Safe System Assessment

FORD RD / WANGANUI RD / GVH
FORD RD / VERNEY RD
FORD RD / GRAHAMVALE RD

Report for Greater Shepparton City Council and VicRoads
1 Executive Summary

The Safe System is a road safety philosophy that requires roads to be designed and managed so that crash-related death and serious injury are avoidable.

A Safe System Assessment is a safety examination of a road-related program, project or initiative carried out using the AP-R509-16 Austroads Safe System Assessment Framework, which has the following characteristics:

**Type:** Existing conditions and proposed works  
**Method:** Assessment team – investigation, site inspection  
**Depth:** Road safety expert assessment (Level 3)

For this project the Safe System Assessment evaluated the current intersections:

1. Goulburn Valley Highway, Wanganui Road and Ford Road;  
2. Ford Road and Verney Road; and  
3. Ford Road and Grahamvale Road.

The assessment also looked at two main options for each intersection, which are traffic signals or a roundabout.

Assumptions were made as part of this assessment which are documented in the assessment.

The Safe System Matrix score for each option – with the lower score being better - is shown in table 1. The table also shows the score that would be achieved if the recommendations from the Safe System Assessment (SSA) were to be incorporated.

<table>
<thead>
<tr>
<th>Option</th>
<th>GVH/Wanganui</th>
<th>Ford/Verney</th>
<th>Ford/Grahamvale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Existing Conditions</td>
<td>208.0 / 448</td>
<td>56.0 / 448</td>
<td>198.0 / 448</td>
</tr>
<tr>
<td>2. Traffic Signals (with FCRTs)</td>
<td>164.0 / 448</td>
<td>62.4 / 448</td>
<td>143.5 / 448</td>
</tr>
<tr>
<td>3. Roundabouts (1-Lane, except GHV/Wanganui, which required 2-Lanes)</td>
<td>151.6 / 448</td>
<td>59.0 / 448</td>
<td>83.9 / 448</td>
</tr>
</tbody>
</table>

While roundabouts have been identified as having the greater alignment with Safe System principles at these locations, it should be noted that if cyclist and/or pedestrian volumes significantly increase the Safe System alignment may skew towards traffic signals. It should also be noted that the score difference for Ford Road and Verney Road is so close that it can be considered that either a roundabout or signals will perform with the same Safe System alignment.

Consistency of treatment may factor into the decision making for Ford Road/Verney Road. As the difference between a roundabout and traffic signals is very small, a roundabout should be considered.

Presented on the next page is a graphical representation of the alignment with Safe System principles (with lower scores being more favourable).
Assumptions:

- Traffic signals with fully controlled right turn (FCRT) on all legs. Designed as per GTA’s drawings. Low pedestrian growth. Low cycling growth. 10 year forecast assumed, except Verney/Ford Road.
- 2 lane roundabout designed as per GTA’s drawings. Low pedestrian growth. Low cycling growth.

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Safe System Score</th>
<th>Total Safe System Score</th>
<th>Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanganui Rd</td>
<td>164.0 / 448</td>
<td>(Better Safe System Alignment)</td>
<td></td>
</tr>
<tr>
<td>Verney Rd/Ford Rd</td>
<td>62.4 / 448 (Too close to call)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grahamvale Rd/Ford Rd</td>
<td>143.5 / 448 (Better Safe System Alignment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verney Rd</td>
<td>59.0 / 448 (Too close to call)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grahamvale Rd</td>
<td>101.6 / 448 (Better Safe System Alignment)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Other factors separately examined included:

- Safe road users
- Safer vehicles
- Advanced vehicle technology
- Maintenance and post-crash response and care

A series of recommendations have been made for both a roundabout and traffic signals to move both of them to better alignment with Safe System principles. If these recommendations are taken on, both traffic signals or a roundabout are considered to have good alignment with Safe System principles. These are listed below.

**This Safe System Assessment provides a series of recommendations/options for the three intersections for both traffic signals or roundabouts to move the Project further Towards Zero.**

**Recommendations/options:**

### Primary Treatments:

#### Traffic Signals:

Consider:

- If traffic signals are installed as the intersection control, consider installing raised platforms or other devices to achieve a design speed of 50km/h.
- While conflicting with the function of these roads, to achieve primary Safe System for pedestrians crossing the road, the speeds would need to be reduced to 30km/h at all crossing points. Alternatively, a separated facility would be required (i.e. an underpass or overpass). It is noted that the likely pedestrian volumes will be low at all crossing locations, except Verney/Ford.
- Reconsider the need for slip lanes at the signalised intersections. Crashes occur when vehicle drivers are looking to their right for gaps in traffic rather than concentrating on pedestrians. If slip lanes are required, ensure that there are acceptable sight lines to the pedestrian crossing location and that the crossing point is raised to lower vehicle speeds (i.e. Wombat Crossing).
- Consider the design specific recommendations in Appendix G.

#### Roundabout:

Consider:

- Installing a single lane roundabout and accept a small level of congestion during some hours of peak traffic volume.
- Installing separators/splitters on the approach to the intersection to minimise ‘straight lining’ through the two-lane roundabout at GVH/Wanganui (see example design in Appendix H).
- Consider the addition of signalised pedestrian crossings on pedestrian desire lines.
- See design specific recommendations in Appendix G.

### Supporting Treatments:

#### Traffic Signals:

Consider:

- If the intersection is not raised and supplemented with advisory speeds, consider adjusting the regulatory speed limit on Grahamvale Road to 60km/h on the approach to the intersection. Consider
extending the 60km/h speed limit on the GVH to the north, and on other roads implementing speed limit reductions to 60km/h if traffic signals are being implemented.

- Ensure that the traffic signals at Grahamvale Road are linked to the railway level crossing to eliminate the possibility of a stacking issue.
- Even with the signal linking, add measures to ensure that a vehicle trapped on the level crossing could ‘escape’ if required.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that raised platforms can be easily installed in the future.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that speed and red light cameras can be easily installed in the future, or consult with the Department of Justice to ascertain if they can be installed as part of the project.
- See design specific recommendations in Appendix G.

Roundabout:

Consider:

- If pedestrian signals are not installed, consider designing pedestrian crossing points so that they can be retrofitted with traffic signals.
- Consider using Danish Offset (aka Z-Crossing) crossings.
- Consider installing cycling crossing points on the roundabout (see example in Appendix H).
- See design specific recommendations in Appendix G.

Other Safe System Elements:

Consider:

- Consider working with the main heavy vehicle operators to ensure that they have undertaken the Heavy Vehicle Rollover Program and they understand the risks of heavy vehicles rolling over at roundabouts.
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2 List of Acronyms

AADT – Annual Average Daily Traffic

FCRT – Fully Controlled Right Turn

GVH – Goulburn Valley Highway

SSA – Safe System Assessment

VMS – Variable Message Sign

WRSB – Wire Rope Safety Barrier

3 List of Figures and Tables

3.1 Figures

Figure 1: The Safe System

Figure 2: The Components of the Safe System

Figure 3: Map showing location of site under assessment (note: not the ultimate design) (source: whereis.com)

3.2 Tables

Table 1 Matrix Score

Table 2 Inspections and/or Meetings

Table 3 Austroads AP-R509-16 Prompts

Table 4: Safe System Assessment Matrix – Existing Conditions – Goulburn Valley Highway/Ford Road/Wanganui Road Intersection

Table 5: Safe System Assessment Matrix – Signalised Intersection (as documented in 170620rep-V117720-Wanganui Rd/Ford Rd-Feasibility Study)

Table 6: Safe System Assessment Matrix – Roundabout (as documented: 170712mem-V117720-Responses to Consolidated Comments (straight alignment))

Table 7: Safe System Assessment Matrix – Existing Conditions – Ford Road/Verney Road Intersection

Table 8: Safe System Assessment Matrix – Signalised Intersection (as documented in: 170620rep-V117720-Wanganui Rd_Ford Rd-Feasibility Study)

Table 9: Safe System Assessment Matrix – Roundabout Intersection (as documented in: 170712mem-V117720-Responses to Consolidated Comments)

Table 10: Safe System Assessment Matrix – Existing Conditions – Ford Road/Grahamvale Road Intersection

Table 11: Safe System Assessment Matrix – Signalised Intersection (as documented in: 170620rep-V117720-Wanganui Rd_Ford Rd-Feasibility Study)

Table 12: Safe System Assessment Matrix – Roundabout Intersection (as documented in: 170712mem-V117720-Responses to Consolidated Comments)

Table 13: Safe System Assessment Comments – Safer Vehicles, People and Post – Crash Care
4 Background

4.1 The Safe System

The Safe System is a road safety philosophy that requires roads to be designed and managed so that crash-related death and serious injury are avoidable. The basic principles are:

1. Humans are fallible, and will inevitably make mistakes when driving, riding or walking.
2. Despite this, road trauma should not be accepted as inevitable. No one should be killed or seriously injured on our roads.
3. Consequently, to prevent serious trauma, the road system must be forgiving so that the forces of collisions do not exceed limits that the human body can tolerate.

In Victoria, the Safe System is represented by the diagram in Figure 1.

*Figure 1: The Safe System*

The Safe System is divided into five core interrelated components shown in Figure 2.

*Figure 2: The Components of the Safe System*
4.2 Safe System Assessment

A Safe System Assessment is a safety examination of a road-related program, project or initiative. The procedure for undertaking a Safe System Assessment is outlined in AP-R509-16 Austroads Safe System Assessment Framework. The Assessment can be undertaken on any of the following:

- An existing road, intersection or length;
- A road investment project, whether at feasibility, design or pre-opening stages;
- A community road safety program or application for funding;
- A road transport policy, strategy or operating procedure.

These assessments are carried out by a specialist, independent and qualified team that considers each of the core components of the Safe System.

4.3 Type and Depth of Assessment

Safe System Assessments can be carried out to assess existing conditions or a future project, they can also be undertaken to compare two or more options.

Safe System Assessments can be conducted by a suitably qualified individual, a team or through a workshop. The depth of investigation can also vary from an in-depth assessment to an expert-opinion based assessment.

This Safe System Assessment has the following characteristics:

**Type:** Existing conditions and proposed works  
**Method:** Assessment team – investigation, site inspection  
**Depth:** Road safety expert assessment (Level 3)
4.4 Assessment Team or Group

Industry practice is to undertake Safe System Assessments as follows:

**Level 1: Desktop Safe System Assessment**
- Undertaken by an individual or a small team
- Participants can be part of the project team (e.g., the designer, engineer, etc.)

**Level 2: Workshop Safe System Assessment**
- Undertaken by a group including the project team and Safe System experts
- Workshop is facilitated to assess aspects of the project and their alignment with the Safe System

**Level 3: Independent Safe System Assessment**
- A team of independent Safe System experts assess the project in consultation with the project team

This Level 3 Safe System Assessment was conducted by:
- **Kenn Beer** (BEng, MPIA), Principal, Safe System Solutions Pty Ltd
- **Reece Gunther** (BEng), Safe System Design Engineer, Safe System Solutions Pty Ltd

At the time of this assessment, there is no formal accreditation process for Safe System Assessments.

4.5 Site Inspections and Meetings

Site inspections and meetings associated with this Safe System Assessment is provided in Table 2 below.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>LOCATION</th>
<th>DATE</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site visit 1</td>
<td>Ford Road</td>
<td>06/10/2017</td>
<td>1400-1445</td>
</tr>
<tr>
<td>Initial meeting</td>
<td>Shepparton City Council Offices</td>
<td>06/10/2017</td>
<td>1500-1600</td>
</tr>
<tr>
<td>Site visit 2</td>
<td>Ford Road</td>
<td>06/10/2017</td>
<td>1600-1800</td>
</tr>
<tr>
<td>Workshop to present initial/draft findings</td>
<td>Shepparton City Council Offices</td>
<td>23/10/2017</td>
<td>1500-1700</td>
</tr>
</tbody>
</table>
5 Assessment Framework

5.1 Process

The Safe System Assessment has been conducted for the existing conditions for the design of intersections for the following intersections:

1. Goulburn Valley Highway, Wanganui Road and Ford Road;
2. Ford Road and Verney Road; and
3. Ford Road and Grahamvale Road.

The application of the Safe System Assessment process considers likely and foreseeable crash types, particularly in relation to trauma forces that result from such crashes.

5.2 Project Background

The Goulburn Valley Highway is an integral transport route connecting the Goulburn Valley Region with Melbourne and forms a vital link in the national highway system between Melbourne and Brisbane.

Greater Shepparton has seen growth in parts of Goulburn Valley Highway and can no longer cater for the large and increasing volumes of traffic that use the Highway daily.

According to VicRoads, in 2016, the full 36km four-lane Shepparton Bypass was estimated to cost approximately $1.3 billion. The project has therefore been split into six stages in order to obtain funding to get the project underway, including a single carriageway each way in the first instance.

Stage 1 will construct 10 km of road from the Midland Highway extending northwards along Excelsior Avenue and Cornish Road to Echuca Road, then east to Wanganui Road where it would rejoin the Goulburn Valley Highway in Shepparton North.

The recent $10.2 million investment will go towards planning, land acquisition and upgrade the intersection of Goulburn Valley Highway at Ford Road and Wanganui Road, Shepparton associated with realising Stage 1 of the bypass.

Ford Road will serve as a critical link between Stage 1 of the Bypass and the Shepparton Alternate Route (Grahamvale Road and Doyles Road).

The Goulburn Valley Highway / Wanganui Road / Ford Road intersection will accommodate significant traffic volumes in the future with the implementation of Stage 1 and proposed levels of development in the area.

5.2.1 Existing Conditions:

Goulburn Valley Highway/Wanganui Road/Ford Road Intersection:

Wanganui Road

Wanganui Road is 3.25km long and extends between Goulburn Valley Highway to the east and Golf Drive to the west. Its entire length forms part of the study area. Also, it functions as a local council road but is located within a Road Zone (Category 2) in the Greater Shepparton Planning Scheme, i.e. connection to Stage 1 of the Shepparton Bypass and Alternate Route.
Wanganui Road is a two-way semi-rural road aligned in an east-west direction and configured with a two-lane, 8.0 metre wide carriageway set within a 20 metre wide road reserve (approx.). Wanganui Road carries approximately 2,200 vehicles per day and has a speed limit of 80kmh along its entire length. There are two minor roadways and 26 property access points that intersect Wanganui Road, many of which are unsealed. The only intersecting road along its length that provides wider network connectivity is Rudd Road, noting that this road also provides access into the residential area to the south west. As such, the majority of the traffic that currently uses Wanganui Road accesses it from Goulburn Valley Highway at its eastern end.

Ford Road

Ford Road is 5.35km long and extends between Goulburn Valley Highway to the west and Lemons North Road to the east. Only the 2.65km section between Goulburn Valley Highway and Grahamvale Road (western end) forms part of the study area. Also, Ford Road is designated as a local council road, however between Verney Road and Grahamvale Road, Ford Road is located within a Road Zone (Category 2) in the Greater Shepparton Planning Scheme, i.e. connection to Stage 1 of the Shepparton Bypass and Alternate Route. Ford Road is currently a two-way semi-rural road aligned in an east-west direction and configured with a two-lane, 9.0m wide carriageway set within a 20m wide road reserve (approx.). It has a 60km/h speed limit and carries approximately 3,000 vehicles per day.

There are five minor roadways and 22 property access points that intersect with Ford Road, with a mix of sealed and unsealed crossings. The main intersecting road along its length that provides broader network connectivity is Verney Road, but other roads are expected to do so as well, as part of the adjacent growth areas and residential developments.

Goulburn Valley Highway

A major arterial route that connects the Goulburn Valley Freeway to the south through central Shepparton and continues north to the Murray Valley Highway. It provides a major freight link and forms part of the B-Double road network. This road intersects the study area at the staggered cross intersection between and where the east-west roads change names from Wanganui Road to Ford Road. The following provides a more brief list of the existing conditions of the Goulburn Valley Highway intersecting Ford/Wanganui Road.

- Unsignalised Intersection
  - Goulburn Valley Highway (North bound)
    - Left turn slip lane into Wanganui Road
    - Dedicated right turn lane into Ford Road North bound; give way on approach
    - Dedicated through lane North bound
  - Goulburn Valley Highway (South bound)
    - Left turn slip lane into Ford Road South bound
    - Dedicated through lane South bound
    - Dedicated right turn lane into Wanganui Road; give way on approach
    - Left turn Slip lane into Numurkah Road (Service road)
    - Dedicated Right turn lane into Numurkah Road (Service road); give way on approach

Speed limit: 60km/h along Goulburn Valley Highway (although the 60km/h speed limit starts very close to the intersection of Ford Road), 80km/h along Wanganui Road and 60km/h along Ford Road.

Ford Road / Verney Road Intersection:
- Single lane roundabout
- Speed limit: 80km/h along Verney Road, transitioning to 60km/h toward approach

**Ford Road / Grahamvale Road intersection:**

- Staggered T-intersection
- Railway crossing on Ford Road (West bound)
- Speed limit: 80km/h along Grahamvale Road

**5.2.2 Original Designs:**

**Goulburn Valley Highway/Wanganui Road/Ford Road Intersection**

**Signalised Intersection:**

The Goulburn Valley Highway / Wanganui Road / Ford Road intersection will accommodate significant traffic volumes in the future with the implementation of the Stage 1 of the Shepparton Bypass and proposed levels of development in the area. As such, and until more detailed traffic analysis is completed, the following facilities are proposed as part of the intersection layout:

- Left-turn slip lanes on each approach
- Continuation of the duplication of Goulburn Valley Highway through the intersection
- Realignment of Wanganui Road and Ford Road to form a standard cross-intersection
- Two through lanes on each approach and departure (noting the Wanganui Road and Ford Road approaches will taper back to one-lane in each direction a suitable distance from Goulburn Valley Highway)
- Right-turn lane on each approach.

**Roundabout Intersection 1:**

- Multilane roundabout

**Roundabout Intersection 2:**

- Multilane roundabout
- Deflected alignment on east side of roundabout

**Ford Road / Verney Road Intersection**

**Signalised Intersection:**

The Ford Road / Verney Road intersection will accommodate moderate traffic volumes in the future (majority along Ford Road) with the implementation of Stage 1 of the Shepparton Bypass and proposed levels of development in the area. It is also noted that shared paths will connect at this intersection, with an existing facility on Verney Road to the south and one proposed along the length of Ford Road. As such, the following facilities are proposed as part of the intersection layout:

- Two through lanes on Ford Road approaches and departures that taper back to one-lane in each direction a suitable distance from Verney Road
- Right-turn lane on each approach.

**Roundabout Intersection:**

- Single Lane/Multilane roundabout
Ford Road / Grahamvale Road intersection

**Signalised Intersection:**

The Ford Road / Grahamvale Road intersection will accommodate significant traffic volumes in the future (with the exception of the east approach) with the implementation of the East-West Link and proposed levels of development in the area. As such, the following facilities are provided in the design:

- Left-turn slip lanes on the south and west approaches (i.e. traffic volumes to and from the east approach are expected to be low)
- Dedicated left turn lane from north approach
- Realignment of the east and west approaches to form a standard cross-intersection
- Separate through and right-turn lanes on each approach, except for the east approach (also allows phasing to isolate the east approach when the boom gates on the rail line are down).

**Roundabout Intersection:**

- Single Lane/Multilane roundabout

As discussed during the project team workshop on 23 October 2017, it is expected that a single lane roundabout will be sufficient at this time, but ability to be converted to a two-lane roundabout should be allowed for..

*Figure 3: Map showing location of site under assessment (note: not the ultimate design) (source: whereis.com)*
5.3 Context of Assessment

Table 3 Austroads AP-R509-16 Prompts

<table>
<thead>
<tr>
<th>Prompts</th>
<th>Comments</th>
</tr>
</thead>
</table>
| What road users are present? Consider the presence of elderly, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school zone speed limits, etc.). | • Majority of road use is expected to be passenger vehicles  
• Low volumes of cyclists and pedestrians expected on road and roadside (with the exception of Verney/Ford).  
• Medium/High volume of heavy vehicles expected  
• Development including a shopping centre proposed on the SE corner of GVH/Ford Rd.  
• School on the south side of Ford Road and significant residential. |
| What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? | • Goulburn Valley Highway is a major arterial road.  
• The surrounding area is primarily classified as residential  
• The speed limit along the subject section of the Goulburn Valley Highway is 60km/h.  
• The speed limit along the subject section of Wanganui Road is 80km/h and Ford Road is 60km/h  
• Types of existing and proposed intersections within the project length are detailed in section 5.2  
• No parking is present or proposed along the roadside |
| What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway. | • More than 30,000 traffic movements per day including 10% heavy vehicles.  
• Standard composition of motorcyclists expected (1%). |
| What is the reason for the project? Is there a specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, etc. | • The project aims to improve safety, access and traffic movements, also addressing future traffic growth and reducing through traffic though the town centre in terms of safety and efficiency. |
5.4 Austroads AP-R509-16 Matrix

In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, area, treatment type etc.) aligns with Safe System principles, a Safe System matrix is used. The purpose of the matrix is to use a risk assessment approach to assess different major crash types (those identified as the predominant contributors to fatal and serious crash outcomes) against the exposure to that crash risk, the likelihood of it occurring and the severity of the crash should it occur. These three attributes form the rows of the matrix.

The columns of the Safe System matrix show the crash types that represent the main crash and road user types that contribute to death and serious injury. They are included as an element of the matrix to help concentrate thinking on crash causes and solutions. They are also provided in this way to ensure that vulnerable road users are directly considered.

The seven major crash types as shown in the matrix columns are:

1. run-off-road (also referred to as ‘loss of control’, or ‘off path on curve/straight’)
2. head-on (or ‘vehicles from opposing directions’)
3. intersection (‘vehicles from adjacent directions’)
4. other (this incorporates all same direction, manoeuvring, overtaking, on path and miscellaneous crashes)
5. pedestrian
6. cyclist
7. motorcyclist.

Pedestrian, cyclist and motorcyclist crashes are separated to highlight the special focus on vulnerable road users. Note that in some circumstances (depending on the purpose of the assessment) other columns may also be added for specific crash types if these are of high importance (e.g. heavy vehicles).

The aim of the Safe System matrix is to reduce the total score towards zero.  

As scores vary along routes and between intersections, an average score is taken for the project as a whole. Detailed matrix assessments were undertaken to determine the overall scores.

When quantifying alignment with Safe System principles, reference is made to AP-R509-16 Table 4.2 which helps to quantify the risk rating scores.
### 5.5 Goulburn Valley Highway/Ford Road/Wanganui Road Intersection

#### 5.5.1 Safe System matrix for Safer Roads, Roadsides and Speeds - Austroads AP-509-16 Matrix for this project

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors that increase the likelihood include:</td>
<td>For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types; AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For pedestrian crash types, AADT is estimated between 50 and 200 vehicles per day (Austroads trigger).</td>
<td>For motorcyclist crash types, AADT is estimated between 50 and 200 vehicles per day (Austroads trigger).</td>
</tr>
<tr>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that decrease the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
</tr>
<tr>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td></td>
</tr>
<tr>
<td>- Uncontrolled intersection meaning that vehicles are likely to run off the road</td>
<td>- No median</td>
<td>- Uncontrolled intersection</td>
<td>- Controlled only by a give way sign (Wanganui) and a Stop Sign (Ford).</td>
<td>- High speed</td>
<td>- No footpaths and crossing facilities</td>
<td>- No footpaths and crossing facilities</td>
<td></td>
</tr>
<tr>
<td>- Many fixed point source hazards in the roadside close to the lane.</td>
<td>Factors that decrease the likelihood include:</td>
<td></td>
<td>Factors that decrease the likelihood include:</td>
<td>Factors that decrease the likelihood include:</td>
<td>Factors that decrease the likelihood include:</td>
<td>Factors that decrease the likelihood include:</td>
<td></td>
</tr>
<tr>
<td>- Acceptable line marking and delineation</td>
<td>- Acceptable line marking and delineation</td>
<td>- Acceptable line marking and delineation</td>
<td>- Auxiliary turning lane</td>
<td>- Auxiliary turning lane</td>
<td>- Auxiliary turning lane</td>
<td>- Auxiliary turning lane</td>
<td></td>
</tr>
<tr>
<td>- Good lighting (assumed based on hardware).</td>
<td>- Good lighting (assumed based on hardware).</td>
<td>- Good lighting (assumed based on hardware).</td>
<td>- Good lighting (assumed based on hardware).</td>
<td>- Good lighting (assumed based on hardware).</td>
<td>- Good lighting (assumed based on hardware).</td>
<td>- Good lighting (assumed based on hardware).</td>
<td></td>
</tr>
<tr>
<td>Factors that increase the severity include:</td>
<td>Factors that increase the severity include:</td>
<td>Factors that increase the severity include:</td>
<td>Factors that increase the severity include:</td>
<td>Factors that increase the severity include:</td>
<td>Factors that increase the severity include:</td>
<td>Factors that increase the severity include:</td>
<td></td>
</tr>
<tr>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- Medium operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td>- High operating speeds (60-70km/h)</td>
<td></td>
</tr>
<tr>
<td>- Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas.</td>
<td>- Intersection type crashes</td>
<td>- Rear end and side swipe crashes</td>
<td>- High percentage of heavy vehicles may</td>
<td>- High percentage of heavy vehicles may</td>
<td>- High percentage of heavy vehicles may</td>
<td>- High percentage of heavy vehicles may</td>
<td></td>
</tr>
<tr>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td></td>
</tr>
<tr>
<td>- High percentage of heavy vehicles.</td>
<td>- High percentage of heavy vehicles</td>
<td>- High percentage of heavy vehicles</td>
<td>- High percentage of heavy vehicles</td>
<td>- High percentage of heavy vehicles</td>
<td>- High percentage of heavy vehicles</td>
<td>- High percentage of heavy vehicles</td>
<td></td>
</tr>
</tbody>
</table>

**Existing Conditions – Goulburn Valley Highway/Ford Road/Wanganui Road Intersection**

Factors to consider:

- **Severity**
  - High operating speeds (60-70km/h)
  - Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas.

- **Likelihood**
  - High operating speeds (60-70km/h)
  - Uncontrolled intersection
  - Many fixed point source hazards in the roadside close to the lane.

- **Exposure**
  - For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).
  - For head-on crash types; AADT is greater than 10,000 vehicles per day (Austroads trigger).
  - For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).
  - For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).
  - For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.
  - For pedestrian crash types, AADT is estimated between 50 and 200 vehicles per day (Austroads trigger).

**Factors that increase the likelihood:**

- High operating speeds (60-70km/h)
- Uncontrolled intersection
- Many fixed point source hazards in the roadside close to the lane.

**Factors that decrease the likelihood:**

- Acceptable line marking and delineation
- Good lighting (assumed based on hardware).
- Straight alignment

**Factors that increase the severity:**

- High operating speeds (60-70km/h)
- Intersection type crashes
- Rear end and side swipe crashes
- High percentage of heavy vehicles

**Factors that decrease the severity:**

- High percentage of heavy vehicles.
### Run-off-road
- Culverts and drop-offs close to the road.
- Factors that *decrease* the severity include:
  - Some frangible poles (sign supports)

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some frangible poles (sign supports)</td>
</tr>
</tbody>
</table>

### Head-on
- For head on crash types the operating speeds (60-70km/h) are considered to be close to tolerable levels for fatalities, however not serious injuries.

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some crash angles may be less severe.</td>
</tr>
</tbody>
</table>

### Intersection
- Some crash angles may be less severe.
- Factors that *decrease* the severity include:
  - Medium operating speeds (60-70km/h) for rear end and side swipe crashes

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vehicle runs over the pedestrian</td>
</tr>
</tbody>
</table>

### Other
- Factors that *decrease* the severity include:
  - Medium operating speeds (60-70km/h) for rear end and side swipe crashes

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium operating speeds (60-70km/h) for rear end and side swipe crashes</td>
</tr>
</tbody>
</table>

### Pedestrian
- Vehicle runs over the pedestrian

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High speeds for pedestrians</td>
</tr>
</tbody>
</table>

Factors that *increase* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High percentage of heavy vehicles</td>
</tr>
</tbody>
</table>

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

### Cyclist
- Factors that *decrease* the severity include:
  - None

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

Factors that *increase* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High percentage of heavy vehicles</td>
</tr>
</tbody>
</table>

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

### Motorcyclist
- Factors that *decrease* the severity include:
  - High speeds for this road user
  - High percentage of heavy vehicles
  - Lack of motorcycle friendly sign supports

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

Factors that *increase* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

Factors that *decrease* the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

### Product

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>48/64</td>
<td>8/64</td>
<td>64/64</td>
<td>16/64</td>
<td>12/64</td>
<td>12/64</td>
<td>48/64</td>
</tr>
</tbody>
</table>

### TOTAL

<table>
<thead>
<tr>
<th></th>
<th>208/448</th>
</tr>
</thead>
</table>

The aim of the Safe System matrix is to reduce the total score towards zero.
### Table 3: Safe System Assessment Matrix – Signalised Intersection

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td></td>
<td></td>
<td>For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td></td>
<td>For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td></td>
<td>For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Factors that increase the likelihood include:</td>
<td></td>
<td>Factors that increase the likelihood include:</td>
<td></td>
<td>Factors that increase the likelihood include:</td>
<td></td>
<td>Factors that increase the likelihood include:</td>
</tr>
<tr>
<td></td>
<td>• High operating speeds (60-70km/h)</td>
<td>• High operating speeds (60-70km/h)</td>
<td>• Controlled only by give-way signs (Wanganui) and a Stop Sign (Ford).</td>
<td>• Left turn deceleration lane (other visual sign blocks vi...</td>
<td>• High traffic volumes</td>
<td>• High traffic volumes</td>
<td>• Inherent stability issues of motorcycles</td>
</tr>
<tr>
<td></td>
<td>• Uncontrolled intersection meaning that vehicles are likely to run-off-the-road avoiding a vehicle entering or exiting the side road.</td>
<td>• No median separating</td>
<td>(Wanganui) and a Stop Sign (Ford).</td>
<td>• High traffic volumes during peak hours, thus people take more risks to exit.</td>
<td>• No crossing facilities</td>
<td>• High traffic volumes</td>
<td>• Surface in average condition</td>
</tr>
<tr>
<td></td>
<td>• Pavement condition is poor.</td>
<td>• Many fixed point source hazards in the roadside close to the lane.</td>
<td>• High operating speeds (60-70km/h)</td>
<td>• High likelihood of red light runners</td>
<td>• Two lanes and turn lanes, separation complex.</td>
<td>• No physically separated facilities</td>
<td>• Motorcycle riders are smaller than other vehicles and thus more likely to be hidden behind another vehicle.</td>
</tr>
<tr>
<td></td>
<td>Factors that decrease the likelihood include:</td>
<td></td>
<td>Factors that decrease the likelihood include:</td>
<td></td>
<td>Factors that decrease the likelihood include:</td>
<td></td>
<td>Factors that decrease the likelihood include:</td>
</tr>
<tr>
<td></td>
<td>• Acceptable</td>
<td>• Acceptable line marking and delineation</td>
<td>• Straight alignment</td>
<td>• Good lighting (assumed based on hardware).</td>
<td>• Auxiliary turning lane or channelised turning lane provided reduces the likelihood for vehicles decelerating in the traffic lane.</td>
<td>• Auxiliary turning lane or channelised turning lane provided reduces the likelihood for vehicles decelerating in the traffic lane.</td>
<td>• Cyclist lanes provided</td>
</tr>
<tr>
<td></td>
<td>Good line marking and delineation</td>
<td></td>
<td></td>
<td></td>
<td>• Straight alignment</td>
<td></td>
<td>• Signalled intersection to control movements</td>
</tr>
<tr>
<td></td>
<td>Good lighting (assumed based on hardware).</td>
<td></td>
<td></td>
<td></td>
<td>• Acceptable</td>
<td></td>
<td>• Improved pedestrian facilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good lighting (assumed based on hardware).</td>
<td></td>
<td>• Improved pedestrian facilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acceptable line marking and delineation.</td>
<td></td>
<td>• Improved pedestrian facilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Improved pedestrian facilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Good lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Not a major desire line</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Generally good sight distances at intersection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pedestrian crossings as part of the intersection signalisation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Fully controlled right turn</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Good lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Not a major desire line</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>• Fully controlled right turn</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Good lighting</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Not a major desire line</td>
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<td></td>
<td>• Fully controlled right turn</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>• Good lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Not a major desire line</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>• Generally good sight distances at intersection.</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>• Pedestrian crossings as part of the intersection signalisation.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>• Fully controlled right turn</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Good lighting</td>
</tr>
</tbody>
</table>

**Legend:**
- **Black text:** Common factor between this plan and the existing conditions
- **Factor (strikethrough):** factor that is removed or significantly diminished between the existing conditions and this option
- **Red text:** New or significantly altered in this option compared to the existing conditions

- **Factors that increase the likelihood include:**
  - High operating speeds (60-70km/h)
  - Uncontrolled intersection meaning that vehicles are likely to run-off-the-road avoiding a vehicle entering or exiting the side road.
  - Pavement condition is poor.
  - Many fixed point source hazards in the roadside close to the lane.

- **Factors that decrease the likelihood include:**
  - Acceptable Good line marking and delineation
  - Good lighting (assumed based on hardware).
  - Straight alignment
  - Signal control

- **Factors that increase the likelihood include:**
  - High operating speeds (60-70km/h)
  - Controlled only by give-way signs (Wanganui) and a Stop Sign (Ford).
  - Left turn deceleration lane (other visual sign blocks visual obstruction).
  - High traffic volumes during peak hours, thus people take more risks to exit.
  - Pavement condition is poor.

- **Factors that decrease the likelihood include:**
  - Acceptable line marking and delineation
  - Good lighting (assumed based on hardware).
  - Acceptable Good line marking and delineation.
### Severity

#### Run-off-road

Factors that **increase** the severity include:
- High operating speeds (60-70km/h)
- Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas.
- Culverts and drop offs close to the road.

Factors that **decrease** the severity include:
- Some frangible poles (sign supports)

#### Head-on

Factors that **increase** the severity include:
- High operating speeds (60-70km/h)

Factors that **decrease** the severity include:
- Some crash angles may be less severe.

#### Intersection

Factors that **increase** the severity include:
- High operating speeds (60-70km/h)
- Right angle crashes possible.
- High percentage of heavy vehicles

Factors that **decrease** the severity include:
- Medium operating speeds (60-70km/h) for rear end and side swipe crashes
- High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end

#### Other

Factors that **increase** the severity include:
- Medium operating speeds (60-70km/h) for rear end and side swipe crashes

Factors that **decrease** the severity include:
- Medium operating speeds (60-70km/h) for rear end and side swipe crashes

#### Pedestrian

Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian.

Factors that **increase** the severity include:
- High speeds for pedestrians
- High percentage of heavy vehicles

Factors that **decrease** the severity include:
- None

#### Cyclist

Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed.

Factors that **increase** the severity include:
- High speeds for this crash type
- High percentage of heavy vehicles

Factors that **decrease** the severity include:
- None

#### Motorcyclist

Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low.

Factors that **increase** the severity include:
- High speeds for this road user
- High percentage of heavy vehicles
- Lack of motorcycle friendly sign supports

Factors that **decrease** the severity include:
- None

<table>
<thead>
<tr>
<th></th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
</table>
| Severity | Factors that increase the severity include:  
- High operating speeds (60-70km/h)  
- Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas.  
- Culverts and drop offs close to the road.  

Factors that decrease the severity include:  
- Some frangible poles (sign supports) | Factors that increase the severity include:  
- High operating speeds (60-70km/h) for intersection type crashes.  
- Right angle crashes possible.  
- High percentage of heavy vehicles  

Factors that decrease the severity include:  
- Some crash angles may be less severe. | Factors that increase the severity include:  
- High operating speeds (60-70km/h) for rear end and side swipe crashes  
- High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end  

Factors that decrease the severity include:  
- Medium operating speeds (60-70km/h) for rear end and side swipe crashes | Factors that increase the severity include:  
- Medium operating speeds (60-70km/h) for rear end and side swipe crashes  

Factors that decrease the severity include:  
- Medium operating speeds (60-70km/h) for rear end and side swipe crashes | Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian.  

Factors that increase the severity include:  
- High speeds for pedestrians  
- High percentage of heavy vehicles  

Factors that decrease the severity include:  
- None | Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed.  

Factors that increase the severity include:  
- High speeds for this crash type  
- High percentage of heavy vehicles  

Factors that decrease the severity include:  
- None | Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low.  

Factors that increase the severity include:  
- High speeds for this road user  
- High percentage of heavy vehicles  
- Lack of motorcycle friendly sign supports  

Factors that decrease the severity include:  
- None |
| Product | 32/64 | 8/64 | 36/64 | 24/64 | 8/64 | 8/64 | 48/64 |

**TOTAL**  164 / 448

The aim of the Safe System matrix is to reduce the total score **towards zero**.
**Table 6: Safe System Assessment Matrix – Roundabout**

**LEGEND**
- **Black text:** Common factor between this plan and the existing conditions
- **Blue text:** Factor that is reduced or significantly diminished between the existing conditions and this option
- **Blue text:** New or significantly altered in this option compared to the existing conditions

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).</td>
<td>Crash types: Rear end, side swipe.</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
</tr>
<tr>
<td>• High operating speeds (60-70 km/h)</td>
<td>• High operating speeds (60-70 km/h)</td>
<td>• Controlled only by give way sign (Wanganui) and a stop sign (Wanganui).</td>
<td>• Uncontrolled intersection (hazardous to pedestrians, cyclist, motorcyclist).</td>
<td>• High traffic volume during peak hours, thus people take more risks to exit.</td>
<td>• High traffic volume during peak hours, thus people take more risks to exit.</td>
<td>• Inherent stability issues of motorcycles.</td>
<td></td>
</tr>
<tr>
<td>• Uncontrolled intersection (meaning that vehicles are likely to run off the road avoiding a vehicle entering an opposite direction road).</td>
<td>• Left turn/deceleration lanes (high sight distance blocking pedestrian vision issues).</td>
<td>• Medium/low operating speeds.</td>
<td>• High traffic volume during peak hours, thus people take more risks to exit.</td>
<td>• Left turn/deceleration lanes (high sight distance blocking pedestrian vision issues).</td>
<td>• Roundabouts increase the likelihood of rear end crashes.</td>
<td>• Inherent stability issues of motorcycles.</td>
<td></td>
</tr>
<tr>
<td>• Many fixed point source hazards in the roadside close to the lane.</td>
<td>• High traffic volume during peak hours, thus people take more risks to exit.</td>
<td>• Medium/low operating speeds.</td>
<td>• All movements open.</td>
<td>• High traffic volume during peak hours, thus people take more risks to exit.</td>
<td>• Medium/low operating speeds.</td>
<td>• Surface is in average condition.</td>
<td></td>
</tr>
<tr>
<td>• Medium/low operating speeds.</td>
<td>• Medium/low operating speeds.</td>
<td>• Medium/low operating speeds.</td>
<td>• Medium/low operating speeds.</td>
<td>• Medium/low operating speeds.</td>
<td>• Medium/low operating speeds.</td>
<td>• Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle.</td>
<td></td>
</tr>
</tbody>
</table>

| Factors that decrease the likelihood include: | Factors that decrease the likelihood include: | Factors that decrease the likelihood include: | Factors that decrease the likelihood include: | Factors that decrease the likelihood include: | Factors that decrease the likelihood include: | Factors that decrease the likelihood include: |
|------------|--------------|---------|--------------|-------|------------|---------|--------------|
| • Acceptable Good line marking and delineation. | • Acceptable Good line marking and delineation. | • Acceptable Good line marking and delineation. | • Acceptable Good line marking and delineation. | • Acceptable Good line marking and delineation. | • Acceptable Good line marking and delineation. | • Acceptable Good line marking and delineation. |
| • Good lighting (assumed based on hardware). | • Good lighting (assumed based on hardware). | • Good lighting (assumed based on hardware). | • Good lighting (assumed based on hardware). | • Good lighting (assumed based on hardware). | • Good lighting (assumed based on hardware). | • Good lighting (assumed based on hardware). |
| • Medium/low operating speeds. | • Medium/low operating speeds. | • Medium/low operating speeds. | • Medium/low operating speeds. | • Medium/low operating speeds. | • Medium/low operating speeds. | • Medium/low operating speeds. |

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
</table>
### Severity

**Run-off-road**
- Factors that increase the severity include:
  - High operating speeds (60-70 km/h)
  - Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas.
  - Culverts and drop-offs close to the road.
- Factors that decrease the severity include:
  - Some frangible poles (sign supports)
  - Medium/low operating speeds

**Head-on**
- Factors that increase the severity include:
  - High percentage of heavy vehicles.
  - If a head-on crash occurs, it is likely to be high speed.
- Factors that decrease the severity include:
  - For head-on crash types, the operating speeds (40-60 km/h) are within most tolerable levels.

**Intersection**
- Factors that increase the severity include:
  - High operating speeds (60-70 km/h) for intersection crashes.
  - Right angle crashes possible.
  - High percentage of heavy vehicles
- Factors that decrease the severity include:
  - Some crash angles may be less severe.
  - Medium/low operating speeds
  - Favourable angles

**Other**
- Factors that increase the severity include:
  - Medium operating speeds (60-70 km/h) for rear end and side impact crashes.
  - High percentage of heavy vehicles
- Factors that decrease the severity include:
  - Medium operating speeds (40-60 km/h) for rear end and side impact crashes.
  - Medium/low operating speeds

**Pedestrian**
- Factors that increase the severity include:
  - Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed.
  - Vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian.
- Factors that decrease the severity include:
  - Medium operating speeds (60-70 km/h) for rear end and side impact crashes.
  - Medium/low operating speeds

**Cyclist**
- Factors that increase the severity include:
  - High speeds for this road user
  - High percentage of heavy vehicles
- Factors that decrease the severity include:
  - None

**Motorcyclist**
- Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low.
- Factors that increase the severity include:
  - High speeds for this road user
  - High percentage of heavy vehicles
  - Lack of motorcycle friendly sign supports
- Factors that decrease the severity include:
  - None

### Product

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/4</td>
<td>1/4</td>
<td>1 1/4</td>
<td>2/4</td>
<td>4/4</td>
<td>4/4</td>
<td>4/4</td>
</tr>
<tr>
<td><strong>Product</strong></td>
<td>32/64</td>
<td>4/64</td>
<td>19.6/64</td>
<td>24/64</td>
<td>12/64</td>
<td>12/64</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>151.6/448</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The aim of the Safe System matrix is to reduce the total score towards zero.
### 5.6 Ford Road/Verney Road Intersection

#### 5.6.1 Safe system matrix for Safer Roads, Roadsides and Speeds - Austroads AP-509-16 Matrix for this project

**Table 7: Safe System Assessment Matrix – Existing Conditions – Ford Road/Verney Road Intersection**

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td>For run-off-road crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For motorcyclist crash types, AADT is estimated between 10 and 50 vehicles per day (Austroads trigger).</td>
</tr>
<tr>
<td>Severity</td>
<td>Factors that increase the severity include: • Medium operating speeds (40-50km/h) • Lower percentage of heavy vehicles. • Factors that decrease the severity include: • Some parametric poles (sign supports)</td>
<td>Factors that increase the severity include: • High percentage of heavy vehicles.</td>
<td>Factors that decrease the severity include: • For head-on crash types the operating speeds (40-50km/h) are considered to be close to tolerable levels for fatalities, however not all serious injuries.</td>
<td>Factors that increase the severity include: • High probability of those crossing travelling at higher speeds.</td>
<td>Factors that increase the severity include: • Low operating speeds (40-50km/h)</td>
<td>Factors that increase the severity include: • Low operating speeds (40-50km/h)</td>
<td>Factors that decrease the severity include: • Medium (Low operating speeds (40-50km/h))</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Factors that increase the likelihood include: • Many fixed point source hazards in the road side close to the lane. • Curvature of the roundabout.</td>
<td>Factors that decrease the likelihood include: • Medium operating speeds (40-50km/h) • Acceptable signs and line marking.</td>
<td>Factors that decrease the likelihood include: • No extended median separator on the approach or departure.</td>
<td>Factors that decrease the likelihood include: • Observed hoon behaviour. • Roundabouts can increase the number of crashes due to human decision making (noting the severity is less).</td>
<td>Factors that decrease the likelihood include: • Medium operating speeds (40-50km/h) • Acceptable line marking and delineation.</td>
<td>Factors that increase the likelihood include: • Medium traffic volumes.</td>
<td>Factors that increase the likelihood include: • Inherent stability issues of motorcycles.</td>
</tr>
<tr>
<td>Probability</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
</tr>
</tbody>
</table>

- Factors that increase the severity include: • Some parametric poles (sign supports)
<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• High percentage of heavy vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Medium/Low operating speeds (40-50km/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vehicles head on crashing are likely to be travelling a higher speed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4</td>
<td>2/4</td>
<td>1/4</td>
<td>1/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
</tr>
<tr>
<td>Product</td>
<td>12/64</td>
<td>4/64</td>
<td>6/64</td>
<td>4/64</td>
<td>6/64</td>
<td>6/64</td>
</tr>
<tr>
<td>TOTAL</td>
<td>50/448</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The aim of the Safe System matrix is to reduce the total score towards zero.
### Table 8: Safe System Assessment Matrix – Signalised Intersection

**LEGEND**

Black text: Common factor between this plan and the existing conditions

Red text: New or significantly altered in this option compared to the existing conditions

**Factors that increase the likelihood include:**
- Many fixed point source hazards in the roadside close to the lane.
- Common point of departure
- Medium/High operating speeds (60+km/h)

Factors that decrease the likelihood include:
- Medium/low operating speeds (40-50km/h)
- Acceptable Good signs and line marking.
- Good lighting (assumed based on hardware).
- Straight alignment

**Factors that increase the severity include:**
- Medium operating speeds (40-50km/h)
- Medium/High operating speeds (50-60km/h)
- High percentage of heavy vehicles.
- Many point source hazards (power poles and overhead line marking).

Factors that decrease the severity include:
- Pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.
- For pedestrian crash types, AADT is estimated between 50 and 90 vehicles per day (Austroads trigger).

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors that increase the likelihood include:</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
</tr>
<tr>
<td>Factors that decrease the likelihood include:</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
</tr>
<tr>
<td>Factors that increase the severity include:</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
</tr>
<tr>
<td>Factors that decrease the severity include:</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
</tr>
</tbody>
</table>

**Crash types:**
- Medium/low operating speeds (40-50km/h)
- Medium/High operating speeds (50-60km/h)
- Red light running is likely to occur.
- Roundabouts may increase the number of crashes due to human decision making (testing the severity is less).
- Factors that decrease the likelihood include:
  - Generally good sight distances at intersection.
  - Acceptable Good line marking and signs
  - Good lighting (assumed based on hardware).
  - Signal control with FCRTs

**Factors that increase the likelihood include:**
- Rear end, side swipe.
- Cyclists struck at speeds above 30 km/h
- Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed.
- Motorcyclists struck at speeds above 30 km/h are likely to be seriously injured or killed.
- Factors that increase the severity include:
  - Medium if low operating speeds (40-50km/h)
  - Medium/High operating speeds (60+km/h)
  - High percentage of heavy vehicles

---

**Note:**
- Red light running is likely to occur.
- Roundabouts may increase the number of crashes due to human decision making (testing the severity is less).
### Run-off-road
- Factors that decrease the severity include:
  - Some frangible poles (sign supports)
  - Factors that increase the severity include:
    - High operating speeds (60+ km/h)
    - High percentage of heavy vehicles

<table>
<thead>
<tr>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium/High operating speeds (60+ km/h)</td>
</tr>
<tr>
<td>Medium/High operating speeds (60+ km/h)</td>
</tr>
<tr>
<td>High percentage of heavy vehicles</td>
</tr>
</tbody>
</table>

### Head-on
- Factors that decrease the severity include:
  - Some frangible poles (sign supports)
  - Vehicles head on crashing are likely to be travelling a higher speed.

### Intersection
- Factors that decrease the severity include:
  - Medium/Low operating speeds (40-50 km/h)
  - Medium/High operating speeds (60+ km/h)
  - Crash angle class severe

### Other
- Factors that decrease the severity include:
  - Low operating speeds (40-50 km/h)

### Pedestrian
- Factors that decrease the severity include:
  - Medium/Low operating speeds (40-50 km/h)

### Cyclist
- Factors that decrease the severity include:
  - Medium/Low operating speeds (40-50 km/h)

### Motorcyclist
- Factors that decrease the severity include:
  - Medium/Low operating speeds (40-50 km/h)
  - Lack of motorcycle friendly sign supports

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>trees) near the intersection.</td>
<td>(60+ km/h) are considered to be close to tolerable levels for fatalities, however not all serious injuries.</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that increase the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td>3 3/4</td>
<td>2 1/4</td>
<td>3/4</td>
<td>2/4</td>
<td>2 1/4</td>
<td>2 3/4</td>
<td>3 3/4</td>
</tr>
<tr>
<td>Product</td>
<td>12.8/64</td>
<td>4.0/64</td>
<td>12.0/64</td>
<td>4.0/64</td>
<td>5.7/64</td>
<td>6.4/64</td>
</tr>
<tr>
<td>TOTAL</td>
<td>56.8/448</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The aim of the Safe System matrix is to reduce the total score towards zero.
### Table 9: Safe System Assessment Matrix – Roundabout Intersection

| Table 9: Safe System Assessment Matrix – Roundabout Intersection |

#### LEGEND

- **Black text:** Common factor between this plan and the existing conditions
- **Factor (strikethrough):** Factor that is removed or significantly diminished between the existing conditions and this option
- **Blue text:** New or significantly altered in this option compared to the existing conditions

#### Exposure

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>For run-off-road crash types, AADT is between 5,000 and 5,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types, AADT is between 5,000 and 5,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is between 5,000 and 5,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is 45-55km/h.</td>
<td>For pedestrian crash types, pedestrian volumes are estimated to be very low based on visual observations.</td>
<td>For motorcyclist crash types, AADT is estimated between 20 and 50 vehicles per day (Austroads trigger).</td>
<td></td>
</tr>
<tr>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td>2/4</td>
<td></td>
</tr>
</tbody>
</table>

#### Likelihood

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many fixed point source hazards in the roadside close to the lane.</td>
</tr>
<tr>
<td>Curve of the roundabout.</td>
</tr>
<tr>
<td>Multiple lanes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No extended median separator on the approach or departure.</td>
</tr>
<tr>
<td>Medium/low operating speeds (40-55km/h).</td>
</tr>
<tr>
<td>Acceptable good signs and line marking.</td>
</tr>
<tr>
<td>Good lighting (assumed based on hardware).</td>
</tr>
<tr>
<td>Straight alignment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed hoon behaviour.</td>
</tr>
<tr>
<td>Roundabouts can increase the number of crashes due to human decision making (noting the severity is less).</td>
</tr>
<tr>
<td>Multiple lanes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium/low operating speeds (40-55km/h).</td>
</tr>
<tr>
<td>Acceptable good signs and line marking.</td>
</tr>
<tr>
<td>Good lighting (assumed based on hardware).</td>
</tr>
<tr>
<td>Straight alignment.</td>
</tr>
<tr>
<td>Generally good sight distances at intersection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roundabouts may increase the number of near end crashes.</td>
</tr>
<tr>
<td>Multiple lanes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single lane roundabout.</td>
</tr>
<tr>
<td>Acceptable good signs and line marking.</td>
</tr>
<tr>
<td>Good lighting (assumed based on hardware).</td>
</tr>
<tr>
<td>Straight alignment.</td>
</tr>
<tr>
<td>Medium/low operating speeds (40-55km/h).</td>
</tr>
</tbody>
</table>

#### Severity

<table>
<thead>
<tr>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium operating speeds (40-55km/h) for run-off-road type crashes.</td>
</tr>
<tr>
<td>Many point source hazards (power poles and trees) near the intersection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>For head-on crash types the operating speeds (40-55km/h) are.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High percentage of heavy vehicles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher probability of those crashing travelling at higher speeds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium/low operating speeds (40-55km/h).</td>
</tr>
<tr>
<td>Crash angles less severe.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle.</td>
</tr>
<tr>
<td>Multiple lanes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherent stability issues of motorcycles.</td>
</tr>
<tr>
<td>Medium traffic volumes.</td>
</tr>
<tr>
<td>Medium/low operating speeds (40-55km/h).</td>
</tr>
<tr>
<td>No separated facilities.</td>
</tr>
<tr>
<td>Cyclists may not be identified at the roundabout.</td>
</tr>
<tr>
<td>Cyclist lanes and on the approach to the roundabout.</td>
</tr>
<tr>
<td>Multiple lanes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium/low operating speeds (40-55km/h).</td>
</tr>
<tr>
<td>Good lighting.</td>
</tr>
<tr>
<td>Refug island.</td>
</tr>
<tr>
<td>Formalised crossing points.</td>
</tr>
<tr>
<td>Generally good sight distances at intersection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that increase the likelihood include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some shoulder area for cyclists to ride on the approach.</td>
</tr>
<tr>
<td>Acceptable good signs and line marking.</td>
</tr>
<tr>
<td>Good lighting (assumed based on hardware).</td>
</tr>
<tr>
<td>Straight alignment.</td>
</tr>
<tr>
<td>Refuge area for shared path users.</td>
</tr>
<tr>
<td>Shared path</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors that decrease the severity include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low percentage of heavy vehicles.</td>
</tr>
</tbody>
</table>
### Factors Affecting Severity

<table>
<thead>
<tr>
<th></th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factors that decrease the severity include:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Some frangible poles (sign supports)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vehicles head on crashing are likely to be travelling a higher speed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low operating speeds (45-55km/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Factors that increase the severity include:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medium/Low operating speeds (45-55km/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High percentage of heavy vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medium/Low operating speeds (45-55km/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lack of motorcycle friendly sign supports</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Factors that decrease the severity include:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medium/Low operating speeds (45-55km/h)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|               | 3.2/4 | 2.0/4 | 1.2/4 | 1.1/4 | 2.1/4 | 2.1/4 | 3.1/4 |
| Product       | 14.1/64 | 4/64 | 7.4/64 | 4.4/64 | 6.7/64 | 6.3/64 | 14.3/64 |
| **TOTAL**     |       |       |       |       |       |       | **57.8 / 448** |

The aim of the Safe System matrix is to reduce the total score **towards zero**.
### 5.7 Ford Road/Grahamvale Road Intersection

#### 5.7.1 Safe System matrix for Safer Roads, Roadsides and Speeds - Austroads AP-509-16 Matrix for this project

**Table 10: Safe System Assessment Matrix – Ford Road/Grahamvale Road Intersection**

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exposure</strong></td>
<td>For run-off-road crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).</td>
</tr>
<tr>
<td><strong>Likelihood</strong></td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
<td>Factors that increase the likelihood include:</td>
</tr>
<tr>
<td></td>
<td>- High operating speeds (80-85km/h)</td>
<td>- High operating speeds (80-85km/h)</td>
<td>- Medium traffic volume during peak hours, thus people take more risks to exit.</td>
<td>- High operating speeds (80-85km/h) increases the likelihood of rear end crashes.</td>
<td>- High traffic volumes</td>
<td>- High traffic volumes</td>
</tr>
<tr>
<td></td>
<td>- Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road.</td>
<td>- No median separating</td>
<td>- All movements open.</td>
<td>- No lighting</td>
<td>- Uncontrolled intersection increases the likelihood of rear end crashes.</td>
<td>- Uncontrolled intersection increases the likelihood of rear end crashes.</td>
</tr>
<tr>
<td></td>
<td>- Many fixed point source hazards in the roadside close to the lane.</td>
<td>Factors that decrease the likelihood include:</td>
<td>- No lighting</td>
<td>- No median separating</td>
<td>- No lighting</td>
<td>- No lighting</td>
</tr>
<tr>
<td></td>
<td>- No lighting</td>
<td>- Straight alignment</td>
<td>- No turn lanes</td>
<td>Factors that decrease the likelihood include:</td>
<td>- No crossing facilities</td>
<td>- No crossing facilities</td>
</tr>
<tr>
<td></td>
<td>Factors that decrease the likelihood include:</td>
<td>Acceptable line marking and delineation</td>
<td>Factors that decrease the likelihood include:</td>
<td>Acceptable line marking and delineation</td>
<td>Factors that decrease the likelihood include:</td>
<td>Factors that decrease the likelihood include:</td>
</tr>
<tr>
<td></td>
<td>- Acceptable line marking and delineation</td>
<td>Factors that decrease the severity include:</td>
<td>Generally good sight distances at intersection.</td>
<td>Acceptable line marking and delineation</td>
<td>Generally good sight distances at intersection.</td>
<td>Generally good sight distances at intersection.</td>
</tr>
<tr>
<td></td>
<td>- Straight alignment</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>- Median non-motorised</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>No median separating</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>Factors that decrease the severity include:</td>
<td>High operating speeds (80-85km/h) for intersection type crashes.</td>
<td>High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end</td>
<td>Pedestrians stuck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian</td>
<td>High speeds for pedestrians</td>
<td>Pedestrians stuck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian</td>
</tr>
<tr>
<td></td>
<td>- High percentage of heavy vehicles</td>
<td>Factors that decrease the severity include:</td>
<td>High percentage of heavy vehicles</td>
<td>Factors that decrease the severity include:</td>
<td>High percentage of heavy vehicles</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>- High operating speeds (80-85km/h)</td>
<td>Factors that decrease the severity include:</td>
<td>Pedestrians stuck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian</td>
<td>Factors that decrease the severity include:</td>
<td>High speeds for pedestrians</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>- High operating speeds (80-85km/h)</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>High percentage of heavy vehicles</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>- High percentage of heavy vehicles</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>- Some fragile poles (sign supports)</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td>- Some cleared area</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
<td>Factors that decrease the severity include:</td>
</tr>
</tbody>
</table>

#### Factors that increase the severity include:
- High operating speeds (80-85km/h)
- Many point source hazards (power poles) near the intersection in the secondary crash zone areas.
- Culverts and drop off channel close to the road.

#### Factors that decrease the severity include:
- Some fragile poles (sign supports)
- Some cleared area
Factors that decrease the severity include:

<table>
<thead>
<tr>
<th></th>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>36/64</td>
<td>24/64</td>
<td>48/64</td>
<td>18/64</td>
<td>12/64</td>
<td>12/64</td>
<td>48/64</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>198 / 448</td>
</tr>
</tbody>
</table>

The aim of the Safe System matrix is to reduce the total score towards zero.
### Table 11: Safe System Assessment Matrix - Signalised Intersection

**Legend**
- **Black text:** Common factor between this plan and the existing conditions
- **Red text:** New or significantly altered in this option compared to the existing conditions

**Factors that increase the likelihood include:**
- High operating speeds (80-85km/h)
- Uncontrolled intersection meaning that vehicles are likely to turn left or right at the intersection or entering/exiting the side road
- Many fixed point source hazards in the roadside close to the lane
- Moonlighting

**Factors that decrease the likelihood include:**
- Acceptable Good line marking and delineation
- Straight alignment
- Traffic signal control

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exposure</strong></td>
<td>For run-off-road crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe, level crossing.</td>
<td>For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.</td>
<td>For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).</td>
</tr>
</tbody>
</table>
| **Likelihood** | Factors that increase the likelihood include:  
- High operating speeds (80-85km/h)  
- Uncontrolled intersection meaning that vehicles are likely to turn left or right at the intersection or entering/exiting the side road  
- Many fixed point source hazards in the roadside close to the lane  
- Moonlighting | Factors that increase the likelihood include:  
- High operating speeds (80-85km/h)  
- No median separating  
- Factors that decrease the likelihood include:  
- Straight alignment  
- Acceptable Good line marking and delineation  
- Traffic signal control | Factors that increase the likelihood include:  
- Medium traffic volume during peak hours, thus people take more risks to ride  
- All movements open  
- High operating speeds (80-85km/h) which is high for traffic signals  
- No lighting  
- No turn lanes  
- Likely to be red light runners | Factors that increase the likelihood include:  
- High operating speeds (80-85km/h)  
- High operating speeds (80-85km/h) increases the likelihood of rear end crashes.  
- Multiple lanes  
- No lighting  
- Railway level crossing  
- This traffic signal will need to be linked  
- Factors that decrease the likelihood include:  
- Generally good sight distances at intersection.  
- Acceptable line marking and delineation  
- Traffic signal control  
- FCRTs | Factors that increase the likelihood include:  
- High traffic volumes  
- High operating speeds (80-85km/h)  
- No crossing facilities  
- No lighting  
- Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle  
- Motorcyclist
| **Severity** | Factors that increase the severity include:  
- High operating speeds (80-85km/h)  
- Many point source hazards (power poles) near the intersection in the secondary crash zone areas. | Factors that increase the severity include:  
- High percentage of heavy vehicles.  
- High operating speeds (80-85km/h)  
- Factors that decrease the severity include:  
- High percentage of heavy vehicles | Factors that increase the severity include:  
- High operating speeds (80-85km/h) for intersection type crashes.  
- Right angle crashes possible.  
- High percentage of heavy vehicles | Factors that increase the severity include:  
- High operating speeds (80-85km/h)  
- High percentage of heavy vehicles may contribute to the severity of crashes such as rear end.  
- Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian | Factors that increase the severity include:  
- High speeds for this crash type  
- High percentage of heavy vehicles  
- Motorcyclists striking at speeds above 30km/h are more likely to be seriously injured or killed. Also, a high proportion of heavy vehicles may contribute to the severity of crashes such as rear end.  
- Active control on the level crossing  
- Traffic signal control and linking to level crossing  
- Motorcyclists striking at speeds above 30km/h are more likely to be seriously injured or killed. Also, a high proportion of heavy vehicles may contribute to the severity of crashes such as rear end. | Factors that increase the severity include:  
- High speed for this road user  
- High percentage of heavy vehicles  
- Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low.  
- Factors that increase the severity include:  
- High speeds for this road user  
- High percentage of heavy vehicles  
- Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low.

### Likelihood

|------|-----|-----|-----|-----|-----|-----|-----|

### Severity

| Risk | 2.0/4 | 1.5/4 | 3.0/4 | 1.5/4 | 2.0/4 | 2.0/4 | 3.0/4 |
Run-off-road | Head-on | Intersection | Other | Pedestrian | Cyclist | Motorcyclist
---|---|---|---|---|---|---
• Culverts and drop-offs/channel close to the road. | Factors that decrease the severity include: | Factors that decrease the severity include: | Factors that increase the severity include: |
Factors that decrease the severity include: |
• Some frangible poles (sign supports) |
• Some cleared area |
Factors that decrease the severity include: |
• High speeds for pedestrians |
• High percentage of heavy vehicles |
Factors that decrease the severity include: |
• None |
Product | 24/64 | 18/64 | 36/64 | 13.5/64 | 8/64 | 8/64 | 36/64

TOTAL | 143.5/448

The aim of the Safe System matrix is to reduce the total score towards zero.
Table 12: Safe System Assessment Matrix - Roundabout Intersection

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td>For run-off-road crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For head-on crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).</td>
<td>For other crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).</td>
<td>For pedestrian crash types, pedestrian volumes are very low based on visual observations.</td>
<td>For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Factors that increase the likelihood include:  • High operating speeds (80 km/h)  • Uncontrolled intersection (95% likely to occur if the road is divided into no entries or exits)  • Multi lanes  • Many point source hazards in the roadside close to the lane.  • No lighting  • Roundabout curvature</td>
<td>Factors that increase the likelihood include:  • High operating speeds (80 km/h)  • Uncontrolled intersection (95% likely to occur if the road is divided into no entries or exits)  • Multi lanes  • Many point source hazards in the roadside close to the lane.  • No lighting  • Roundabout curvature</td>
<td>Factors that increase the likelihood include:  • High operating speeds (80 km/h)  • Uncontrolled intersection (95% likely to occur if the road is divided into no entries or exits)  • Multi lanes  • Many point source hazards in the roadside close to the lane.  • No lighting  • Roundabout curvature</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
<td>Factors that increase the likelihood include:  • High operating speeds (80 km/h)  • Uncontrolled intersection (95% likely to occur if the road is divided into no entries or exits)  • Multi lanes  • Many point source hazards in the roadside close to the lane.  • No lighting  • Roundabout curvature</td>
<td>Factors that increase the severity include:  • High operating speeds (80 km/h)  • Uncontrolled intersection (95% likely to occur if the road is divided into no entries or exits)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
</tr>
<tr>
<td>Severity</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
<td>Factors that increase the severity include:  • High percentage of heavy vehicles  • High operating speeds (80 km/h)  • Multi lanes  • Many point source hazards (power poles) near the intersection in the secondary crash zone area.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Run-off-road</th>
<th>Head-on</th>
<th>Intersection</th>
<th>Other</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Motorcyclist</th>
</tr>
</thead>
</table>
| • Culverts and drop-offs/channel close to the road. | Factors that decrease the severity include:  
  • Some frangible poles (sign supports)  
  • Some cleared area  
  • Medium/low operating speeds | • Favourable angles of crashes such as rear-end | Factors that decrease the severity include:  
  • Medium/low operating speeds  
  • Favourable angles for these crash types | vehicle runs over the pedestrian | Factors that decrease the severity include:  
  • Medium/low operating speeds | Factors that decrease the severity include:  
  • High speeds for this road user  
  • High percentage of heavy vehicles  
  • Medium/low operating speeds  
  • Medium/low operating speeds |
| 2.0/4 | 0.5/4 | 1.2/4 | 2.0/4 | 3.5/4 | 3.5/4 | 4.0/4 |
| Product | 12.0/64 | 1.5/64 | 10.8/64 | 18/64 | 12.3/64 | 14.0/64 | 33.0/64 |
| TOTAL | | | | | | **101.6 / 448** |

The aim of the Safe System matrix is to reduce the total score towards zero.
## 5.8 Safer Vehicles, People and Post-Crash Care (high level comments)

Table 13: Safe System Assessment Comments – Safer Vehicles, People and Post – Crash Care

<table>
<thead>
<tr>
<th>Safe System Element</th>
<th>Prompt</th>
<th>Comments/issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road User</td>
<td>Are road users likely to be alert and compliant? Are there factors that might influence this?</td>
<td>• Anyone travelling from Melbourne will have passed through Shepparton and thus is less likely to be in an immediate state of fatigue when passing through these intersections. However, travelling from the north on the National Highway/Goulburn Valley highway this may be the first intersection with major treatment, and thus may surprise a fatigued driver.</td>
</tr>
</tbody>
</table>
| Road User           | What are the expected compliance and enforcement levels (alcohol/drugs, speed, road rules, and driving hours)? What is the likelihood of driver fatigue? Can enforcement of these issues be conducted safely? | • While the hoon driving check (see below) does not indicate a high level of hoon behaviour, it is expected that there will be some hoon behaviour. Some hoon behaviour was observed on site and there were skid marks witnessed.  
• There are no pubs/clubs directly adjacent to these intersections. |
| Road User           | Are there special road uses (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism), or risk-taking behaviours? | • No special road uses are noted, although there are recreational cyclists that use Ford Road.                                                                                                                   |
| Vehicle             | What level of alignment is there with the ideal of safer vehicles?                                                                                                                                    | • There is nothing to indicate this project contravenes the ideals of safer vehicles.                                                                                                                             |
| Vehicle             | Are there factors which might attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed/existing road design? Is this route used by recreational motorcyclists? | • Motorcycle volumes are expected to be approximately 1% consistent with state averages.                                                                                                                      |
| Vehicle             | Are there enforcement resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement of these issues be conducted safely? | • VicRoads TSS operate in the area  
• There is nothing hampering enforcement.                                                                                                           |
| Vehicle             | Has vehicle breakdown been catered for?                                                                                                                                                                | • Shoulders provide space for broken down vehicles to manoeuvre out of the traffic lane.                                                                                                                        |
| Vehicle             | Have advanced vehicle features been considered?                                                                                                                                                        | • To support emerging technologies including Lane Departure Warning, Lane Keeping Assistance and Traffic Sign Recognition, standard road markings and signs must be used wherever required and must not be worn out, obscured, inconsistent or confusing. It has been identified that the combination of inadequate maintenance of roads and inconsistencies in road markings and traffic signs is a major obstacle to the effective implementation of advanced vehicle features.  
• Avoid blacking out redundant pavement markings, as this may confuse a vehicle that is reading the line marking |
<p>| Post-crash care     | Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access stopping space)?                                                       | • No issues identified.                                                                                                                                                                                      |</p>
<table>
<thead>
<tr>
<th>Safe System Element</th>
<th>Prompt</th>
<th>Comments/Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-crash care</td>
<td>Do emergency and medical services operate as efficiently and rapidly as possible?</td>
<td>• There are medical services in Shepparton, thus it is assumed that efficient post-crash care is available.</td>
</tr>
</tbody>
</table>
| Post-crash care     | Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc. | • No specific features are part of this project  
• Consider utilising VMSs as part of a wider VMS strategy if appropriate. |
| Maintenance         | Can all road features be maintained in a safe and efficient manner?     | • No non-standard features which may create maintenance issues are noted. |
5.9 Safer People

For the Safe System to work, it is necessary for users of the system to behave in ways that will allow the system to protect them. It is therefore important that road users understand that they have to keep their side of the bargain (or agreement), if they are to be protected by the way the roads and vehicles have been configured to keep them safe. There are no guarantees of protection, however, if drivers choose to travel at speeds well over the speed limit or, as result of being impaired, if they drive in a risky or reckless manner. Crucial, then, is that the community understands what the Safe System is and what it hopes to achieve and, importantly, the way they need to observe traffic laws if they are to enjoy the protection that the system has to offer.

Hoon behaviour:

Figure below shows the Safe Driving Program Orders which has been used as a proxy for the level of hoon behaviour in the area. Compared to the surrounding regions, Ford Road has a low rate of hoon behaviour.

Figure 4: Safe Driving Program Orders
6 Recommendations

Infrastructure recommendations are classified into categories as instructed in AP-R509-16 Austroads Safe System Assessment Framework.

Definitions of the alignment with Safe System principles are:

**Primary Treatments**: Road planning, design and management considerations that virtually eliminate the potential of fatal or serious injuries occurring in association with the foreseeable crash types.

**Step Towards**: Road planning, design and management considerations that improve the overall level of safety associated with foreseeable crash types, but do not virtually eliminate the potential of fatal or serious injuries occurring. However, when applied to an existing road environment they improve the ability for a Primary Treatment to be implemented in the future.

**Supporting Treatments**: Road planning, design and management considerations that improve the overall level of safety associated with foreseeable crash types, but do not virtually eliminate the potential of fatal or serious injuries occurring. When applied to an existing road environment they do not change the ability for a primary treatment to be installed in the future.

Project managers are encouraged to implement as many of the recommendations as possible, with preference for Primary Treatments.

Where matrix scores still remain high, project managers are encouraged to look to the other elements of the Safe System to reduce risk.

**This Safe System Assessment provides a series of recommendations/options to move the Project further Towards Zero.**

**Recommendations/options:**

**Primary Treatments:**

**Traffic Signals:**

Consider:

- If traffic signals are installed as the intersection control, consider installing raised platforms or other devices to achieve a design speed of 50km/h.
- While conflicting with the function of these roads, to achieve primary Safe System for pedestrians crossing the road, the speeds would need to be reduced to 30km/h at all crossing points. Alternatively, a separated facility would be required (ie. an underpass or overpass). It is noted that the likely pedestrian volumes will be low at all crossing locations, except Verney/Ford.
- Reconsider the need for slip lanes at the signalised intersections. Crashes occur when vehicle drivers are looking to their right for gaps in traffic rather than concentrating on pedestrians. If slip lanes are required, ensure that there are acceptable sight lines to the pedestrian crossing location and that the crossing point is raised to lower vehicle speeds (ie. Wombat Crossing).
- Consider the design specific recommendations in Appendix G.
Consider:

- Installing a single lane roundabout and accept a small level of congestion during some hours of peak traffic volume.
- Installing separators/splitters on the approach to the intersection to minimise ‘straight lining’ through the two-lane roundabout at GVH/Wanganui (see example design in Appendix H).
- Consider the addition of signalised pedestrian crossings on pedestrian desire lines.
- See design specific recommendations in Appendix G.

**Supporting Treatments:**

**Traffic Signals:**

Consider:

- If the intersection is not raised and supplemented with advisory speeds, consider adjusting the regulatory speed limit on Grahamvale Road to 60km/h on the approach to the intersection. Consider extending the 60km/h speed limit on the GVH to the north, and on other roads implementing speed limit reductions to 60km/h if traffic signals are being implemented.
- Ensure that the traffic signals at Grahamvale Road are linked to the railway level crossing to eliminate the possibility of a stacking issue.
- Even with the signal linking, add measures to ensure that a vehicle trapped on the level crossing could ‘escape’ if required.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that raised platforms can be easily installed in the future.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that speed and red light cameras can be easily installed in the future, or consult with the Department of Justice to ascertain if they can be installed as part of the project.
- See design specific recommendations in Appendix G.

**Roundabout:**

Consider:

- If pedestrian signals are not installed, consider designing pedestrian crossing points so that they can be retrofitted with traffic signals.
- Consider using Danish Offset (aka Z-Crossing) crossings.
- Consider installing cycling crossing points on the roundabout (see example in Appendix H)
- See design specific recommendations in Appendix G.

**Other Safe System Elements:**

Consider:

- Consider working with the main heavy vehicle operators to ensure that they have undertaken the Heavy Vehicle Rollover Program and they understand the risks of heavy vehicles rolling over at roundabouts.
7 Conclusion

The installation of either traffic signals or a roundabout at both the GVH and Grahamvale Road intersections with Ford Road will improve alignment with Safe System principles, however for both of these intersections the better alignment with Safe System principles are roundabouts (acknowledging that there are some complications with a roundabout near the railway level crossing at Grahamvale Road).

This is not the case for Verney / Ford Roads intersection. The installation of traffic signals or the retention of the single lane roundabout moves this intersection further from a Safe System intersection (the retention is score is driven by the expected increase in pedestrian volumes). The other scores are predominately due to the increased speeds and lanes.

Modifications to a roundabout or traffic signals can be incorporated into the current designs to give very high alignment with Safe System principles.

8 References


Jurewicz C, Sobhani Dr A, Woolley Dr J, Dutschke Dr J, Corben Dr B, 2015, Proposed vehicle impact speed -severe injury probability relationships for selected crash types, Australasian Road Safety Conference.

Moon and Mihailidis, Outcome Based Management of Roadside Hazards, ACRS 2013,
Appendix A: Photos
Photo 1: Goulbourn Valley Highway facing south on the approach to Ford Street.

Photo 2: Ford Street facing west on the approach to the Goulbourn Valley Highway
Photo 3: Goulbourn Valley Highway facing north at the intersection of Wanganui Road.

Photo 4: Goulbourn Valley Highway facing south at the intersection of Wanganui Road.
Photo 5: Goulbourn Valley Highway facing south east at the intersection of Wanganui Road.

Photo 6: Wanganui Road on the approach to the Goulbourn Valley Highway facing east.
Photo 7: Ford Road facing west on the approach to the Verney Road roundabout.

Photo 8: Verney Road facing north on the approach to the Ford Road roundabout.
Photo 9: Verney Road shared path facing north on the approach to the Ford Road roundabout.

Photo 10: Verney Road facing south on the approach to the Ford Road roundabout.
Photo 11: Ford Road facing east on the approach to the Verney Road roundabout.

Photo 12: Grahamvale Road on the approach to Ford Road facing north.
Photo 13: Ford Road facing west on the approach to Grahamvale Road.

Photo 14: Grahamvale Road on the approach to Ford Road facing south.
Photo 15: Ford Road facing east on the approach to Grahamvale Road.
Appendix B: Crash History (last 5 years)
All by node type

Source: ArcGIS
Appendix C: Surrounding Land Use
Appendix D: Surrounding Land Use 2
Appendix E: Road Hierarchy Map
Source: VicRoads
Appendix G: Design Review Comment
General Comments.

- For roundabout and signalised intersection options the design remains silent on the use of barriers to shield motorists from road side hazards such as major channels, vegetation, power poles. Consider developing a barrier strategy for the project to address the issues stated above and to improve road safety.

- For the roundabout intersection options, the design has remained silent on installing pedestrian and cyclist infrastructure. To improve pedestrian and cyclist safety consider developing a pedestrian and cyclist strategy, which should address issues such as but not limited to the following; crossing points at intersections, separation between traffic movements, and connectivity to any new developments and the existing network. (Image: roundabout with no cyclist/ped infrastructure)
• For the roundabout intersection options, the approaches to the intersection remain straight. Motorists approaching the intersection can do so at higher speed which may result in failure to give way and run-off road crashes at these locations. Consider installing reverse curves or raised platforms to slow motorists approaching the intersection.

• For some signalised intersections options the plans detail a skew in the pedestrian path alignment when crossing at the intersection. Skews in pedestrian paths at intersections should be avoided where possible as the sudden change in direction is awkward for pedestrians and more importantly those with disabilities such as the vision impaired. Consider re-aligning the pedestrian paths as so pedestrians cross 90 degrees to traffic.
Goulburn Valley Highway – Ford Road Signalised Intersection.

- For motorists traveling North along GVH, on the departure side of the intersection pavement markings are not shown. This could result in poor lane discipline and side-swipe crashes at this location. Consider installing pavement markings at this location to improve motorist safety.
• There is a commercial business located on the South-East corner of the intersection. The design remains silent on re-instating access to this site which could result in un-safe movements and crashes at this location. Consider detailing access points on plans with consideration given to vehicle movements into and out of this business and ensure they can be performed safely.
• The design details on-road cyclist lanes at the intersection location. Currently motorists and cyclists are unaware of conflict locations between intersection movements which could result in crashes at
this location. Consider installing ‘green pavement’ at conflict points to alert motorists and cyclists alike as so they can act and proceed with caution at these locations.
- The design has remained silent on the existing access for the commercial business located on the North-West corner of the intersection. Consider removing this access to simply intersection movements and improve road safety at this location.

- Located on the South-East corner of the intersection there is a solid line shown, as such it is unclear as to the width of the traffic lane at this location. Consider removing the dark line as so the single lane develops into two lanes at the intersection location.
Verney Road – Ford Road Signalized Intersection

- For motorists traveling West on Ford Road approaching Access Road intersection are focused on intersection movements occurring ahead whilst performing a lateral shift. The kerb at this location has a number of kinks in its alignment which could result in a vehicle mounting the kerb and run-off road crashes at this location. Consider installing a straight taper at this location.
Grahamvale – Ford Road Signalised intersection.

- The plans detail no designated East-West crossing points for the existing railway crossing. This could result in unsafe movements and crashes at this location. Consider installing a designated railway crossing point for pedestrians and cyclists at this location.
• If a train is coming and the railway crossing is activated, motorists turning into Ford Road or on Ford Road heading East may become stranded within the intersection resulting in crashes. Consider linking the phasing of the intersection to the railway crossing as so Eastbound movements at the intersection are not permitted whilst the railway crossing is activated.
Goulburn Valley Highway – Ford Road Roundabout (Centred option).

- Centring the roundabout at this location ensures intersection deflection is equally distributed across all four approaches. This is the preferred layout as it offers the best results in reduced vehicle speeds through the intersection.

- Vehicle turn templates have not been provided for review. Conduct checks to ensure clearances to kerb and channel as well as other vehicle movements are being maintained as to reduce vehicle stability issues and sideswipe crashes at the intersection location.
Intersection sightlines are being obscured East of the intersection by existing vegetation as well as commercial developments, which could result in crashes at these locations. Ensure that intersection sightlines are free of obstructions as to improve motorists/pedestrian/cyclist safety at the intersection location as per the Austroads Guidelines.
Goulburn Valley Highway – Ford Road Roundabout (Shift to the East option).

- Placing the roundabout off centre at this location has resulted in the intersection deflection being unevenly distributed for the North-South approaches. For motorists traveling south the intersection offers little in the way of deflection as such motorists can maintain their speed through the intersection which could result in failure to give-way and run-off road crashes at this location. And for the North approach the large deflection requirement for motorists has resulted in reduction in through speeds and high level of safety. Consider installing a centrally located roundabout at this location as it will offer the best results in terms of safety for all intersection approaches.
• Shifting the roundabout to the East at this location has resulted in less deflection and greater vehicle speeds for motorists turning left from Goulburn Valley Highway onto Ford Road. This may result in run-off road as well crashes with pedestrian/cyclists crossing North-South at this location. Consider re-aligning the approach of Goulburn Valley Highway to further reduce vehicle speeds.

• Refer to dot points 2&3 (centred option) and general comments 1,3 & 4 as they apply for this layout also.
Verney Road – Ford Road Roundabout.

- Vehicle turn templates have not been provided for review. Conduct checks to ensure clearances to kerb and channel as well as other vehicle movements are being maintained as to reduce vehicle stability issues and sideswipe crashes at the intersection location.
- Intersection sightlines are being obscured South of the intersection by existing vegetation as well as residential developments, which could result in crashes at these locations. Ensure that intersection sightlines are free of obstructions as to improve motorists/pedestrian/cyclist safety at the intersection location.
- Refer general comments 1,3&4 as they apply for this layout also.
Grahamvale Road – Ford Road Roundabout.

- Placing the roundabout off centre at this location has resulted in the intersection deflection being unevenly distributed for the North-South approaches. For motorists traveling south the intersection offers little in the way of deflection as such motorists can maintain their speed through the intersection which could result in failure to give-way and run-off road crashes at this location. And for the North approach the large deflection requirement for motorists has resulted in reduction in through speeds and high level of safety. Consider installing a centrally located roundabout at this location as it will offer the best results in terms of safety for all intersection approaches.
• Shifting the roundabout to the East at this location has resulted in less deflection and greater vehicle speeds for motorists turning left from Grahamvale Road onto Ford Road. This may result in run-off road as well crashes with pedestrian/cyclists crossing North-South at this location. Consider realigning the approach of Grahamvale Road to further reduce vehicle speeds.

• The combination of shifting the roundabout to the East and the proximity of the existing rail crossing to the proposed intersection has resulted in a sharp curve located on the south-east corner. Large vehicles turning left from Ford Road into Grahamvale Road at this location may be required to mount the kerb and channel causing stability issues which could result in crashes at this location. Consider adjusting the intersection layout so all intersection movements can be performed safely.
• The departure lane width for Motorists traveling South on Grahamvale road appears to be quite narrow which could result in large vehicles mounting the kerb at this location resulting in stability issues and crashes at this location. Consider checking vehicle turn templates for all intersection movements and ensure that all clearances to kerb and channel are being maintained.

• Refer to dot points 2&3 (centred option) and general comments as they apply for this layout also.
Appendix H: Examples
Example of a separation on the approach to a roundabout and catering for recreational cyclists:

Raised platform at a signalised intersection (Belmont, Victoria):
Catering for cyclists at roundabouts:

Pedestrian facilities close to a roundabout acting as metering
Appendix H: Crash Reduction Factor discussion
Two lane roundabout vs traffic signals:

**Vehicle to vehicle collisions:**

From Give Way/Stop to two lane roundabout:

Victorian crash reduction factors are 60% for an urban environment and 70% for a rural environment (VicRoads 2016).

NSW is more refined with the use of CRFs and attempts to disaggregate crash reduction by road user movements. NSW uses an 85% CRF for all crash types except u-turn, head on, rear end, lane change, parallel lanes turning and pedestrians. For these they use: u-turn (70%), head on (35%), a negative crash reduction factor for rear end (-20%), lane change (-20%), parallel lanes (-20%). Interestingly, NSW award a CRF of 65% for pedestrians at two lane roundabouts. 35% reduction in off carriageway

Factoring in the expected road use (heavily dominated by passenger vehicles), the expected crash types, the urban fringe environment an overall crash reduction factor of 65% is considered conservatively appropriate.

The driver of the CRF for roundabout is actually the reduction in severity of crashes as opposed to the reduction in the frequency of crashes. This impacts on the severity outcome of crashes in the Safe System Assessment matrix.

As the subject area is in an urban fringe environment, a CRF of 65% has been assumed.

Sources:

Austroads 2010
Austroads 2012B
Turner et al. 2008
Elvik et al. 2009
ITE 2004
Daniels et al. 2008
Isebrands 2003
De Brabander and Vereeck (2007)
Teale 1984
Jensen 2013
Harkey et al. 2008
Isebrands 2012
Persaud et al. 2001

From Give Way/Stop to traffic signals:

Victorian crash reduction factors are 45% for all environments (VicRoads 2016).

NSW data backs up the Victorian data for most crash types, however the disaggregation of the data shows spectrum of estimated crash reduction factors from crash increases to 75%. At the more severe end of the spectrum there is lower CRFs of 20 – 40%
Hit pedestrians is a CRF of only 30% for all speed zones with traffic signals. If the FCRT is removed this reduces to 5%.

Sources:

Turner et al. (2010) - metro
Turner et al. (2010) - regional
Turner, B et al. (2012) (does not distinguish between turn controls)
Davis and Aul (2007) (major approach protected only)
Harkey et al. (2008) (rural - did not differentiate turn control)
Harkey et al. (2008) (urban, three leg - did not differentiate turn control)
Harkey et al. (2008) (urban, four leg - did not differentiate turn control)
AASHTO (2010) (rural - does not distinguish between turn controls)
AASHTO (2010) (urban, four leg - does not distinguish between turn controls)
Scully et al. (2006) (does not differentiate between turn control)
Teale et al. (1979) and Teale (1984) (does not differentiate between turn controls)
Pernia et al. (2002) (does not differentiate between turn controls)