RAA Highway Assessment

Highway One

August 2013

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0	05/08/13	IB, RB, MJ	CM	Draft.
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Contents

Executive Summary

Highway One is 200 km in length, heading North from Pt. Wakefield to Pt. Augusta. Forming part of Australia's National Highway network. Highway One joins Adelaide with the South Australian outback, being the most direct route to the Northern and Western regions of the country. This highway has been previously analysed by RAA in Towards 2020 (2009) and Backwater to Benchmark (2005)

Towards 2020 predicted that traffic volumes would significantly increase post 2012 due to expected mining expansion in the Roxby Downs area. At the time of Towards 2020 the highway carried between 2,500 and 7,800 vehicles per day. The 2013 traffic volumes are between 2,700 and 8,100 vehicles per day, with up to 29.5% of these being commercial vehicles. This has been a moderate increase over the last four years, and the trend may continue to increase if mining predictions are accurate.

RAA conducted a review of Highway One 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 lane widths were 3.5m which is adequate however future lane widening may be required if mining expansion continues in the region. The sealed shoulder width was generally found to be acceptable however approximately 70km of highway has a sealed shoulder width of less than 1 metre and these sections require upgrading.

Highway One has approximately 15 overtaking lanes, despite the number of lanes provided, drivers continue to overtake and high risk locations and the addition of further overtaking lanes are likely to discourage this driving behaviour.

The review found that a number of safety features have been constructed along Highway One including 70km of Audio Tactile Line Marking (ATLM). ATLM is an effective treatment for reducing the instances of run-off road collisions but while RAA welcomes this treatment, 130km of the highway has been left untreated.

The review included a pavement assessment of highway one. The assessment found that the ride quality was above average or very good for almost the entire highway offering motorists a smooth and comfortable ride with little undulation. Rutting was also examined and found to be acceptable for most of the highway. A number of sections south of Port Germein were below average with rut depths of 10 – 15mm and a short section between Port Germein and Port Pirie was unacceptable with depths above 15mm. It is important that these sections are treated as a matter of urgency as the ruts can increase the risk of aquaplaning and when sufficiently deep, may affect steering performance for vehicles.

Highway One has roadside hazards including significant vegetation for approximately 45km of which 8km is protected with roadside barriers. As collisions with fixed objects accounts for a large number of rural highway fatalities and serious injuries, it is important that funding is secured to provide further barrier treatment for these hazards.

The review found that there were 21 rest stops on Highway One which is considered sufficient for its length. Upgrades to the rest stops should however be considered to increase their appeal and encourage motorists to stop for frequent breaks. It is also important that the rest stops should be modified where appropriate to accommodate commercial vehicles so that heavy vehicle drivers can also benefit from their facilities.

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 (166.6 km)**
- **Improved skid resistance (31.5 km)**
- **Provision of audio tactile edge of carriageway line marking (135.1 km)**
- **Provision of a central median barrier (without duplication) (43 km)**
- **Upgrade junction treatments (protected turn lanes) (51 Sites)**
- **Shoulder sealing greater than 1m (82.7 km)**

Table 1 shows the results of the 2012 AusRAP star rating for the Augusta 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**
★★★★★	-	11%	+ 11%
★★★★	3%	26%	+ 23%
★★★	61%	63%	+ 2%
★★	33%	-	- 33%
★	3%	-	- 3%

Table 1 - AusRAP Star Rating Pre & Post Investment Plan

1 Traffic Volumes

Highway One is 200 km in length, heading North from Pt. Wakefield to Pt. Augusta. Forming part of Australia's National Highway network. Highway One joins Adelaide with the South Australian outback, being the most direct route to the Northern and Western regions of the country. This highway has been previously analysed by RAA in Towards 2020 (2009) and Backwater to Benchmark (2005)

Highway One is South Australia's busiest highway, supporting heavy tourist traffic and high volumes of commercial vehicles travelling between Western Australia and the Northern Territory. The highway has been considered hazardous for motorists due to high traffic volumes, frequent roadside hazards, high risk intersections, and high cases of driver fatigue. Previous recommendations for improvements include the installation of roadside and median barriers, a bypass of Pt. Wakefield, and complete duplication between Pt. Wakefield and Pt. Augusta in the long term.

Towards 2020 predicted that traffic volumes would significantly increase post 2012 due to expected mining expansion in the Roxby Downs area. At the time of Towards 2020 the highway carried between 2,500 and 7,800 vehicles per day. The 2013 traffic volumes are between 2,700 and 8,100 vehicles per day, with up to 29.5% of these being commercial vehicles. This has been a moderate increase over the last four years, and the trend may continue to increase if mining predictions are accurate.

RAA conducted a review of Highway One in 2012 to assess the conditions of the road, what improvements have been made, and what still needs to be done.

2 Crash Statistics

The crash statistics for the past five years have been steadily increasing with an average of 87 crashes per year. The highest number of crashes occurred in 2011 with 107 crashes but there has been little improvement in 2012 during which time 104 crashes occurred.

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

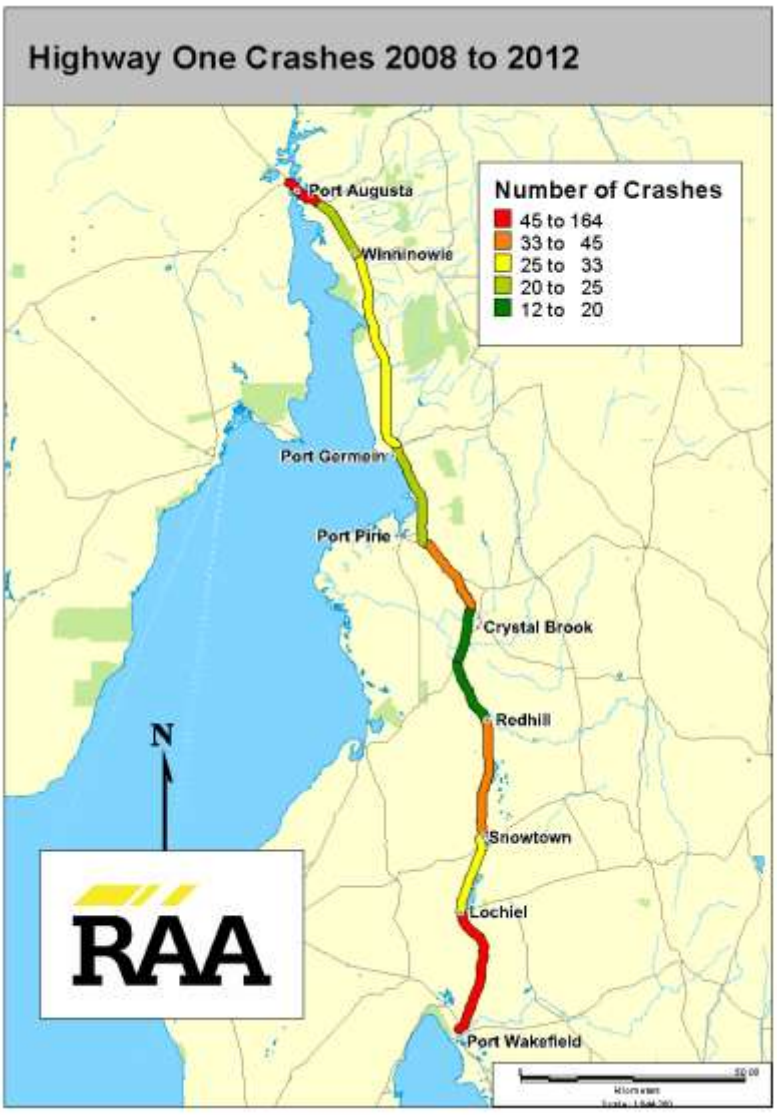

Figure 1 – Crashes Along Highway One, 2008-2012

Crash totals tend to vary along different sections of the Augusta Highway with a high frequency of crashes occurring on approach to Port Augusta as well as between Port Wakefield and Lochiel.

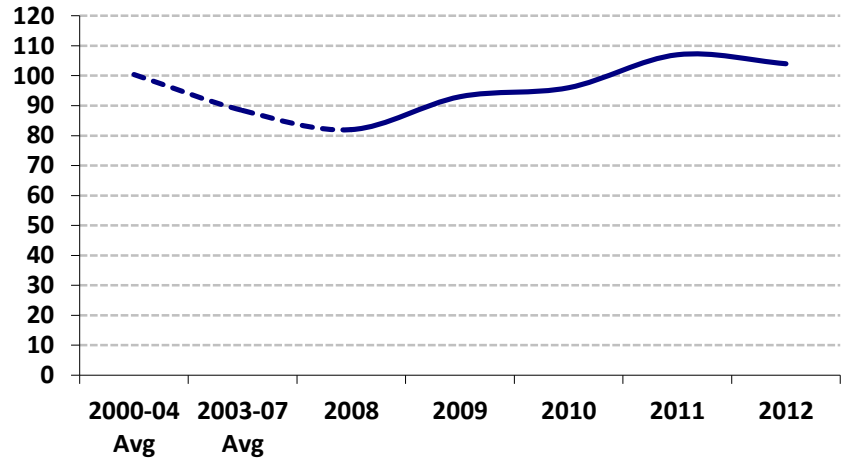

Figure 2 – Crashes On Highway One, 2008-2012

The majority of crashes along the Augusta Highway tend to involve property damage only. During the five year monitoring period there have been 309 property damage only crashes, 117 minor injury crashes, 45 serious injury crashes and 11 fatal crashes.

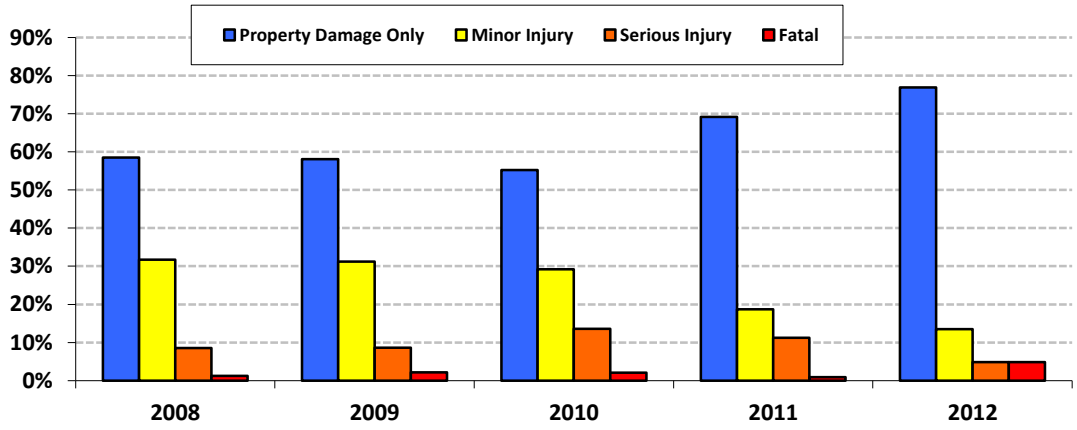

Figure 3 – Crashes By Severity, 2008-2012

Crash Severity	Cost per Crash[1]	Number of crashes	Total Cost (2012 Values)
Property Damage Only	$11,743	309	$3,628,527
Minor Injury	$17,309	117	$2,025,153
Serious Injury	$340,000	45	$15,300,000
Fatal	$7,200,000	11	$79,200,000

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

Crashes along the Augusta Highway between 2008 and 2012 cost $100,153,680. This figure includes losses to workplace and households as well as 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

3.1 Lane Widths

Highway One is characteristically straight with long sweeping bends and does not have any instances of tight bends with restricted visibility. Driving lane widths on Highway One are currently acceptable, with 100% of the highway having lane widths of 3.5 metres or more. Lane width improvements may be considered to accommodate higher volumes of heavy freight vehicles should the mining activity continue to grow as the current lane widths may not then be satisfactory.

3.2 Sealed Shoulders

As recommended in *Towards 2020,* sealed shoulders on Highway One should be a minimum of 1.2 metres. Sealed shoulders are effective in preventing run off road crashes as they provide the driver time and space to correct their course if lose attention and drift from the driving lane, and it is therefore important to provide shoulder seals of sufficient width. Sealed shoulders on Highway One are between 1 metre and 2.4 metres for the majority of the highway. Approximately 70 km of the highway has sealed shoulders of less than 1 metre, and it is encouraging to note that there are no sections on Highway one that are without a sealed shoulder.

[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 Highway One with driving lane of approximately 3.6 metres and sealed shoulders of approximately 1.3 metres, 5 km North of Snowtown (Google Street View 2010)

Like the width of the driving lanes, the sealed shoulders were also found to be acceptable. Increasing the width of the sealed shoulder should however be considered if heavy freight movements continue to increase in the area as a result of the mining expansion, to provide a larger safety buffer for the heavy vehicles.

3.3 Wide Centreline Treatment

Overtaking lanes are important on routes such as Highway One since there are high volumes of slower moving heavy vehicles. A lack of overtaking lanes leave drivers with no option but to make value judgements as to the most suitable locations to overtake and requires the judgement of safe breaks in the traffic. Often a lack of overtaking opportunities causes frustration which leads to the driver taking unnecessary risks when attempting to overtake a vehicle. Highway One has approximately 15 overtaking lanes in either direction, which over its length equates to approximately one overtaking lane every 13.5 km. This frequency of overtaking may be considered adequate for most highways however due to high traffic volumes and the traffic composition, the current frequency of overtaking lanes is insufficient for discouraging drivers from overtaking at riskier locations.

The best solution to eliminate the risk of head-on collisions from overtaking is full duplication of the section of highway between Pt. Wakefield and Pt. Augusta to provide two lanes of traffic in each direction. While this has the highest cost, in the long term, it is the only solution that will significantly improve the efficiency of South Australia's busiest highway, while eliminating the risk of head-on collisions.

Other options include further construction of overtaking lanes for other sections of the highway or installing median barriers to prevent motorists from overtaking in areas which have been identified as high risk.

Figure 5 - Separating Median barrier fencing, used to prevent head-on collisions due to driver fatigue, however could be also be implemented to prevent overtaking in high risk areas (Google Street View 2010)

3.4 Audio Tactile Line Markings

Audio-Tactile Line Markings (ATLM) are a good counter measure to reduce run-off collisions caused by driver fatigue. ATLM consist of a series of raised bars positioned on

the edge lines of the highway, 50mm wide, 150mm long and at 200mm spacing along the edge line. 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 due to 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 that they have drifted from the traffic lane and offers an opportunity to correct their course before they leave the sealed carriageway. ATLM also helps to highlight delineation in wet or low visibility situations, such as heavy rain or fog.

Highway One currently has ATLM for approximately 70 km of its length, with the remaining 130 km having no ATLM. Application of ATLM for its entire length would be a worthy improvement that could reduce the crash rate.

4 Pavement Performance

4.1 Ride Quality

The ride quality along Highway One is above average or good indicating a very smooth ride with few undulations for most of the highway. There is a very short section between Rehill and Crystalbrook that is below average but given the length of the section, pavement rehabilitation should be reasonably low cost and quick to apply. RAA welcomes the standard of ride quality on Highway One and hopes to see this standard applied across the other highways in SA.

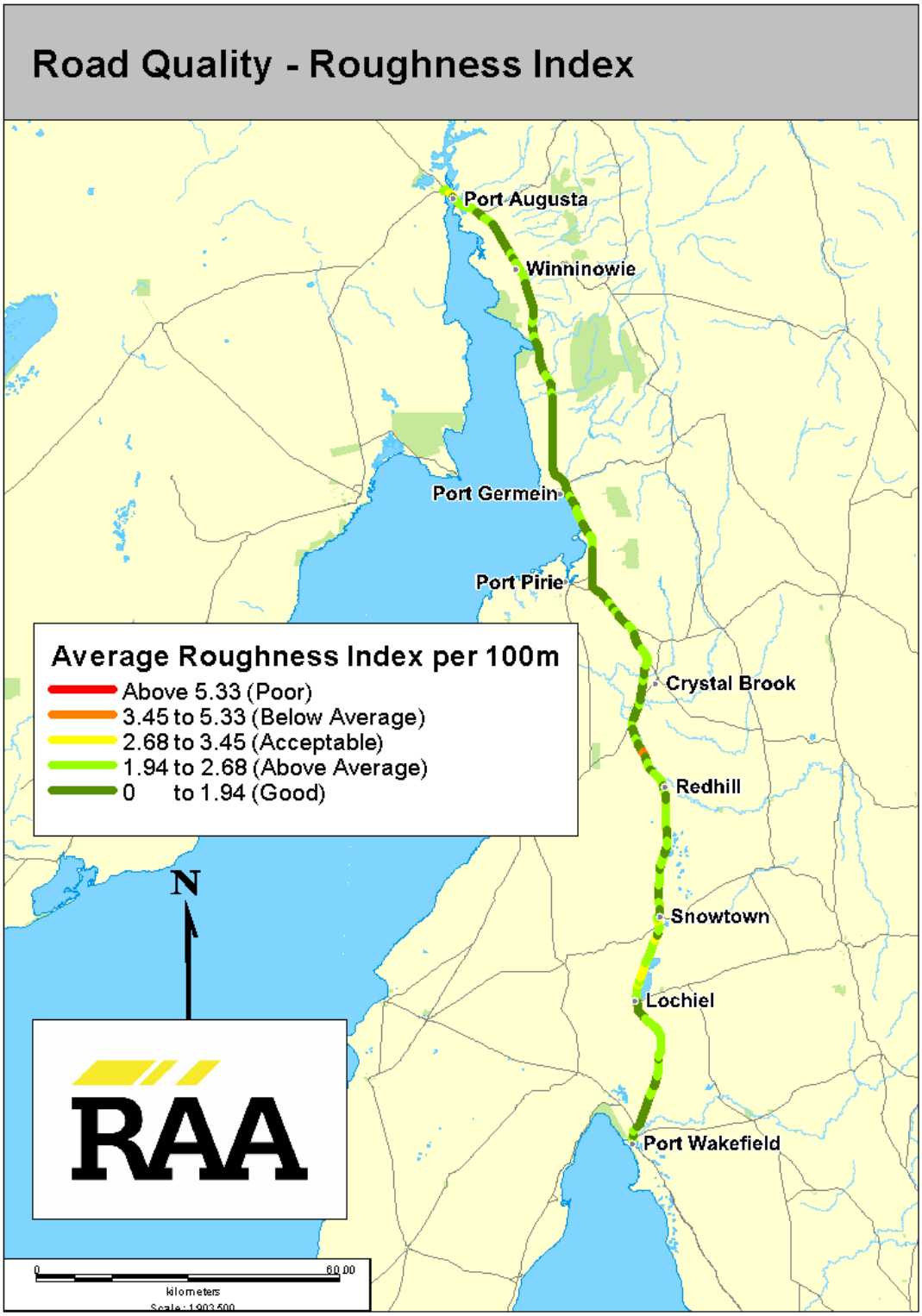

Figure 6 – Ride Quality Map for Highway One

4.2 Rutting

Towards 2020 has identified rutting as the major surface quality issue on Highway One, with most of the highway suffering from some level of rutting. The area of road 5 – 10 km South of Pt. Pirie was identified as being of particularly poor quality at the time of Towards 2020.

Rutting is the channelling of the road under both wheel paths which occurs over time due to high volumes of heavy vehicles. Rutting is dangerous as it can trap rainwater, which can cause aquaplaning and result in a loss of control of the vehicle. Severe cases of rutting can also act as “guide rails” to the tyres, reducing steering performance and causing issues for tracking of trailers.

Some improvements have been made to the highway since Towards 2020 through maintenance and upgrade works. AusRAP has described approximately 174 km of the highway as being in “good” condition, approximately 17 km as “Medium” condition, and approximately 8 km as “poor” condition. The pavement data recorded shows that rutting is within acceptable limits of 5 to 10mm for most of the highway. North of Port Germein, rut depths were shallow and considered above average or good. Nevertheless, there are a number of short sections south of Port Germein that had rut depths of between 10 and 15mm which is below average. Of particular concern is a section midway between Port Germein and Port Pirie with ruts above 15mm in depth recorded. This is a poor standard and should be rectified as a matter of urgency. Since this level of rutting occurs over a relatively short section, RAA would expect that pavement rehabilitation on this section would be achievable within the next 12 months.

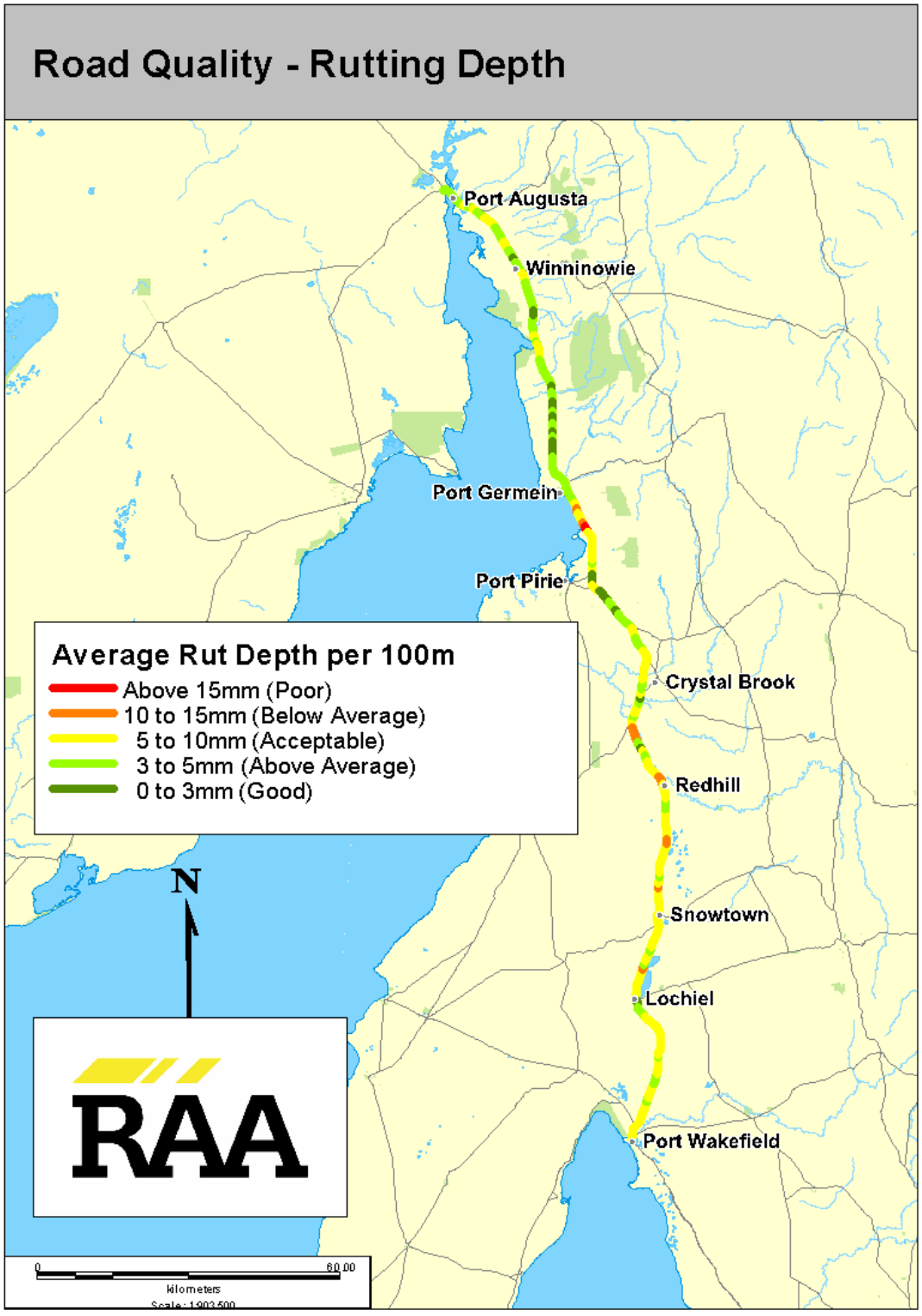

Figure 7 – Rutting Map for Highway One

5 Roadside Hazards

As with all major highways in South Australia, roadside hazards are a significant risk for motorists should they run-off road due to fatigue or inattention. Roadside hazards increase the likelihood of injuries or fatalities occurring as a result of vehicles leaving the shoulder. *Towards 2020* identified significant trees and roadside embankments as the major hazards encountered on Highway One.

Vegetation levels on Highway One vary throughout the length of the road from sparse, to areas of dense trees. AusRAP data shows that approximately 45 km of the highway are lined with trees of a diameter greater than 10 cm, and the remaining 155 km has no significant vegetation recorded near the edge of the road.

Figure 8 - An example of significant vegetation on Highway One, approximately 10 km South of Snowtown (Google Street View 2010)

Rigid safety barriers and flexible wire rope barriers are currently in place to protect from some hazards and embankments. There is approximately 8 km of safety barrier along the entire length of Highway One.

Since collisions with fixed objects account for the highest number of crashes on rural highways in South Australia, it is important to consider protecting these hazards, or removing the hazards such as trees and vegetation completely. As it would be both impractical and uneconomical to construct safety barrier fencing to protect the entire 45km section of roadside hazards, further research should be undertaken to prioritise the locations at which the barriers are provided.

6 Rest Areas

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

According to DPTI's latest guide to rest stops in South Australia , Highway One currently has a total of 21 rest stops along the stretch between Pt. Wakefield and Pt. Augusta. 12 of these are on rural sections of the road between towns, and 9 are in small towns such as Pt. Wakefield, Lochiel, Snowtown, Redhill, Crystal Brook, Warnertown, Pt. Pirie, Pt. Germein, and Pt. Augusta. When averaged over the route, rest stops are provided very frequently and are more frequent than many other highways in SA.

The provision of rest stops is therefore not a priority but work should be undertaken to maintain and upgrade the rest stops where possible. Upgrades that should be considered include provision of full facilities at all rest stops, including shelter, tables, bins, lighting, drinking water, and toilets. Focus should also be directed towards making all rest stops accessible to both private and commercial vehicles, so that the rest stops can also offer benefit to the drivers of heavy vehicles.

7 AusRAP

The AusRAP star rating for Augusta Highway is shown in Table 3 below. Since 2007, 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 3% of the Augusta Highway rated as 4-star.

	Length (%)		
Star Rating	2005	2007	2012
★★★★★	-	-	-
★★★★	47%	-	3%
★★★	53%	100%	61%
★★	-	-	33%
★	-	-	3%

Table 3 - AusRAP Star Rating 2006 - 2012

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

	Length (%)		
Star Rating	2012	Post Investment Plan	Change
★★★★★	-	11%	+ 11%
★★★★	3%	26%	+ 23%
★★★	61%	63%	+ 2%
★★	33%	-	- 33%
★	3%	-	- 3%

Table 4 - AusRAP Star Rating Pre & Post Investment Plan

8 Recommendations

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

- **Installation of roadside barriers (166.6 km)**
- **Improved skid resistance (31.5 km)**
- **Provision of audio tactile edge of carriageway line marking (135.1 km)**
- **Provision of a central median barrier (without duplication) (43 km)**
- **Upgrade junction treatments (protected turn lanes) (51 Sites)**
- **Shoulder sealing greater than 1m (82.7 km)**

These recommendations would maintain the section of route rated at 3-star while significantly increasing the length of the highway rated 4-star and 5-star. Additionally there would no longer be 1-star or 2-star sections of highway, satisfying the international 3-star minimum benchmark.

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.

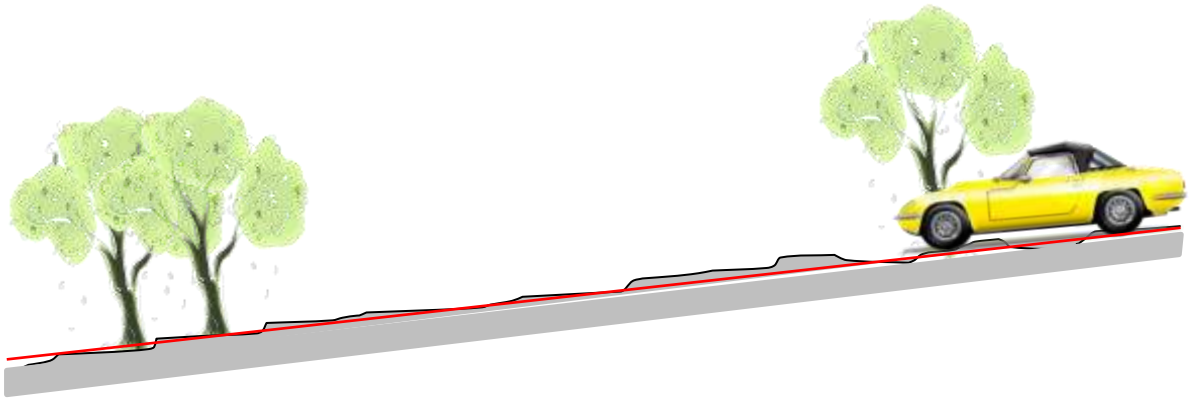

Figure 1 – Longitudinal Road Section

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.

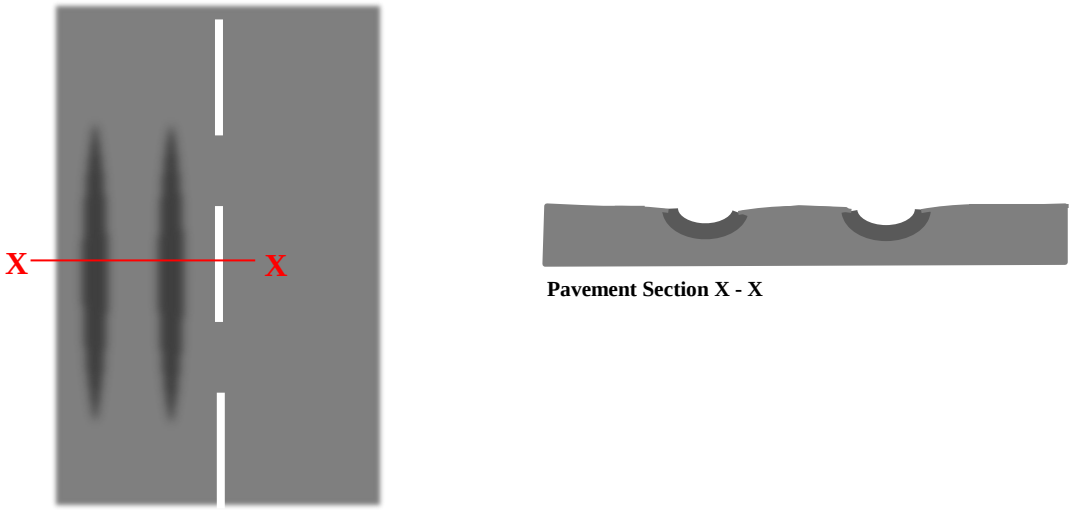

Figure 2 – Pavement Rutting

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.

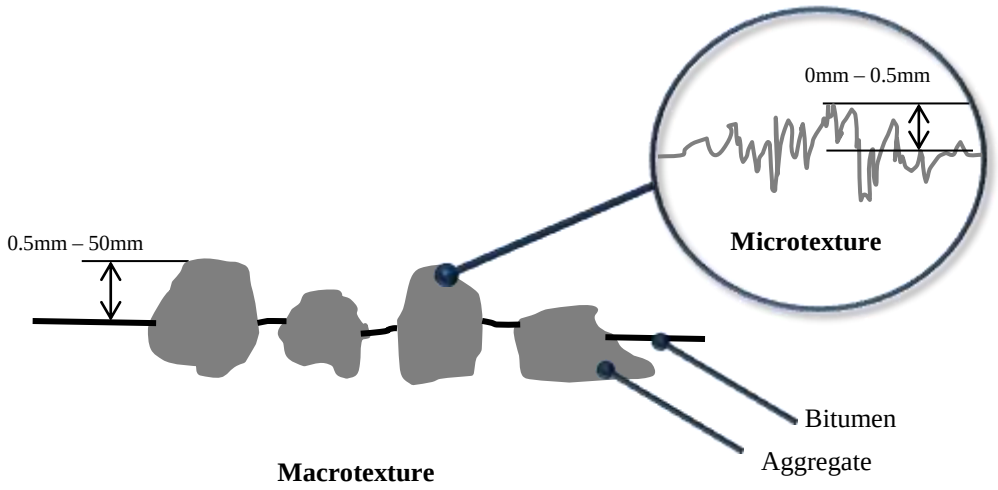

Figure 3 – Pavement Texture

Appendix B
AusRAP Safer Roads Investment Plan

Highway One

Safer Roads Investment Plan

Total FSIs Saved	Program BCR
655.77	4.81

Countermeasure	Length / Sites	FSIs saved	Program BCR
Roadside barriers - passenger side	91.40 km	196.67	5.85
Roadside barriers - driver side	75.20 km	166.87	6.22
Shoulder rumble strips	135.10 km	83.80	2.31
Skid Resistance (paved road)	31.50 km	77.46	5.21
Central median barrier (no duplication)	43.00 km	65.25	5.69
Protected turn lane (unsignalised 3 leg)	44 sites	24.84	17.02
Shoulder sealing passenger side (>1m)	36.70 km	14.92	1.78
Shoulder sealing driver side (>1m)	46.00 km	14.49	4.90
Protected turn lane (unsignalised 4 leg)	7 sites	10.00	35.96
Sight distance (obstruction removal)	0.10 km	0.93	200.53
Pave road surface	0.10 km	0.47	6.25
Clear roadside hazards - driver side	0.20 km	0.08	3.98
Total		**655.77**	**4.81**