

Queensland Road Safety Technical User Volumes (QRSTUV)

Guide to Safe System Assessment

August 2024



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About this document

The *Queensland Road Safety Technical User Volumes (QRSTUV): Guide to Safe System Assessment* is the guideline used inform how Safe System Assessments are conducted in Queensland.

How to use this document

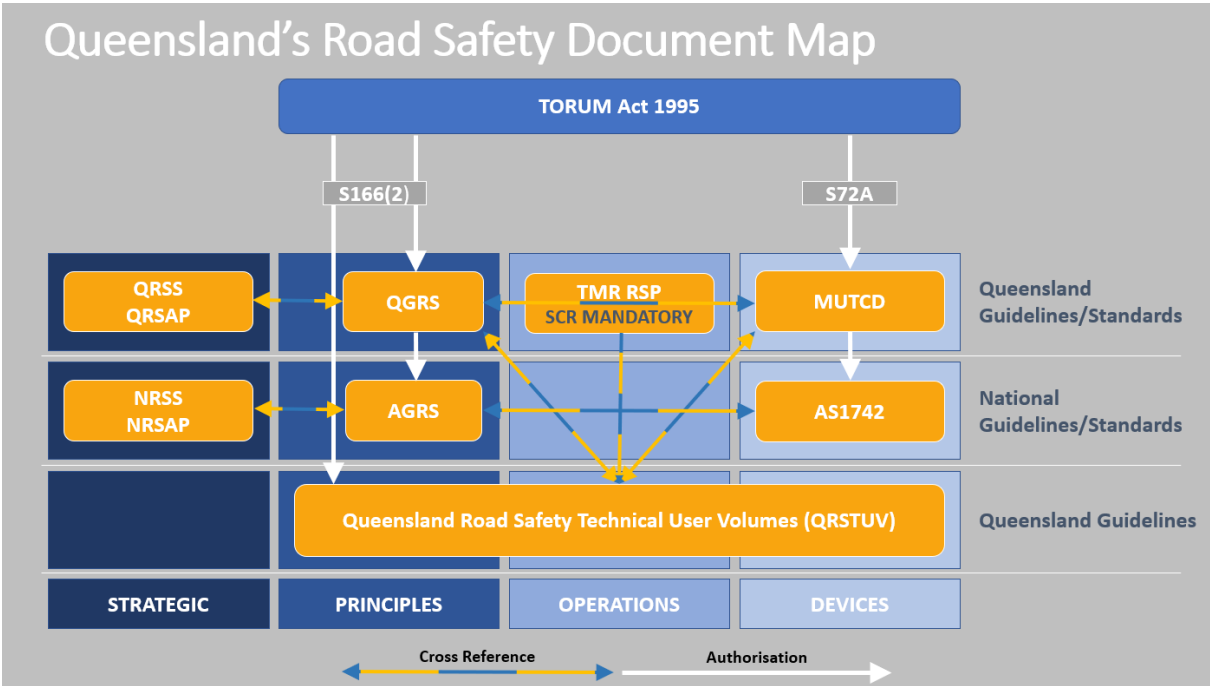
The Department of Transport and Main Roads has agreed to adopt the standards published in Austroads Guides and Australian Standards as part of national harmonisation. The department seeks to avoid duplicating information addressed in national guidance and has developed documents instead that provide Queensland-specific advice while following the structure established in Austroads Guides and Australian Standards.

Queensland-specific advice includes practices which vary from national practice because of local environmental conditions (such as geography, soil types, climate); different funding practices; local research; local legislation requirements; and to expand instruction on particular issues.

As such, the *Queensland Guide to Road Safety (QGRS)* takes precedence over the *Austroads Guide to Road Safety (AGRS)* except where the Austroads Guide is accepted without changes. In the same manner, the *Queensland Manual of Uniform Traffic Control Devices (Queensland MUTCD)* takes precedence of the Australian Standard 1742, except where the Australian Standards are accepted without changes.

The *QRSTUV: Guide to Safe System Assessment* is designed to be read and applied together with the QGRS, AGRS, Queensland MUTCD and AS 1742. Readers shall have access to the Austroads Guide and Australian Standards to understand its application in Queensland.

A summary of the documents relevant to road safety practice in Queensland, and their links, is provided below:



Definitions

The following general amended definitions apply when reading the QRSTUV: Guide to Safe System Assessment.

Reference to...	Means
AGRS	<u>Austroads Guide to Road Safety</u>
AS 1742	<u>Australian Standard 1742 Manual of Uniform Traffic Control Devices</u>
QGRS	<u>Queensland Guide to Road Safety</u>
QRSS	<u>Queensland Road Safety Strategy</u>
QRSTUV	<u>Queensland Road Safety Technical User Volumes</u>
Queensland MUTCD	<u>Queensland Manual of Uniform Traffic Control Devices</u>
RSP	Queensland Department of Transport and Main Roads <u>Road Safety Policy</u>
TORUM Act 1995	<u>Transport Operations (Road Use Management) Act 1995 (Qld)</u>

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1 Introduction

This guideline, the *Queensland Road Safety Technical User Volumes (QRSTUV): Guide to Safe System Assessment*, is intended to provide guidance to any organisation or authority involved with, or seeking information about, undertaking a Safe System Assessment.

2 Purpose

The purpose of this document is to provide guidance to project managers, planners, designers, and the broader industry on the process of undertaking a Safe System Assessment (SSA) in Queensland. The document provides guidance to enable a Safe System Assessment to be applied consistently across Queensland.

3 Scope

The guidance in this document can be applied to the implementation, completion, or the review of Safe System Assessments.

Safe System Assessments may be triggered based on government / agency policy and practices and/or as part of development approvals.

4 Referenced documents

This guideline refers to the following documents / publications:

- Austroads, 2016, Research Report AP-R509-16: *Safe System Assessment Framework*.
- VicRoads, 2018, *Safe System Assessment Guidelines*, Version 1.0.
- Transport and Main Roads, 2008, Policy for *Conduct of Road Safety Audits in Main Roads*.
- *Transport and Main Roads, 2008, Road Safety Audit Policy Supporting Guidelines*.

5 Part 1 – Understanding Safe System Assessments

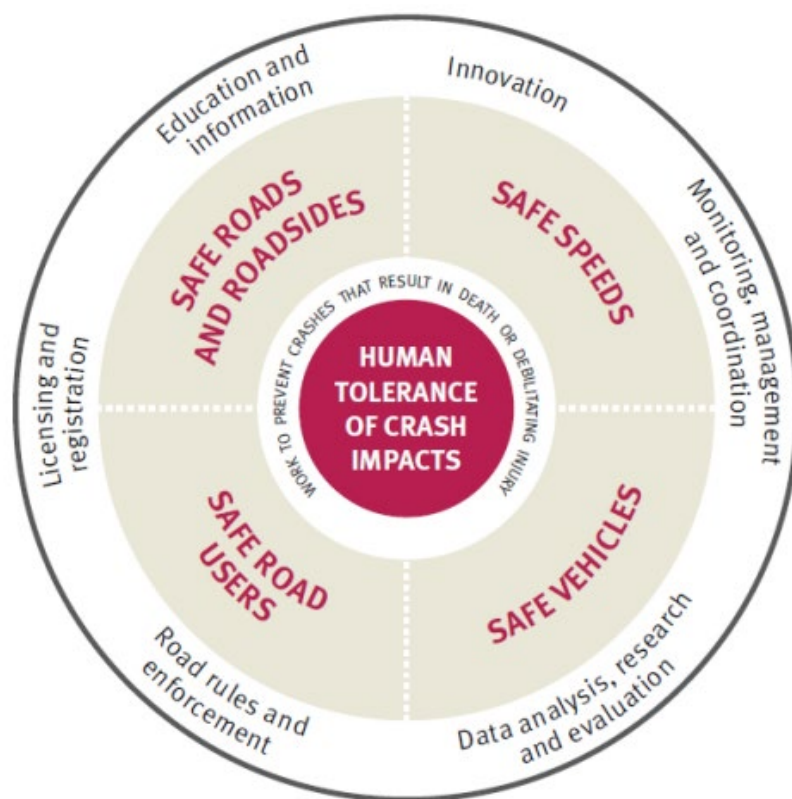
5.1 The Safe System

The Safe System is a road safety philosophy that requires roads to be designed and managed so that 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. To prevent serious trauma, the road system must be forgiving, so that the forces of collisions do not exceed the limits that the human body can tolerate.

The Safe System philosophy underpins Queensland's strategic approach to road safety. As shown below, it is commonly divided into four core interrelated pillars – safe roads and roadsides, safe speeds, safe vehicles and safe road users.

Figure 5.1 – Safe System model



Source: Queensland's Road Safety Strategy 2022-2031.

Safe Roads and Roadsides: Relates to both the road itself and the roadside. This considers ways to design, operate and maintain the road network to reduce the chance of a crash occurring as well as the consequence when one does occur.

Safe Speeds: Relates to the speed at which vehicles are likely to travel on the road and the impact speed of vehicles in the event of a crash. It involves managing vehicle speeds so that in the event of a crash, collision forces on the human body are within tolerable levels, reducing injury severity. Factors that influence operating speeds include posted speed limits, the level of compliance with the speed limit and physical constraints. Unsafe speeds can increase both likelihood and consequence of a crash.

Safe Vehicles: Relates to the safety features, including intelligent technologies that are incorporated into vehicles of different types, which contribute to crash avoidance and/or reducing the severity of crashes.

Safe Road Users: Relates to road user behaviour, driver / rider training and licensing, levels of compliance and personal safety equipment, particularly in the case of vulnerable road users such as cyclists and motorcyclists. Road user behaviour, their level of experience, and training can influence the likelihood of a crash occurring.

5.2 What is a Safe System Assessment?

An SSA is a tool that has been developed to assess the extent to which a proposed infrastructure project aligns with Safe System principles and the objective to eliminate fatal and serious injuries. The process allows project options to be compared with a base case (i.e. existing conditions), with each other, and against a fully aligned Safe System option.

An SSA will identify areas where there is risk of fatal or serious injury crashes and supports the exploration of amendments, which, if adopted, would improve alignment with the Safe System approach. If Safe System principles are being followed and applied correctly, there should be a trend towards zero in the SSA scores when progressing from existing conditions to the initial design options and, finally, to the adopted design. The scoring process used to compare options against each other and/or with a base case is described in Section 6.7.

An SSA examines the safety aspects of a road project and provides an understanding of how road users interact within the road environment and with each other, and the safety risks associated with it. The assessment process enables Safe System thinking to be applied at the earliest stages of a project to inform project options.

The SSA and Road Safety Audit (RSA) are complementary safety assessments conducted during the various stages of a road project. Further explanation regarding the difference between an SSA and RSA is provided in Section 5.4.

The methodology and framework for conducting SSAs was developed by Austroads. Guidance on the process and further background information can be found in Austroads Research Report AP-R509-16: *Safe System Assessment Framework*.

An SSA provides the following benefits:

- a way of informing the problem definition to align with Safe System principles
- a way of determining how well a project proposal aligns with Safe System principles
- a method to compare project design options from a Safe System perspective
- information on design and scope changes that will move a project proposal closer to the Safe System objective of eliminating the risk of fatalities and serious injuries
- a method to assist planners, designers and project managers to progress the Safe System approach from theory to practice, and
- a sound basis for the planning and design of road and related infrastructure.

The SSA has several applications including, but not limited to, the assessment of road infrastructure project options, informing multi criteria analysis, assisting planning and route selection, and for the assessment of treatment options for Black Spot and Safer Roads Sooner nominations.

5.3 When to undertake a Safe System Assessment

SSAs provide the greatest benefit when conducted at the earliest stages of a project, typically during planning stages, when adjustments to the concept, design and/or scope of the project are more readily accommodated. This is the time where Safe System aligned treatment options can be identified and compared to other options, thus challenging the project to deliver Safe System outcomes.

It should, however, be recognised that while SSA recommendations contribute to a project's scope and objectives, there are often a number of other considerations which can impact on decision-making, such as design, operational or budgetary parameters and potential environmental and community impacts.

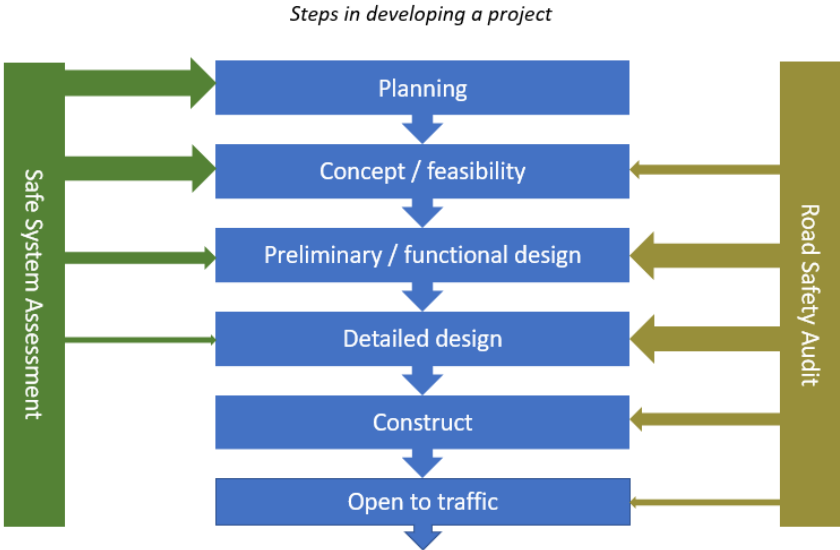
Note that each jurisdiction / agency may have their own specific policy or requirements as to when an SSA is to be completed, typically outlining:

- a policy statement
- when an SSA is required and for what type of projects
- who it affects / applies to
- under what conditions it applies
- any conditions or restrictions
- any specific requirement (e.g. SSA team requirements, skills)
- roles and responsibilities, and/or
- any other specific jurisdictional requirements.

Generally, an SSA will only need to be conducted at one stage of project development but utilised as development and design proceeds. However, if there are subsequent changes to the design scope that are likely to impact on Safe System alignment, the SSA should be reviewed and repeated as necessary.

SSA and RSA should be used during project planning and design as complementary tools to maximise road safety outcomes. Figure 5.3 shows a general indication of the stages at which SSAs and RSAs have the greatest benefit. Transport and Main Roads' Policy for *Conduct of Road Safety Audits in Main Roads* and *Road Safety Audit Policy Supporting Guidelines* specifies requirements for RSAs during the development, design and implementation of road projects. Additional information on the relationship between SSA and RSA is presented in Section 5.4.

Figure 5.3 – When to undertake Safe System Assessments and Road Safety Audits



Note: arrow widths are indicative of the relative benefit

Source: Adapted from VicRoads, 2018.

5.4 Safe System Assessments and Road Safety Audits

An SSA does not replace the need for an RSA to be conducted for a project. An SSA evaluates a project's alignment with Safe System principles and identifies ways to improve the alignment with a focus on minimising fatal and serious injuries. It investigates the inherent risk of the infrastructure and includes consideration of road user exposure. An SSA produces an aggregated risk score which is used to compare project options, with a focus on identifying strategies that address all pillars of the Safe System.

In comparison, RSA is a formal examination of a road or road project, which usually focuses on the likelihood of a crash, regardless of severity, to ensure that no hazards are built into the road environment when a project is implemented. An RSA identifies individual deficiencies of a road or road project and assigns a risk rating for each explicit item. Specific recommendations are made to mitigate the identified road safety risk considering Safe System speed thresholds.

An SSA and RSA should complement each other to maximise the road safety outcomes of a project. The SSA assesses the overarching scope of a project at the earlier stages where significant alterations can be made, with the RSA following, to examine the detailed stages of a project. Table 5.4 highlights the key similarities and differences between the two.

Table 5.4 – Comparison of Safe System Assessment and Road Safety Audit

Scope	Road Safety Audit	Safe System Assessment
Identifies issues that impact the likelihood of crashes	✓	✓
Identifies issues that impact the severity of crashes	sometimes	✓
Identifies issues that impact the exposure to crashes	×	✓
Provides recommendations for improved road safety outcomes	✓	✓
Considers all road users	✓	✓
Focuses on fatal and serious injury reduction	×	✓
Focuses on all crashes	✓	×
Investigates safer vehicles	×	✓
Investigates safer people	sometimes	✓
Investigates the impact on maintenance	sometimes	✓
Investigates the impact on post-crash care	×	✓
Makes recommendations to redesign the project if required	sometimes	✓
Encourages innovative design to improve harm minimisation	×	✓

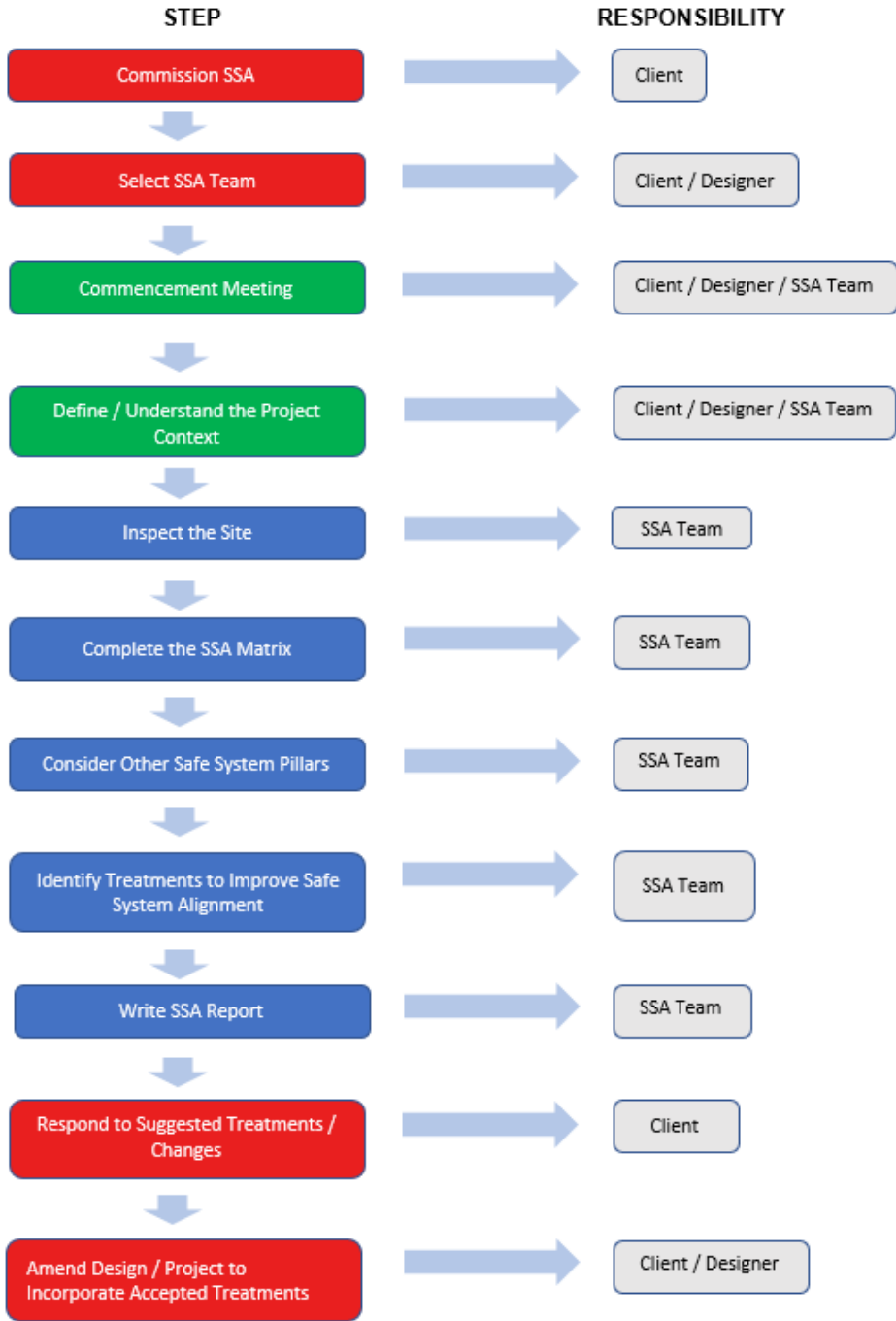
Source: Adapted from VicRoads, 2018.

6 Part 2 – Undertaking a Safe System Assessment

6.1 End-to-end snapshot of the Safe System Assessment Process

This section of the guide outlines the steps in undertaking an SSA and briefly explains what is involved in each step. Figure 6.1 below, and the remainder of Part 2, not only walks practitioners end-to-end through the SSA process, but also highlights areas of responsibility.

Figure 6.1 – Steps in the SSA Process



Source: Adapted from VicRoads, 2018.

For further information regarding the definition of client refer to Austroads *Guide to Road Safety*, Part 6, Section 8.2.1.

6.2 Commission the Safe System Assessment

The commissioning of an SSA is an important step in the process and sets the expectations of all parties involved in the process. During commissioning, shared understanding of the objectives, requirements, and outcomes of the assessment are agreed on by all parties. It involves procuring or establishing an SSA team with suitable skills and experience to undertake the SSA. For guidance on the selecting an SSA team refer to Section 6.3. The client is responsible for preparing the SSA brief and commissioning the SSA team.

An SSA brief should be prepared which clearly states the scope of the assessment, the assessment tasks and requirements, and the expectations of the assessment team. A template for preparing an SSA brief is provided in Appendix A.

6.3 Select the SSA Team

An SSA team should include personnel who are experienced in undertaking SSAs. Team members should have experience in road design, road safety, or traffic management and have knowledge and understanding of Safe System principles.

An SSA should be undertaken by a team of two to four members. This should include at least one member who must be knowledgeable regarding the Safe System and its application and where possible should be independent of the project being assessed. Other team members may be associated with the planning / design of the project or provide a diverse range of experiences that may be relevant to the project. For example, if the project is on the Principal Freight Network or Principal Bicycle Network, consideration should be given to including practitioners who are experienced in these fields. Additionally, team members representing specific road users or community groups may also add value to the process. The composition of the team will be project dependent, however, a multi-disciplinary team may result in a broader consideration of safety issues and a better Safe System alignment in the context of the functionality of that piece of the network.

Although there is the desired skillset, the Safe System Assessment encourages the inclusion of a range of team members from different backgrounds, disciplines, or user groups. The team composition does not need to be restricted to within one organisation. For example, a group of Local Governments and/or Transport and Main Roads districts may combine resources to conduct SSAs within their regions. This approach may be suited to regional and remote areas with a smaller resource base.

In some circumstances an SSA may be undertaken by a single person who is knowledgeable regarding the Safe System and its application. This person must also have experience in conducting SSAs. This arrangement would need to be in agreement with the client and all members of the project team, and be justified and documented in the SSA. However, a team consisting of a mix of skills relevant to the project being assessed is preferred. If an SSA is conducted by an individual, it should be peer reviewed by a person who is also knowledgeable regarding the Safe System and its application.

6.4 Commencement Meeting

The commencement meeting provides an opportunity for the project team (designers and project personnel) to provide the background and context of the project to the SSA team. This includes the purpose of the project, known issues and items to note from a design, planning or construction perspective. The meeting would typically be attended by the client, representatives from the design team, and by all members of the SSA team. The SSA team should be provided with all the information and data required to enable the SSA Matrix and other parts of the assessment to be completed.

Information to be provided to the SSA team should include, but not be limited to:

- the project purpose and objectives
- design plans for each of the options to be assessed
- traffic and road user data – current and projected volumes for general traffic, heavy vehicles, pedestrians, cyclists, and motorcyclists (estimated if actual data is not available)
- crash data and any known safety issues
- road classification / function (e.g. Movement and Place classification, Heavy Vehicle route, Principal Cycle Network route etc.)
- the existing speed limit and any proposed changes
- any relevant community / stakeholder issues (the SSA team is not expected to engage the community or stakeholders), and
- current / planned land uses (particularly those which generate pedestrians, bicyclists or heavy vehicles) and access requirements.

At the commencement meeting, agreement should be reached on the format of the assessment i.e. will the project be assessed as a whole, based on uniformity, or is it to be divided into components? For projects that involve treatments over an extended route length or complex projects comprising a number of different treatment elements (e.g. a road duplication with several intersection upgrades) it may be appropriate to assess different components of the design independently. Appendix B provides guidance based on some typical scenarios although it is noted that some common reasons to divide the SSA are major intersections or non-uniformity along midblock sections.

6.5 Understanding the project context

Defining and understanding the context of the project is the first step of the actual assessment. Austroads sets out prompts (refer to Figure 6.5) to assist with this part of the assessment.

Figure 6.5 – Template for setting the project context

Prompts	Comments
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, maintenance/asset renewal, etc.	
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)? What alternative routes exist?	
What is the speed environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location?	
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.).	
What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	

Source: Austroads (2016).

Note that the items in the above table are not an exhaustive list of considerations when defining project context, and simply act as a prompt to consider any issues of specific relevance to the location and its functionality.

6.6 Site inspection

A daytime site inspection should be undertaken for SSAs so the team can observe the characteristics of the site and how various modes and road users interact with the road environment (which is difficult to ascertain from a desktop review). A site visit can provide deeper insight into the nature of any safety issues and provide an understanding of the context of the project. Night-time inspections could also be considered, particularly if activity / network use changes after dark or if the SSA team considers that there may be an elevated risk of crashes involving any road users at night. The client or designer may be involved in the site inspections at the discretion of the SSA team.

Greenfield sites also warrant a site inspection in order to gain a comprehensive understanding of how a road project being assessed will interact and connect with the surrounding land uses.

6.7 The Safe System Assessment Matrix

The SSA Matrix (Table 6.7) is to be completed for all assessments. The matrix is completed for the existing conditions and each of the project options to assess the extent to which they align with Safe System principles. This is achieved through a scoring system which considers seven crash types and the exposure, likelihood and severity associated with each crash type. Each element is assigned a score out of four. The exposure, likelihood and severity scores for each crash type are multiplied to give a product out of 64. These are then added to determine the total SSA score out of 448. A score of zero or close to zero indicates a high level of alignment with the Safe System.

Commentary on factors that either increase or decrease the risk should be provided in each cell of the matrix to provide some reasoning behind the adopted scores.

The matrix may be modified or expanded to include additional crash types depending on the nature of the project being assessed. Information regarding the crash types and guidance on scoring is provided in Sections 6.7.1 and 6.7.2 respectively.

It is important to note that while the total score is used to check alignment with Safe System principles, there is a level of subjectivity based on the individuals or groups undertaking the analysis. Thus, scores for different roads or projects must not be compared against one another. The SSA only provides a comparison between the existing conditions and the concept design / design options for a single project, as assessed by the same SSA team, to determine whether the project is trending towards zero.

The existing conditions and concept design(s) are assessed before potential treatments are identified that may be accepted to produce a revised design that is more closely aligned with a Safe System. The matrix can be used to demonstrate how the Safe System aligned option may improve the Safe System alignment of a project.

For the assessment of greenfield sites, there is no assessment of existing conditions as no existing infrastructure (base case) is present. Assessments in this case would include a comparison of the Safe System alignment of various project options, which could also be compared against the fully aligned Safe System option.

Table 6.7 – Safe System Assessment Matrix

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclists
Exposure Comments							
Exposure Score	/4	/4	/4	/4	/4	/4	/4
Likelihood Comments	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> • 	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> • 	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> • 	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> • 	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> • 	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> • 	Factors that increase the likelihood include: <ul style="list-style-type: none"> • Factors that decrease the likelihood include: <ul style="list-style-type: none"> •
Likelihood Score	/4	/4	/4	/4	/4	/4	/4
Severity Comments	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> • 	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> • 	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> • 	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> • 	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> • 	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> • 	Factors that increase the severity include: <ul style="list-style-type: none"> • Factors that decrease the severity include: <ul style="list-style-type: none"> •
Severity Score	/4	/4	/4	/4	/4	/4	/4
Product (multiply scores above for crash type)	/64	/64	/64	/64	/64	/64	/64
Total							/448

Source: Adapted from VicRoads (2018).

6.7.1 Crash Types

As discussed above, an SSA considers various crash types. The crash types indicated in the Austroads *Safe Systems Assessment Framework* are described in Figure 6.7.1.

Figure 6.7.1 – Crash Types Used in the Safe System Assessment Matrix

Crash Type	Description
Run-off-road	A crash that occurs when a vehicle leaves the roadway to the left or right without impacting another vehicle. Includes run-off-road crashes at intersections. Does not include crashes involving motorcyclists or cyclists as they are considered separately.
Head-on	A crash that occurs when one vehicle crosses onto the wrong side of the road and impacts head-on with another vehicle. Includes head-on crashes at intersections. Does not include crashes involving motorcyclists or cyclists as they are considered separately.
Intersection	Crashes occurring at intersections, including side impacts involving vehicles from adjacent directions, collisions between right turning and opposing vehicles and rear-end crashes. Does not include run-off-road, head-on, pedestrian, cyclist or motorcyclist crashes at intersections (these crash types are considered separately).
Other	Any relevant crash types that are not covered by the specific categories in this table. May include crashes involving vehicles entering or leaving driveways, side swipes, collisions with parked vehicles, loss of control without leaving the carriageway and crashes involving animals.
Pedestrian	All crashes involving pedestrians, including persons boarding or alighting from a vehicle and anyone working on the road or roadside.
Cyclist	All crashes involving cyclists.
Motorcyclist	All crashes involving motorcyclists.

Source: VicRoads (2018).

While the above crash types and those presented in Table 6.7 are the minimum number of crash types that are considered in an SSA, further crash types can be added depending on the nature of the project being assessed. For example, where the project involves public transport, or interaction with rail infrastructure, additional columns for public transport or rail can be added. Similarly, where there is risk associated with heavy vehicles being present, a column for heavy vehicles can be added.

For additional context, intersection crashes can be further broken down into different intersection crash types for complex intersections. Note, none of the crash types listed in Table 6.7 should be removed from the SSA matrix. If a crash type is not applicable for a site, then commentary can be provided accordingly within the matrix.

The total maximum scores will need to be adjusted accordingly to reflect the number of columns within the matrix. When the number of crash types is modified this must be duplicated across the base case, project options and Safe System options for consistency when comparing options.

6.7.2 Scoring

As touched on earlier, the scoring that can be applied to the category of exposure, likelihood and severity range from 0 to 4. Figure 6.7.2(a) provides guidance on how to score each category. Fraction scores (e.g. 2.5) may be used for likelihood or severity where it is considered that the situation being assessed falls between the guidance provided in two adjoining rows of Figure 6.7.2(a).

It is recognised that there will be a level of subjectivity in scoring depending on the person(s) undertaking the assessment. As such, it is reinforced that the assessment of existing conditions and all proposed design options are to be undertaken by the same SSA team for consistency purposes. Scores for a particular project should not be directly compared against those of another project.

Practitioners may find it difficult to differentiate between road user exposure and crash likelihood as these factors are usually combined as likelihood in traditional risk assessment methods. In the SSA process, exposure and likelihood are considered separately. Exposure is the number of road users that have the potential to be involved in the particular crash type. Likelihood reflects the probability that an individual road user (vehicle occupant, pedestrian, cyclist or motorcyclist) will be involved in a crash. Figure 6.7.2(b) provides further guidance on factors to be considered when assessing exposure and likelihood.

Projects that extend over a longer route or are more complex may be divided into several sections for the assessment. Each section would be scored independently using the matrix to compare the base case, the project options, and the Safe System aligned option. The score for each section would be used to determine the Safe System alignment for that individual section. A total score for the project can also be calculated by adding the total scores for each section to provide an indication of a projects overall Safe System alignment.

Figure 6.7.2(a) – Safe System Assessment Matrix Scoring System

Score	Road user exposure	Crash likelihood	Crash severity
0	There is no exposure to a certain crash type. This might mean that there is no side flow or intersecting roads, no cyclists, no pedestrians or no motorcyclists.	There is only minimal chance that a given crash type can occur for an individual road user given the infrastructure in place. Only extreme behaviour or substantial vehicle failure could lead to a crash. This may mean, for example, that two traffic streams do not cross at grade or pedestrians do not cross the road.	Should a crash occur, there is only minimal chance that it will result in a fatality or serious injury to the relevant road user involved. This might mean that kinetic energies transferred during a crash are low enough not to cause a fatal or serious injury (FSI), or that excessive energies are effectively redirected / dissipated before being transferred to the road user. Users may refer to Safe System critical impact speeds for different crash types, while considering impact angles and roadside hazards / barriers that are present.
1	Volumes of vehicles that might be involved in a particular crash type are particularly low, therefore exposure is low. For run-off-road, head-on and "other" crash types, AADT is < 1,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are < 10 units/day	It is highly unlikely that a given crash type will occur.	Should a crash occur, it is highly unlikely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are fairly low during a crash or the majority are effectively dissipated before reaching road user.
2	Volumes of vehicles that might be involved in a particular crash type are moderate, therefore exposure is moderate. For run-off-road, head-on and "other" crash types, AADT is between 1,000 and 5,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are 10 to 50 units/day	It is unlikely that a given crash type will occur.	Should a crash occur, it is unlikely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are moderate and the majority of the time are effectively dissipated before reaching the road user.
3	Volumes of vehicles that might be involved in a particular crash type are high, therefore exposure is high. For run-off-road, head-on and "other" crash types, AADT is between 5,000 and 10,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are 50 to 100 units/day	It is likely that a given crash type will occur.	Should a crash occur, it is likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are moderate, but are not effectively dissipated before reaching the road user.
4	Volumes of vehicles that might be involved in a particular crash type are very high or the road is very long, therefore exposure is very high. For run-off-road, head-on and "other" crash types, AADT is > 10,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are > 100 units/day	The likelihood of individual road user errors leading to a crash is high given the infrastructure in place (e.g. high approach speed to a sharp curve, priority movement control, filtering right turn across several opposing lanes, high speed).	Should a crash occur, it is highly likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are high enough to cause a FSI crash and it is unlikely that the forces will be dissipated before reaching the road user.

Source: VicRoads (2018).

Figure 6.7.2(b) – Exposure measures and typical likelihood factors

Crash Type	Exposure Measures	Typical Likelihood Factors
Run-off-road	Total volume of vehicles (AADT) using the road	<ul style="list-style-type: none"> • Horizontal and vertical alignment • Pavement condition • Shoulders – width, sealed or unsealed • Number, type and offset to roadside hazards such as poles, trees, steep batters etc. • Presence of barriers, barrier type and position • Speed limit and operationing speed • Volume of heavy vehicles • Potential for driver fatigue
Head-on	Total volume of vehicles (AADT) using the road	<ul style="list-style-type: none"> • Horizontal and vertical alignment • Pavement condition • Number and width of lanes • Separation between opposing traffic streams • Median or centre line barriers • Overtaking opportunities • Speed limit and operating speed • Volume of heavy vehicles • Potential for wrong way movements
Intersection	Total volume of vehicles (AADT) entering the intersection	<ul style="list-style-type: none"> • Intersection type – cross, T, multi-leg, grade separated etc. • Intersection control – signalised, roundabout, STOP or GIVE WAY • Intersection features – dedicated turns lanes, channelization, movement bans etc. • Number of conflict points and complexity • Minor road volumes and movements • Volume of heavy vehicles • Right turn volumes
Other	Total volume of vehicles (AADT) using the road	<ul style="list-style-type: none"> • Varies according to the crash type being considered
Pedestrian	Number of pedestrians	<ul style="list-style-type: none"> • Controlled or uncontrolled crossings • Crossing type (signalised, zebra, wombat, grade separated etc.) • Pedestrian characteristics (young, elderly, mobility impaired, intoxicated etc.) • Presence of a refuge or median • Volume of traffic • Speed of traffic • Crossing distance and number of lanes • Separation from vehicular traffic, including heavy vehicles
Cyclist	Number of cyclists	<ul style="list-style-type: none"> • Cyclist characteristics (age, commuting, recreational, training etc.) • Presence and type cycling infrastructure (separated paths, on-road bicycle lanes, wide kerbside lanes, bike boxes, controlled crossings, refuges etc.) • Volume of motorised traffic • Separation from motorised traffic, including heavy vehicles • Speed limit and operational speed of traffic
Motorcyclist	Number of motorcyclists – assume 1% of AADT if specific data not available	<ul style="list-style-type: none"> • Horizontal and vertical alignment • Pavement condition • Number and width of lanes • Speed limit and operating speed • Number and type of roadside hazards • Volume of other vehicles • Sight line restrictions • Right turn control at intersections

Source: VicRoads (2018).

6.8 Additional Safe System Components

An SSA is primarily focussed on road and roadside infrastructure and speed. However, the framework also includes consideration of the other pillars that comprise the Safe System (i.e. road users and vehicles). Consideration is also given to post-crash care, which is often recognised as the fifth pillar of the Safe System.

Observations or information arising from the SSA relating to ‘non-environmental’ risk factors (for example, behavioural or vehicular) which also potentially impact on safety are captured in Figure 6.8 shown below. Capturing and sharing this information with partner agencies, in particular Queensland Police Service and Local Governments, has the potential to inform targeted educational and enforcement campaigns, thus addressing the other pillars of a Safe System. Existing cross-agency networks, like Traffic Advisory Committees and Speed Management Advisory Committees for speed-related matters, provide an ideal forum for this holistic approach to road safety.

Figure 6.8 – Additional Safe System components

Pillar	Prompts	Comments
Road user	<p>Are road users likely to be alert and compliant? Are there factors that might influence this?</p> <p>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 activities be conducted safely?</p> <p>Are there special road users (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism) or risk-taking behaviours?</p>	
Vehicle	<p>What level of alignment is there with the ideal of safer vehicles?</p> <p>Are there factors that may 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?</p> <p>Are there resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement activities be undertaken safely?</p> <p>Has vehicle breakdown been catered for?</p>	
Post-crash care	<p>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)?</p> <p>Do emergency and medical services operate as efficiently as possible?</p> <p>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?</p> <p>Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?</p>	

Source: VicRoads (2018).

6.9 Potential Treatments

Following completion of the assessment of existing road conditions and the proposed design options, the SSA team should review the results and identify areas where the FSI crash risk can be reduced. Particular attention should be given to the highest risks identified by the SSA Matrix scores as these will be the areas where the greatest gains are possible. The SSA team should document suggested treatments and design changes so that they can be considered by the client. The SSA team is expected to re-score the project with the suggested design changes prior to consideration and a decision from the client to either accept or reject each suggestion.

Figure 6.9 lists a number of treatments and measures that may be considered in order to reduce the risk of FSI crashes. Not all of these treatments will be applicable to every situation and the list is not exhaustive. A more comprehensive list of treatments is included in Austroads *Safe System Assessment Framework* Section 4.6 and Table 4.5 to Table 4.11). Figure 6.9 below and Table 4.5 to Table 4.11 in Austroads provide an indication of which components of risk (i.e. exposure, likelihood and severity) will be influenced by the treatment. The SSA team should also consider whether there are any emerging or innovative treatments, which have recently been developed or are being trialled, that may be relevant to the project being assessed.

Treatment suggestions made by the SSA team are to be classified as primary or supporting treatments. Primary treatments are those that have the potential to eliminate or come close to eliminating the risk of FSI crashes. Supporting treatments are effective in reducing the risk of FSI crashes but not to the extent of a primary treatment (i.e. there is a residual moderate or significant FSI crash risk). Primary treatments should be given priority; however, it is recognised that some may not be feasible due to constraints such as an environmental, other project objectives and cost as highlighted in earlier sections.

Note that where a change in the posted speed limit is recommended as treatment to reduce crash risk, it will require a speed limit review to be completed in accordance with the process specified in the QRSTUV: *Guide to Speed Management*, which involves further approval outside of the SSA process.

Figure 6.9 – Potential treatments

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	<ul style="list-style-type: none"> Promote use of alternative, higher quality routes 	<ul style="list-style-type: none"> Promote use of alternate, higher quality routes 	<ul style="list-style-type: none"> Close intersection Left-in / left-out treatments Direct traffic to higher quality intersection 	<ul style="list-style-type: none"> Consider specific treatments for the identified crash type(s) 	<ul style="list-style-type: none"> Separation (footpath) Reduce traffic volume 	<ul style="list-style-type: none"> Separation (cycle path) Reduce traffic volume Shared use path 	<ul style="list-style-type: none"> Separate motorcycle lanes
Likelihood	<ul style="list-style-type: none"> Lower speed Sealed shoulders Audio-tactile linemarking Improved skid resistance Consistent design 	<ul style="list-style-type: none"> Lower speed One-way traffic Audio-tactile linemarking Improved skid resistance Consistent design Ban overtaking 	<ul style="list-style-type: none"> Grade separation Lower speed Roundabout Raised platforms Left-in / left-out treatments Ban movements Turning lanes Delineation 	<ul style="list-style-type: none"> Consider specific treatments for the identified crash type(s) 	<ul style="list-style-type: none"> Separation (crossing) Lower speed Pedestrian refuges Pedestrian signals Improved skid resistance Improved lighting Improved sight distance 	<ul style="list-style-type: none"> Separation (crossing) Lower speed Bicycle lane Bicycle box at intersections Improved skid resistance 	<ul style="list-style-type: none"> Lower speed Shared motorcycle / bus / taxi lanes Consistent design Improved skid resistance
Severity	<ul style="list-style-type: none"> Roadside & median barriers Wide run out areas Lower speed 	<ul style="list-style-type: none"> Median barriers Wide median Lower speeds 	<ul style="list-style-type: none"> Grade separation Lower speed Roundabout Raised platforms Left-in / left-out treatments Ban movements 	<ul style="list-style-type: none"> Consider specific treatments for the identified crash type(s) 	<ul style="list-style-type: none"> Lower speed (below 40 km/h) 	<ul style="list-style-type: none"> Lower speed (below 40 km/h) 	<ul style="list-style-type: none"> Lower speed Motorcycle-friendly barrier systems

Source: VicRoads (2018).

6.10 Safe System Assessment Reports

The following information should be provided in an SSA report, noting this is not an exhaustive list:

- executive summary
- list of the members of the assessment team
- list of meetings and site inspections
- project background
- the context of the project (using the template in Table 6.5)
- description of the project and the design options being assessed
- Safe System Assessment Matrix (Table 6.7), with scores and commentary on factors considered in determining the scores, for existing conditions and design options
- commentary on other Safe System components (using the template in Figure 6.8), and
- suggested treatments / changes to the proposed design which would improve alignment with Safe System principles.

A basic report template is provided in Appendix C, which incorporates the above items, which may be used. This template can be modified for specific project requirements and for more complex projects. Reports prepared by consultants should generally be consistent with the template and include similar content and structure. Other tools and report formats can be used that are fit for purpose for the scale of the project.

6.11 Respond to suggestions

An SSA will usually suggest a number of measures that can increase a project's alignment with Safe System principles. These measures will also have varying levels of feasibility and ease of implementation due to site constraints, environmental impacts or funding limitations and that the SSA is only one tool informing the decision making process. It is expected that some design changes will be accepted while others may not be viable or may be considered for future implementation. However, it is important to consider how the project fits within an overall route strategy and the benefits of achieving a high level of alignment with Safe System principles in the short term, which will negate the potential need to revisit the site in the future.

Noting the above, it is important that the client and designers give due consideration to suggestions that are feasible and provide improved alignment with the Safe System. When considering suggestions, it is important that the project team also responds to any potential design change they do not support with robust reasoning. Reasons for not adopting suggestions should not simply be based on maintaining existing conditions (e.g. retaining an existing speed limit or existing median treatment) as these conditions will have been considered during the SSA. To close out the assessment and provide feedback, the SSA team should be advised of any proposed changes to the design or scope in response to the SSA report and should re-score the project, incorporating the design and scope changes that have been accepted. The revised score can be compared to the other project options to determine if the adopted changes have improved the Safe System alignment of the project and whether any of the adopted design changes increased the risk of other crash types.

The project team should also consider any suggestions made by the SSA team that relate to the other Safe System pillars (i.e. roads users, vehicles and post-crash care). This may require advice from the appropriate business area. Recommendations that are beyond the scope of the project would generally be referred to the relevant jurisdiction / agency.

6.12 Implement changes

The final step of the SSA process is to ensure that accepted suggestions that increase alignment with Safe System principles are implemented. It is the responsibility of the client and the designers to ensure that the planning, design and/or scope are amended to incorporate the accepted changes and that they are implemented. If necessary, the amended planning, design and/or scope should be referred to the SSA team for review to ensure that appropriate changes have been implemented and not misinterpreted by the designer.

Approval of amended designs and project scope should follow established procedures.

6.13 Further Information

Further information about these guidelines or Safe System Assessments in general, can be provided by contacting Safer Roads, via the following email: SaferRoads@tmr.qld.gov.au.

Appendix A: SSA brief template

Table A – Safe System Assessment (SSA) Brief

Project Details

Project Location:	
Project Description:	
Project Number:	

Client / Design Team Contact Details

Organisation / Department:	
Contact Name:	
Contact No.	
Email Address:	

Assessment Details

Purpose of the Assessment:	
Scope of the Assessment:	
Specific Requirements:	
Deliverables and Timeframes:	
Completion Date:	

Project Information

Project Objectives:		
Previous Safety Assessment:		
Design Options To Be Assessed:		
Crash Data (5 Years):	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Speed Survey Data:	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Traffic Data:	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Design Drawings:		
Other information:		

List of Documents Supplied

Document Ref.	Document Title	Scale	Date

SSA Requested By:		Date:	
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Appendix B: Assessment of Long Route and Complex Projects (Safe System Assessment Guidelines, VicRoads, 2018)

The purpose of this appendix is to provide guidance on the method of assessing projects where the proposed works are over an extended length of road. For an intersection upgrade, the limits of a Safe System Assessment will generally be clear (i.e. the assessment limits will usually coincide with the limits of the project) and the assessment can be conducted using a single set of SSA matrices to score existing conditions and each project design option. This will also be the case for a road project for which the proposed works are generally homogeneous over a length of road e.g. the duplication of a road between two major intersections. However, for projects that extend over significant length of road, the SSA may need to be divided into two or more components with the design options for each component to be scored independently.

The suggested methods of analyses for several typical scenarios are discussed below.

Scenario 1: A 20 km length of winding rural arterial road, on which there are several low standard horizontal curves, is proposed to be upgraded with a combination of treatments including wide centreline markings, curve alignment markers, tactile edge lines and installation of flexible barriers at selected high-risk locations (i.e. non-continuous barrier). The proposed treatments cover a significant proportion of the route although there are some short segments which will remain untreated.

The objective of the SSA in this case should be to assess the whole of the 20 km length in order to determine the extent to which the proposed treatments improve alignment with Safe System principles. Accordingly, the project would not be divided into segments and a single set of SSA matrices should be completed for existing conditions and each design option. Any intersections along the route would be assessed within these matrices.

Scenario 2: An outer urban arterial road is to be duplicated over a length of 3.5 km. As part of the project, three major intersections are to be modified. Two are currently roundabouts and one is traffic signal controlled. There are also several local residential streets that intersect the arterial road.

Under this scenario, the preferred approach is to separate the major intersections from the rest of the project. Each of the major intersections would generally be assessed independently i.e. for each intersection, SSA matrices would be completed for existing conditions and each design option.

The balance of the project (i.e. the mid-block segments between the major intersections together with all of the minor intersections) would be assessed and scored separately.

Scenario 3: Overtaking opportunities are to be improved over a 160 km length of rural highway by constructing overtaking lanes. Five locations have been selected and several design options are to be assessed, including 2+1 treatments with flexible barrier in a narrow median and wide median treatments without a barrier. Alternative treatments to provide access to minor intersecting roads are also to be assessed.

Under this scenario it is not practical to assess the whole of the route as only a small proportion is actually being treated. Each location at which a passing lane is proposed should be assessed separately. However, it is likely that there will be a degree of consistency between each of the assessments.

Appendix C: SSA report template

- Report template for documenting a Safe System Assessment.

