Old Vasse Road (SLK 0.54 – 2.011)

Design Report

14 March 2025

Ref: 304770543

PREPARED FOR:

[redacted]
Shire of Manjimup

PREPARED BY:

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Stantec

Revision Schedule

Revision No.	Date	Description	Prepared by	Project Manager Final Approval
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Contents

1. Introduction

1.1 General

This Civil Design Report has been prepared for the Shire of Manjimup. The report outlines the findings of the engineering review of the design for the upgrade from SLK 0.54 to SLK 2.011 Old Vasse Road.

It is noted that due to the requirement to retain existing mature trees, some aspects of the design do not conform to Austroads design standards. To enable the retention of trees, and to mitigate the impact of the retained trees on the safety of road users, various cost-effective modifications to the design are suggested. However, it must be stated from the outset, that the best outcome for road user safety would be to remove trees to establish appropriate clear zones for design and operating speed. Where this is not possible, the installation of appropriate safety barriers may be an appropriate treatment to improve road user safety, but the installation of safety barriers has not been considered as part of this review.

1.2 Site Location

The site is located at SLK 0.54 to SLK 2.011 Old Vasse Road, south-west of Pemberton in Western Australia.

1.3 Safety in Design

The provision of Safety in Design services is part of the scope of deliverables for this engagement.

2. Civil Services

2.1 Objectives

- To design the upgrade of Old Vasse Road using Austroads Standards and standard restricted access vehicle RAV route assessment guidelines. Provide advice on areas of non-compliance as well as other suggestions for design adjustments for constructability and/or quality.

2.2 Design Standards, Site Conditions and Constraints

2.2.1 Applicable Standards

The Design Review was undertaken with consideration of the following documents:

- Austroads Guide to Road Design Part 3: Geometric Design
- MRWA Guide to the Assessment of RAV Routes

2.2.2 Basis of Design Information

- Feature Survey of Old Vasse Road provided by the Shire of Manjimup.
- Geotechnical investigation conducted by the Shire of Manjimup.
- Traffic counts as supplied by the Shire of Manjimup
    - VPD of approximately 100vpd (please note that the information supplied did not provide a full week, so an assumption was made for one day on the provided data)

2.2.3 Existing Service Infrastructure

- No assessment of existing services has been undertaken

2.3 Design Criteria

The design criteria used in assessment of the Design is outlined below.

2.3.1 Shire of Manjimup Design Requirements

The Shire of Manjimup advised of the following design criteria:

- Design vehicle:
    - RAV Vehicle Class 3
- Design speed of 90km/hr
- Proposed Road width 6.0m with 1m gravel shoulders

2.3.2 Austroads Design Requirements

The general basis of road design is as follows:

<u>Typical Cross-Section</u>

As per Austroads Table 4.2, the typical crossfall of a sprayed seal road is 3%.

As per Austroads clause 4.2.6 and Table 4.5 and based on the traffic volume supplied by the shire of Manjimup (Dated 31/5/24 – 13/6/24), the AWDT is 102, assumption has been made that the AADT would be between 150-500 to consider

the peak season periods. The minimum width of lane for a rural road shall be 3.1m, with 0.5m sealed shoulder and 1.5m total shoulder width.

Table 4.5: Single carriageway rural road widths (m)

Element	Design AADT				
	1–150	150–500	500–1000	1000–3000	> 3000
Traffic lanes(1)	3.7 (1 x 3.7)	6.2 (2 x 3.1)	6.2–7.0 (2 x 3.1/3.5)	7.0 (2 x 3.5)	7.0 (2 x 3.5)
Total shoulder	2.5	1.5	1.5	2.0	2.5
Minimum shoulder seal (2),(3),(4),(5),(6)	0	0.5	0.5	1.0	1.5
Total carriageway	8.7	9.2	9.2–10.0	11.0	12.0

1 *Traffic lane widths include centrelines but are exclusive of edge-lines.*
2 *Where significant numbers of cyclists use the roadway, consideration should be given to fully sealing the shoulders. Suggest use of a maximum size 10 mm seal within a 20 km radius of towns.*
3 *Wider shoulder seals may be appropriate depending on requirements for maintenance costs, soil and climatic conditions or to accommodate the tracked width requirements for Large Combination Vehicles.*
4 *Short lengths of wider shoulder seal or lay-bys to be provided at suitable locations to provide for discretionary stops.*
5 *Full width shoulder seals may be appropriate adjacent to safety barriers and on the high side of superelevation.*
6 *A minimum 7.0 m seal should be provided on designated heavy vehicle routes (or where the AADT contains more than 15% heavy vehicles).*

MRWA's RAV Guidelines specify a minimum sealed width of 5.9m, and Carriageway width of 7.9m as a minimum for a Rav 2-4 Route.

Appendix A: Rural Road Minimum Width

	60 to 70 km/h		80 to 100 km/h	
	Carriageway Width (m)	Sealed Width (m)	Carriageway Width (m)	Sealed Width (m)
0 to 150 AADT / VPD* **				
RAVs Categories 2-4	7.6	3.3	7.9	3.4
RAVs Categories 5-7	7.7	3.4	8.0	3.5
RAVs Categories 8-10	8.2	3.8	8.6	3.9
150 to 500 AADT / VPD				
RAVs Categories 2-4	7.6	5.6	7.9	5.9
RAVs Categories 5-7	7.7	5.7	8.0	6.0
RAVs Categories 8-10	8.2	6.1	8.6	6.4
500 to 1 000 AADT				
RAVs Categories 2-4	7.9	6.1	8.2	6.4
RAVs Categories 5-7	8.0	6.2	8.3	6.5
RAVs Categories 8-10	8.6	6.6	9.0	6.9
More than 1 000 AADT				
RAVs Categories 2-4	9.6	6.8	9.9	7.1
RAVs Categories 5-7	9.7	6.9	10.0	7.2
RAVs Categories 8-10	10.6	7.6	11.0	8.0

We understand that the Shire of Manjimup is applying a 3m lane width and 1.0m unsealed shoulder, being a sealed width of 6m and carriageway width of 8m, in line with the Shire of Manjimup road hierarchy.

We advise that the typical road cross-section does not conform to Austroads requirements for the total carriageway of 9.2m for the estimated traffic volume.

Batters to Existing

As per Austroads Table 4.11, desirable cut batter grades are 1 in 3, with maximum of 1 in 2. **Cut batters in the design are 1 in 3 and comply to Austroads guidelines. We note that earthworks batters may be locally adjusted in some locations to mitigate impact of works on existing trees which must be protected. As a result of these adjustments, batters may not comply with Austroads design guidelines.**

As per Austroads Table 4.11, desirable fill batter grades are 1 in 6, with maximum of 1 in 4. **Fill batters in the design are 1 in 4 which is the maximum fill batter and does comply with Austroads design guidelines. We further note that additional steepening of batters may be required to mitigate impact on existing trees.**

We note that the ability for the design to conform to Austroads Design guidelines for earthworks batters is impacted by the need to protect existing trees. The existing trees to be protected will impact the safety of the road design, by impacting the grade of batters and the hazard rating of the road side environment. We note that this impact is typical for roads in the region. We understand that the use of guard rails is not contemplated by the

design or construction budget but could be an option for reducing the risk to future road users from the sub-standard batter grades and roadside hazards.

Car Stopping Sight Distance

As per Austroads Table 5.5, the minimum stopping sight distance for a 90km/hour design speed is **130m** (absolute minimum) or **150m** (desirable) minimum using a 2.0 second reaction time.

Table 5.5: Stopping sight distances for cars on sealed roads

Design speed (km/h)	Absolute minimum values Only for specific road types and situations[1] based on $d = 0.46$[2],[3]			Desirable minimum values for all road types based on $d = 0.36$			Values for major highways and freeways in flat terrain[7] based on $d = 0.26$	
	R_T = 1.5 s[4]	R_T = 2.0 s[4]	R_T = 2.5 s	R_T = 1.5 s[4]	R_T = 2.0 s[4]	R_T = 2.5 s	R_T = 2.0 s	R_T = 2.5 s
40	30	36	–	34	40	45	–	–
50	42	49	–	48	55	62	–	–
60	56	64	–	64	73	81	–	–
70	71	81	–	83	92	102	113	123
80	88	99	–	103	114	126	141	152
90	107	119	132	126	139	151	173	185
100	–	141	155	–	165	179	207	221
110	–	165	180	–	193	209	244	260
120	–	190	207	–	224	241	285	301
130	–	217	235	–	257	275	328	346
Corrections due to grade [5] [6]	**–8**	**–6**	**–4**	**–2**	**2**	**4**	**6**	**8**
40	5	3	2	1	–1	–2	–2	–3
50	8	5	3	2	–1	–3	–4	–5
60	11	8	5	2	–2	–4	–6	–7
70	15	11	7	3	–3	–5	–8	–10
80	20	14	9	4	–4	–7	–10	–13
90	25	18	11	5	–5	–9	–13	–16
100	31	22	14	6	–6	–11	–16	–20
110	38	26	17	8	–7	–13	–19	–24
120	45	31	20	9	–8	–16	–22	–29
130	53	37	23	11	–10	–18	–26	–34

1 *These values are only suitable for use in very constrained locations. Examples of this in Australia are:*
- *lower volume roads*
- *mountainous roads*
- *lower speed urban roads*
- *sighting over or around barriers.*

It is not clear if the design will conform to this requirement given the proximity of trees to the roadside on bends. Available sight distances shall be confirmed onsite during construction and appropriate measures taken to mitigate any outstanding risk.

Truck Stopping Sight Distance

As per Austroads Table 5.6, the minimum stopping sight distance for a Truck at a 90km/hour design speed **is 190m** (reaction time of 2.0 seconds) or **205m** (reaction time of 2.5 seconds).

Table 5.6: Truck stopping sight distances

Operating speed (km/h)	Single unit trucks, semi-trailers and B-doubles Based on $d = 0.29$[1]							
	R_T = 1.5 s[2]					R_T = 2.0 s		R_T = 2.5 s
40	38					44		49
50	55					62		69
60	74					82		91
70	96					105		115
80	120					131		142
90	147					160		172
100	–					191		205
110	–					225		241
Corrections due to grade [3] [4]	**–8%**	**–6%**	**–4%**	**–2%**	**2%**	**4%**	**6%**	**8%**
40	8	6	3	2	–1	–3	–4	–5
50	13	9	5	3	–2	–4	–6	–7
60	19	13	8	4	–3	–6	–8	–11
70	25	17	11	5	–4	–8	–11	–14
80	33	23	14	6	–6	–11	–15	–19
90	42	29	18	8	–7	–13	–19	–24
100	52	35	22	10	–9	–16	–23	–29
110	63	43	26	12	–11	–20	–28	–36

1 *On any horizontal curve with a side friction factor greater than the desirable maximum value for trucks, the stopping sight distance values given should be based on a coefficient of deceleration that is reduced by 0.05.*
2 *Reaction times of 1.5 s cannot be used in Western Australia. A 1.5 s reaction time is only to be used in constrained situations where drivers will be alert. Typical situations are given in Table 5.2. The general minimum reaction time is 2.0 s.*
3 *If the roadway is on a grade, designers shall adjust stopping sight distance values by applying these grade corrections derived with d = 0.29. Downhill grades are shown as negative, with uphill listed as positive. The grade adopted is determined using the average grade over the braking length.*
4 *Corrected stopping sight distances should be rounded conservatively to the nearest 5 m.*

Note: Combinations of design speed and reaction times not shown in this table are generally not used.

It is not clear if the design will conform to this requirement given the proximity of trees to the roadside on bends. Available sight distances shall be confirmed onsite during construction and appropriate measures taken to mitigate any outstanding risk.

Horizontal Geometry and Superelevation

As per Austroads table 7.6, the minimum radii of horizontal curves based on superelevation and side friction factors are:

Table 7.6: Minimum radii of horizontal curves based on superelevation and side friction at maximum values

Operating speed km/h	Urban roads		Rural roads					
	e_{max} = 5%		e_{max} = 6%		e_{max} = 7%		e_{max} = 10%	
	f_{max} = Des min	f_{max} = Abs min	f_{max} = Des min	f_{max} = Abs min	f_{max} = Des min	f_{max} = Abs min	f_{max} = Des min	f_{max} = Abs min
40	36	31	35	31	34	30	31	28
50	56	49	55	48	53	47	49	44
60	98	75	94	73	91	71	83	66
70	161	107	154	104	148	102	133	94
80	240	163	229	157	219	153	194	140
90	354	255	336	245	319	236	–	–
100	–	–	437	358	414	342	–	–
110	–	–	529	529	–	–	–	–
120	–	–	667	667	–	–	–	–
130	–	–	783	783	–	–	–	–

On steep downgrades

On steep downgrades there is a greater chance of some drivers tending to overdrive horizontal curves. Therefore, the minimum curve radius from Section 7.6.1 should be increased by 10% for each 1% increase in grade over 3%, using Equation 7.

$$R_{min_{ongrade}} = R_{min} \left[1 + \frac{G - 3}{10}\right] \quad 7$$

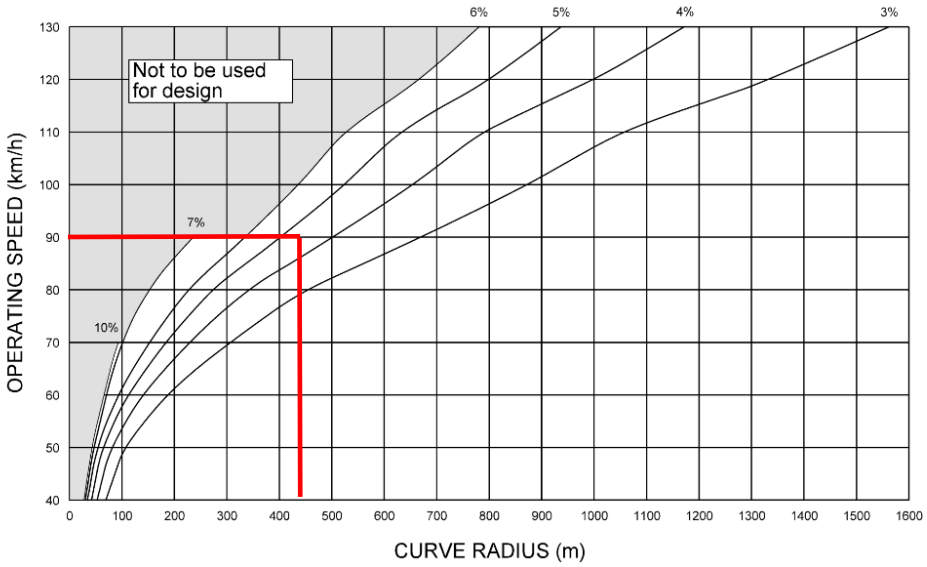
We advise that the following horizontal curve do not conform to the requirements of Austroads based on the horizontal curve equation for a design speed of 90km/h:

- **SLK 1.07 – 1.15 (which has a radius of 130m, on a downslope of 3.54%) should be increased to 337m**
- **SLK 1.59 – 1.72 (which has a radius of 190m, on the crest) (Option 1)**
- **SLK 1.62 – 1.68 (which has a radius of 85m, on the crest) (Option 2)**

The two identified section above does not conform to the requirements of Austroads for a design speed of 90km/hr. Assuming that the horizontal curve radii cannot be changed due to constraints, the super elevation should be increased to the requirements of Table 7.7 and 7.8 and advisory curve speed signage installed for 70km/hour for option 1 and 85km/hour for option 2.

As per Austroads Table 7.7, the superelevation for the relationship between speed, radius and superelevation (V ≥ 80km/h).

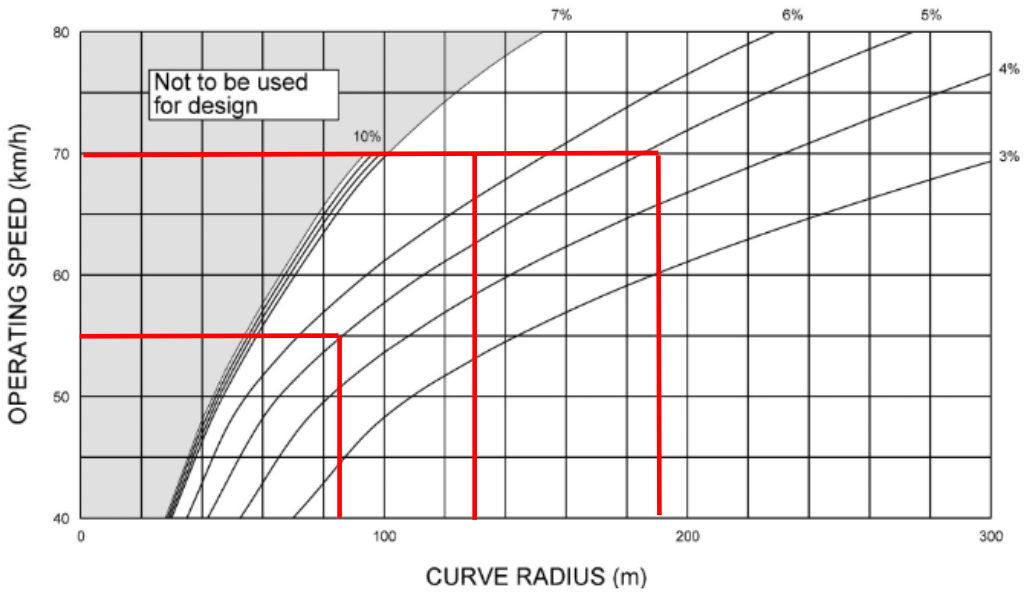
Figure 7.7: Rural roads: relationship between speed, radius and superelevation (V ≥ 80 km/h) and urban roads: relationship between speed, radius and superelevation (V ≥ 90 km/h)



Note: Based on a desirable maximum side friction for e ≤ 6%, absolute maximum side friction for e > 6%, and a linear distribution of side friction for e ≤ 6%.

As per Austroads Table 7.8, the superelevation for the relationship between speed, radius and superelevation (V<80km/h).

Figure 7.8: Rural roads: relationship between speed, radius and superelevation (*V* < 80 km/h)



Note: Based on a desirable maximum side friction for e ≤ 6%, absolute maximum side friction for e > 6%, and a linear distribution of side friction for e ≤ 6%.

We advise that the following horizontal curves will require superelevation based on the requirements from figure 7.7 and 7.8 for a design speed of 90km/h and advisory speed limit of 70 and 50km/h:

- **SLK 1.07 – 1.15 (which has a radius of 130m, advisory speed sign at 70km/h) requires a superelevation of 6%.**
- **SLK 1.37 – 1.45 (which has a radius of 437m) requires a superelevation of 5%.**
- **SLK 1.59 – 1.72 (which has a radius of 190m and advisory speed sign at 70km/h) (Option 1) requires a superelevation of 5%.**
- **SLK 1.62 – 1.68 (which has a radius of 85m and advisory sign at 50km/h) (Option 2) requires a superelevation of 5%.**

Superelevation Development

As per Austroads Table 7.11, the minimum superelevation development length required for a 90km/h design speed, from -3% to +6% shall be approximately 90m and from -3% to +5% shall be approximately is 80m. For a 70km/h design speed, the minimum superelevation development length, from -3% to +6%, shall be approximately 60m.

As per Austroads Chapter 7.9 and Table 7.13, lane widths on horizontal curves shall be widened to suit design vehicles.

Table 7.13: Curve widening per lane for current Austroads design vehicles

Radius (m)	Single unit truck/ bus (12.5 m)	Long rigid bus (14.5 m)	Articulated bus (19 m)	Prime move and semi-trailer (19 m)	Prime move and semi-trailer (25 m)	B-double (25 m)	B-double (26 m)	A-double (Type I) (36.2 m)	B-triple (35.4 m)	A-triple (53.4 m)
30	Use Turning Templates									
40	1.00									
50	0.80		1.00							
60	0.70	1.00	0.80							
70	0.60	0.90	0.70	1.00						
80	0.50	0.80	0.60	0.90		1.10				
90	0.50	0.70	0.50	0.80		1.00	1.10			
100	0.40	0.60	0.50	0.70		0.90	1.00			
120	0.30	0.50	0.40	0.60	1.00	0.70	0.80	1.00	1.10	
140	0.30	0.40	0.30	0.50	0.90	0.60	0.70	0.90	0.90	
160	0.30	0.40	0.30	0.40	0.80	0.60	0.60	0.80	0.80	1.10
180	0.20	0.30	0.30	0.40	0.70	0.50	0.50	0.70	0.70	1.00
200	0.20	0.30	0.20	0.30	0.60	0.40	0.50	0.60	0.70	0.90
250	0.20	0.20	0.20	0.30	0.50	0.40	0.40	0.50	0.50	0.70
300	0.10	0.20	0.20	0.20	0.40	0.30	0.30	0.40	0.40	0.60
350	0.10	0.20	0.10	0.20	0.30	0.30	0.30	0.40	0.40	0.50
400	0.10	0.20	0.10	0.20	0.30	0.20	0.20	0.30	0.30	0.40
450	–	0.10	0.10	0.20	0.30	0.20	0.20	0.30	0.30	0.40
500	–	0.10	–	0.10	0.20	0.20	0.20	0.20	0.30	0.40
600	–	0.10	–	0.10	0.20	0.10	0.20	0.20	0.20	0.30
700	–	–	–	–	0.20	0.10	0.10	0.20	0.20	0.30

The following horizontal curves are to be widened to cater for the restricted access vehicles.

- **SLK 1.07 – 1.15 (which has a radius of 130m) requires 0.7m widening**
- **SLK 1.37 – 1.45 (which has a radius of 437m) requires 0.2m widening.**
- **SLK 1.59 – 1.72 (which has a radius of 190m) (Option 1) requires 0.5m widening.**
- **SLK 1.62 – 1.68 (which has a radius of 85m) (Option 2) requires 1.10m widening.**

Vertical Geometry

As per Austroads Table 8.3, for a 100km/h design speed the general maximum grade for a flat terrain is considered within a range of 4-6% longitudinal grade.

As per Austroads Table 8.4, the desirable maximum length for a greater than 4-5% grade is 600m. **The length of 4.69% slope is approximately less than 100m. The design conforms to this criteria.**

As per Austroads Table 8.5, minimum longitudinal grades shall generally be 0.5%. **The design conforms to this criteria.**

As per Austroads Table 8.6, for a 90km/h design speed the minimum length of crest curve required to satisfy appearance criterion is 80-100m with a corresponding K value of 160-200. **The design does not conform to this criteria.**

As per Austroads Table 8.7, for a 90km/h design speed the absolute minimum K value of crest curve required to satisfy sight distance criterion is 31.8. **The minimum size crest vertical for the proposed design is 39.12, which does comply with the absolute minimum requirement as per Table 8.7. It is noted that a larger K value vertical curve is not feasible given the site constraints.**

Table 8.7: Minimum size crest vertical curve (*K* value) for sealed roads (*S* < *L*)

Design speed (km/h)	Based on stopping sight distance for a car[1] h_1 = 1.1 m h_2 = 0.2 m							
	Absolute minimum values for specific road types and situations[2] based on d = 0.46[3][4]			Desirable minimum values for most urban and rural road types based on d = 0.36			Values for major highways and freeways in flat terrain[8] based on d = 0.26	
	R_T = 1.5 s[5]	R_T = 2.0 s	R_T = 2.5 s	R_T = 1.5 s[5]	R_T = 2.0 s	R_T = 2.5 s	R_T = 2.0 s	R_T = 2.5 s
40	2.1	2.9	–	2.6	3.5	–	4.8	–
50	4.0	5.4	–	5.2	6.8	–	9.6	–
60	7.0	9.2	–	9.3	11.8	–	17.2	–
70	11.3	14.6	–	15.3	19.1	–	28.6	–
80	17.3	22.0	–	23.9	29.3	–	44.6	–
90	25.5	31.8	38.8	35.5	42.9	51.0	66.6	76.6
100	–	44.5	53.7	–	60.8	71.4	95.7	109.0
110	–	60.6	72.3	–	83.6	97.3	133.4	150.6
120	–	80.6	95.3	–	112.2	129.6	181.1	202.9
130	–	105.1	123.3	–	147.6	169.1	240.5	267.7
Minimum capability provided by the crest vertical curve size[6]	Car stopping at night[7]	d = 0.61 (dry road braking), h_1 = 0.65 m, h_2 = 0.3 m. d = 0.46, h_1 = 0.65 m, h_2 = 0.5 m.		d = 0.53 (dry road braking), h_1 = 0.65 m, h_2 = 0.2 m. d = 0.46, h_1 = 0.65 m, h_2 = 0.3 m.			d = 0.37, h_1 = 0.65 m, h_2 = 0.2 m.	
	Truck stopping	d = 0.29, h_1 = 2.4 m, h_2 = 0.3 m.		d = 0.25, h_1 = 2.4 m, h_2 = 0.2 m.			d = 0.18, h_1 = 2.4 m, h_2 = 0.2 m.	
	Truck stopping at night[7]	d = 0.29, h_1 = 1.05 m, h_2 = 1.25 m.		d = 0.29, h_1 = 1.05 m, h_2 = 0.6 m.			d = 0.26, h_1 = 1.05 m, h_2 = 0.2 m.	

1 *If the roadway is on a grade, adjust the stopping sight distance values by the process described in Note 5 of Table 5.5 to calculate the minimum size crest curve.*

2 *These values are only suitable in constrained locations. Examples of this in Australia are:*

- *lower volume roads*
- *mountainous roads*
- *lower speed urban roads*
- *sighting over or around barriers.*

As per Austroads Table 8.9, for a 90km/h design speed the minimum K value of crest curve required to satisfy truck stopping sight distance criterion is 32. **The design does conforms to this criteria.**

As per Austroads Figure 8.9, for a 90km/h design speed the minimum K value of sag curve required for a rural road without street lighting is within 21 to 35. The minimum K value of sag curve for a Low Standard Road is 6 to 13. **The minimum sag curve K value is 16.9 which conforms to the Low Standard Road.**

2.3.3 Stormwater Drainage

We have not assessed the compliance of the Stormwater Drainage system to design standards.

We note that proposed new pipes should be no smaller than the existing pipes they replace, and a minimum size of either 375mm or 450mm diameter should be considered, subject to local best practice. Sufficient offset between headwalls and the edges of pavements and crossovers should be considered, and minimum cover requirements should be achieved. Measures to reduce scour shall be implemented as appropriate.

Subsoil drainage may be used to manage groundwater and reduce impact on pavements, particularly where open drains are removed and replaced with kerbing.

2.4 Action Register

The following items have been identified for review / action:

Item	Description	Comments	Action
1	Road Cross Section	Road width does not comply to Austroads Guideline of 9.2m carriageway	**Nil.** Local standard used. Carriageway width compliant with RAV requirements
2	Roadside	As per Austroads Table 4.11, desirable cut batter grades are 1 in 3 with a maximum of 1in 2. As per Austroads Table 4.11, desirable fill batter grades are 1 in 6, with maximum of 1 in 4. Proposed cut batter grades are 1 in 3 and fill batters are 1:4 with localised steepening to reduce the number of trees to be removed, which does not comply with Austroads design guidelines.	**Maintain** the 1 in 3 cut batter grades and 1 in 4 fill batter grades. Due to the design constrained of maintaining existing mature trees, steeper fill batters will be steeped in localised areas to preserve the highly valued vegetation.
3	Sight Distance	It is not clear if the required sight distances are achieved due to the presence of roadside vegetation.	**Actual sight distance to be confirmed during construction.** If required sight distance standards are not met, efforts shall be made to improve the available sight distance as far as practical (by pruning) or for signage to warn of the risks and/or to reduce speeds to be installed.
2	Horizontal Geometry	The following horizontal curves do not comply with Austroads Table 7.6 SLK 1.07 – 1.15 SLK 1.59 – 1.72 Option1 SLK 1.62 – 1.68 Option 2	Assuming that the horizontal curve radii cannot be changed due to constraints; the **super elevation should be increased to 5 - 6%** (refer to Table 7.7, 7.8), and **advisory curve speed signage installed for 70km/hour and 50km/hour for option 2.**
3	Horizontal Geometry	Lane width widening we be required for the following curves SLK 1.07 – 1.15 (which has a radius of 130m) requires 0.7m widening SLK 1.37 – 1.45 (which has a radius of 437m) requires 0.2m widening. SLK 1.59 – 1.72 (which has a radius of 190m) (Option 1) requires 0.5m widening. SLK 1.62 – 1.68 (which has a radius of 85m) (Option 2) requires 1.10m widening.	We recommend that the lane and seal width for the mention curves should be widened to their requirements to accommodate the expected RAV 3 vehicles which include 27.5m combinations. If overall pavement widening is not achievable, **consideration should be given to sealing shoulders.**

4	Vertical Geometry	As per Austroads Table 8.6, for a 90km/hr design speed the minimum length of crest curve required to satisfy appearance criterion is 80-100m with a corresponding K value of 160-200. The design does not conform to this criteria.	**Nil.** Appearance criteria will not be met.

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