Department of Transport

Design Exception Reports (DER)

RDN 01-02

April 2021

Abstract

The purpose of this Road Design Note (RDN) is to step the designer through the process of documenting a design which contains Design Exceptions in a Design Exception Report (DER).

Key Information

Design Exception Reports (DER) must be completed for designs containing Design Exceptions.

The RDN steps through key components of documenting a Design Exception and gives guidance where Design Exceptions may or may not be used (Appendix E-F).

Where information contained in this RDN cannot be followed, the designer, engineer or team should seek technical advice (from the Department of Transport or delegated Technical Advisor) and gain acceptance (where necessary) for a departure from the content in this guideline.

1. Purpose

The purpose of this Road Design Note (RDN) is to give road designers guidance on how to document a design containing Design Exceptions. All Design Exceptions that are included in the preferred solution must be consistently documented, reviewed and accepted before the design is finalised at the end of each design phase.

This RDN will assist designers document a Design Exception in a Design Exception Report (DER). The DER should be an attachment to the Design Report.

The DER should include information about the following;

Project Details	Project details to provide decision-makers with context about the Design Exceptions
Design Exception (Change) Details	The details of the design exceptions, reasons for changes, consequences of meeting an NDD option and the options which were considered
Justification & Impact Assessment	Detailed justification of the application of design exceptions including a risk assessment of the preferred option
Mitigation Measures	Document mitigation measures that will be adopted to reduce the risk of the design exceptions

The focus of this RDN is road design component of the project development. For further information about how to complete a report that documents a departure from a technical standard or guidelines for other disciplines, please contact the relevant DoT technical areas for guidance.

2. The Context Sensitive Design (CSD) approach and Design Exceptions

Designers should adopt the Context Sensitive Design (CSD) approach throughout the development of a design. The Context Sensitive Design approach is outlined in *RDN 01-01 Application of Context Sensitive Design*. The CSD approach encourages the exploration of “flexible design solutions” to ensure designers select values for design elements that best address the project objectives and fit the context by minimising the impact on constraints.

The selection and justification of values for design elements (including Design Exceptions) must be done with an understanding of the project objectives, the context and constraints and the corridor strategy and must be documented in the projects' Design Report (See *DoT's Supplement to AGRD Part 1*). Selecting Design Exception values based ONLY on capital cost or budget constraints is not adequate justification for adopting Design Exceptions. Designers should be aware of the legal implications of adopting design exceptions (see Appendix J) and their responsibilities under Section 28 of the Victorian Occupational Health and Safety Act 2004.

3. Accepting Designs that include Design Exceptions

The decision to accept a design containing one or multiple Design Exceptions lies with the return/ultimate asset owner ONLY (for example, the Department of Transport on behalf of the state as infrastructure operator or local council). The ultimate asset owner[1] decides to accept the design as they will have ultimate accountability for inheriting any risk associated with the application of Design Exceptions.

The ultimate asset owner will likely have internal governance processes that evaluate the proposal and determine whether the design is acceptable. Usually, the Design Exception impacts across a number of disciplines (depending on the complexity) and there is a need to seek subject matter expert advice to determine the acceptable outcome.

It is the responsibility of the designer to;

- Identify and document any Design Exception (DE)
- Have designs with Design Exceptions accepted by the asset owner
- Inform the ultimate asset owner of the risks of implementing a design with Design Exceptions
- Provide justification to support their design and decisions

It is important that key design criteria are agreed and accepted early in the development of a design (Refer *DoT's Supplement to AGRD Part 1 V4.4.3.2 Acceptance of Design Criteria*).

4. Design Exception Reports (DER)

This section steps the designer (or project officer acting on behalf of the designer) through the process of documenting one or multiple Design Exceptions. This information is documented within a Design Exception Report.

Figure 1 is a conceptual diagram to illustrate that decisions for accepting design exceptions will vary based on how the design exceptions have been applied in accordance with published guidance conditions. The complexity and risk of a decision give an indication to the designer of the expected levels of details, analysis and supporting justification that is required in a Design Exception Report.

Appendix E provides general guidance conditions for project types and the typical design criteria that can be adopted based on these types. Appendix F guidance conditions for design element combinations which should be avoided. Appendix G provides guidance conditions where design exceptions should not be applied.

Road design elements interact with each other in different ways and whilst some combinations of values for various design elements produce desirable outcomes, others may result in performance or levels of service that are less than required. Road design guidelines and standards specify values for design elements and guidance conditions about how these values should be used in combination to produce desirable outcomes.

Example 4.1 – Horizontal Curve Radius and Guidance Conditions

For example, the value of a horizontal curve radius informs how fast a vehicle can travel around it while still in control of the vehicle (operational speed). However, to achieve the desired speed for the horizontal curve radius, appropriate values will need to be selected for superelevation (curve crossfall), pavement friction, vertical geometry including crest and sag curves, lane widths (including lane widening for larger vehicle tracking), drainage flow paths and pit locations, combination with a secondary curve (to create a reverse or compound curve).

[1] an asset may be maintained by a contract for a set period after construction. After this period, the asset is returned to the state to operate and maintain. For these scenarios, the state (as represented by DoT) is the ultimate asset owner and will be required to authorise the design as it will be the state that inherits the risk once the asset has been handed over to DoT.

In addition to this, the value of the horizontal curve radius in combination with values of other design elements will significantly impact available sight distance (particularly if the radius is located at or close to an intersection).

Austroads Guide to Road Design Part 3 Appendix A.4 EDD for Horizontal Curves with Adverse Superelevation specifies guidance conditions for adopting adverse crossfall for horizontal curves. Two of these guidance conditions where adverse superelevation may be applied to horizontal curves are;

- It is only applicable to a restoration or widening project on an existing road in an urban area.
- It is only applicable to geometric elements where the operating speed (85th percentile speed) is less than or equal to 80 km/h. Note that this would preclude it from being used on most roads with a speed limit of 80 km/h or higher.

If the design is in an urban area with an operating speed of 60km/h and conforms with all the other guidance conditions in AGRD Part 3 Appendix A.4 section, then the level of complexity and therefore level of risk is low as the design is **completely** in accordance with the guidance conditions.

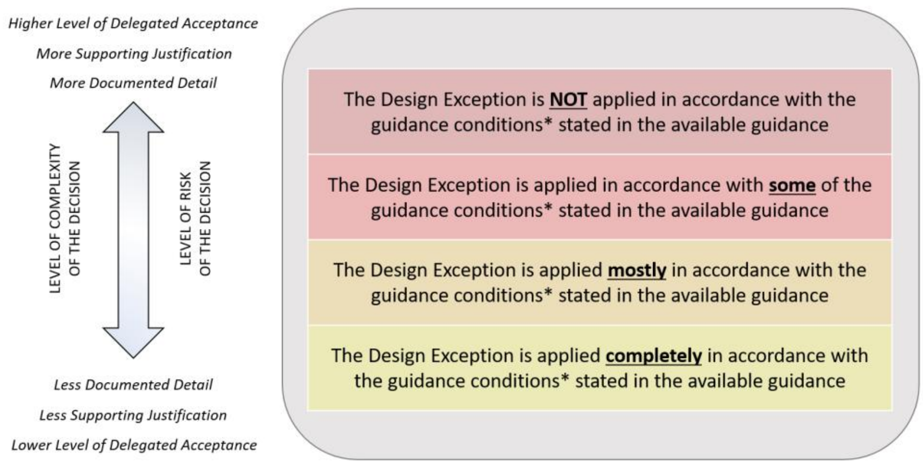
If the design is in a rural area with an operating speed of 60km/h and conforms with all the other guidance conditions, then the design is **mostly** in accordance with guidance conditions and there is some level of complexity and risk with the decision.

If the design is in a rural area and has a 90km/h operating speed but conforms to all the other guidance conditions, the design is in accordance with **some** of the guidance conditions and the decision has a significant level of complexity and risk.

If the design is in a rural area, has a 90km/h operating speed and does not conform to the other guidance conditions, then the design is **NOT** in accordance with the guidance conditions and the decision has a high level of complexity and risk.

In certain circumstances, it may not be feasible to apply design exceptions in accordance with stated guidance conditions. However, there still may be benefits for implementing the design which are significant improvements to the existing conditions.

Figure 1: Levels of Complexity and Risk for Design Exception Decisions



* Guidance conditions for the application of EDD and DE values are stated in RDN 01-02 and design element specific guidance such as RDN's and Supplements to the Austroads Guide to Road Design

A Design Exception Report (DER) template for complex submissions is found in Appendix A. This is the recommended template where more justification and detail is required to support the preferred design option.

A Design Exception Report (DER) template for simple submissions is found in Appendix B. This template may be used where Design Exceptions are relatively simple and require less documented detail and supporting justification.

Please Note: The designer/project officer should always confirm the appropriate DER format with their client. This is of particular significance for MTIA projects where there may be specific processes and governance required to accept the DER.

The following sections suit the recommended template in Appendix A, although the content could be adjusted to suit another format.

4.1 Section 1: Project Details

This section guides the designer through documenting Design Exceptions in a Design Exception Report (DER). It provides information about details which should be included under each section of the DER.

4.1.1 Project description

A short description of the project including the key project objectives, posted and design speed, traffic volumes and safety record.

4.1.1.1 State the Project Objectives

The Project Objectives state why the project is being undertaken and what the project is intending to accomplish. See *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects Appendix A. A.2 Establishing Project Objectives.*

The Project Objectives informs those who are reviewing the DER of the objectives that should be achieved by the geometry and layout of the design. The Project Objectives form part of the Performance-based Criteria that will be used as the reference for assessing the performance of project options.

4.1.1.2 State the Posted Speed Limit and Design Speed

The design speed helps the assessor to understand the design values which should be considered. Where the operating speed and/or posted speed differs from the design speed then this should be stated.

If there are varying design speeds on different sections of the project, then this should also be stated.

4.1.1.3 State the traffic volume and composition

The traffic volume and composition should be provided and cover relevant user groups where necessary.

- General traffic volumes (AADT or Peak Hour volumes)
- Heavy Vehicle (%)
- Motorcyclists
- Cyclists
- Pedestrians

Include the future traffic volumes for the design year.

4.1.1.4 State the substantive safety of the existing road

The substantive safety is reflected in the crash history of the existing road. The most recent 5-year crash data should be stated for the existing section of road. Specific information should be provided about the location, crash type and users of any fatal and serious injury (FSI) crashes. Comments should be provided as to whether existing geometry and layout (a pre-existing design exception) could have contributed to the crashes.

4.1.1.5 Network-wide Design

Network-wide Design is one of the performance-based criteria of Context Sensitive Design (Refer *RDN 01-01*). The designer should state how the project aligns with the corridor strategy for the route, including information of any future upgrades and how this project fits or does not preclude the ultimate network-wide design option.

4.1.2 Project Location

Provide brief details of the location of the project. Include a map of the project area highlighting the area of the design exception/s.

4.1.3 Relevant Scope of project works

The designer should state the type of project works, extents and limits of the project. This may include stating the project type category for the design. Classifying the project type provides guidance about the adoption flexible design criteria that can be used to explore solutions that address the Performance-based Criteria.

There are four main types of road construction projects;

Table 1: Typical Road Design Project Types

Project Type	Changes to Existing Road
New Road or Duplication	A new road or duplication involving a new alignment or significant changes to existing geometry and intersections.
Restoration (Major)	A project on an existing road involving major changes to the cross section, intersection layouts and targeted geometric improvements
Restoration (Minor)	A project on an existing road involving minor changes to the cross section and intersection layouts while retaining existing geometry
Maintenance & Improvement Works	A project involving maintenance and minor upgrades to seal width, barriers, signs and linemarking

Appendix E outlines the generally acceptable minimum criteria that should be adopted for each project type.

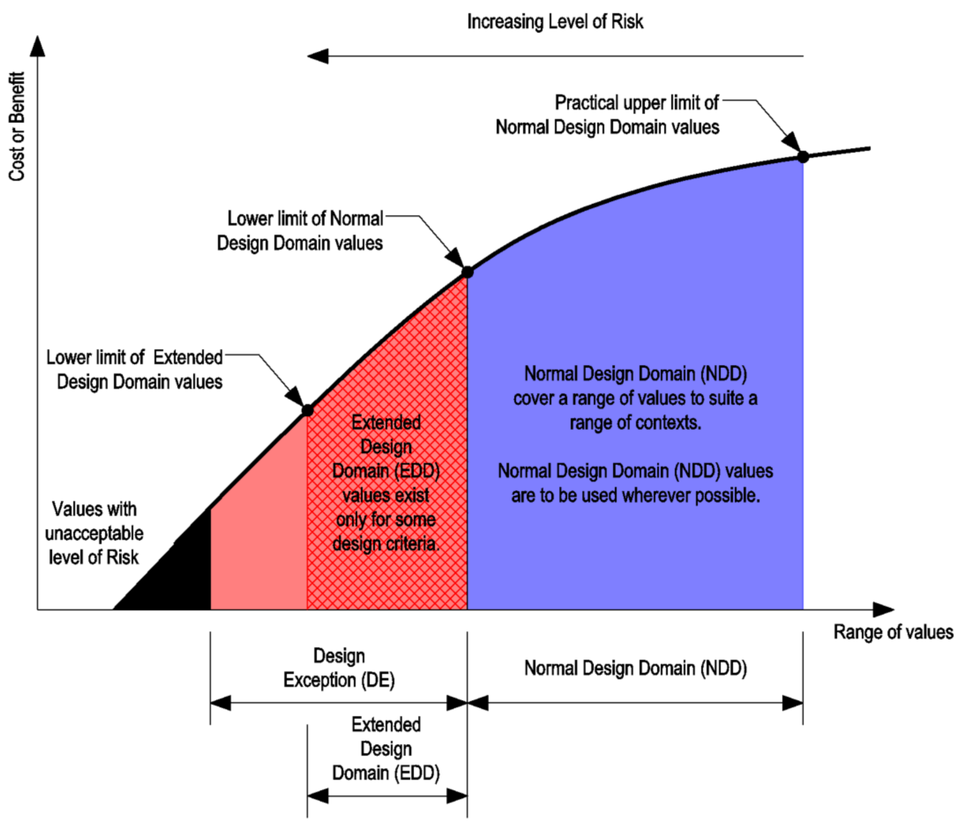
4.2 Section 2: Design Exception Details

4.2.1 Design Exception Type

A Design Exception is a technical departure from a road design standard or guideline.

Design Exceptions are the range of values below the Normal Design Domain (NDD) range. As shown in Figure 2, the Department of Transport (DoT) considers the Extended Design Domain (EDD) range as a subset of Design Exceptions.

Figure 2: NDD and Design Exceptions



While Extended Design Domain values are below Normal Design Domain range, the Austroads Guide to Road Design and DoT's publications may provide justification and conditions for generally accepted applications of EDD.

NDD values are typically contained in the main body of the Austroads Guide to Road Design (AGRD) and DoT Supplements. Extended Design Domain (EDD) values are found in the appendices of AGRD (Refer *RDN 01-01* and the *Supplement to AGRD Part 1* for further information).

4.2.1.1 What is the type/s of Design Exception?

There are four main types of Design Exceptions:

a) Extended Design Domain (EDD)

b) Design Exception (where EDD does not exist or cannot be met)

c) A pre-existing Design Exception

d) Design Exceptions for Innovative Designs and Emerging Treatments

Identifying the type/s of Design Exception allows the designer to apply the guidance about what is generally acceptable for that Design Exception type, given the project context and constraints. This also assists the reviewer to assess the design against this project context and available guidelines.

a) Extended Design Domain (EDD)

The EDD range of values do not exist for all documented NDD. Design elements for which there is an EDD include:

Table 2: Design Elements where EDD Exists

• cross-sections (see Austroads 2015, Part 3)
• sight distance on roads (see Austroads 2015, Part 3)
• adverse superelevation on horizontal curves in urban areas (see Austroads 2015, Part 3)
• sight distance at intersections (see Austroads 2015, Part 4A)
• intersection turn treatments (see Austroads 2015, Part 4A).
• Some DoT publications such as RDN's include EDD.

EDD are generally the acceptable minimum standard to be adopted for road restoration projects. See Appendix D for project types where EDD can be used.

Table 3: Examples of Application of EDD to Project Types

• Improving or rehabilitating existing roads or existing intersections (including modifying or realigning geometric elements in constrained locations)
• Constructing new intersections on existing roads in constrained locations (which may include modifying the intersection type)
• Building temporary roads or intersections
• Where there is no crash history associated with the design element being considered
• Where there are other significant constraints.

b) Design Exception (where EDD does not exist or cannot be met)

In certain contexts, an environment may be so constrained that EDD values cannot be adopted without significant impacts on important constraints. In these situations, it may be required to adopt Design Exceptions to be able to meet the project objectives whilst minimising the impact on constraints.

Table 4 provides examples where Design Exceptions may be required.

Table 4: Reasons for Design Exceptions

• On rural restoration and urban projects in very constrained situations where:
○ a disproportionate amount of funding is required to improve a particular geometric element (for example, cost to relocate major services or excavate hard rock)
○ land acquisition is not permissible
○ there are prohibitive environmental or heritage constraints.
• Where the NDD:
○ is impractical or unreasonable to apply (as determined by a suitably qualified technical expert)
○ is overly conservative for a particular context based on demonstrated safety evidence but not necessarily research and test data
○ makes a recommendation that is not relevant in the particular case
• Where there is no available EDD criterion but research or experience shows that one is justified.

Design Exceptions might be acceptable for the types of road design outlined in Appendix E.

c) A pre-existing Design Exception

This typically occurs on an upgrade project when it is proposed to retain an existing substandard design element. See *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects Appendix A.2.2 Existing Infrastructure Performance.* Table 5 outlines examples of pre-existing design exceptions.

Table 5: Pre-existing Design Exception Examples

• A vertical crest curve not meeting sight-distance requirements on a section of road to be resurfaced or widened on the existing formation
• A short-length merge on a constrained exit from a signalised intersection that is to be upgraded
• Narrow lanes in a constrained urban area being retained with the reallocation of the roadside space to a bus lane.
• Legacy barrier systems with tested performance specifications less than current standards

d) Design Exceptions for Innovative Designs and Emerging Treatments

A situation might arise when constraints require the development of an innovative design that has not previously been applied on the network or in a similar context. The DoT's Context Sensitive Design Approach encourages the exploration of innovative solutions and emerging treatments.

Refer *RDN 01-01 Context Sensitive Design (CSD) for Road Projects Appendix C.5 Design Approach and Values for Innovative and Emerging Treatments.*

Due to lack of supporting data, this type of design exception presents unknown levels of risk to the road users. Therefore, they require a more rigorous level of assessment and post-implementation monitoring to ensure that risks are managed appropriately.

Relevant monitoring and evaluation is required where a new or innovative treatment is being proposed. The designer is to provide information and costs about the relevant monitoring and evaluation in Section 4 of the DER.

4.2.2 Project Phase (Stage)

The project phase indicates how progressed the project is from planning through to design and construction. *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects* highlights the various phases of design. Providing this information informs those who are reviewing the DER at what stage the project is at.

4.2.3 Relevant Requirements

Information should be provided about the Design Exception with reference to the relevant guidelines or standard;

- The value of the Design Exception and the design criteria (for example, reduced stopping sight distance to 140m over a length of 60m for a 110km/h design speed)
- State the degree of severity. Degree of severity is not a percentage. It is a statement of the additional risk of the adopted values compared to the standard (for example, 140m stopping sight distance is achieved where 209m is required. State what 140m equates to in terms of reduction to reaction times and deceleration coefficients)
- State the standard or guideline that is not achieved (for example, Austroads Guide to Road Design Part 3, Section 5.3.1 Car Stopping Sight Distance Table 5.5)
- State whether there are multiple Design Exceptions proposed at the same location and whether the combination of Design Exceptions is acceptable or not acceptable

4.2.4 Proposed Design Exceptions (Change/Departure)

The designer should provide adequate information (drawings, calculations, measurements and reports) about the preferred option. Drawings should clearly identify the application of Design Exception/s with relevant details such as;

- Length or area of exposure of the Design Exception where NDD is not achieved
- Location on the project
- Key constraints with information such as type of constraint and offsets (measurements) to constraints
- Mitigation measures where applicable

Where appropriate, it is recommended that the designer liaise with technical experts to ensure that the preferred option is fit-for-purpose and that it adequately addresses the risks.

4.2.4.1 Multiple Design Exceptions

If the design contains multiple design exceptions (particularly at the same location), this may be listed in the form of a table and referenced through the DER. Multiple design exceptions can significantly increase the risk (particularly if the design exceptions are applied against guidance conditions). The risk associated with the cumulative result of combining design exceptions should be assessed and not just the isolated risks of each design exceptions.

For information about documenting multiple Design Exceptions refer to Appendix C.

4.2.5 Reasons for Design Exceptions (Change/Departure)

Designers should include the following justification for the application of Design Exceptions for the Preferred Design Option;

- Calculations and justification as documented in the *Austroads Guide to Road Design* and DoT's *Guidelines*.
- Reference to the type of Design Exception that is being proposed (See Section 1).
- Justification for the preferred option to demonstrate why the application of the design criteria is acceptable given the project objectives, constraints and context.
- Reference to the DoT Design Decision Making Principles (Refer to *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects*) should be made to support the preferred option.
- State the guidance conditions which ARE met, and the guidance conditions which ARE NOT met.
- Reference relevant examples on the network with a similar context and have satisfactory substantial safety to support the proposal.
- Whole-of-life costs (including capital costs, maintenance costs and operational costs) should be provided, where reasonable, to compare whole-of-life costs with other options.

4.2.6 Consequences of providing a NDD (conforming) solution

The designer should state what would be the result of designing a conforming design. In the context of Design Exceptions, the conforming design is a design that meets NDD values for design elements. Sufficient detail should be provided about an NDD design so that;

- The NDD option can be reasonably compared with and assessed against the preferred option and other options
- The constraints are clearly identified that prevent an NDD option from being implemented

To assist in understanding an NDD option, designers should include drawings that clearly identify the constraints that prevent it from being implemented. Where possible, the designer should evaluate what would be required to achieve a NDD design and provide justification as to why this NDD design is not feasible.

For new road or duplication projects, and major restoration projects, NDD design values should be adopted wherever possible. An NDD design option should be stated with higher levels of detail and evaluated with greater analysis to fully understand the implications of adopting an NDD design.

For minor restoration projects and maintenance projects where it is understood that more flexible design criteria may be necessary given the context and constraints, an NDD option should be stated (and developed where feasible) and evaluated to the point that it is clear an NDD option does not fit within the project context or constraints.

Whole-of-life costs (including capital costs, maintenance costs and operational costs) should be provided, where reasonable, to compare whole-of-life costs with other options.

The evaluation of the NDD option should reference how well the option aligns with the *Performance-based Criteria*.

4.2.7 Options Considered (List)

This is a list of the options that were considered for a quick reference. Detailed assessment of options considered should be documented in Section 4.3.2.

4.2.8 Consultation

The designer should state any consultation that they have had with Subject Matter Experts (SME's) and Technical Experts about the application of the Design Exceptions. Relevant correspondence should be attached to the Design Exception Report. The correspondence should focus on any assessment or comment on the risk or application by SME's and Technical Experts and any conditions of use which were specified in the correspondence.

4.2.9 Prior Approved Changes/Departures

There may have been previous submissions for Design Exceptions for the project which have been approved or accepted. However, the previous submissions would not have considered the current submission and the additional risk associated with the Design Exceptions. The following questions should be asked about how previous submissions may affect the current submission;

- Are previously agreed changes/departures located in the same areas as the current submission?
- What additional risk does the current submission add to previously agreed changes/departures?
- Do previously agreed changes/departures need to be reassessed given the current submission?
- Does the combination of previously agreed changes/departures and the current submission categorise the decisions for submissions as highly complex and with a high level of risk?
- Do previously agreed changes/departures require additional mitigation measures as a result of the increased risk from the current submission?

4.2.10What guidance conditions of the Design Exception are achieved?

Guidance conditions are provided for Design Exceptions where they should and should not be applied. These guidance conditions are published in guidelines such as DoT Supplements to AGRD and RDN's.

Appendix E outlines general guidance conditions for the application of Design Exceptions based on the project type. Appendices F and G outline general guidance conditions where Design Exceptions should not be applied.

4.3 Section 3: Justification & Impact Assessment

The justification and impact assessment of the preferred design option can be addressed by completing the relevant sections of the DER. For Design Exceptions, the key categories to be addressed are;

- Road Safety and alignment with the Safe System

- Network Efficiency and Access
- Operations
- Maintainability (including Safety)

These key categories should be addressed through undertaking a risk assessment of the preferred design option and documenting the outcomes in the relevant sections.

4.3.1 Undertake a Risk Assessment of the Preferred Design Option

A risk assessment is required to assess the risks of implementing a Design Exception/s and should follow similar steps outlined in Austroads *Guide to Road Safety Part 7: Road Network Crash Risk Assessment and Management*.

A risk assessment must be done on the preferred option. The risk assessment must be done on the solution (as a whole) which includes the context, rather than doing an assessment on the individual (isolated) design value. The risk of a Design Exception cannot be determined based on the mere difference to a Standards. It must be determined based on its effect in the proposed solution.

Risks may not necessarily be physical risks. Risks may also include: reputational risk; financial risk; risks to assets; risks to environment and cultural heritage; legal and compliance risk; safety, health and wellbeing risk; operational risk and maintenance risk.

The following process is a guide and can be used to assess the risk of the use of Design Exception values.

1. Identify the risks of implementing the Design Exception at the location on the project
2. List each identified risk in the Risk Table
3. Apply appropriate mitigation strategies to reduce the severity of each identified risk
4. Evaluate each risk with a quantitative or qualitative risk assessment tool
5. Determine whether each risk is acceptable

If an identified risk is found to be unacceptable, then this should be noted as a reason why a particular option was rejected or not considered as the preferred option.

A designer can follow an alternative risk assessment process or use other risk assessment tools as long as it is clear as to why the risks of implementing a Design Exception are acceptable. The process outlined in this guide ensures that the risks have been assessed and documented so that Design Exceptions can be reviewed by the return asset owner and their subject matter experts.

4.3.1.1 Risk Table

Risk tables are used to document risks as part of a risk assessment process. Each identified risk should be listed in the risk table. An example of a risk table is given below.

Table 9: Risk Assessment Table Template

Option Name/Number:			
Option Description:			
Risk	**Mitigation Strategies**	**Risk Rating**	**Acceptable Risk?**
{Risk 1}			
{Risk 2}			
{Risk n}			

Risks should also include non-physical events that relate to the delivery of the project. These include; operational risk, moral or ethical risk, time and financial risk, legal risk. These should be captured in the risk table and addressed with mitigation strategies where necessary.

All Design Exceptions need to be assessed and the risks that may result from each application. Appendix I includes questions that may help to identify and assess risks.

4.3.1.2 Risk Assessment Tools

Risk assessment tools provide a way of measuring the relative risk to determine whether the risk is acceptable to the return asset owner and operator. Appendix I provides examples of a quantitative (numerical rating) and qualitative (value rating) tool that can be used to rate risk.

There are many risk assessment tools available for determining the likelihood and severity of risks. These include computer modelling, calculations and simulations. Each of these tools can provide a way of evaluating the risk. However, some design elements have specific risk assessment tools for determining the performance of the design. Where there is a prescriptive methodology for determining the risk associated with a design element this must be used and stated in this section of the report.

Where specific risk assessment tools are used, these should be referenced together with any assumptions or parameters that were used to determine the risk. The results, along with relevant commentary on the implications of the results, should be provided as part of the DER.

4.3.1.3 Road-User Capability Assessment

A Road-User Capability Assessment is a risk assessment that views the design from the road-users perspective and takes into account their needs, requirements, characteristics and abilities. The designer should state a view as to whether the design provides acceptable road-user capability. This is a statement about the ability of a road-user (driver, rider, pedestrian) to evaluate information about the road environment and react to the risks without adverse outcomes. This assessment should demonstrate that road-user capability is within an acceptable (reasonable) level of risk.

Further information can be found in *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects Appendix D.3. Road-user Capability Assessment*.

4.3.1.4 Similar examples elsewhere on the network

While not meeting desirable design criteria, similar designs have been implemented elsewhere that perform to an acceptable level of safety and performance. Only similar examples with comparable context and risk profiles (i.e. traffic volume or road-user exposure) can be used as justification. Note that unsupported examples of precedence cannot be used as justification for a Design Exception. (Over time, engineering justification might become available – after sufficient monitoring and evaluation – and the criteria then added to official design guides.)

Table 8: Examples of Design Exceptions that could be used to support adopting a similar exception

• A short merge on the exit to a roundabout that has been converted from one to two lanes
• An intersection approach to provide additional lanes where lane widths and/or alignment do not meet EDD criteria
• A vertical crest not meeting sight-distance criteria in a constrained location but with mitigating treatments similar to nearby locations on the same road.
• Reduced barrier offset as a result of providing additional traffic lanes within an existing cross section

4.3.2 Options Considered

All options that were considered should be documented as part of the DER. Enough detail should be provided about each option so that;

- It is clear what is proposed in each option
- Relative comparisons can be made between the options and the preferred option
- Reasons for rejecting options can be clearly understood (including any assumptions)
- If the Design Exception is revisited in the future, then it is clear what options have been already investigated
- Legal requirements are met as it can be clearly demonstrated that a project has endeavoured to do what is reasonable

Designers may also want to evaluate a ‘do nothing’ option for comparison.

Drawings of all options that were considered should be provided as they are often the best way to present the alternative designs. Projects may consider producing an options report with all relevant information (including drawings and diagrams) and submitting it as an attachment to the Design Exception Report (DER).

Information about the whole-of-life costs (including capital costs, maintenance costs and operational costs) should be provided (where reasonable) for all options so that a comparison can be made with other options.

All options should be evaluated against the *Performance-based Criteria (*See *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects)*.

4.4 Section 4: Mitigation Measures

The Safe System principles state that the road environment should be forgiving such that the likelihood of fatal and serious injury is minimal.

Where values outside the NDD are adopted, the risk of an FSI may be increased. Therefore, some form of mitigation of the likely adverse effects must be incorporated in the design to offset this risk. The objective of a mitigation measure is to avoid adversely affecting substantive safety without detracting from operational efficiency.

Mitigation strategies must be considered for each Design Exception. These strategies, and their expected impact on the substantive safety of the road, must be documented in the DER and the design report. Due consideration should also be given to the cost of mitigation. In particular, the cost of a Design Exception, including all mitigation costs (such as whole-of-life costs for maintenance and repair of mitigation measures), should be evaluated against the cost of achieving a similar solution using NDD values.

Such mitigation measures might include:

- providing advance notice to drivers of a particular condition (for example, using signage, line marking, etc.)
- enhancing the design of a related geometric element (that is, providing higher than normal values to other design elements to compensate for a potentially adverse effect)
- implementing features to lessen the severity of an incident or action
- increasing the values of other design elements to well above the minimum NDD values to reduce the effect of the Design Exception
- reducing the speed limit or
- a combination of some or all of these measures.

Mitigating an isolated Design Exception (for example, a crest curve) is easier than mitigating a series of sub-standard elements over the same distance. Common mitigation strategies are included in Appendix H. Where applying EDD values is proposed, some mitigation strategies are included in the Austroads Guide to Road Design.

4.4.1 Monitoring and evaluating the preferred design option

Where the risk associated with the design are either high or the outcomes are somewhat unknown there should be a plan to monitor the Design Exception based on the likelihood and severity of the risks that were identified. Monitoring, and the subsequent evaluation of the data gathered, is essential to ensure that the performance of the design option is as expected, particularly if safety had to be balanced against other competing factors. Monitoring should be undertaken once the project is completed and at specified intervals thereafter.

Each Design Exception should be analysed to determine the most appropriate level of monitoring. This should be based on the risk-profile of the Design Exception. Where the risks are relatively low no monitoring may be required, and a review of the design exception may only occur as a result of an incident. Where the risk assessment uncovers a potential for particularly severe outcomes – or the risk cannot be accurately quantified – a greater degree of monitoring will be required. In these cases, adjacent sections of the road should also be monitored for migration effects. The quality of the proposed monitoring scheme should be considered in the decision to accept (or reject) a Design Exception. Therefore, the cost implications (including capital and operational cost) of the scheme should be included.

References

Austroads 2015, *Guide to Road Design Part 2: design considerations*, AGRD02-15, Austroads, Sydney, NSW.

FHWA 2007, *Mitigation Strategies for Design Exceptions*.

TMR. 2013, *Guidelines for Road Design on Brownfield Sites*.

Main Roads WA 2018, *Guidelines for the Extended Design Domain & Design Exception Process*

Appendices

APPENDIX A	Design Exception Report (Full Template)
APPENDIX B	Design Exception Report (Short Template)
APPENDIX C	Multiple Design Exceptions in a DER
APPENDIX D	Examples of Common Design Exceptions
APPENDIX E	Applying the EDD and Design Exceptions to Project Types
APPENDIX F	Examples of Design Element Combinations to be Avoided
APPENDIX G	Applications where Design Exceptions are not to be used
APPENDIX H	Mitigation Strategies
APPENDIX I	Risk Assessment Tools
APPENDIX J	Legal Considerations for Using Design Exception

Revision History

Version	Date	Description of Change
0.1	Dec 2019	Working Release
1.0	April 2021	First Version

Additional Notes on Current Version

Content and editorial changes to align with the latest version of Austroads Guide to Road Design Part 1 Objectives of Road Design (2021) and DoT's Supplement

Content and editorial changes to align with DoT's format for documenting a Departure from a Technical Standard

Contact Details

Road Design and Safe System Engineering

Department of Transport
60 Denmark St, Kew Vic 3101

Email: safesystemdesign@roads.vic.gov.au

Appendix A: Design Exception Report (Complex DE Template)

The designer/project officer submitting a DER should confirm with their client what the relevant internal DoT processes and governance are required for accepting a DER.

Agency Reference No. *#####*	**DoT Reference No.** *DoT use only*

Proponent Details				
Delivery Agent/Designer			**Date Submitted**	*XX Month 2020*
Contact Details	***Name:***	***Telephone:*** *#### ### ###*	***Email Address:***	
DoT Contact	***Name:***	***Telephone:*** *#### ### ###*	***Email Address:***	

Project Details	
Project Name	
Project Description	
Project Location	
Relevant Scope of Project Works	

Design Exception Details	
Design Exception Type ☐Extended Design Domain ☐Design Exception (Not EDD) ☐Pre-existing Design Exception ☐Innovative Design Exception	
Project Stage	
Location of Design Exception/s (Coordinates for GIS records)	
Relevant Requirement(s)	
Proposed Design Exceptions	
Reason for Design Exceptions	
Options considered (list)	
Consequence of providing NDD (conforming) solution	
Consultation	
Prior Approved Changes/Departures	

Justification & Impact Assessment	
Road Safety and alignment with the Safe System	

Network Efficiency and access	
Operations	
Maintainability (including Safety)	
Reliability and Comfort	
Environment and Sustainability	
Planning and Land Management	
Key Stakeholders	
Interface with Other Projects	
Utility Services	
Programme Impact	
Options Considered	
Other	

Mitigation Measures

Included Measures	**Civil Works**	*Detail any civil works included to mitigate the Change/Departure.* *This may include increasing/improving another design value/element in the immediate vicinity to offset a safety or efficiency reduction or improving another part of the network to have a no worse off overall scenario.*
	Other Mitigation	*Detail other elements that mitigate the Change/Departure. For example:* • *Financial savings offered as part of a -Change/reduction.* • *Financial contribution for increased maintenance activity/costs as a result of a Change.* • *Complementary methods of improving safety, i.e. a speed reduction.*
Monitoring and evaluating		*What monitoring will be required to ensure it is performing as predicted*
Rejected Measures		*Outline and explain mitigation measures that were considered and rejected.*

Financial Considerations

Financial position

☐No change ☐Savings offered to the Client ☐Additional funds sought from the Client

Financial value	*$####*
Comments	*If seeking additional funds, robust discussion and justification are required.*

Attachments and Other Information

			Supports	
List of Attachments	**Document ID**	**Document Title**	**Description**	**Justification**
	Attachment A	*e.g. Design Plans*	☐	☐
	Attachment B	*e.g. Detailed Risk Assessment*	☐	☐
	Attachment C	*e.g. Previous approved departure*	☐	☐
Other Information	*Outline any other relevant information that would assist with the Department's review.*			

Appendix B: Design Exception Report (Simple DE Template)

The designer/project officer submitting a DER should confirm with their client what the relevant internal DoT processes and governance are required for accepting a DER.

Agency Reference No. *#####*	**DoT Reference No.** *DoT use only*

Proponent Details				
Delivery Agent/Designer			**Date Submitted**	*XX Month 2020*
Contact Details	***Name:***	***Telephone:*** *#### ### ###*	***Email Address:***	
DoT Contact	***Name:***	***Telephone:*** *#### ### ###*	***Email Address:***	
Project Details				
Brief Project Description	*Include details about the project name, description, location and scope of works*			
Design Exception Details				
Location of Design Exception/s	*(Coordinates for GIS records)*			
Preferred Design Option	*Information about the design including Design Exception, standard or guideline that is not met and reason for the design*			
Consequence of providing an NDD (conforming) solution	*Detail the consequences of achieving an NDD design (i.e. impacts to property, utilities, environment)*			
Justification & Impact Assessment				
Road Safety and alignment with the Safe System	*Information about the design including Design Exception, standard or guideline that is not met and reason for the design*			
Operations				
Maintainability (including safety)				
Impacts on Constraints	*Such as Utilities, Properties and Property Boundaries, Environment and Heritage*			
Other options which were considered	*List options which were considered and why they were not considered to be the preferred solution*			
Other	*Detail the consequences of achieving a NDD design (i.e. impacts to property, utilities, environment)*			
Mitigation Measures				
Included Mitigation Measures	*Detail any elements included to mitigate the Change/Departure.*			
Monitoring and evaluating	*What monitoring will be required to ensure it is performing as predicted*			
Rejected Measures	*Outline and explain mitigation measures that were considered and rejected.*			
Financial Considerations				
Financial position ☐No change	☐Savings offered to the Client		☐Additional funds sought from the Client	
Financial value	*$####*			
Comments	*If seeking additional funds, robust discussion and justification are required.*			

Appendix C: Multiple Design Exceptions in a DER

Below is an example of documenting multiple Design Exceptions into one submission.

<table>
<tr><th colspan="3">Design Exception Details</th></tr>
<tr><td rowspan="3">Relevant Requirement(s)</td><td>DE01</td><td></td></tr>
<tr><td>DE02</td><td></td></tr>
<tr><td>DE(n)</td><td></td></tr>
<tr><td rowspan="3">Locations of Design Exceptions
(Coordinates for GIS records)</td><td>DE01</td><td></td></tr>
<tr><td>DE02</td><td></td></tr>
<tr><td>DE(n)</td><td></td></tr>
<tr><td rowspan="3">Proposed Design Exceptions</td><td>DE01</td><td></td></tr>
<tr><td>DE02</td><td></td></tr>
<tr><td>DE(n)</td><td></td></tr>
<tr><td rowspan="3">Reason for Design Exceptions</td><td>DE01</td><td></td></tr>
<tr><td>DE02</td><td></td></tr>
<tr><td>DE(n)</td><td></td></tr>
<tr><td rowspan="3">Options considered (list)</td><td>DE01</td><td></td></tr>
<tr><td>DE02</td><td></td></tr>
<tr><td>DE(n)</td><td></td></tr>
<tr><td rowspan="3">Consequence of providing NDD (conforming) solution</td><td>DE01</td><td></td></tr>
<tr><td>DE02</td><td></td></tr>
<tr><td>DE(n)</td><td></td></tr>
</table>

A summary table or excel spreadsheet can be attached to the submission. An example of the information that should be supplied in a summary table is shown below.

#	Type of DE	Value of DE	Relevant Requirement	NDD option	Consequence of NDD option	Options Considered	Risks	Risk Rating	Mitigation Measures and Monitoring	Location (Coordinates)	Combination with other Design Exceptions?
DE01											
DE02											
DE(n)											

Appendix D: Examples of Common Design Exceptions

This appendix gives designers examples of the information that may be requirement for common types of Design Exceptions. The examples provided are;

- Example 1 – Reduced Barrier Offset
- Example 2 – Reduced Lane Widths
- Example 3 – Reduced Sight Distance
- Example 4 – Reduced Median Widths
- Example 5 – Drainage (Flow Widths)
- Example 6 – Drainage (Flow Depths)
- Example 7 – Partially Protected Hazards (Length of Need)
- Example 8 – Partially Protected Hazards (Working Width)
- Example 9 – General: A Pre-existing Design Exception

Example 1 – Reduced Barrier Offset

<table>
<tr><th>Design Exception Request – Reduced Barrier Offset</th></tr>
<tr><td>NDD Option:

State what would be required to achieve Normal Design Domain barrier offsets (See AGRD Part 6; DoT Supplement to AGRD Part 6; RDN 0602; RDN 0608; RDN 0615).

Clearly show the constraints (i.e. utility pole/s close to kerb, vertical drop, constrained ROW) that mean NDD offset cannot be achieved. State what would be required (i.e. move poles; build retaining wall, land acquisition) to achieve a NDD design. If it is possible, provide a cost analysis of achieving a NDD design (i.e. $X to relocate each pole, $X for retaining wall, $X for property acquisition due to increased earthworks).

An alternative NDD design may be to realign the road (dependent on the site). This should also be investigated if it is a feasible option.</td></tr>
<tr><td>Preferred Design Option:</td></tr>
<tr><td>On a plan drawing, clearly show each location and context where the barrier offsets have been reduced. Note the offset on the plan at each location with the dimensions. Note the length dimension on the plan for each offset that has been reduced. Depending on the project, it may be best to show an overall design marking the locations where there is reduced barrier offset.</td></tr>
<tr><td>Use relevant justification from the DoT Design Decision Making Principles as to why the preferred option has been developed and include this in the relevant sections of the template/DER. This may include;

- Utility Services Principle if providing a NDD offset would require relocation of a utility pole/s
- Safe System Principle to justification for the implementation of a barrier to protect a hazard if it isn’t already protected
- Environmental Sustainability Principle if the reason why a NDD offset was not achieved was due to the protection of environmental flora
- Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.</td></tr>
<tr><td>Consider the Risk questions in Appendix I and undertake a risk assessment for the preferred option. Some of the key criteria and questions that are relevant would be; the traffic volume; the degree of severity (how much below the NDD offset is the proposed design?).

Some key risk events may be;

- Increased number of nuisance hits due to reduced offset
- Increased exposure to maintenance workers due to increased repair</td></tr>
</table>

- Increased time barrier is ineffective due to increased hits - Reduced width for cyclists (if applicable) - Break downs adjacent to a barrier with reduced offset - CFA requirements Complete a Risk Table for each application of EDD or DE criteria using a quantitative or qualitative risk assessment tool to rate the risk of a particular event. Mitigation strategies may include; - Chevron paint to indicate no stopping adjacent to reduced offset - ATLM - Emergency breakdown bays and signage
Other Options Investigated: Show any options that were developed. These may include options to; - Remove constraints - Reduce speed - Realign road/carriageway Document the reasons why each option was developed, how the options were assessed, what risks were associated with each option, what the reasons were for rejecting the option (reference the relevant DoT Design Decision Making Principles and include this in the relevant sections of the template/DER).

Example 2 – Reduced Lane Widths

Design Exception Request – Reduced Lane Widths
NDD Option: State what would be required to achieve an NDD design with lane widths in accordance with Austroads Guide to Road Design Part 3 Section 4.2.4 and the DoT's Supplement to AGRD Part 3. NDD lane widths include any curve widening that is required for heavy vehicles if the project is part of the heavy vehicle network (See RDN 0401; Austroads Guide to Road Design Part 3 Section 7.9). NDD requires lane widths of 3.5m. The lower limit of EDD lane widths are noted in Austroads Guide to Road Design Part 3 Section A.2. Any lane widths below the lower limit of EDD values are considered a Design Exception. Clearly show using plans and demonstrate with justification why an NDD design cannot be implemented, outlining key constraints such as utilities, drainage, property, environmentally sensitive areas/features. If it is possible, undertake an assessment of what the cost would be to deliver an NDD compliant design.
Preferred Option:
Provide plans and cross sections that clearly show the area where Design Exception reduced lane widths are being proposed. Note the lane widths with text on the lanes. If reduced lane widths are only for a section of the project, clearly show where the transitions occur from NDD lane widths to Design Exception lane widths. Clearly note/highlight the constraints that are driving the requirement for reduced lane widths. It may be beneficial to provide an overall layout plan at a larger scale to show the context of the lane reduction.
Austroads Guide to Road Design Part 3 Section 4.2.4 states that narrower lanes may be considered where any of the following apply: - The road reserve or existing development form stringent controls preventing wider lanes - The road is in a low speed environment - There is little or no truck traffic (Check RDN 0401 and Heavy Vehicle maps to determine if the route is a designate Heavy Vehicle route)

- The alignment and safety records are satisfactory in the case of a reconstructed arterial.

Reference the DoT Design Decision Making Principles as justification for the preferred option.

- Utility Services Principle if providing NDD lane widths would require relocation of a utility pole/s or significant impacts to existing drainage or utilities.
- Safe System Principle to demonstrate that reduced lane widths will not result in a decrease in safety or increased crash rate
- Environmental Sustainability Principle if the reason why NDD lane widths was not achieved due to the protection of environmental flora
- Road Network Efficiency Principle to demonstrate providing additional lanes will increase the safe mobility of people (i.e. increase traffic flow/volumes without adversely affecting congestion).

Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.

Two things the project needs to address;

- What is the degree of severity? I.e. is it 3.1m, 2.8m, 3.3m?
- How does this fit with the corridor strategy? i.e. are the lane widths consistent in the project with the context (either side of the project what are the lane widths?) Is this part of an upgrade of the corridor (i.e. should the project be aiming for a higher standard than the exist because this project is part of a progressive upgrade)? How does the lane widths fit in with the overall seal width for the road/carriageway?

Key risks that need to be addressed through reduced lane widths;

- Increased side swipe crash rate due to narrower lanes
- Reduced pavement life due to concentrated wheel path
- Increased head-on risk in two-way high-speed roads
- Increased risk of lane departure

Complete a Risk Table for each application of EDD or DE design element using a quantitative or qualitative risk assessment tool to rate the risk of a particular event.

Mitigation strategies may include;

- Audio Tactile Line Marking
- Lower speed

Sealed shoulders

Other Options Investigated:

Clearly document and provide details of any options that have been investigated. These may be combinations of increasing the lane widths and decreasing the sealed shoulder. State or provide reasons why these options were rejected or not the preferred option.

Example 3 – Reduced Sight Distance

Design Exception Request – Reduced Sight Distance

NDD Option:

Normal Design Domain Sight Distance requirements are found in Austroads Guide to Road Design Part 3 Section 5. Normal Design Domain for intersections is found in Austroads Guide to Road Design Part 4A Section 3.

State what would be required to achieve a Normal Design Domain design demonstrating this through plans, cross sections and longitudinal sections with particular focus on the areas where an EDD/DE design element is going to be implemented.

State the reasons why NDD sight distance cannot be achieved. A number of reasons why a NDD design can not be achieved may be;

- NDD design requires extensive reconstruction
- NDD design requires extensive earthworks
- NDD may impact key constraints, environmental/utilities/properties/buildings/structures

Undertake a cost estimate of an NDD design if feasible.

Preferred Option:

Develop a design containing EDD/DE design elements using the guidance from Austroads Guide to Road Design Part 3 Appendix A Section A.3 and Austroads Guide to Road Design Part 4A Appendix A Section A.2.

Clearly show the areas where EDD/DE values has been used. Provide plans, cross sections and longitudinal sections. Show the relevant sight triangles and what is achieved by the design. Provide sight distance reports showing the areas where NDD sight distance cannot be achieved. Clearly show the constraints and note them on the drawings.

Reference the DoT Design Decision Making Principles as justification for the preferred option.

- Utility Services Principle if providing NDD lane widths would require relocation of a utility pole/s or significant impacts to existing drainage or utilities.
- Safe System Principle to demonstrate that the preferred option does not increase the risk of FSI's above an unacceptable level. The preferred option may substantially improve the existing conditions.
- Environmental Sustainability Principle if the reason why NDD lane widths was not achieved due to the protection of environmental flora
- Road Network Efficiency Principle to demonstrate providing the preferred option will increase the safe mobility of people (i.e. increase traffic flow/volumes without adversely affecting congestion, more efficient and safe access).

Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.

Key questions that need to be answered by the risk assessment;

- What does the preferred option achieve in terms of sight distance? What sight distance is achieved for tail light height (0.65m)? What sight distance is achieved for top of vehicle height (1.25m)? What is the NDD requirement?
- What is the extent of the reduced (EDD/DE sight distance) sight distance? Is it for 20m? 50m? 100m? What does this equate to in terms of travel time? Is this within the reaction time?

Key risks that need to be addressed through reduced sight distance;

- Increased risk of FSI
- Increased crash rate
- Increased risk of run off road
- Increased risk of head-on crashes for two-way roads

Complete a Risk Table for each application of EDD or DE values using a quantitative or qualitative risk assessment tool to rate the risk of a particular event.

Document any mitigation strategies;

- Audio Tactile Line Marking
- Curve Advisory Markers
- Advisory speed signs
- Crest or Sag warnings
- Side Road Activated Speeds (SRAS) for low volume high-speed rural intersections

Fully sealing the shoulders to provide manoeuvring area where there is reduced sight distance

Other Options Investigated: Options may include reducing the speed, changing the intersection form, changing access.

Example 4 – Reduced Median Widths

Design Exception Request – Reduced Median Widths (Narrow Median for two-way rural roads)
NDD Option: State what would be required to achieve an NDD design for a narrow median or Wide Centre Line Treatment as indicated in the Austroads Guide to Road Design Part 3 and RDN 0308 and RDN 0309. The NDD values for a narrow median with a central barrier is equal to a width of 6.2m or greater. For Wide Centre Line Treatment the NDD value is 1.0m. Clearly show with plans and cross sections why an NDD design cannot be implemented. Plans should clearly show constraints that impact on an NDD design. These include utilities, environment, property and accesses. Undertake a cost estimate of an NDD design if feasible.
Preferred Option:
Develop and present plans and cross section clearly showing the EDD/DE elements. If the proposal is for a typical cross section that contains EDD/DE then show a cross section and note on the plan the widths at regular intervals. Demonstrate how the preferred option containing EDD/DE addresses the key constraints that prevent a NDD design. Show how the preferred design works with the overall route strategy for the corridor.
Reference the DoT Design Decision Making Principles as justification for the preferred option. - Utility Services Principle if providing NDD median widths would require relocation of a utility pole/s or significant impacts to existing drainage or utilities. - Safe System Principle to demonstrate that the preferred option does not increase the risk of FSI's above an unacceptable level. The preferred option may substantially improve the existing safety conditions. - Environmental Sustainability Principle if the reason why NDD median widths was not achieved due to the protection of environmental flora - Road Network Efficiency Principle to demonstrate providing the preferred option will increase the safe mobility of road users Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.
Key questions for EDD/DE narrow median with central barrier that need to be answered by the risk assessment; - Increased nuisance hits resulting in time where the barrier will not be effective - Increased exposure of maintenance crews when repairing - Deflection not contained within the median - Reduced recovery area Key questions for EDD/DE WCLT that need to be answered by the risk assessment; - Is there a reduced effectiveness of the treatment? - How does this fit with the overall route strategy?

Complete a Risk Table for each application of EDD or DE values using a quantitative or qualitative risk assessment tool to rate the risk of a particular event. Some mitigation strategies; - Audio tactile line marking - RRPM's - Chevron line marking at transitions - signs
Other Options Investigated: Document and present other options investigated and reasons why they were rejected. These may include; - increasing decreasing shoulder widths and increasing median widths - decreasing lane widths and increasing median widths - widening on one side - widening formation - If a Narrow Median with Central Barrier is proposed, an alternative could be implementing a Wide Centre Line Treatment

Example 5 – Drainage (flow widths)

Design Exception Request – Drainage – Increased Flow Widths
NDD Option: State what would be required to achieve a design that results in flow widths complying with the maximum flow widths required in Austroads Guide to Road Design Part 5A and VicRoads Supplements. The allowable flow width is dependent on the width and nature of the road space adjacent to the kerb (e.g. freeway shoulder, bicycle lane or traffic lane), which will also determine the design storm to use, which will be either the 1 in 10 year or 1 in 5 year ARI event. Larger storm events should also be considered to ensure that safety related criteria (flow depth x velocity) are also satisfied. Provide alignment/drainage plans, cross sections and supporting drawings such as drainage longitudinal plans as required demonstrating why a design in accordance with AGRD Part 5A and VicRoads Supplements cannot be achieved. These plans should clearly show any constraints that make these flow width requirements unachievable, such as services or environmental or cultural heritage constraints and lane and shoulder widths available.
Preferred Option:
Develop preferred option and provide alignment/drainage plans and cross sections clearly showing the actual flow widths achieved and noting locations where these flow widths exceed the maximum flow widths in AGRD Part 5A and VicRoads Supplement. Clearly show lane / shoulder widths provided and constraints controlling the drainage design. The design storm event adopted should also be documented, along with flow safety calculations at locations where flow width requirements are not achieved.
Use relevant justification from the DoT Design Decision Making Principles as to why the preferred option has been developed. This may include; - Utility Services Principle if providing an NDD complying design would require relocation of a utility service - Safe System Principle to demonstrate that the location and width of the inundated pavement and reduced effective lane widths will not result in a decrease in safety or increased crash rate, considering all road users

- Environmental Sustainability Principle if the reason why an NDD offset was not achieved was due to the protection of environmentally significant flora or cultural heritage artefacts.

Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.

Key risks that need to be addressed with wider flow widths;

- increased risk of lane departure, in particular bicycles veering into the adjacent traffic lane
- increased side swipe crash rate due to effectively narrower lanes
- increased head-on risk in two-way high-speed roads
- increased 'major' event flows and potential for flooding of road and roadside and safety implications
- inconvenience to pedestrians through splashing

Complete a Risk Table for each application of DE using a quantitative or qualitative risk assessment tool to rate the risk of a particular event.

Document any mitigation strategies, which may include;

- lane or shoulder widening
- longer pits to facilitate increased capture rates
- relocation of pedestrian facilities (to avoid splashing)

Other Options Investigated:

Document and present other options investigated and reasons why they were rejected. These may include;

- installation of additional pits
- service relocation
- modifying the grade of the road
- increasing shoulder or lane widths to increase allowable flow width
- increasing crossfall adjacent to kerb and channel to reduce flow width for a given flow rate
- use of an alternative drainage system such as a linear drainage system or grated trench

Example 6 – Drainage (flow depths)

Design Exception Request – Drainage – Increased Flow Depths (Aquaplaning)

NDD Option:

State what would be required to achieve a design that results in flow depths complying with the maximum allowable flow depths required in Austroads Guide to Road Design Part 5A and DoT's Supplements to appropriately address the risk of aquaplaning.

Based on depths using the Gallaway Formula in AGRD Part 5A, the desirable maximum flow depth is 2.5mm, with a maximum allowable flow depth of 5mm and 4mm in higher risk situations including high speed roads and approaches to intersections.

Provide alignment/drainage plans (with contours) showing critical flow paths and demonstrating why a design in accordance with AGRD Part 5A and DoT's Supplements cannot be achieved. These plans should show any constraints that make these flow depth requirements unachievable.

Preferred Option:

Develop preferred option and provide alignment/drainage plans (showing contours) clearly showing the critical flow paths and locations along these flow paths where allowable flow depths are exceeded. Longitudinal sections and cross sections at these locations should also be provided. Computations using the Gallaway formula should also be provided noting design parameters adopted.

Key constraints affecting the flow depths achieved should be documented. Where the existing pavement surface is a significant control on the design surface, assessments of the flow depths at critical locations on the existing pavement should also be provided.
Use relevant justification from the DoT Design Decision Making Principles as to why the preferred option has been developed. This may include; - Utility Services Principle if providing an NDD complying design would require relocation of a utility service - Safe System Principle to demonstrate that the location of the critical flow paths with not result in a decrease in safety or increased crash rate - Environmental Sustainability Principle if the reason why an NDD offset was not achieved was due to the protection of environmentally significant flora. Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.
Key risks that need to be addressed with potential aquaplaning; - increased risk of runoff road crashes - increased intersection crash rate - increased head-on risk in two-way high-speed roads Complete a Risk Table for each application of DE using a quantitative or qualitative risk assessment tool to rate the risk of a particular event. Document any mitigation strategies, which may include; - adopting pavement surface with greater texture depth, such as open graded asphalt or use of 10mm stone spray seal - provision of roadside/median safety barriers to reduce risks associated with errant vehicles - moving critical flow paths to lower risk locations - lower speed
Other Options Investigated: Document and present other options investigated and reasons why they were rejected. These may include; - changes to longitudinal grading - modifying rates of superelevation rotation - introduction of crown lines to reduce flow path lengths - modifying the grade of the road

Example 7 – Partially protected hazards (length of need)

Design Exception Request – Partially protected hazards (length of need)
NDD Option: State what would be required to achieve a design with Normal Design Domain barrier lengths (See AGRD Part 6; DoT Supplement to AGRD Part 6). This may require relocation of the hazard, relocating an access, selecting a different barrier type or flaring the barrier terminal. Clearly show the constraints (i.e. access roads, constrained ROW) that mean NDD length of need cannot be achieved. State what would be required (i.e. remove the hazard, move other roadside furniture; move an access road, earthworks, different barrier design, land acquisition) to achieve a NDD design. If it is possible, provide a cost analysis of achieving a NDD design (i.e. $X to relocate each pole, $X for property acquisition due to increased earthworks).

An alternative NDD design may be to realign the road (dependent on the site). This should also be investigated if it is a feasible option.
Preferred Design Option:
On a plan drawing, clearly show each location and context where the hazard has been partially protected. Note the required barrier length of need on the plan at each location with the dimensions. Note the actual length dimension on the plan for each hazard. Depending on the project, it may be best to show an overall design marking the locations where there is partially protected hazard.
Use relevant justification from the DoT Design Decision Making Principles as to why the preferred option has been developed. This may include; - Utility Services Principle; if providing a NDD offset would require relocation of a utility pole/s - Access Principle; if providing a desirable barrier length would require relocation or closure of a critical access point. - Safe System Principle; justification for the implementation of a barrier to protect a hazard if it isn't already protected. - Environmental Sustainability Principle; if the reason why a NDD solution was not achieved was due to the protection of environmental flora Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.
Consider the Risk questions in Appendix H and undertake a risk assessment for the preferred option. Some of the key criteria and questions that are relevant would be; the traffic volume; the degree of severity (how much below the NDD offset is the proposed design?). Some key risk events may be; - Increased number of impacts with the hazard - Consequence of the hazard being damaged or collapsing Complete a Risk Table for each application of EDD or DE values using a quantitative or qualitative risk assessment tool to rate the risk of a particular event. Mitigation strategies may include; - Selecting a more rigid barrier type to gain addition barrier offset. - Selecting a barrier terminal more suitable for site. - Flaring the barrier and terminal to maximise the barrier length achieved. - Installing barrier further upstream to capture run-off-roads prior to the hazard. - ATLM
Other Options Investigated: Show any options that were developed. These may include options to; - Remove constraints - Reduce speed - Realign road/carriageway Document the reasons why each option was developed, how the options were assessed, what risks were associated with each option, what the reasons were for rejecting the option (reference the relevant DoT Design Decision Making Principles).

Example 8 – Partially protected hazards (working width)

Design Exception Request – Partially protected hazards (working width)

NDD Option:

State what would be required to achieve a design with Normal Design Domain barrier working width (See AGRD Part 6; DoT's Supplement to AGRD Part 6, RDN 06-02). This may require relocation of the hazard, a different barrier type, a reduced barrier offset (example 1) or local stiffening.

Clearly show the constraints (i.e. hazard type, vertical drop, constrained ROW) that mean NDD working width of need cannot be achieved. State what would be required (e.g. remove the hazard, move other roadside furniture; move an access road, earthworks, different barrier design, land acquisition) to achieve a NDD design. If it is possible, provide a cost analysis of achieving a NDD design (e.g. $X to relocate each pole, $X for other barrier types).

An alternative NDD design may be to realign the road (dependent on the site). This should also be investigated if it is a feasible option.

Preferred Design Option:

On a plan drawing, clearly show each location and context where the hazard has been partially protected. Note the required barrier working width on the plan at each location with the dimensions. Note the actual working width dimension on the plan for each hazard. Depending on the project, it may be best to show an overall design marking the locations where there is partially protected hazard.

Use relevant justification from the DoT Design Decision Making Principles as to why the preferred option has been developed. This may include;

- Utility Services Principle; if providing a NDD offset would require relocation of a utility pole/s
- Safe System Principle; justification for the implementation of a barrier to protect a hazard if it isn't already protected.
- Environmental Sustainability Principle; if the reason why a NDD solution was not achieved was due to the protection of environmental flora

Investment Benefit Principle to show the comparative costs for implementing an NDD design compared with the preferred option. Demonstrate why this cost differential is significant in the context of the project.

Consider the Risk questions in Appendix I and undertake a risk assessment for the preferred option. Some of the key criteria and questions that are relevant would be; the traffic volume; the degree of severity (how much below the NDD offset is the proposed design?).

Some key risk events may be;

- Vehicle is redirected into the hazard
- Increased number of impacts with the hazard
- Consequence of the hazard being damaged or collapsing

Complete a Risk Table for each application of EDD or DE values using a quantitative or qualitative risk assessment tool to rate the risk of a particular event.

Refer DoT's Supplement to AGRD Part 6 V6.3.15.5 – Constrained locations. Designers must demonstrate that the have systematically considered all barrier configurations/design (e.g. barrier offset, type, variant, etc).

Mitigation strategies may include;

- Select a more rigid barrier type.
- Adopt an EDD working width value – crash testing > engineering simulation > interpolation > extrapolation
- Locally stiffen the barrier.
- Modify hazard to be slip-based
- ATLM

Other Options Investigated: Show any options that were developed. These may include options to; - Remove constraints - Reduce speed - Realign road/carriageway Document the reasons why each option was developed, how the options were assessed, what risks were associated with each option, what the reasons were for rejecting the option (reference the relevant DoT Design Decision Making Principles).

Example 9 – General: A Pre-existing Design Exception

Design Exception Request – General: Pre-existing Design Exception
NDD Option: Often it is not possible or not feasible for smaller projects or minor restoration and maintenance projects to achieve a NDD design where it is proposed to retain an existing Design Exception (such as horizontal curve). In these cases, it is not reasonable to expect that an NDD design will be developed as it is most likely out of scope. For new road projects or major restoration projects it is expected that an NDD option would be developed or investigated to a higher level of detail than for a minor restoration or maintenance project (See Appendix E.) However, the designer should be able to state: - The values of NDD design elements required to improve the existing Design Exception - General information about what would be required to upgrade the existing Design exception to NDD (i.e. move power poles, earthworks to widen carriageway or improve vertical alignment, acquisition of property) - Why the NDD option is either out of scope or not feasible Providing information about an NDD option - Demonstrates that the designer understands the NDD design standards and what would be required to meet this - Identifies this for future reference if the project area were to be revisited in future projects
Preferred Design Option: On drawings (plans, cross sections and longitudinal sections) clearly show the design exception in the project area. Highlight any constraints that may contribute to why an NDD option is not feasible or out of scope. Undertake an analysis of the existing geometry and demonstrate what performance standard it produces. State how the existing geometry or layout produces an acceptable level of performance, particularly in relation to safety and access and mobility. Demonstrate through a road-user capability assessment that road-users are not exposed to an unreasonable level or risk (See *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects Appendix D.3. Road-user Capability Assessment.*) State how retaining the existing geometry or layout aligns with the project purpose and need, including the project scope and project type. Use examples of other sites that may have a similar risk profile as justification for the retaining of existing geometry or layout. Highlight any improvements to the existing geometry or layout that aim to improve the existing performance. Reference the relevant DoT Design Decision Making Principles as justification.
Other Options Investigated: Show any options that were developed. These may include options to;

- Restricting or changing access arrangements
- Upgrading aspects of the existing geometry or layout
- Remove constraints
- Reduce speed

Document the reasons why each option was developed, how the options were assessed, what risks were associated with each option, what the reasons were for rejecting the option (reference the relevant DoT Design Decision Making Principles).

Appendix E: Applying EDD and Design Exceptions to Project Types

It is important that designers first identify the most appropriate type of road design for a project, given the context of the project, the project values and the competing objectives.

The table below – adapted from Guidelines for Road Design on Brownfield Sites (TMR 2013) – sets out the recommended minimum design criteria for typical geometric parameters (or design elements) for various project types. Designers should strive to achieve the best possible outcomes considering context rather than adopting minimum criteria.

Table E.1: Project Type and recommended minimum design criteria

<table>
<tr><th>Project Type</th><th>Project Types</th><th>Geometric Changes</th><th>Typical Geometric Element Assessed[1]</th><th>Minimum Design Criteria</th></tr>
<tr><td>New Roads or Duplication Projects</td><td>• New roads or
• Complex, high risk or expensive projects involving modification to existing roads. For example:
– Duplication of existing roads where there more than 500 m realignment of an existing road is needed.
• New climbing or overtaking lanes</td><td>New alignments or major modifications to existing roads</td><td>All</td><td>• NDD
• EDD* if a brownfield site and context warrants
• Design exception, if an exceptional circumstance</td></tr>
<tr><td>Restoration project (major)</td><td>• Sealing of an unsealed road or
• Restoration projects (roads and/or intersections) involving increases to the earthworks footprint for most of the project length. For example:
– shoulder widening
– overlay and widening</td><td>Major cross-sectional changes including road widening</td><td>All</td><td>• NDD
• EDD* otherwise NDD
• Design exception where prohibitively expensive to justify NDD</td></tr>
<tr><td rowspan="4">Restoration project (minor)</td><td rowspan="4">Restoration projects (roads and/or intersections) where the earthworks footprint does not change or there is localised marginal change to the footprint. This includes projects with:
– significant increases in seal width
– structural overlays
– surface shape correction
– full shoulder seal projects (but if the change in seal width is likely to significantly increase driver speed, use road design type</td><td rowspan="4">Surface profile changes that do not involve widening</td><td>• Crossfalls
• Superelevation
• Flow path depths at curve transitions</td><td>EDD* otherwise NDD.</td></tr>
<tr><td>Verge width and sight distance requirements, if retrofitting roadside barriers</td><td>• EDD* otherwise NDD or
• design exception if prohibitively expensive to justify NDD</td></tr>
<tr><td>Geometric elements associated with a significant crash history (in spite of existing appropriate mitigating devices)</td><td>• EDD* otherwise NDD (remove hazard); or
• Apply suitable mitigating devices.</td></tr>
<tr><td>All others</td><td>Retain the design exceptions</td></tr>
</table>

	restoration project major) – batter flattening or reshaping			
Maintenance Projects & Improvement Works	Maintenance type projects that do not involve structural overlays, formation widening or significant increases in seal width, but where some heavy / specialised plant is required, as given by the examples in the dot points below.	No geometric changes. The works involve only: • restoring existing geometry, (except for very minor and localised surface profile changes) • pavement rehabilitation • minor overlays (small height increase) • resheet unsealed roads • reseal • part shoulder seal • signs (such as advisory speed signs and CAMS) • Installing safety barriers Where the pavement is not being rehabilitated, the roadway must retain its shape with respect to crossfall and grade to classify as Class D.	Verge width and sight distance requirements, if retrofitting roadside barriers	• EDD* otherwise NDD, or • Design exception, if prohibitively expensive to justify NDD
			Geometric elements with crash histories identified in road safety audits	Apply suitable mitigating devices
			All others	Retain design exceptions.

[1] In this table, geometric elements are defined as those that affect the shape of roadway formation, for example, those that affect the horizontal and vertical alignment, cross-section, intersection geometry etc. These may impact features such as lane width, batter slope, stopping sight distance, side friction, intersection turn treatment type and taper length.

* Where an EDD criterion exists.

Appendix F: Design element combinations to be avoided

Table F.1 outlines known combinations of design elements which are likely to result in poor performance (particularly in poor safety). These design element combinations should be avoided. Where they cannot be avoided, designers will require greater levels of justification, analysis and details in the design report as the decision to accept the design exceptions contains a higher level of complexity and risk (see Section 4).

Table F.1: Design element combinations to be avoided

Design exception	Combination with Geometric Minima
A substandard horizontal curve radius or substandard compound horizontal curve	• A tight crest curve, especially if the horizontal curve or compound curve starts after the crest curve • Inadequate perception of, or sight distance to the horizontal curve or compound curve • A hazardous roadside (for example, where there are large trees, deep drains, steep fills close to the roadside, etc.) • Inadequate superelevation • Long drainage paths on the road surface • A floodway • A narrow carriageway • A steep downgrade • An intersection
A substandard vertical crest curve	• A small radius horizontal curve or compound curve • A narrow carriageway • A hazardous roadside • A floodway just after the crest curve • A likelihood of hazards on the roadway • An intersection
A narrow bridge or culvert (one lane or two lane of substandard width)	• Limited visibility • Steep downgrades leading to it • A small radius horizontal curve or compound curve • Being located just after a small radius crest curve
Substandard sight distance	• A small radius horizontal curve or compound curve • A narrow carriageway • A minor leg of an non-signalised intersection

Appendix G: Applications where Design Exceptions should not be used

Table G.1 outlines known conditions where design exceptions should not be used as they are likely to result in poor performance (particularly in poor safety). Using design exceptions in these stated conditions should be avoided. Where applying design exceptions in these conditions cannot be avoided, designers will require greater levels of justification, analysis and details in the design report as the decision to accept the design exceptions contains a higher level of complexity and risk (see Section 4).

Table G.1: Where Design Exceptions should NOT be used

• There is a crash history linked to the use of the design exception (particularly if there has been more than one crash and/or there are mitigating devices in place).
• The use of the same or similar design exception has caused safety problems elsewhere on the network.
• The value of the Design Exception is well outside the range of values in the design domain (that is, the degree or severity of the exception is high).
• The Design Exception is an isolated case and not consistent with road-user expectation (that is, a driver could not reasonably be expected to adequately perceive and negotiate the substandard element). An example is a substandard curve when all others on the same road are generous.
• On-road restoration or low-volume projects where the pavement is being replaced (particularly if minimal earthworks are required to provide safety improvements).
• On-road restoration of higher function and/or higher traffic volume roads. (In these cases, consideration should be given to improving existing standards rather than retaining substandard design elements.)
• For intersection sight distance. In this case, EDD values are the lowest that should be adopted.
• Where the Design Exception can be avoided with minimal effort or expense.
• Where the design is not sufficiently developed to reveal the potential effects on safety and traffic operations.
• Where alternatives with improved substantive safety have significant long-term benefits.
• The Design Exception is combined with other minimum geometric design elements. The greater the number of minima combined, the lower is the likelihood that the exception will result in a successful design.
• Where the Design Exception leads to unacceptable risk to those who need to maintain the asset.

Appendix H: Mitigation Strategies

Mitigation strategies should be implemented wherever a Design Exception is proposed to reduce likelihood and severity of risks. Table F.1 has been adapted from Federal Highway Administration *Mitigation Strategies for Design Exceptions, Chapter 4 Mitigation Strategies, Table 22* and highlights possible mitigation strategies which should be investigated and implemented where feasible. It is important that designers evaluate the effectiveness of any mitigation strategy as part of a risk assessment.

Table H.1: Mitigation Strategies

Design Criteria	Objective	Potential Mitigation Strategies
Design Speed	Reduce operating speeds to the design speed.	Cross-sectional elements to manage speed
		Introduce horizontal curves to reduce speeds
Lane Width & Shoulder Width	Optimise safety and operations by distributing available cross-sectional width.	Select optimal combination of lane and shoulder width based on site characteristics
	Provide advance warning of lane width reduction.	Signing
	Improve ability to stay within the lane.	Wide pavement markings
		Enhanced pavement markings (higher retroreflectivity)
		Raised pavement markings
		Delineators
		Lighting
		Audio tactile centreline
		Audio tactile edgeline
	Improve ability to recover if driver leaves the lane	Sealed or partially-sealed shoulders
		Safety edge (bevelled asphalt)
	Reduce crash severity if driver leaves the roadway	Remove or relocate fixed objects
		Traversable slopes
		Breakaway safety hardware
		Shield fixed objects and steep slopes
	Provide space for enforcement and disabled vehicles.	Pull-off areas
Bridge Width	Provide advance warning and delineation of narrow bridge. Improve visibility of narrow bridge, bridge rail, and lane lines.	Signing
		Reflectors on approach guardrail and bridge rail
		Post-mounted delineators
		High-visibility bridge rail
		Bridge lighting
		Enhanced pavement markings (higher retroreflectivity)
	Maintain pavement on bridge that will provide safe driving conditions.	Skid-resistant pavement
	Reduce crash severity if driver leaves the roadway.	Crashworthy bridge rail, approach guardrail and end terminals
	Provide space for disabled vehicles or emergencies on long bridges.	Pull-off areas.

	Provide quick response to disabled vehicles or emergencies on long bridges.	ITS Systems – surveillance cameras
Horizontal Alignment & Superelevation	Provide advance warning	Signing
		Pavement marking messages
		Dynamic curve warning systems
	Provide delineation	Chevron Alignment Markers (CAMs)
		Post-mounted delineators
		Reflectors on barrier
	Improve ability to stay within the lane	Widen the roadway at horizontal curves
		Skid-resistant pavement
		Enhanced pavement markings (higher retroreflectivity, RRPMs)
		Lighting
		Audio tactile centreline
		Audio tactile edgeline
	Improve ability to recover if driver leaves the lane.	Sealed or partially sealed shoulders
		Safety edge (bevelled asphalt)
	Reduce crash severity if driver leaves the roadway	Remove or relocate fixed objects
		Traversable slopes
		Breakaway safety hardware
		Shield fixed objects and steep slopes
Vertical Alignment	See (8) Grade and (9) Stopping Sight Distance	
Grade	Provide advance warning	Signing for steep grades
	Improve safety and operations for vehicles ascending or descending steep grades.	Climbing lanes
		Downgrade lanes
	Capture out-of-control vehicles descending steep grades	Escape ramps / Arrestor beds
	Improve ability to stay within the lane.	Enhanced pavement markings
		Delineators
		Audio tactile centreline
		Audio tactile edgeline
	Improve ability to recover if driver leaves the lane	Sealed or partially-sealed shoulders
		Safety edge (bevelled asphalt)
	Reduce crash severity if driver leaves the roadway.	Remove or relocate fixed objects
		Traversable slopes
		Breakaway safety hardware
		Shield fixed objects and steep slopes
	Address drainage on flat grades	Adjusting gutter profile on curbed cross sections
		Continuous drains
Stopping Sight Distance	Mitigate sight distance restrictions	Signing and speed advisory supplementary plates (crest vertical curves)

		Lighting (sag vertical curves)
		Adjust placement of lane within the roadway cross section (horizontal)
		Lower-height barrier
		Increased shoulder width
		Cross-sectional elements to manage speed to suit reduced sight distance
	Improve ability to avoid crashes.	Wider shoulders
		Wider clear zones
	Improve driver awareness on approach to intersections.	Advanced warning signs
		Dynamic warning signs
		Larger or additional STOP/GIVE WAY signs
		Intersection lighting
Cross Slope	Provide warning of slippery pavement	"Slippery When Wet" Signing
	Improve surface friction	Pavement grooving (PCC pavement).
		Open-graded friction courses (HMA pavement)
	Improve drainage	Transverse pavement grooving (PCC pavement)
		Open-graded friction courses (HMA pavement)
		Pavement edge drains
	Mitigate cross-slope break on the high side of superelevated curves.	Modified shoulder cross slope
Vertical Clearance	Advance warning	Signing (static or dynamic)
	Preventing impacts with low structures.	Alternate routes
		Large vehicle restrictions
Lateral Offset to Obstruction	Improve visibility of objects near the roadway	Delineate objects
		Lighting
	Optimise operations by distributing available cross-sectional width.	Provide full outside lane width and/or additional offset
	Improve visibility of the lane lines.	Enhanced pavement markings

Appendix I: Risk Assessment Tools

I.1 Risk Table Questions

Table I1: Questions to help assess risks due to Design Exceptions

• What is the road-user capability? Is it justifiable, reasonable and defensible?
• What are the traffic volumes, the composition of traffic (the types of vehicles and the types of user), and current speeds at the site? How does this exposure affect the likelihood of an adverse event occurring?
• In what environment is the road situated – for example, urban or rural – and how might this affect driver behaviour (such as their state of alertness, number of decisions needing to be made, etc.)?
• What is the degree or severity of the design exception? (For example, providing 140 m of stopping sight distance when 165 m is specified in the NDD might be acceptable, but providing only 80 m might not.) How might the degree of severity affect the likelihood and severity of an adverse event?
• Are there multiple design exceptions for the same location and, if so, is there potential for an accumulation of risk? • (For example, if a horizontal curve does not meet NDD criteria for both minimum radius and superelevation, the crash risk will increase if the horizontal stopping sight distance is also less than the minimum specified.) • Check Appendix F for design element combinations to avoid.
• What is the extent of the design exception (is the exception for an isolated element or for a series of such elements)?
• What is the measure of exposure and the extent of influence? (For example, compare a short bridge that does not meet bridge width criteria with a bridge with a constrained cross-sectional width over an extended length.)
• What is the expected duration of the Design Exception? (For example, is the section of road intended to be upgraded or reconstructed in the near future? Are the works temporary or permanent?)
• Are there other features whose risk might compound the risk associated with the design element, such as roadside furniture, trees, terrain, drains, intersections, etc.? (For example, for a crest vertical curve with a reduced stopping sight distance, the safety risk is increased if there is an intersection within the curve or just beyond the crest.)
• What is the substantive safety where the design exception will be located? This is essential for evaluating risk. Consideration should also be given to any expected changes in conditions that might influence future substantive safety (such as a change in land-use, change in traffic composition, nearby intersection upgrades, etc.).

Table I2: Road User Considerations

• What types of road users will be exposed to the Design Exception? (Pedestrians, Cyclists, Motorcyclists, Heavy Vehicles, Cars)
• What specific risks may relate to the different road-user groups? What risks may result from interactions between users of the same road user group and the design exception? What risks may result from interactions between different road-user groups and the design exception?
• Within each road-user groups, are there risks that may impact vulnerable road-users with specific characteristics? (for example – children, elderly, inexperienced road users, road users with a disability)
• Are there places of interest in the project area that require specific consideration of the risks for a particular road-user group? (for example, a school, a shopping centre, a park or playground, a child care centre, a retirement village, a tourist attraction, an industrial centre)

Table I3: Different Risk Types

Reputational Risk	Financial Risk	Risks to Assets	Risks to the Environment and Cultural Heritage
Legal and Compliance Risk	Safety, Health and Wellbeing Risk	Operational Risk	Maintenance Risk

I.2 Quantitative Risk Assessment Tool

A quantitative risk tool can be used to rate the relative risk resulting from implementing a Design Exception. This quantitative risk tool uses exposure, likelihood and severity of a crash or outcome as a result of implementing a Design Exception.

Table I2: Quantitative Risk Assessment Tool

(Based on the *Safe System Assessment Framework* risk assessment)

	Exposure	Likelihood	Severity	Total
Risk	0 to 4	0 to 4	0 to 4	= Exposure x Likelihood x Severity

0 – Not Applicable; 1 – highly unlikely or very low; 2 – unlikely or low; 3 – likely or medium to high; 4 – highly likely or very high

This tool gives a total from 0 to 48 where lower values represent low risk and higher values represent high risk. The project team should determine whether any risk score is too high and thus is an unacceptable level of risk.

Exposure

- What is the exposure of a road user/s (various road user types may need to be considered)?
- What is the extent of Design Exception exposure (for example, is the Design Exception in an isolated location, or is it for a significant proportion of the project?
- How often will a particular user group be exposed to the risk caused by Design Exception (for example how regularly will a maintenance worker be exposed to the increased risk)?

Likelihood:

- What is the likelihood that a crash will occur as a result of the Design Exception?
- What is the likelihood of the event or adverse outcome as a result of the Design Exception?

Severity:

- What is the severity should a crash occur?
- What is the result of the event should it occur? Would it have a low or high impact?

I.3 Qualitative Risk Assessment Tool

A qualitative risk assessment tool rates the risk with qualitative terms (such as low, medium and high) to assess the risk associated with implementing a Design Exception. It may help to determine which risks may be considered unacceptable if mitigation strategies cannot reduce a risk classification.

Risks that cannot be reduced from a high-risk classification should be identified as reasons why an option is rejected or not considered as the preferred option. The preferred option should not contain any risks that are classified as high.

I3.1 Austroads Guide to Road Safety Risk Assessment

The following tables have been taken from Table 4.1, Table 4.2, Table 4.3 and Table 4.4 from Austroads *Guide to Road Safety Part 6A: Implementing Road Safety Audits*.

Table I3.1.1: How often is the problem likely to lead to a crash?

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five or ten years
Improbable	Less often than once every ten years

Table I3.1.2: What is the likely severity of the resulting crash type?

Severity	Description	Examples
Catastrophic	Likely multiple deaths	High-speed, multi-vehicle crash on a freeway. Car runs into crowded bus stop. Bus and petrol tanker collide Collapse of a bridge or tunnel
Serious	Likely death or serious injury	High or medium-speed vehicle/vehicle collision. High or medium-speed collision with a fixed roadside object. Pedestrian or cyclist struck by a car.
Minor	Likely minor injury	Some low-speed vehicle collisions. Cyclist falls from bicycle at low speed. Left-turn rear-end crash in a slip lane.
Limited	Likely trivial injury or property damage only	Some low-speed vehicle collisions. Pedestrian walks into object (no head injury). Car reverses into post.

Table I3.1.3: The resulting level of risk

	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low

Table I3.1.4: Treatment approach

Risk	Suggested treatment approach
Intolerable	Must be corrected.
High	Should be corrected or the risk significantly reduced, even if the treatment costs is high.
Medium	Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high.
Low	Should be corrected or the risk reduced, if the treatment cost is low.

I.3.1 DoT Risk Matrix Tool

The following table displays the overall level of risk after the consequence(s) and likelihood have been determined. Measuring the likelihood level against the assessed consequence on the risk level matrix below will provide the risk level or severity rating at both the initial and current stages. Action required for the determined risk level is also outlined in this table.

LIKELIHOOD	Almost Certain 5	Medium	Medium	High	High	Extreme
	Likely 4	Low	Medium	Medium	High	Extreme
	Possible 3	Low	Low	Medium	Medium	High
	Unlikely 2	Low	Low	Medium	Medium	Medium
	Rare 1	Low	Low	Low	Low	Medium
		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
		CONSEQUENCE				

Risk definitions

Extreme Risk	Consequences would threaten DoT viability and have serious implications for Government. Requires immediate action by DoT executive leadership team to implement stringent new controls to mitigate risk.
High Risk	Consequences would threaten the effective operation of DoT, a key DoT area, function or service. Existing controls must be effective and require additional mitigation action to be managed by executive management.
Medium Risk	Consequences would threaten a DoT activity. Existing controls must be effective and possibly additional mitigation action implemented. Mitigating action may be managed below executive management level.
Low Risk	Risk is managed by current practices and procedures. Consequences are dealt with by routine operations - monitor routine practices and procedures for effectiveness – maintain regime of continuous improvement.

Table I3.2: Likelihood Matrix

Select the likelihood category in the table below that is most suitable:

- Likelihood for risks that are activity based
- Frequency for risks that are time based

Rating	Likelihood	Frequency Single Events	Frequency Recurring Events
Almost Certain (5)	76-100%	More than likely to happen	Several times a year
Likely (4)	51-75%	As likely as not to happen (50/50)	Once or twice a year
Possible (3)	31-50%	Likelihood less than 50/50	Once in two years
Unlikely (2)	11-30%	Likelihood low but not negligible	Once in five years
Rare (1)	0-10%	Negligible likelihood	Once in 10 years or unlikely for the event to occur

Appendix J: Legal Considerations for Using Design Exceptions

National Workplace Health & Safety (WH&S) and Victorian Occupational Health & Safety (OH&S) Legislation, Codes and Practices clearly outline the responsibilities of a designer to develop a 'safe design'[2].

Section 28 of the Victorian *Occupational Health and Safety Act 2004* states

(1) A person who designs a building or structure or part of a building or structure who knows, or ought reasonably to know, that the building or structure of the part of the building or structure is to be used as a workplace must ensure, so far as is reasonably practicable, that it is designed to be safe and without risks to health of persons using it as a workplace for a purpose for which it was designed.

For the purposes of designs completed by the Department of Transport (DoT) or Contractors/Consultants employed or engaged by DoT, the word "Structure" shall be taken to include the following:

- Bridges
- Tunnels
- Culverts
- Roads (including all component parts of the road such as signs, gantries, lighting poles and signals)
- Footpaths and Landscaping

It is the duty of the designer to ensure that the design can be;

- safely constructed
- safely operated and safely used,
- safely inspected, repaired and maintained
- safely decommissioned.

As part of designing a 'safe design', it is also the responsibility to identify the risk, assess the risk, eliminate or control the risk and review the effectiveness of the controls.

For designs containing Design Exception values, it is the responsibility of the designer to demonstrate that the design that they developed is a 'safe design'. The process, tools and information contained in this RDN and *RDN 01-01 Context Sensitive Design (CSD) for Roads Projects* provide guidance to designers to help develop and justify their design as a 'safe design'.

Although it is a requirement for designers to submit a Design Exception Report for approval, this does not remove the responsibility of the designer to ensure they have produced a 'safe design'. The designer is ultimately responsible for the design they develop and therefore it is essential that the designer is satisfied that the design they have developed is a 'safe design' and that the risk is acceptable.

[2] https://www.worksafe.vic.gov.au/safe-design-safety-basics