Australia, Adelaide.

Appendix A
Pavement Performance Factors

Overview of Pavement Properties

Roughness

The pavement roughness refers to the irregularities in the road's surface in the direction of travel. These irregularities vary from 0.5m to 50m long and are measured in relation to the intended road surface and recorded in terms of the International Roughness Index (IRI). As the IRI increases, it indicates a rougher pavement surface which will produce an uncomfortable ride for the vehicle's occupants through bumps and undulations. Figure 1 shows the longitudinal profile of a road with an exaggerated surface. The red line indicated the intended surface level and the difference between the lines is the measured roughness.

The roughness is not only important for the ride quality experienced by the motorist but prolonged vehicle exposure to a rough road may also increase wear, maintenance and fuel consumption.

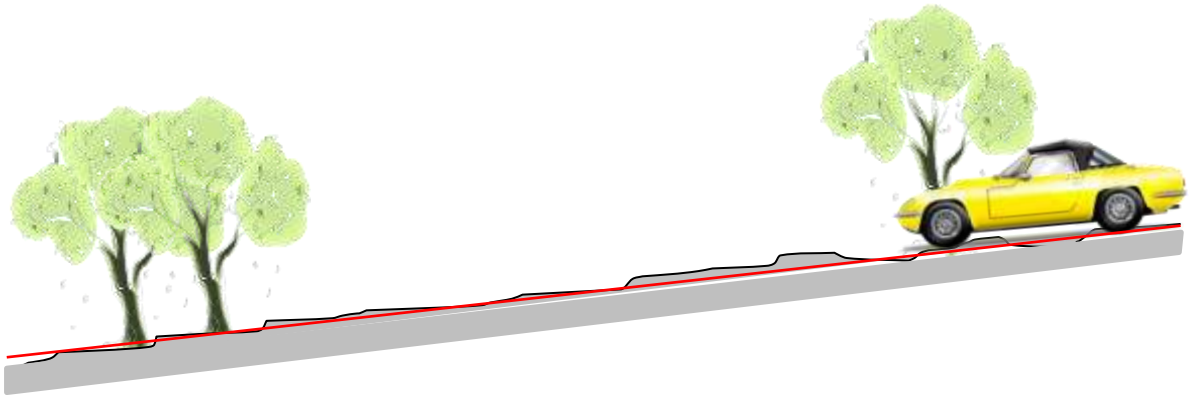

Figure 1 – Longitudinal Road Section

Rutting

A rut is a defect in the form of a longitudinal depression in the pavement surface. It usually occurs in the wheel path of vehicles (Figure 2) and is caused by high volumes of heavy vehicles over time. Ruts can also form as a result of environmental influences such as extensive rainfall combined with a poorly sealed surface. This can permit moisture to enter the pavement foundations which can weaken the structure or cause movement in the soil beneath, both of which can lead to rutting.

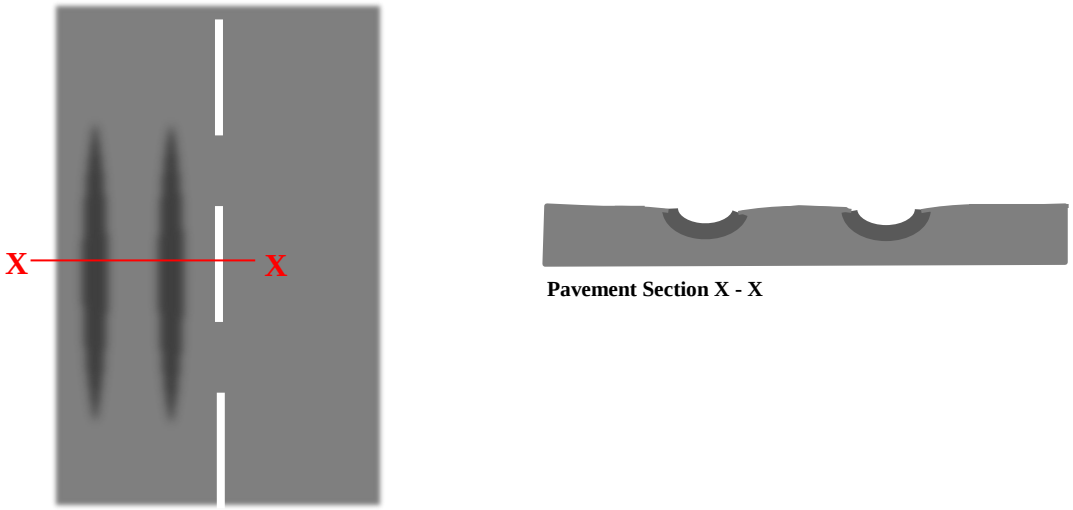

Figure 2 – Pavement Rutting

While rutting can lead to further pavement deterioration, several other problems may also arise as a result. Deep ruts can cause a “guide channel” for wheels and drivers may experience reduced steering performance or having difficulty with trailers tracking the vehicle. Ruts are also prone to filling with water which can increase the potential for aquaplaning, depending on the vehicle speed and depth of the rut. Drivers should always exercise caution when driving in wet weather but particularly on roads that are prone to bad rutting.

Texture

The pavement texture is important to ensure safety for motorists as it provides friction between the contact area of the tyre and the pavement surface. If there is insufficient friction between the tyre and surface the braking distance will be significantly reduced and if the vehicle speed is too high, there may be a loss of control on curves and bends resulting in collisions with roadside objects.

There are two forms of texture within the road surface, the microtexture and macrotexture. The microtexture is created by the rough surface of the aggregate in the surface the road and contributes to the friction that ensures the vehicle maintains contact with the road and provides good braking performance. The macrotexture is formed from the grooves created in the road surface by the different heights and shape of the aggregate and is important to ensure that rainwater drains away from the tyre, reducing the potential for aquaplaning.

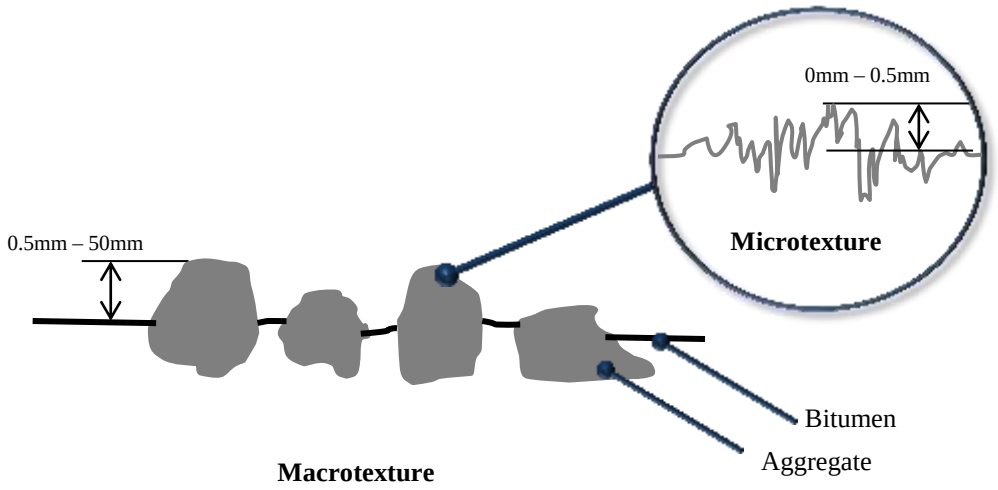

Figure 3 – Pavement Texture

Appendix B
AusRAP Safer Roads Investment Plan

Sturt Highway

Safer Roads Investment Plan

Total FSIs Saved	Program BCR
212.19	3.20

Countermeasure	Length / Sites	FSIs saved	Program BCR
Sight distance (obstruction removal)	0.20 km	0.76	72.06
Additional lane (2 + 1 road with barrier)	0.40 km	1.64	0.70
Clear roadside hazards - driver side	1.60 km	0.40	4.90
Skid Resistance (paved road)	4.50 km	20.26	8.91
Clear roadside hazards - passenger side	5.80 km	1.52	4.51
Central median barrier (no duplication)	7.50 km	9.59	3.76
Shoulder sealing passenger side (>1m)	8.30 km	3.21	1.36
Protected turn lane (unsignalised 4 leg)	11 sites	9.74	12.18
Protected turn lane (unsignalised 3 leg)	29 sites	10.76	9.54
Shoulder sealing driver side (>1m)	36.90 km	8.69	3.61
Shoulder rumble strips	39.20 km	21.03	1.95
Roadside barriers - passenger side	54.40 km	49.86	2.54
Roadside barriers - driver side	59.30 km	74.73	3.48
Total		**212.19**	**3.20**