Road Safety Inspection

Project:	Jarrahdale road SLK 3.375 to SLK 3.75
Author:	Tony Shaw
Date:	12/05/20
Reference:	2005012-01

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Contents

Safety Audit Document Control Sheet

Project Location:	Jarrahdale road SLK 3.375 to SLK 3.75
Project Proposal:	RSI in support of Blackspot submission
Audit Stage:	Existing road Safety Inspection
Prepared for:	Shire of Serpentine Jarrahdale
Prepared by 1:	Tony Shaw
Prepared by 2:	Shawmac
Audit Team Leader:	Tony Shaw
Audit Team Leader Organisation:	Shawmac
Audit Reference:	2005012-01
Report Issue Date:	12/05/20

File Reference: Y:\Jobs Active 2020\T&T - Road Safety\Shire of Serpentine Jarrahdale_Blackspot RSA_2005012\Report\Jarrahdale Road RSA.docx

1 Introduction

1.1 Scope of Audit

The audit considered the existing road environment on Jarrahdale road between SLK 3.375 and SLK 3.75.

This Road Safety Audit has been undertaken in accordance with the requirements contained in the Main Roads Western Australia Policy and Guidelines for Road Safety Audits.

The background and objective of the proposed project is to identify any impediments to road safety and where these are identified to recommend initiatives to improve these to allow for safe passage for all road users.

The Audit was undertaken by Tony Shaw of Shawmac Pty Ltd with reference to the details provided in the Audit Brief.

The audit comprised an examination of the site and other information listed in Appendix D.

All the findings described in Section 2 of this report are considered by the audit team to require action in order to improve the safety of the proposed site and to minimise the risk of crash occurrence and reduce potential crash severity.

The audit team has examined and reported only on the road safety implications of the project as presented and has not examined or verified the compliance of the design to any other criteria.

1.2 The Audit Team

Auditor No.	Name	Role	Organisation
00023	Tony Shaw	Audit Team Leader	Shawmac Pty Ltd
00143	Richard Jois	Audit Team Member	Shawmac Pty Ltd.

1.3 Specialist Advisors

There were no Specialist Advisors. Prad Maha from the Shire of Serpentine Jarrahdale attended as an advisor.

1.4 Safe System Findings

The aim of Safe System Findings is to focus the Road Safety Audit process on considering safe speeds and by providing forgiving roads and roadsides. This is to be delivered through the Road Safety Audit process by accepting that people will always make mistakes and by considering the known limits to crash forces the human body can tolerate. This is to be achieved by focusing the Road Safety Audit on particular crash types that are known to result in higher severity outcomes at relatively lower speed environments to reduce the risk of fatal and serious injury crashes.

The additional annotation “IMPORTANT” is used to provide emphasis to any road safety audit finding that has the potential to result in fatal or serious injury or findings that are likely to result in the following crash types above the related speed environment: head-on (>70 km/h), right angle (>50 km/h), run off road impact object (>40 km/h),

and crashes involving vulnerable road users (>30 km/h), as these crash types are known to result in higher severity outcomes at relatively lower speed environments.

The exposure and likelihood of crash occurrence has been considered for all findings deemed “IMPORTANT” and evaluated based on the auditor’s professional judgement considering factors such as traffic volumes and movements, speed environment, crash history and the road environment. The likelihood of crash occurrence has been designated either “VERY HIGH”, “HIGH”, “MODERATE” or “LOW” and this additional annotation has been displayed following the “IMPORTANT” annotation on applicable findings.

1.5 Previous Safety Audits

there are no known previous audits.

1.6 Background Data

1.6.1 Crash History

Review of the crash history for the section of Jarrahdale Road audited for the 5-year period to December 2019 indicated the following. There was only 1 recorded crash involving a hit animal crash with PDO Major outcome.

Summary Crash History

Selection Criteria	Value
Road	JARRAHDALE RD (1080002)
Date	01/01/2015 to 31/12/2019
Road SLK	3.38 to 3.75

Severity	Count	Percentage
Fatal	0	0.0%
Hospital	0	0.0%
Medical	0	0.0%
PDO Major	1	100.0%
PDO Minor	0	0.0%
Other / Unknown	0	0.0%
Total:	**1**	**100.0%**

MR Type	Count	Percentage
Involving Overtaking	0	0.0%
Involving Parking	0	0.0%
Involving Animal	1	100.0%
Involving Pedestrian	0	0.0%
Entering / Leaving Driveway	0	0.0%
Other / Unknown	0	0.0%
Total:	**1**	**100.0%**

Light Conditions	Count	Percentage
Daylight	0	0.0%
Dawn Or Dusk	0	0.0%
Dark - Street Lights On	0	0.0%
Dark - Street Lights Off	0	0.0%
Dark - Street Lights Not Provided	1	100.0%
Other / Unknown	0	0.0%
Total:	**1**	**100.0%**

Object Hit	Count	Percentage
SEC Pole	0	0.0%
Traffic Light Post	0	0.0%
Traffic Sign	0	0.0%
Commercial Sign Post	0	0.0%
Tree	0	0.0%
Other	2	100.0%
Total:	**2**	**100.0%**

Road Grade	Count	Percentage
Level	0	0.0%
Crest Of Hill	0	0.0%
Slope	0	0.0%
Other / Unknown	1	100.0%
Total:	**1**	**100.0%**

Road Alignment	Count	Percentage
Curve	0	0.0%
Straight	0	0.0%
Other / Unknown	1	100.0%
Total:	**1**	**100.0%**

Speed a Factor	Count	Percentage
Yes	0	0.0%
No	0	0.0%
Other / Unknown	1	100.0%
Total:	**1**	**100.0%**

Road Condition	Count	Percentage
Wet	0	0.0%
Dry	1	100.0%
Other / Unknown	0	0.0%
Total:	**1**	**100.0%**

MR Nature	Count	Percentage
Rear End	0	0.0%
Head On	0	0.0%
Sideswipe Opposite Dirn	0	0.0%
Sideswipe Same Dirn	0	0.0%
Right Angle	0	0.0%
Right Turn Thru	0	0.0%
Hit Pedestrian	0	0.0%
Hit Animal	0	0.0%
Hit Object	1	100.0%
Non Collision	0	0.0%
Other / Unknown	0	0.0%
Total:	**1**	**100.0%**

Figure 1: Crash History

1.6.2 Traffic Data

The traffic volumes for Jarrahdale Road are shown on the following figure.

mainroads WESTERN AUSTRALIA

SITE 1086

Hourly Volume

Jarrahdale Rd (1080002)

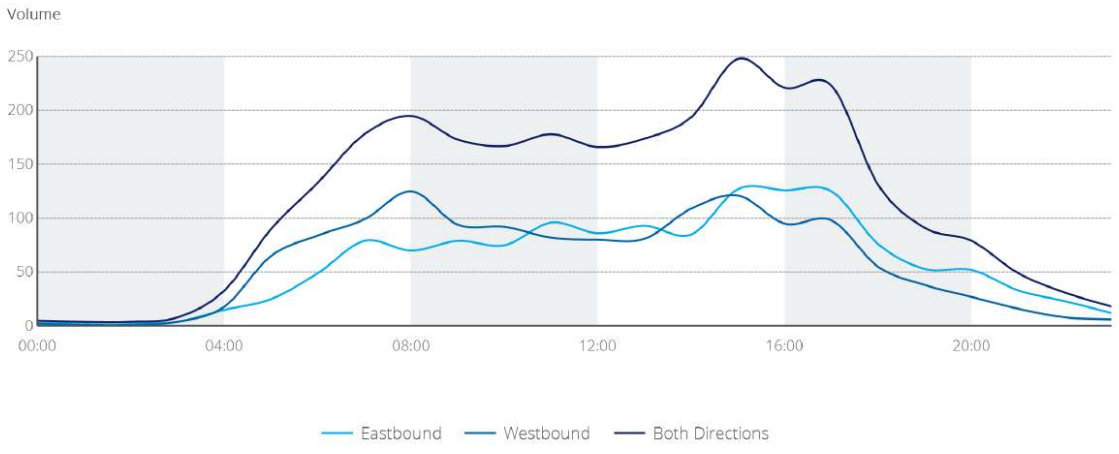
East of South Western Hwy (SLK 0.36)

2017/18
Monday to Friday

	All Vehicles			Heavy Vehicles			
	EB	WB	Both	EB	WB	Both	%
00:00	3	2	5	1	1	2	40.0
01:00	3	1	4	2	1	3	75.0
02:00	3	1	4	2	0	2	50.0
03:00	4	4	8	2	1	3	37.5
04:00	15	18	33	3	3	6	18.2
05:00	25	65	90	6	5	11	12.2
06:00	49	84	133	9	13	22	16.5
07:00	79	99	178	14	14	28	15.7
08:00	70	125	195	13	12	25	12.8
09:00	79	94	173	14	13	27	15.6
10:00	75	92	167	11	15	26	15.6
11:00	96	82	178	18	15	33	18.5
12:00	86	80	166	13	12	25	15.1
13:00	93	81	174	8	17	25	14.4
14:00	85	109	194	13	10	23	11.9
15:00	127	121	248	16	21	37	14.9
16:00	126	95	221	14	14	28	12.7
17:00	125	98	223	10	12	22	9.9
18:00	76	55	131	2	5	7	5.3
19:00	53	38	91	4	4	8	8.8
20:00	52	27	79	2	1	3	3.8
21:00	33	16	49	2	1	3	6.1
22:00	23	8	31	0	0	0	0.0
23:00	12	6	18	0	0	0	0.0
TOTAL	1392	1401	2793	179	190	369	13.2

Peak Statistics

AM	TIME	11:00	08:00	07:30	11:00	06:45	11:00
	VOL	96	125	200	18	16	33
PM	TIME	16:15	15:00	15:00	15:30	15:00	15:00
	VOL	128	121	248	16	21	37



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1.6.3 Speed Data

The posted speed on Jarrahdale Road adjacent to the site is 80 km/h. MRWA data for Jarrahdale Road at SLK 0.36 indicates an 85th percentile speed of 82 km/h.

1.6.4 Appendices

Appendix A – Audit Findings Location Plan

Appendix B – Audit Photographs

Appendix C – Crash Reports

Appendix D – List of Documents Provided for the Audit

Appendix E – Corrective Action Report (CAR)

2 Items Raised in this Audit

2.1 Finding - Unprotected Batter

Steep unprotected batter slopes are located adjacent to the carriageway.

Justification of the finding

Should a vehicle inadvertently leave the roadway in the section of road where there are steep unprotected batters a driver is likely to experience loss of control with the resultant crash causing serious or fatal injury.

High severity crashes with embankments are primarily due to vehicle rollover. Factors that are considered to contribute to the likelihood of vehicle rollover include:

- Embankment (fill) slopes – batter slopes between 4:1 and 3:1 is traversable but too steep for a driver to recover, and a slope of steeper than 3:1 is critical as the errant vehicle is likely to overturn.
- Embankment height – the likelihood of vehicle rollover with a high severity outcome increases significantly where the embankment height exceeds 1.5 m and embankment slopes are critical.
- Ground conditions on the embankment – the probability of vehicle rollover is increased if there is a likelihood that the vehicle's tyres will dig into the ground or the vehicle will strike a surface irregularity (e.g. large rocks, sharp mounds or depressions) which could trip the vehicle.
- Absence of rounding at gradient changes of roadside terrain – rounding should be applied at gradient changes (hinge points) as it provides drivers with a greater opportunity to maintain or regain control of the vehicle and decreases the likelihood of rollover by preventing the vehicle from achieving large values of angular momentum about the longitudinal roll axis.
- Embankment slopes should be no steeper than 4:1, as drivers who encroach onto such slopes have a greater chance of safely bringing their vehicle to a stop or controlling it down the slope. In order to cater for the different characteristics and performance of heavy commercial vehicles, embankment slopes of 6:1 or flatter are desirable where this can reasonably be achieved, particularly where truck volumes are high.

Austroads Guide to Road Design Part 6 provides a warrant for treatment of an embankment on intermediate speed (i.e. 70 to 90 km/h) and high-speed (i.e. > 90 km/h) roads with a traffic volume greater than 2000 vehicles per day. The treatment may include embankment flattening or the installation of a suitable road safety barrier system.

Recommendation

Provide safety barrier along the section of road where the batter slopes exceed 4 in 1 and embankment height is greater than 1.5 metres.

[IMPORTANT | HIGH]

2.2 Finding - Non-compliant Barrier

Non-compliant barrier is currently installed adjacent to the bridge at about SLK 3.375.

Justification of the finding

Should a vehicle inadvertently leave the roadway in the vicinity of the non-compliant leading terminal, the barrier may fail to perform as intended and result in a crash causing serious or fatal injury.

Austroads Guide to Road Design Part 6 indicates that terminal treatments and crash cushions or impact attenuators are used to terminate a road safety barrier. These devices are specifically designed to ensure that the ends of road safety barriers provide safe conditions for occupants of vehicles that may impact this area of a road safety barrier.

Key performance aspects (AS/NZS 3845 – 1999) are that barrier terminals should:

- Where necessary, incorporate an anchor to the road safety barrier system to enable the full tensile strength of the system to be developed during impacts with the barrier at locations away from the terminal.
- Not cause an impacting vehicle to roll, vault or yaw in an inappropriate manner (applies to leading and trailing terminals).
- Not spear the impacting vehicle or cause undue problems with debris.
- Should perform acceptably when impacted from either direction, except when erected on a single direction carriageway where there is a low probability of a vehicle impacting the terminal from the reverse direction.
- Be tested in accordance with AS/NZS 3845 – 1999 and as the tests are undertaken in a controlled environment actual site conditions need to be considered when selecting an end terminal treatment.

Recommendation

Modify the barrier so as to provide compliant terminals.

[IMPORTANT | MODERATE]

2.3 Finding - Unprotected Culvert

Unprotected culvert headwalls are located adjacent to the carriageway.

Justification of the finding

Should a vehicle inadvertently leave the roadway in the section of road where there are the steep unprotected culvert headwalls a driver is likely to experience loss of control with the resultant crash causing serious or fatal injury.

Austroads Guide to Road Design Part 6 indicates that the ends of culverts that cross under the road or are located

parallel to the road constitute hazards if they are within the area of interest (e.g. clear zone). Road design should aim to eliminate all non-essential drainage features. Where drainage features are unavoidable, they should be designed as follows:

- Drains parallel to the road (e.g. under a driveway or side road) – traversable culvert end treatments should be installed wherever a culvert exists parallel to the road and within the area of interest.
- Perpendicular to the road (headwall treatment) – Culverts that run perpendicular to the road (i.e. run under the road) should be designed to be traversable or present a minimal obstruction to an errant vehicle if the fill batter is of a low enough slope to be driveable, or be protected with an appropriate road safety barrier if the slope is not driveable.
- Alternatively, the culvert can be extended to a location further from the travelled way (e.g. at the clear zone distance) where the end is less likely to be impacted by errant vehicles, although this option may not be preferred.

Recommendation

Provide safety barrier along the section of road where culvert headwalls are unprotected and pose a hazard.

[IMPORTANT | HIGH]

2.4 Finding - Unsealed Shoulders

shoulders are unsealed and in places exhibit signs of drop off and edge break.

Justification of the finding

Should a vehicle inadvertently leave the roadway where shoulders are unsealed and where there is excessive edge break and / or drop off. a driver may lose control and crash with vehicle occupants suffering serious or fatal injuries.

MRWA indicate that Single Vehicle lane departure (run-off road, head-on) crashes in the rural high-speed state roads are the largest contributor to death and serious injuries on this part of the state network and evidence has proven there are a number of treatments which may be applied to greatly reduce these crashes from occurring. Sealing shoulders and installing Audible Edge lines have shown to substantially reduce the chance of these crash types by between 43% - 67% depending on the existing carriageway formation.

Austroads Guide to Road Design Part 3 indicates that road shoulders are provided to carry out two functions; structural and traffic. The traffic functions of the shoulder are:

- an initial recovery area for any errant vehicle;
- a refuge for stopped vehicles on a firm surface at a safe distance from traffic lanes;
- a trafficable area for emergency use;

- space for cyclists;
- clearance to lateral obstructions;
- provision of additional width for tracking of large vehicles.

Recommendation

Preferably provide sealed shoulders or at a minimum undertake maintenance to condition shoulders, repair edge break and remove edge drop off.

[IMPORTANT | LOW]

3 Audit Statement

I hereby certify that the audit team have examined the documents listed in Appendix C in undertaking this Road Safety Audit and confirm that this audit has been carried out independently and in accordance with Main Roads Policy and Guidelines for Road Safety Audit.

Audit Team Leader

Tony Shaw

Shawmac

12/05/20

4 Appendix A – Audit Site Location / Details

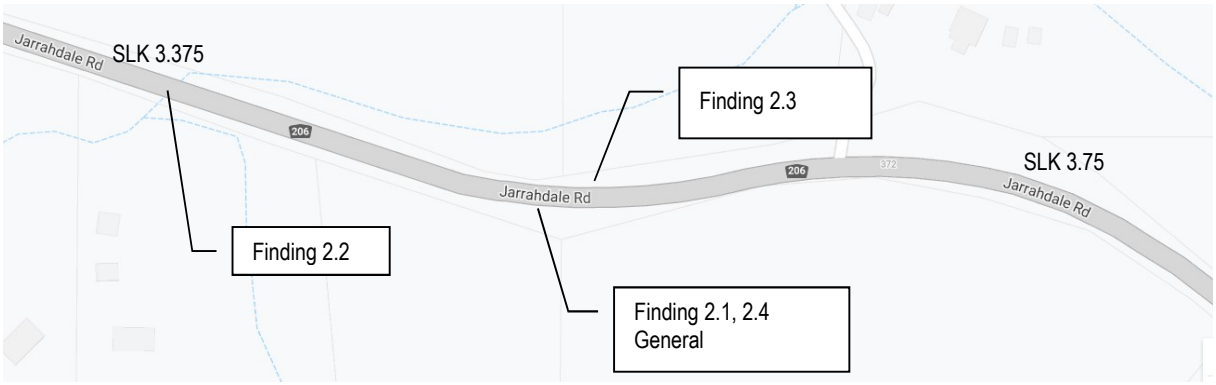

Figure 2: Location of Findings

5 Appendix B – Audit Photographs

Figure 3: Finding 2.1 - Steep Batter Slopes

Figure 4: Finding 2.2 - Non-compliant Barrier

Figure 5: Finding 2.3 - Unprotected Culvert

Figure 6: Finding 2.4 Unsealed Shoulder

6 Appendix C – Crash Reports

Detailed Crash History

Report Criteria

Road	SLK	CWY
1080002 - Jarrahdale Rd	3.37 to 3.75	All

Parameter	Value	Description
From Date	01/01/2015	
To Date	31/12/2019	
Crash Type	All	
Severity	All	

Road	Road Name	SLK	CWY	True Dist	Intersection	Date	Day	Time	Severity	Crash No.	Type	Light Cond	Road Cond	Speed Limit	Traffic Control	Road Feature	Road Alignment	Speed Factor	MR Nature	Location	RUM	Unit	Unit Type	From Dir	To Dir	Veh/Ped Move	First Object Hit	Second Object Hit	Third Object Hit	Target Impact Point
108000 2	Jarrahdale Rd	3.38	S	3.38		11/10/ 2019	Friday	1930	PDO Major	20192 92474	Midblock	Dark - Street Lights Not Provided	Dry	80	No Sign Or Control	Bridge			Hit Object	On Left Verge After Leaving Cway	72:Off Path On Straight: Off Left Cway Obj	Colliding	Utility	E	W	Swerving: To Avoid Animal	Emban kment	In Water		

7 Appendix D – List of Documents Provided for Audit

No documents provided for audit. References made include MRWA crash data website and MRWA trafficmap website.

8 Appendix E – Corrective Action Report

Corrective Action Report – Jarrahdale Road

Road Safety Inspection

Ref	Findings and Recommendations	Project Manager		
		Agree / Disagree	Reason for Disagreeing	Proposed Action and Comments
2.1	**Finding - Unprotected Batter** Steep unprotected batter slopes are located adjacent to the carriageway. **Justification of the finding** Should a vehicle inadvertently leave the roadway in the section of road where there are steep unprotected batters a driver is likely to experience loss of control with the resultant crash causing serious or fatal injury. High severity crashes with embankments are primarily due to vehicle rollover. Factors that are considered to contribute to the likelihood of vehicle rollover include: Embankment (fill) slopes – batter slopes between 4:1 and 3:1 is traversable but too steep for a driver to recover, and a slope of steeper than 3:1 is critical as the errant vehicle is likely to overturn. Embankment height – the likelihood of vehicle rollover with a high severity outcome increases significantly where the embankment height exceeds 1.5 m and embankment slopes are critical. Ground conditions on the embankment – the probability of vehicle rollover is increased if there is a likelihood that the vehicle's tyres will dig into the ground or the vehicle will strike a surface irregularity (e.g. large rocks, sharp mounds or depressions) which could trip the vehicle. Absence of rounding at gradient changes of roadside terrain – rounding should be applied at gradient changes (hinge points) as it provides drivers with a greater opportunity to maintain or regain control of the vehicle and decreases the likelihood of rollover by preventing the vehicle from achieving large values of angular momentum about the longitudinal roll axis. Embankment slopes should be no steeper than 4:1, as drivers who encroach onto such slopes have a greater chance of safely bringing their vehicle to a stop or controlling it down the slope. In order to cater for the different characteristics and performance of heavy commercial vehicles, embankment slopes of 6:1 or flatter are desirable where this can			

Ref	Findings and Recommendations	Project Manager		
		Agree / Disagree	Reason for Disagreeing	Proposed Action and Comments
	reasonably be achieved, particularly where truck volumes are high. *Austroads Guide to Road Design Part 6* provides a warrant for treatment of an embankment on intermediate speed (i.e. 70 to 90 km/h) and high-speed (i.e. > 90 km/h) roads with a traffic volume greater than 2000 vehicles per day. The treatment may include embankment flattening or the installation of a suitable road safety barrier system. **Recommendation** Provide safety barrier along the section of road where the batter slopes exceed 4 in 1 and embankment height is greater than 1.5 metres. [IMPORTANT | HIGH]			
2.2	**Finding - Non-compliant Barrier** Non-compliant barrier is currently installed adjacent to the bridge at about SLK 3.375. **Justification of the finding** Should a vehicle inadvertently leave the roadway in the vicinity of the non-compliant leading terminal, the barrier may fail to perform as intended and result in a crash causing serious or fatal injury. *Austroads Guide to Road Design Part 6* indicates that terminal treatments and crash cushions or impact attenuators are used to terminate a road safety barrier. These devices are specifically designed to ensure that the ends of road safety barriers provide safe conditions for occupants of vehicles that may impact this area of a road safety barrier. Key performance aspects (AS/NZS 3845 – 1999) are that barrier terminals should: Where necessary, incorporate an anchor to the road safety barrier system to enable the full tensile strength of the system to be developed during impacts with the barrier at locations away from the terminal. Not cause an impacting vehicle to roll, vault or yaw in an inappropriate manner (applies to leading and trailing terminals). Not spear the impacting vehicle or cause undue problems with debris. Should perform acceptably when impacted from either direction, except when erected on a single direction carriageway where there is a low probability of a vehicle impacting the terminal from the reverse direction. Be tested in accordance with AS/NZS 3845 – 1999 and as the tests are undertaken in a controlled environment actual site conditions need to be considered when selecting an end terminal treatment. **Recommendation** Modify the barrier so as to provide compliant terminals.			

Ref	Findings and Recommendations	Project Manager		
		Agree / Disagree	Reason for Disagreeing	Proposed Action and Comments
	[IMPORTANT | MODERATE]			
2.3	**Finding - Unprotected Culvert** Unprotected culvert headwalls are located adjacent to the carriageway. **Justification of the finding** Should a vehicle inadvertently leave the roadway in the section of road where there are the steep unprotected culvert headwalls a driver is likely to experience loss of control with the resultant crash causing serious or fatal injury. *Austroads Guide to Road Design Part 6* indicates that the ends of culverts that cross under the road or are located parallel to the road constitute hazards if they are within the area of interest (e.g. clear zone). Road design should aim to eliminate all non-essential drainage features. Where drainage features are unavoidable, they should be designed as follows: Drains parallel to the road (e.g. under a driveway or side road) – traversable culvert end treatments should be installed wherever a culvert exists parallel to the road and within the area of interest. Perpendicular to the road (headwall treatment) – Culverts that run perpendicular to the road (i.e. run under the road) should be designed to be traversable or present a minimal obstruction to an errant vehicle if the fill batter is of a low enough slope to be driveable, or be protected with an appropriate road safety barrier if the slope is not driveable. Alternatively, the culvert can be extended to a location further from the travelled way (e.g. at the clear zone distance) where the end is less likely to be impacted by errant vehicles, although this option may not be preferred. **Recommendation** Provide safety barrier along the section of road where culvert headwalls are unprotected and pose a hazard. [IMPORTANT | HIGH]			
2.4	**Finding - Unsealed Shoulders** shoulders are unsealed and in places exhibit signs of drop off and edge break. **Justification of the finding** Should a vehicle inadvertently leave the roadway where shoulders are unsealed and where there is excessive edge break and / or drop off. a driver may lose control and crash with vehicle occupants suffering serious or fatal injuries. MRWA indicate that Single Vehicle lane departure (run-off road, head-on) crashes in the rural high-speed state roads are the largest contributor to death and serious injuries on this part of the state network and evidence has proven there are a number of treatments which may be applied to greatly reduce these crashes from occurring. Sealing shoulders and			

Ref	Findings and Recommendations	Project Manager		
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	installing Audible Edge lines have shown to substantially reduce the chance of these crash types by between 43% - 67% depending on the existing carriageway formation. *Austroads Guide to Road Design Part 3* indicates that road shoulders are provided to carry out two functions; structural and traffic. The traffic functions of the shoulder are: an initial recovery area for any errant vehicle; a refuge for stopped vehicles on a firm surface at a safe distance from traffic lanes; a trafficable area for emergency use; space for cyclists; clearance to lateral obstructions; provision of additional width for tracking of large vehicles. **Recommendation** Preferably provide sealed shoulders or at a minimum undertake maintenance to condition shoulders, repair edge break and remove edge drop off. [IMPORTANT | LOW]			
	END			

Corrective Action Report – Jarrahdale Road

Road Safety Inspection

NOTE:

- This Corrective Action Report is to be read in conjunction with the full Road Safety Audit Report and its findings and recommendations.
- The asset owners (MRWA and/or LGA) **must** be informed of these findings, recommendations and proposed actions.
- Items not under the responsibility of this project representative must be forwarded to the persons / agencies who are responsible.

These findings and recommendations have been considered, and the actions listed will be taken accordingly.

Responsible Project Representative	Company / Agency / Division	Position	Date

Asset Owner Representative	Company / Agency / Division	Position	Date