AusRAP assessment of Peak Downs Highway 2013

SUMMARY

The Royal Automobile Club of Queensland (RACQ) commissioned an AusRAP assessment of Peak Downs Highway based on the iRAP protocol. The purpose is to provide star ratings and investment levels for improved safety outcomes on Peak Downs Highway. The star ratings provide a measure of the safety performance of the road infrastructure.

The total road length assessed is 267 km. Out of this, about 5% is rated as 1-star, 54% as 2-star, 40% as 3-star and 1% as 4-star for car occupants. The proportion of the network in each star band by road user is shown in Table S.1.

<table>
<thead>
<tr>
<th>Road user type</th>
<th>Length (km)</th>
<th>Proportion in each star rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Vehicle occupant</td>
<td>266.5</td>
<td>0%</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>266.5</td>
<td>0%</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>266.5</td>
<td>87%</td>
</tr>
<tr>
<td>Bicycle</td>
<td>266.5</td>
<td>87%</td>
</tr>
</tbody>
</table>

A snapshot of key safety features that have a large influence on safety outcomes are as follows:

- Road is mostly undivided (only 0.3 km is divided)
- 78% of the road has narrow sealed shoulder width (< 1.0 m)
- 49% of the road has unforgiving roadside conditions within 10 m from the edge line that may cause serious or fatal injury in the event of a run-off collision (due to trees, non-frangible poles, ditches, rollover upward slopes, steep downward slopes, aggressive rock face, etc.)
- 41% of the road has narrow to medium lane width (< 3.25 m)
- 14% has polished road surface (skid resistance coded as poor)
- The road has intersection frequency of one intersection for every 3 km of travel.
- 99% of the road has good horizontal alignment (straight to moderate curving)
- 83% of the road has good delineation

The top-five recommended treatments in terms of the number of estimated deaths and serious injuries prevented are improved skid resistance; roadside barriers; provision of additional lanes (2+1 lanes); shoulder rumble strips; and intersection right turn provisions.

Disclaimer: While attempts have been made to ensure the accuracy of the information contained in this report, the Royal Automobile Club of Queensland makes no statements, representations, or guarantees about the accuracy or completeness of it.
1  INTRODUCTION

RACQ commissioned an AusRAP assessment of Peak Downs Highway based on the iRAP protocol. The purpose is to provide star ratings and investment levels for improved safety outcomes on the Peak Downs Highway.

1.1 AusRAP star ratings

AusRAP star rating is a methodology, based on the iRAP protocol with an associated web-based tool, ViDA, used to assess the safety potential of roads, provides star ratings and to develop road safety investment plans. The star ratings provide a measure of the safety performance of the road infrastructure. The star ratings are derived from a Star Rating Score (SRS) based on road safety inspection data and the extensive real-world relationships between road attributes and crash rates.

The SRS concept provides an objective measure of the likelihood of a crash occurring and its severity and has been designed as a measure of the inherent safety of a road network. The higher the SRS the less safe the road section is likely to be based upon the physical road engineering and roadside features. The aim of the SRS is to provide a star rating of the road network in a similar manner to the current 5-star rating scales for new car safety. A 5-star road will provide road users with the safest form of design standards in regard to road cross-section, layout, roadside environment and intersection design and frequency and a 1-star rating represents a road with relatively poor road infrastructure design.

The structure of the car occupant SRS equation is shown in Figure 1.1.

![Figure 1.1: Structure of car occupant SRS equation](image-url)
1.2 iRAP software - ViDA

The iRAP processing software, ViDA, is a web-based tool that uses road inspection data to score roads, generate countermeasures, estimate casualty numbers, make an appraisal of investment opportunities and assist local practitioners in the design of network safety upgrading schemes:

(a) Risk Score – Road features are scored and combined to reflect the overall safety of the infrastructure on a road section – both the likelihood of being involved in a crash and the potential injury severity are taken into account. A Risk Score for each road user group is generated and can be shown on a map.

(b) Generating Countermeasures – A ‘logic’ system, based on known infrastructure safety deficits, is used to generate programmes of low-cost countermeasures that are likely to save a significant number of lives. The proposed countermeasures are appropriate for use in low and middle income countries.

(c) Estimating Casualty Numbers – Using historic crash data, an estimate of the number of casualties that would be expected on a road section from the coded infrastructure related data is determined. The results are used alongside the countermeasure generation tool to estimate the number of casualties that are likely to be saved through action.

(d) Economic Appraisal – In order to make the best investment decisions, iRAP’s economic appraisal methodology compares the cost of implementing road-safety schemes with the economic benefits of saving lives and reducing serious injuries. The methodology for calculating the cost of deaths, serious injuries and generating countermeasures is specific to the country and its state of economic development.
2 METHODOLOGY

2.1 Study network

Peak Downs Highway is approximately 267 km, from running north-east from Gregory Development Road to Bruce Highway. The road is mainly undivided and speed limit is generally high in excess of 90 km/h.

2.2 Road inspection

2.2.1 Video data

The first step of the road inspection process was the video data collection of the road. The video data was collected by RoadTek with a special vehicle, equipped with 4 cameras (forward camera, right camera, left camera and rear camera). An example of the video data is shown in Figure 2.1.

2.2.2 The coding process

The coding process was undertaken using the Hawkeye viewing software. It involved viewing the video image of the road in the safe environment of the office and the recording of several road attributes using a pre-designed rating form as shown in Figure 2.2.

The rating was conducted at 100 m intervals. The rated data was supplemented with AADT and several other model data sets (GPS data, horizontal alignment, and vertical grade) obtained automatically from GipsiTrac data collected at 10 m intervals. The resulting composite data was then uploaded into the ViDA web-based tool for processing, analysis and calculations of SRS, star ratings, fatality estimates and investment level.
2.3 Crash data and fatality model calibration

To ensure a true reflection of the typical crash types along a road network, the fatality estimation model applies a ‘crash-type calibration factor’. These factors are based on an analysis of the fatal and serious injury proportions associated with each crash type along the road by road user type.

The latest five years data on fatal and serious injury crashes recorded on Peak Downs Highway was sourced from Queensland Transport and Main Roads (TMR). This data was analysed and proportion of fatal and serious injury casualties by road user group - car, motorcycle, bicycle and pedestrian – determined. Further analysis was conducted to determine the proportion of each crash type considered in the model (Table 2.1).

Table 2.1: Crash parameters used

<table>
<thead>
<tr>
<th>Vehicle occupant &amp; motorcycle crash types (%)</th>
<th>Pedestrian crash types (%)</th>
<th>Bicycle crash types (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run-off loss of control</td>
<td>Pedestrian crashes along road (both sides combined)</td>
<td>Bicycle crashes along road</td>
</tr>
<tr>
<td>Head-on due to loss of control</td>
<td>Pedestrian crashes crossing side-road</td>
<td>Bicycle crashes - run-off</td>
</tr>
<tr>
<td>Head-on due to overtaking</td>
<td>Pedestrian crashes crossing through-road</td>
<td>Bicycle crashes - intersections</td>
</tr>
<tr>
<td>Intersection crashes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property access crashes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorcycle crashes along road</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary of the crash data is shown in Table 2.2.

Table 2.2: Crash summary (2007 – 2011)

<table>
<thead>
<tr>
<th></th>
<th>Total casualties</th>
<th>Car occupant</th>
<th>Motorcyclists</th>
<th>Bicyclists</th>
<th>Pedestrians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>15</td>
<td>86.7%</td>
<td>13.3%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Killed and serious injuries (KSI)</td>
<td>87</td>
<td>94.3%</td>
<td>4.6%</td>
<td>0.0%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>
2.4 Development of countermeasures and investment plans

The ViDA model considers more than 80 proven road improvement options to generate affordable and economically sound investments that will save lives. These road improvement options range from low-cost road delineation to higher-cost intersection upgrades and road surface upgrades. The development of the plans follows three key steps:

- Using the star ratings and traffic volume data, the estimated numbers of deaths and serious injuries are distributed throughout the road network.
- For each 100 metre section of road, countermeasure options are tested for their potential to reduce deaths and injuries.
- Each countermeasure option is assessed against affordability and economic effectiveness criteria. The economic benefit of a countermeasure (measured in terms of the economic benefit of the deaths and serious injuries prevented) must, at a minimum, exceed the cost of its construction and maintenance. That is, it must have a benefit cost ratio (BCR) greater than one. In many circumstances, the ‘threshold’ BCR for a plan is lifted above one, which has the effect of reducing the overall cost of the plan. This ensures that an affordable plan for a location can be generated while still representing a positive investment return and responsible use of public money.

The methodology underpinning this process is available in Safer Roads Investment Plans: The iRAP Methodology (www.irap.org/library.aspx). The models have been calibrated with local data to ensure that the results reflect local conditions.

2.5 Economic and countermeasure cost

The treatment cost of appropriate countermeasures supplied by TMR and used in the Bruce Hwy assessment was used. Other data sets required include the following economic parameters:

- cost of a fatality ($7,209,000) and serious injuries ($624,600)
- discount rate of return – 4%
- traffic growth – 5% per annum.
3 RESULTS

The total length of the Peak Downs Highway assessed is 267 km. Detailed results are available from the ViDA web-site (http://vida.irap.org/en/home). Summary of findings are provided below.

3.1 Star ratings

The smooth star ratings (over a typical 3 km length for rural sections and 1 km for urban areas) for Peak Downs Highway are shown in Table 3.1 and a map showing the car occupant star ratings in Figure 3.1. For car occupants, about 5% of the road length is rated as 1-star, 54% as 2-star, 40% as 3-star and 1% as 4-star. This map shows the risk faced by an individual motorist travelling on the road. The star ratings based on the individual 100 m sections of road, i.e., raw star rating results are shown in Appendix A

Table 3.1: Smooth star ratings – Peak Downs Highway

<table>
<thead>
<tr>
<th>Star ratings</th>
<th>Car</th>
<th>Motorcycle</th>
<th>Pedestrian</th>
<th>Bicycle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (km)</td>
<td>Percent</td>
<td>Length (km)</td>
<td>Percent</td>
</tr>
<tr>
<td>5 stars</td>
<td>0.0</td>
<td>0%</td>
<td>0.0</td>
<td>0%</td>
</tr>
<tr>
<td>4 stars</td>
<td>2.4</td>
<td>1%</td>
<td>0.0</td>
<td>0%</td>
</tr>
<tr>
<td>3 stars</td>
<td>108</td>
<td>40%</td>
<td>47.5</td>
<td>18%</td>
</tr>
<tr>
<td>2 stars</td>
<td>143.2</td>
<td>54%</td>
<td>173.7</td>
<td>65%</td>
</tr>
<tr>
<td>1 star</td>
<td>12.9</td>
<td>5%</td>
<td>45.3</td>
<td>17%</td>
</tr>
<tr>
<td>Not applicable</td>
<td>0.0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>266.5</td>
<td>100%</td>
<td>266.5</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 3.1: Car occupant smooth star ratings – Peak Downs Highway
3.2 Star ratings by road sections – car occupants

This section provides the smooth star ratings (over 3 km for rural sections and 1 km for urban areas) by road sections for car occupants. Table 3.2 shows the proportion of the road in each star band by road section for car occupants. Maps showing the car occupant star ratings for each section are shown in Figure 3.2 to Figure 3.4.

Table 3.2: Distribution of smooth star ratings by road section

<table>
<thead>
<tr>
<th>Section</th>
<th>Length (km)</th>
<th>Proportion in each star rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gregory Development Road to Dysart Road</td>
<td>89.3</td>
<td>* 10% ** 27% *** 63% **** 0% ***** 0%</td>
</tr>
<tr>
<td>Dysart Road to Nebo</td>
<td>89.2</td>
<td>* 0% ** 54% *** 46% **** 0% ***** 0%</td>
</tr>
<tr>
<td>Nebo to Bruce Highway</td>
<td>88.0</td>
<td>* 4% ** 80% *** 13% **** 3% ***** 0%</td>
</tr>
<tr>
<td>All sections</td>
<td>266.5</td>
<td>* 5% ** 54% *** 40% **** 1% ***** 0%</td>
</tr>
</tbody>
</table>

Figure 3.2: Car occupant smooth star ratings - Peak Downs Highway from Gregory Development Road to Dysart Road
Figure 3.3: Car occupant smooth star ratings - Peak Downs Highway from Dysart Road to Nebo

Figure 3.4: Car occupant smooth star ratings - Peak Downs Highway from Nebo to Bruce Highway
3.3 Road safety investment plan

The top five countermeasures in terms of KSI saved are provision of:

- roadside barriers
- improved skid resistance
- provision of additional lanes (2+1 lanes)
- shoulder rumble strips
- intersection right turn provision at 26 unsignalised 3-leg intersections.
3.4 Key road features

This section provides five or six stand-out facts about each road section. It is expected these will be used to generate talking points for discussions.

Gregory Development Road to Dysart (89 km)
- 37% of the section rated as 1 or 2-star and 63% as 3 or 4-star
- section is undivided and has 13 intersections (1 intersection every 6.9 km)
- 41% of the road section has unforgiving roadside conditions within 10 m from the edge line
- 89% has narrow sealed shoulder width (< 1.0 m)
- 49% has poor delineation

Dysart to Nebo (89 km)
- 54% of the section rated as 1 or 2-star and 46% as 3 or 4-star
- 43% of the section has unforgiving roadside conditions within 10 m from the edge line
- 84% of the section has narrow sealed shoulder width (< 1.0 m)
- section is undivided and has 19 intersections (1 intersection every 4.7 km)
- 100% of the section has good delineation
- 68% of the section has shoulder rumble strips

Nebo to Bruce Highway (88 km)
- 84% of the section rated as 1 or 2-star and 16% as 3 or 4-star
- section is mostly undivided and has 63 intersections including four railway crossings (1 intersection every 1.4 km)
- 62% of the section has unforgiving roadside conditions within 10 m from the edge line
- 28% of the section shoulder rumble strips
- 99% of the section has good delineation
3.5 Typical images by star rating

Typical 1-star, 2-star, 3-star and 4-star road sections are shown in Figure 3.5 to Figure 3.8.

![Figure 3.5: Peak Downs Highway, chainage (TDIST) 52.417 km, 1-star](image)
(undivided, severe roadside environment close to road, very sharp curve, no overtaking opportunities, narrow sealed shoulder width)

![Figure 3.6: Peak Downs Highway, 33B, chainage (TDIST) 75.667 km, 2-star](image)
(undivided, severe roadside environment close to road, curve, no overtaking opportunities, narrow sealed shoulder width)
Figure 3.7: Peak Downs Highway, chainage (TDIST) 2.175 km, 3-star
(undivided, straight, moderate roadside environment, narrow sealed shoulder width, good delineation)

Figure 3.8: Peak Downs Highway, chainage (TDIST) 86.6 km, 4-star
(undivided, straight, low speed environment of 60 km/h, moderate roadside environment, good sealed shoulder width)
4 CONCLUSIONS

This report presents star ratings and investment plan for improved safety outcome on Peak Downs Highway. For vehicle occupants, about 5% of the road length is rated as 1-star, 54% as 2-star, 40% as 3-star and 1% as 4-star.

A snapshot of key safety features that have a large influence on safety outcomes on the road are:

- road is mostly undivided (only 0.3 km is divided)
- 78% of the road has narrow sealed shoulder width (< 1.0 m)
- 49% of the road has unforgiving roadside conditions within 10 m from the edge line that may cause serious or fatal injury in the event of a run-off collision (due to trees, non-frangible poles, ditches, rollover upward slopes, steep downward slopes, aggressive rock face, etc.)
- 41% of the road has narrow to medium lane width (< 3.25 m)
- 14% has polished road surface (skid resistance coded as poor)
- the road has intersection frequency of one intersection for every 3 km of travel.
- 99% of the road has good horizontal alignment (straight to moderate curving)
- 83% of the road has good delineation

The total investment levels based on a minimum BCR of 1.0 is estimated at about $80.5 million. This investment plan is predicted to save about 67 road deaths and serious injuries over 20 years and will reduce the length of 1 and 2-star road sections to 10% from 59%.

The top-five recommended treatments for the Peak Downs Highway in terms of the number of estimated deaths and serious injuries prevented are:

- roadside barriers
- improved skid resistance
- provision of additional lanes (2+1 lanes)
- shoulder rumble strips
- intersection right turn provision at 26 unsignalised 3-leg intersections.
APPENDIX A  STAR RATINGS BASED ON 100M SECTIONS

The values in Table A.1 and Figure A.1 are based on the star rating of individual 100m sections of road, i.e., raw star rating results.

Table A.1: Distribution of star ratings (raw results) by road user

<table>
<thead>
<tr>
<th>STAR RATINGS</th>
<th>CAR</th>
<th>MOTORCYCLE</th>
<th>PEDESTRIAN</th>
<th>BICYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LENGTH (KMS)</td>
<td>PERCENT</td>
<td>LENGTH (KMS)</td>
<td>PERCENT</td>
</tr>
<tr>
<td>5 Stars</td>
<td>0.40</td>
<td>0%</td>
<td>0.30</td>
<td>0%</td>
</tr>
<tr>
<td>4 Stars</td>
<td>15.30</td>
<td>6%</td>
<td>2.00</td>
<td>1%</td>
</tr>
<tr>
<td>3 Stars</td>
<td>134.00</td>
<td>50%</td>
<td>100.00</td>
<td>33%</td>
</tr>
<tr>
<td>2 Stars</td>
<td>85.00</td>
<td>32%</td>
<td>99.20</td>
<td>37%</td>
</tr>
<tr>
<td>1 Star</td>
<td>31.80</td>
<td>12%</td>
<td>65.00</td>
<td>24%</td>
</tr>
<tr>
<td>Not applicable</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>TOTALS</td>
<td>266.50</td>
<td>100%</td>
<td>266.50</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure A.1: Star ratings – Peak Downs Highway