



Llywodraeth Cymru
Welsh Government

Requirements for Road Restraint Systems. Implementation Guide – Wales

Instructions for use:

This guidance document applies to all works proposed on, or immediately adjacent to the trunk road and motorway network in Wales. This includes; highway improvement schemes, maintenance activities and work being undertaken by / or on behalf of third party organisations.

This document provides those involved with the design, maintenance and installation of Road Restraint Systems with further guidance when applying the Design Manual for Roads and Bridges publication CD 377 “Requirements for road restraint systems” - Wales National Application Annex.

This document supersedes any previous advice issued by the Welsh Government regarding this process.

March 2023

Mae'r ddogfen hon ar gael yn Gymraeg hefyd / This document is also available in Welsh
Rydym yn croesawu gohebiaeth a galwadau ffôn yn Gymraeg / We welcome correspondence and telephone calls in Welsh

**Requirements for Road Restraint Systems
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1 Introduction

- 1.1.1 The UK's roads are amongst the safest in Europe¹, nonetheless the number of Personal Injury Collisions involving vehicles leaving the carriageway remains high when considered as a proportion of all collisions². Despite the large proportion of collisions involving vehicles leaving the carriageway nationally, the number of incidents of a vehicle leaving the carriageway at one particular location is likely to be low.
- 1.1.2 Justifying the introduction of relatively expensive Road Restraint Systems (RRS's) to reduce safety risks can be challenging, as is determining the appropriate risk assessment to evaluate the provision of RRS, especially given the nature of trunk roads across the Welsh road network.
- 1.1.3 This document has been developed to provide those involved with the design, maintenance and installation of RRS with further guidance when applying the Design Manual for Roads and Bridges (DMRB) publication [CD 377 "Requirements for road restraint systems" - Wales National Application Annex](#). This document also provides guidance on road restraint asset management.

2 Scope

- 2.1.1 It should be noted that both this document, and the requirements and advice in DMRB document CD 377, applies to all works on the Overseeing Organisations motorway and trunk road network, this includes:
- Highway improvement schemes,
 - Maintenance activities,
 - Work being undertaken by / or on behalf of other third party organisations, such as, local authorities, rail authorities, utility companies and developers. There is additional guidance on this in [WG Procedure & Advice Guidance PAG 109/18 – "Welsh Government Motorway and Trunk Road Network. Section 38, 184, and 278 Agreements under the Highways Act 1980"](#).
- 2.1.2 The documents will also apply when third party organisations are undertaking works adjacent to the motorway or trunk road network, that:
- proposes features that may potentially present a hazard to motorway and trunk road users,
 - proposes features that may be vulnerable to errant motorway and trunk road vehicles, or;

¹ PACTS July 2021 – In 2020 the UK was the 3rd safest country in Europe.

² Reported road accidents, vehicles and casualties tables for Great Britain 2020 – Almost 30% of Personal Injury Collisions involve single vehicles hitting an object off the carriageway.

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- may impact on the intended performance of an existing RRS on the motorway or trunk road network.

3 Terms and definitions

3.1.1 The terms and definitions used in this document are consistent with the parent DMRB document CD 377. Any additional terms specifically used in this document are identified below:

Term	Definition
ERIC	Commonly used acronym to describe the hierarchy of control measures for taking account of the general principles of prevention; Eliminate, Reduce, Isolate, Control.
Like for Like RRS repair	Permanently repairing RRS features to match the existing RRS system, which may not be to current requirements or specifications as the legacy RRS system originally installed does not meet updated requirements or specifications. Note: CD 377 WNAA uses the term “Like for Like renewal”.
Overseeing Organisation	Welsh Government.
Parent document	DMRB CD 377.
RRS Replacement	Replacing a legacy RRS system or feature with a new system or feature that meets the current requirements and specifications.
Temporary repair / mitigation	Provision of a holding repair or providing temporary traffic management, while a permanent solution is being agreed with the Overseeing Organisation.

4 Updates to this PAG document

4.1.1 It is intended that this PAG document will be periodically reviewed and updated to ensure that changes to policy and procedures related to the provision of RRS are addressed.

5 DMRB CD 377 - Wales National Application Annex

5.1.1 The CD 377 “Requirements for road restraint systems” - Wales National Application Annex (WNAA) shall be implemented forthwith on all the Overseeing Organisation’s motorway and all-purpose trunk roads in Wales. The WNAA has been developed to address the specific needs for trunk roads in Wales and therefore alters and supplements the main CD 377 document. The impact of the WNAA is generally set out below in the sequence of the WNAA, however this is adjusted where appropriate to present a more detailed explanation of the impact of the WNAA.

5.1.2 The WNAA replaces CD 377 clause 1.2 with clause W/1.2.

W/1.1	CD 377, clause 1.2 shall not apply
W/1.2	This document shall apply to all motorways and trunk roads across the Wales road network.
NOTE	Guidance on the implementation of CD 377 and this document can be found in RRRSG (W) [Ref 6.N].

5.1.3 This has the effect of making CD 377 applicable to all motorways and trunk roads in Wales, including those with speed limits of less than 50mph and traffic flows of less than 5,000 vehicles AADT (which are exempt in England as a result of the main body text clause 1.2).

5.1.4 However, this should not be seen as a more onerous requirement because of the WNAA replacement of CD 377 clause 1.7, with WNAA clause W/1.7 (see below), which allows an appropriate risk assessment (approved by the Overseeing Organisation) to be used on all motorways and trunk roads in Wales. Therefore, the choice between the Road Restraint Risk Assessment Process for Wales (RRRAPfW) and a risk assessment is a matter of judgement for the designer and Overseeing Organisation.

Application of risk assessments to determine RRS requirements	
W/1.6	CD 377, clause 1.7 shall not apply.
W/1.7	For all motorways and trunk roads across the Wales road network, a risk assessment that is acceptable to the Overseeing Organisation, shall determine whether RRS is necessary.

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- 5.1.5 As CD 377 clause 1.7 does not apply in Wales the associated NOTE to clause 1.7 in the main CD 377 text is also not applicable. However, clause 1.7's reference to guidance in CD 377 Appendix A for low flow and / or low speed roads is replaced via the NOTE associated with WNAA clause W/2.3, shown below. This allows the Overseeing Organisation to accept any risk assessment it considers is appropriate for the particular instance.

W/2.3	Where the use of the RRRAP [Ref 9.N] for Wales is disproportionate to the scale of the works or route, the use of alternative methods of undertaking a risk assessment as to whether an RRS is warranted shall be agreed with the Overseeing Organisation.
NOTE	Examples of alternative methods of undertaking an assessment based on risk as to whether an RRS is warranted include the following: <ol style="list-style-type: none">1) RRRAP [Ref 9.N] applied with local considerations, for example on a junction modification scheme, the RRRAP [Ref 9.N] can be applied locally to the junction rather than the entire route;2) CD 377 [Ref 2/I] Appendix A;3) Local policies or methods that are acceptable to the Overseeing Organisation.

- 5.1.6 WNAA supplements CD 377 clause 1.4 by adding an additional sentence in W/1.4 (shown below) to allow a like-for-like renewal (repair) where an existing RRS needs a minor repair or suffers accidental damage. This option is not available in the main CD 377 document. The adoption of this choice is a matter of judgement and agreement with the Overseeing Organisation.

Like for like renewal (additional to CD 377, 1.4)	
W/1.4	Where an existing RRS needs minor repairs or suffers accidental damage, a like-for-like renewal of a RRS shall be agreed with the Overseeing Organisation.

- 5.1.7 Similarly, where making a RRS compliant is considered to be too expensive or cause undue delay WNAA advice clause W/1.4.1 (see below) allows a like-for-like repair to be agreed via an evidence-based business case.

W/1.4.1	Where making RRS compliant with current requirements results in significant undue additional expense or delay, a like-for-like reinstatement should be supported by a evidence-based business case, comparing options.
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- 5.1.8 WNAA clause W/1.5 requires the evidence-based business case to be recorded and agreed with the Overseeing Organisation.

W/1.5	Any evidence-based business case for like-for-like reinstatement shall be recorded and agreed with the Overseeing Organisation.
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6 General Requirements

- 6.1.1 The WNAA replaces CD 377 clause 2.2 including its associated notes, NOTE 1 to NOTE 6, with clause W/2.2, plus new associated notes NOTE 1 and NOTE 2, as shown below.

W/2.2	On all motorways and trunk roads across the Wales road network, the RRRAP [Ref 9.N] for Wales shall be used to formally record the type and location of all of the hazards which are to be mitigated by the design.
NOTE 1	The RRRAP [Ref 9.N] can be used on motorways and all purpose trunk roads having a speed limit of 50mph or greater, and an AADT of 5,000 or greater.
NOTE 2	Access to the RRRAP [Ref 9.N] for Wales can be obtained from the Overseeing Organisation.

- 6.1.2 This WNAA clause has the effect of requiring the RRRAPfW to be used, removing the comment about RRRAP being a software tool (CD 377 Note 1) and the reference to guidance on the use on roads with low speeds and/or low flows (CD 377 Notes 2 and 3). It also removes the advice that RRRAP may be inappropriate for central reserves, roundabouts and junction areas (CD 377 Note 4), information on what data RRRAP uses and data it can provide (CD 377 Note 5) and that RRRAP does not cover pedestrian restraint systems, arrester beds, anti-glare systems or cattle grids (CD 377 Note 6). It is advised that CD 377 Notes 1 to 6 **are still applicable in Wales** and that in future updates to CD 377 these notes will be reinstated for the Welsh road network.
- 6.1.3 WNAA clause W/2.2 requires RRRAPfW to be used to formally record the type and location of all of the hazards which are to be mitigated by the design. However, this requirement is only applicable where the RRRAPfW process is being applied and is not required if an alternative risk assessment method is proposed and has been agreed with the Overseeing Organisation, as permitted by WNAA clause W/2.3 (this will be clarified in future updates to the CD 377 WNAA).

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- 6.1.4 WNAA clause W/2.3 is a supplementary clause to the main CD 377 document and offers the alternative methods of risk assessment where the use of RRRAPfW for determining the need for RRS is disproportionate to the scale of works or route. This shall be agreed with the Overseeing Organisation.

W/2.3	Where the use of the RRRAP [Ref 9.N] for Wales is disproportionate to the scale of the works or route, the use of alternative methods of undertaking a risk assessment as to whether an RRS is warranted shall be agreed with the Overseeing Organisation.
NOTE	Examples of alternative methods of undertaking an assessment based on risk as to whether an RRS is warranted include the following: <ol style="list-style-type: none">1) RRRAP [Ref 9.N] applied with local considerations, for example on a junction modification scheme, the RRRAP [Ref 9.N] can be applied locally to the junction rather than the entire route;2) CD 377 [Ref 2.I] Appendix A;3) Local policies or methods that are acceptable to the Overseeing Organisation.

- 6.1.5 In the examples given above in the WNAA clause W/2.3 NOTE, bullet point 1) is considered to be in accordance with CD 377 main body text requirements and advice, bullet point 2) references the Appendix A alternative method that was replaced by WNAA clause W/1.6 and bullet point 3) allows any policy or method that is acceptable to the Overseeing Organisation to be used where the use of RRRAPfW is disproportionate to the scale of the works or route.

7 Passively safe road furniture and winter maintenance crossing points

- 7.1.1 WNAA clauses W/3.1, W/3.2 and W/3.2.1 to W/3.2.3 provide additional requirements to CD 377 clause 3.43. They do not replace any of CD 377 clause 3.43 so both the parent document and WNAA requirements and advice apply in Wales. However, subject to some conditions, WNAA clause W/3.2.3 allows passively safe sign / signal posts to be located in the working width of double-sided safety barrier in the central reserve.
- 7.1.2 WNAA clause W/3.3 removes CD 377 clauses 3.109 to 3.113 inclusive and replaces them with WNAA clauses W/3.3.1 and W/3.3.2. These clauses address winter maintenance crossing points through the central reserve. The effect of the WNAA is to allow the Overseeing Organisation to agree these crossing points on a case by case basis. WNAA clause W/3.3.2 requires the consultations to include emergency services and operational needs.

8 Cattle grids - Siting of cattle grids

- 8.1.1 WNAA removes CD 377 clause 13.3 and replaces it with clause W/4.1 as below:

W/4.1	Cattle grids and any associated by-pass shall be located within highway land unless a legal agreement with the relevant land owner has been entered in to.
NOTE	For cattle grids to be located on non-highway land, a legal agreement is entered into under Section 87 of the Highways Act 1980 [Ref 1.I].

- 8.1.2 This amendment removes the CD 377 advice that new cattle grids should be located within the highway boundary and the associated NOTE. The WNAA note associated with clause W/4.1 clarifies that when siting cattle grids on non-highway land then a legal agreement under Section 87 (Highways Act 1980) is entered into with the landowner.

9 Summary of amendments

- 9.1.1 In summary, the WNAA allows the designer to undertake an appropriate risk assessment for proposals for new, repaired and replacement RRS which should be agreed with the Overseeing Organisation on a case by case basis.
- 9.1.2 On motorways and trunk roads with a speed greater than 50mph or daily volumes greater than 5,000 vehicles, a full RRRAPfW is the default risk assessment requirement, however on other trunk roads, and where the use of the RRRAPfW is disproportionate to the scale of the works or route, the use of alternative methods of undertaking a risk assessment as to whether a RRS is warranted should be agreed with the Overseeing Organisation. See Table 3 for further guidance on the application of RRRAPfW / risk assessment to different types of scheme.
- 9.1.3 The text below provides further guidance to designers who are either following the RRRAPfW process or developing their own risk assessment for acceptance by the Overseeing Organisation.

10 General requirements

Application

- 10.1.1 On all motorways and trunk roads across the Wales road network, the RRRAPfW should typically be used to formally record the type and location of all of the hazards which are to be mitigated by the design.
- 10.1.2 However, where the use of the RRRAPfW is disproportionate to the scale of the works or route, the use of alternative methods of undertaking a risk assessment as to whether an RRS is warranted should be agreed with the Overseeing Organisation, see Table 3 for guidance.
- 10.1.3 Examples of alternative methods of undertaking an assessment based on risk as to whether an RRS is warranted include the following:
- 1) RRRAPfW applied with local considerations, for example on a junction modification scheme, the RRRAPfW can be applied locally to the junction rather than the entire route;
 - 2) CD 377 Appendix A;
 - 3) Local policies or methods that are acceptable to the Overseeing Organisation.

Approach to completion of Risk Assessments / RRRAPfW

- 10.1.4 The first action is to confirm the need for the scheme, its extents, and the applicability of CD 377 WNAA clause W/1.3 (also see Table 3 of this document). The second action is to follow the ERIC principle of dealing with all hazards as set out in CD 377 clause 2.3.1 of; eliminate, reduce, inform and only then to consider control which is the provision of RRS.
- 10.1.5 The scheme then proceeds in two simultaneous directions:
- 1) Commission a Risk / RRRAPfW assessment. If the scheme is being undertaken on a section of the network that has already been assessed, then this action may be as simple as retrieving the completed risk assessment / RRRAPfW assessment from files. However, in most circumstances this action will comprise the employment of resources to deliver a new risk assessment / RRRAPfW. The initial assessment should be as coarse as possible, ensuring that all hazards are identified and using conservative assumptions as to the severity / aggressiveness of the hazard.
 - 2) Consider whether RRS installation or upgrade is possible as part of the scheme in question. It is essential that engineering judgement is employed in this action and wherever possible this should be underpinned with evidence, see section 11 of this document. RRS installation or upgrading will always be technically possible but there may be many reasons why it should not be carried out as part of the scheme in question. The professional judgement that will need to be

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made at this stage will need to consider the points identified in Table 1 and the evidence highlighted in Table 2.

- 10.1.6 If engineering judgement concludes that RRS provision is not appropriate as part of the scheme in question, then, subject to the Overseeing Organisations approval, the scheme should progress independently of the risk assessment / RRRAPfW outcome. The justification for this is that safety is likely to have been a key driver behind the need for the scheme and delay to the scheme could have unacceptable consequences. The risk assessment / RRRAPfW is a mandatory requirement that provides a robust audit trail, and it is essential that no scheme covered by WNAA clause W/1.3 in the CD 377 proceeds beyond Road Safety Audit Stage 2 (see DMRB document [GG 119 'Road safety audit'](#) clause 5.20 for detailed information about Road Safety Audits) without completion of a risk assessment / RRRAPfW.
- 10.1.7 In the event that the risk assessment / RRRAPfW concludes that RRS provision or upgrading is necessary, but the designer's judgement is that RRS provision should not be included as part of the scheme, the agreement in principle of the Overseeing Organisation should be sought.
- 10.1.8 Where the risk assessment / RRRAPfW indicates a new RRS is necessary and the Overseeing Organisation's agreement is to proceed with the scheme without RRS works, it will be necessary to submit a formal application for a Departure from Standards (see [WG Procedure and advice guidance \(PAG\) 101/14: departures from standards for trunk roads and motorways](#) for details on how to apply for Departure from Standards).
- 10.1.9 Where the need for RRS works is not identified through a risk assessment or RRRAPfW undertaken by the designer and agreed by the Overseeing Organisation there is no requirement to submit a Departure from Standards. The Departure is only required where a risk assessment / RRRAPfW identifies a need for RRS and this is not proposed to be installed as part of a scheme.
- 10.1.10 Where a Departure is proposed to be submitted, it will be imperative that engineering judgement underpinned with evidence (see Tables 1 and 2 of this document) is employed to consider whether alternative measures to reduce the risk of errant vehicles impacting with unprotected hazards can be installed as part of the scheme. The alternative measures could include the following:
- Hazard indicators such as reflective strips
 - Warnings such as improved signage and road markings
 - Speed enforcement
 - Localised speed restrictions
 - Removal or relocation of hazards
 - Vegetation removal to improve visibility
 - Changes to the road alignment
 - Alternative containment measures

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- 10.1.11 The consideration of alternative measures should be described in full on the Departure from Standards application form. The form should also provide an indication of the potential for RRS provision to be undertaken as part of future schemes in the vicinity, typically where a larger scheme is currently programmed and RRS provision may be proportionate to the cost of that scheme.
- 10.1.12 To ensure that schemes are not delayed by the Departure process, the Departures should be submitted as early as possible in the preliminary design stage. For cases where a Departure has been approved and the omission of RRS is acceptable to the Overseeing Organisation, the need for RRS will be placed in the appropriate renewals programme and managed in accordance with WG renewal policies.

11 Engineering judgement / use of data as evidence

11.1.1 Engineering judgement is required whenever undertaking a risk assessment, to both determine the need for RRS and to determine the most appropriate risk assessment to utilise in the evaluation.

11.1.2 Items that should inform engineering judgement are summarised in Table 1. This is not an exhaustive list and designers should apply their own judgement based on their experience and knowledge related to the specific scheme under consideration.

Table 1 – Examples of Engineering Judgement

Ref.	Engineering Judgement	Considerations
1.	What is the nature of the hazard being considered for protection with RRS?	For example, is the hazard a single signpost that may present road users with minimal risks, or is the hazard the potential for rail incursion that could result in catastrophic outcomes.
2.	Go through ERIC principles first.	Can the hazard be eliminated, reduced or relocated?
3.	Will the cost of RRS provision or upgrading be proportionate to the cost of the scheme?	Will the costs and impacts of providing the RRS outweigh its potential safety benefits?
4.	Will the cost of the provision of RRS make the scheme undeliverable?	If the scheme becomes undeliverable, there may be wider safety benefits that do not get realised.
5.	Are there other more cost effective methods of reducing the risk of an errant vehicle impact with roadside hazards at this location?	Relocation of the hazard. Passively safe street furniture. Alternative restraint methods for low risk sites. Additional traffic signs, road markings or high friction surfacing. Reduced speed limits (mandatory or advisory).
6.	Will the delay to design and construction of the RRS result in a road safety risk? Can RRS provision be accommodated within the existing highway boundary, without land acquisition? Can RRS be provided without significantly affecting the	The delay to design (including land purchase) and construction of a RRS may result in an inappropriate diversion remaining in place or Temporary Traffic Management remaining in place for an extended period, resulting in an increased safety risk.

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Ref.	Engineering Judgement	Considerations
	current scheme programme and increasing disruption to a level disproportionate to the benefits provided by the RRS?	
7.	Would the provision of a RRS increase the severity of a collision?	<p>Could the RRS present a greater hazard than the feature being protected?</p> <p>Could the adjacent land provide a safer roadside for errant vehicle run-off than impact with a RRS?</p> <p>RRS can be a hazard for errant motorcyclists.</p>
8.	How will the provision of a RRS impact on construction and maintenance risks?	Will these construction risks be potentially higher than any risk to users?
9.	Will the RRS or cattle grid provision be environmentally acceptable?	<p>Will verge clearance / widening have a significant impact on biodiversity and habitat?</p> <p>Will the RRS and associated work have a visual impact?</p> <p>Will the cattle grids trap hedgehogs and amphibians or create a noise problem for neighbours?</p>
10.	Will the RRS affect the emergency use of a verge by road users?	<p>If there is insufficient RRS set-back, vehicles may be forced to remain on the carriageway in the event of a breakdown, which may create an operational hazard, rather than having access to the relative safety of a soft or hard verge.</p> <p>Will the provision of RRS impact on road users' ability to wait away from their vehicle in the case of a breakdown or other incident?</p>
11.	Could RRS provision at this location impact negatively on social aspects?	Through restricting accesses to properties or fields, or through diverting funds from higher risk locations?

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Ref.	Engineering Judgement	Considerations
12.	Will a non-compliant RRS be required in the location?	<p>Could a non-compliant system present road users with a greater risk than the hazard being protected? For example, by a reduced length of need, non-compliant set-back or working width?</p> <p>Note: this will be influenced / determined by the Departure from Standard process</p> <p>Would a compliant system result in an unaffordable scheme or unacceptable impacts?</p>
13.	Driver behaviour	What is the likelihood of drivers speeding or overtaking in the location?
14.	If replacing an existing RRS at a low risk site, would retaining the existing system be acceptable in the short term?	Although the existing RRS may have reached its end of life or is now considered a non-compliant system, does it still provide adequate protection for the low risk location in the short term (while a longer term RRS replacement or removal is being planned)?
15.	If replacing a damaged RRS, is the damage minor, can the repair be deferred until large scale works are programmed?	At low risk sites, risks to maintenance operatives fixing minor collision damage could be reduced if minor repairs can be coordinated with large scale works.
16.	Buildability	Can the proposed RRS be constructed without significant traffic management and disruption.

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Ref.	Engineering Judgement	Considerations
17.	Maintainability	<p>Is the proposed RRS product in current use on the trunk road network, are components and competent installers readily available in the UK to meet WGTRMM timescales for repair?</p> <p>Does the system permit the rapid 'like for like' repair of damaged components?</p> <p>How easy are the cattle grids to maintain?</p>
18.	Interfaces with existing RRS systems	<p>Is testing required on non-standard transition interfaces to demonstrate an adequate system?</p> <p>Note: this will be influenced / determined by the Departure from Standard process.</p>

11.1.3 Engineering judgement should be underpinned by evidence wherever possible; Table 2 below includes examples of the type of data that can be used to help achieve informed decisions made within a risk assessment.

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Table 2 - Examples of data that can be used to inform a risk assessment

Ref.	Data Source	Description / use
A.	Personal Injury Collision (PIC) Data.	<p>What PICs have occurred at the location in the last 5 years?</p> <p>How many of these PICs have involved vehicles leaving the carriageway?</p> <p>How many single vehicle loss of control PICs have there been?</p> <p>Have PICs involved a vehicle striking objects at the edge of the carriageway?</p> <p>Is there a foreseeable risk of a PIC in the location?</p>
B.	Road Geometry.	<p>Is the site on a bend or at a conflict point where road users may be more likely to leave the carriageway?</p> <p>Is the horizontal and vertical alignment compliant with the DMRB?</p> <p>Is the cross-section compliant with the DMRB?</p> <p>Is the crossfall / superelevation compliant?</p> <p>Are there any obstructions to sight lines?</p>
C.	Surfacing condition / skid resistance.	<p>What condition is the road surface in, is there any SCRIM data available?</p>
D.	Traffic flow volumes and composition.	<p>Is it a low flow site with predominately local road users?</p> <p>Is the road being used by vulnerable users – for example popular motorcycling routes?</p>
E.	Vehicle Speeds.	<p>Are the actual vehicle speeds notably above or below the posted speed limit?</p> <p>Are vehicle speeds appropriate for the geometry of the road?</p>
F.	Street lighting provision.	<p>Is the highway well-lit to minimise the risk of errant vehicles?</p> <p>Are road studs provided?</p>

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Ref.	Data Source	Description / use
G.	Traffic signing and road markings.	Is the highway well signed to minimise the risk of errant vehicles (for example the use of bend warnings signs and chevron boards) ? Is a double white line system in place? Is there edge of carriageway lines? High friction surfacing? Are existing road markings, road studs and traffic signs well maintained?
H.	Asset Maintenance Records.	These could highlight both injury collisions (that have gone unreported) and damage only collisions with existing assets along a route. These could highlight locations where persistent asset damage or damage only collisions have occurred.
I.	Operational Incident Data.	Do regional operational and maintenance teams have any records of incidents in the location?
J.	Stakeholder Engagement.	Are there any records of issues in the location (for example speed compliance issues)? Are there any records of road user complaints?
K.	Weather.	Is the location prone to fog or flooding which may increase the risk of road users leaving the carriageway?
L.	Manufacturer's RRS system test data.	Can the manufacturer underwrite the design for a particular application? e.g. the use of innovative RRS systems.
M.	Environmental data.	Are amphibians and hedgehogs present near to the proposed cattle grid site? Are Badgers present near to proposed concrete RRS?
N.	Net Zero.	Have the whole life carbon cost of alternative RRS been considered?

12 Road Restraint Risk Assessment Process for Wales (RRRAPfW)

- 12.1.1 Where a full RRRAPfW (Option 1 CD 377 WNAA clause W/2.3) has been selected the RRRAPfW assessment should be undertaken utilising the Wales organisation area within [WebRRRAP](https://rrrap.nationalhighways.co.uk/rrrap/login/login.htm) which can be found in <https://rrrap.nationalhighways.co.uk/rrrap/login/login.htm>. The [WebRRRAP User Guide](https://www.standardsforhighways.co.uk/help?tab=general-information#road-restraints-risk-assessment-rrrap) can be found in <https://www.standardsforhighways.co.uk/help?tab=general-information#road-restraints-risk-assessment-rrrap>.
- 12.1.2 The risk based RRS standard does not follow the traditional standard format. The standard has two parts that should be used together:
- The written requirements and Advice document, CD 377 'Requirement for Road Restraint Systems', which contains some mandatory requirements but gives mainly advice and guidance, and;
 - The 'Road Restraint Risk Assessment Process (RRRAPfW)', which enables the designer for each site / scheme to establish the need for a vehicle restraint and, if so, its performance requirements.
- 12.1.3 The RRRAPfW provides the designer with a tool to assist in the provision of a safe road design for hazards that are sited adjacent to the carriageway.
- 12.1.4 The RRRAPfW tool provides the client with an auditable record of the roadside in the form of a list of roadside furniture, structures, water hazards, roads, railways and other features which pose a hazard to errant vehicles that have left the carriageway. It also provides a record of the solution the designer has optimised through the process of hazard design, moving or removing hazards, specifying setback – working width combinations and benefit cost analysis for installation specification and future maintenance.
- 12.1.5 It applies site specific data to each hazard allowing the risk of impact and likelihood of occupant injury to be assessed for any hazard with multiple complex factors being applied which may influence the risk of life changing injury. Factors such as offset from the running lane, topography of the ground in advance of the hazard, the aggressiveness of the hazard itself and other factors such as bend severity, collision history, traffic volume, vehicle type balance and any effects on third parties.

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- 12.1.6 The formulae within the RRRAPfW reproduce research findings reflecting risk factors found in a number of research reports undertaken in the UK and Worldwide. These are summarised in the [Errant Vehicle report](#) also stored on the <https://www.gov.uk/guidance/standards-for-highways-online-resources> site. The outputs of RRRAPfW were benchmarked against IRRS and CD 377 and have been developed through the continuous improvement process over the last 15 years. The RRRAPfW outputs provide a good basis for hazard mitigation solutions whether that is removal of the hazard, installation of passively safe furniture or protection with vehicle restraint safety systems. The provision of solutions exceeding current standards require agreement with the Overseeing Organisation. The provision of solutions not meeting current standards require agreement with the Overseeing Organisation through the Departure from Standards process.
- 12.1.7 The RRRAPfW allocates an aggressiveness value to each hazard adjacent to the road and quantifies risk by estimating the equivalent fatalities per vehicle km. For very aggressive objects adjacent to high speed roads, the RRRAPfW indicates that the provision of a RRS is required to lower the risk to an acceptable level, regardless of the traffic flow.
- 12.1.8 However, as traffic flow decreases the benefit / cost ratio of solutions also decreases. This is because although the overall risk decreases when a RRS is provided, the benefit is relatively small due to the relatively low number of collisions it prevents. Therefore, where two-way traffic flows are less than 5,000 AADT the designer should; assess whether the output from the RRRAPfW are practicable, if the benefit / cost ratio results warrant RRS provision and discuss their findings with the Overseeing Organisation.
- 12.1.9 This does not apply to the provision of parapets.

13 RRRAPfW Account Application

Account Application Process

- 13.1.1 Where risk assessment Option 1 has been selected from CD 377 WNAA clause W/2.3 the RRRAPfW assessment should be undertaken utilising the Wales organisation area within WebRRRAP which can be found at <https://rrrap.nationalhighways.co.uk/rrrap/login/login.htm>
- 13.1.2 To access the WG area of WebRRRAP the user should send an email request to: RRRAP@gov.wales with the following details: -
- User Name
 - Organisation Name
 - Email Address
 - Contact Number
 - Regional Area (SWTRA / NMWTRA)

NOTE: RRRAPfW is not a storage system, records should be downloaded / backed up on a frequent basis. It is required that once the design has reached the

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print off appendix 4-1 stage, the record is removed (or downloaded by csv file) to free up record slots.

- 13.1.3 For any RRRAPfW / risk assessment to be completed, all records declarations need to be completed and signed off. Once the declaration is signed and the entry is final the output csv file is to be submitted to RRRAP@gov.wales where the record will be retained on the WG asset management system for future needs.

14 Resource requirements for RRRAPfW assessments

- 14.1.1 Designers should reference the RRRAPfW associated with CD 377 which can be found on the National Highway's website - <https://www.standardsforhighways.co.uk/dmrb/>.
- 14.1.2 Input into the RRRAPfW should be proportionate to the likelihood of the output being used for detailed design purposes. That is to say, if from the outset the designer knows that RRS provision will not be undertaken as part of the scheme that prompted the RRRAPfW assessment, the RRRAPfW can be completed as a desk-based exercise. This could be completed using resources such as freely available internet mapping services, videos and aerial photographs. The designer should however take care to ensure that a conservative approach is taken so that no significant hazards are missed from the assessment. The designer needs to bear in mind the scenario of a Police Road Death Investigation following a vehicle impact with an unprotected hazard. The Investigation will need to be able to identify the impacted hazard, what the assessment recommended and what the designer concluded if the hazard was to remain unprotected.
- 14.1.3 The above does not mean that each individual tree, telegraph pole or structure needs to be identifiable on the assessment output. The RRRAPfW guidance note indicates that it is perfectly acceptable to group hazards together as a cluster, using the worst-case characteristics. Likewise, if the assessment is not being used as a detailed design tool it would be acceptable to identify types of hazards in generic terms. It is essential that comments be provided on the form to explain the decision-making process.
- 14.1.4 If the potential to install RRS increases during the course of scheme design, then it may well be necessary to revisit the assessment to refine the input. This may require a site visit to take more accurate measurements.
- 14.1.5 WG are supportive of innovative survey techniques that reduce risk exposure to the designers and on-road operatives. Lean techniques and Innovation leading to best practice are to be captured and shared to improve safety for all.

15 Selection of risk assessment method

- 15.1.1 Table 3 below provides further guidance on the application of RRRAPfW / risk assessment to different types of scheme. The table is not exhaustive and there will be other types of scheme where designers will have to use their engineering judgement and gain agreement from the Overseeing Organisation on the appropriate assessment process to be used.

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Table 3 – Selection of risk assessment method

Ref.	Type of Work	Definition	CD 377 WNA clause	Most likely assessment method	Possible exceptions
1	Routine / cyclic maintenance.	Works which includes all routine and cyclic work, and ad-hoc repairs.	W/1.3.1	No requirement to use RRRAPfW or to review or amend any RRS	
2	Safety Critical interventions.	Category 1 defect reinstatement.	W/1.3.1	No requirement to use RRRAPfW or to review or amend any RRS	Where an element of the RRS cannot be replaced like-for-like e.g. a ramped terminal containing a welded angle beam.
All other works on motorways and trunk roads across Wales			W/2.2		
3	Minor RRS repairs or following accidental damage.		W/1.4 W/1.5	No requirement to use RRRAPfW or an approved Risk Assessment. 1) If necessary, provide a temporary holding repair or mitigation while a permanent solution is being agreed (as required by the Trunk Road Maintenance Manual (WGTRMM)). 2) 'Like for like' repair to be agreed in writing with Overseeing Organisation based on evidence-led business case to justify the choice of option. Record and agree with Overseeing Organisation as CD 377 W/1.5.	1) Potentially do nothing further if upcoming scheme includes work on the RRS (and the interim risks can be managed). Confirm in writing with Overseeing Organisation. 2) If damage is extensive and remaining RRS is aged and in poor condition discuss replacement with Overseeing Organisation and assess additional impact if also brought up to current standards (see 4 and 7 below). 3) Where a parapet is damaged and structural assessment or further investigatory work is required to ensure a repair will not result in further structural damage (e.g. severing of reinforcement in over coring of anchors).

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Ref.	Type of Work	Definition	CD 377 WNAA clause	Most likely assessment method	Possible exceptions
4	Replace existing RRS with compliant RRS (other than life expired)		W/1.4.1	RRRAPfW or an approved Risk Assessment	Prepare evidence-led business case including Risk Assessment to support a 'like for like' repair. Record and agree with Overseeing Organisation as CD 377 W/1.5
5	New Roads		W/1.3 Bullet 1)	RRRAPfW or an approved Risk Assessment and RRS provision	RRRAPfW is the default for high speed / high flow roads. Risk Assessment is more appropriate for roads with <5,000 AADT, or speed limits of 40mph or less, or junction only.
6	Highway cross-section is being altered permanently		W/1.3 Bullet 2)		
7	RRS serviceable life expired and needs replacing		W/1.3 Bullet 3)		
8	Hazard is introduced, moved or modified.	Including utility companies, modifying or installing equipment.	W/1.3 Bullet 4)		
9	Change in risk at, or near the edge of the carriageway		W/1.3 Bullet 5)		

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Ref.	Type of Work	Definition	CD 377 WNAA clause	Most likely assessment method	Possible exceptions
10	RRS needs to be dismantled	Other than where localised sections need to be removed to gain access.	W/1.3 Bullet 6)		
11	Proposed highway works near an unprotected hazard, or RRS non-compliant to CD 377		W/1.3.1 Bullet 1)		

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Ref.	Type of Work	Definition	CD 377 WNAA clause	Most likely assessment method	Possible exceptions
12	Proposed highway works are being carried out near an existing RRS which is life (service life) expired	Excluding routine maintenance and safety critical interventions	W/1.3.1 Bullet 2)	RRRAPfW or an approved Risk Assessment and RRS provision	RRRAPfW is the default for high speed / high flow roads. Risk Assessment is more appropriate for roads with <5,000 AADT, or speed limit of 40mph or less, or junction only.
13	Proposed highway works are being carried out near an existing RRS that has less than 5 years serviceable life remaining, and no other major maintenance works are planned during the remaining life of the existing RRS	Excluding routine maintenance and safety critical interventions	W/1.3.1 Bullet 3)		
14	Works behind an existing RRS	May impact on the ability of the RRS to perform as intended		Approved Risk Assessment	

Notes:

1. Always refer to CD 377 for full text, including WG WNAA
2. The list above is set out in a sequence to suit its use, not in the sequence elements appear in CD 377

16 Supplementary Information

16.1 Highway Planning Guidance - RRRAP DMRB CD 377

- 16.1.1 Privately owned highway boundary features and / or new development works near to the trunk road may have a bearing on road safety, a developer should therefore be responsible for clarifying any works proposed within this area (within 15m of the trunk road as a guide).
- 16.1.2 The developer will be responsible for reviewing the risks this work may have on trunk road users and submit a report (risk assessment) to the Welsh Government in line with DMRB CD 377. The outcome of this report may show that the developer is to provide a new RRS or make changes to an existing RRS.
- 16.1.3 When the required RRS is to be provided for highway road safety purposes, it may be delivered through a S278 agreement (including commuted sums) and will usually be adopted by the Highway Authority.
- 16.1.4 When a review indicates that no RRS is required on highway safety grounds, risks of developing next to the trunk road will be for the developer to address within the development, this will include administering supposed risks that future occupiers / owners may have due to the development's proximity to a trunk road.
- 16.1.5 To clarify if a risk assessment is required, the developer should provide details of the proposals to the email address; RRRAP@gov.wales, to gain a specialist's written confirmation.

16.2 Construction (Design and Management) Regulations 2015

- 16.2.1 The CDM regulations will apply to both new RRS schemes and the repair / replacement of existing RRS.

16.3 Environmental constraints to RRS provision

- 16.3.1 Large parts of the motorway and trunk road network in Wales are covered by environmental protections, which can constrain the installation of RRS. In some cases, schemes completed as part of the Trunk Road Forward Programme include commitments relating to minimising the visual impact and these commitments need to be considered as part of the feasibility of installing RRS.

16.4 Quality Management

- 16.4.1 Management procedures should ensure that records are retained in an appropriate archive for the necessary period, such that they remain secure, accessible and retrievable.
- 16.4.2 All information pertaining to RRS (survey, assessment, departures, photographs, inspection data, etc) should be recorded onto the IRIS Road Restraint Module (RRM) and assigned to the relevant road restraint asset.
- 16.4.3 Details of the RRS installed by the Contractor, including details of any changes made during the construction phase, together with justification, should be recorded via the risk assessment / RRRAPfW and submitted to the Overseeing Organisation as part of the Health and Safety File information.
- 16.4.4 For further details and advice on recording RRS information enquiries should be made to the email address RRRAP@gov.wales.

16.5 The Wales Transport Strategy 2021

- 16.5.1 [The Wales Transport Strategy 2021](#) sets out a new way of thinking that places people and climate change at the front and centre of the transport system. This document contains numerous aspirations, including goals for :
- The Well-being of Future Generations,
 - Decarbonisation,
 - Maintaining and enhancing biodiversity,
 - Making better use of existing infrastructure.
- 16.5.2 With respect to infrastructure and the provision of RRS the strategy commits to:
- continue to make best use of existing transport infrastructure by maintaining it and managing it effectively and efficiently,
 - upgrade existing infrastructure to meet legal obligations on accessibility and safety and to address issues such as congestion, and changes to vehicle standards, and;
 - explore future infrastructure improvements that reduce carbon emissions, including infrastructure for new fuels such as hydrogen, technology that facilitates more sustainable aviation and cargo operations, and materials innovation that improves service life, speed of construction and maintenance and reduces environmental impacts.
- 16.5.3 The Wales Transport Strategy should be applied when considering replacing, repairing and providing new RRS.

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<p>Is the cross-section compliant with the DMRB? Is the crossfall / superelevation compliant? Are there any obstructions to sight lines?</p>
<p>4.1 <u>Surfacing condition / skid resistance:</u></p> <p>What condition is the road surface in, is there any SCRIM data available?</p>
<p>4.2 <u>Street lighting provision:</u></p> <p>Is the highway well-lit to minimise the risk of errant vehicles? Are road studs provided?</p>
<p>4.3 <u>Traffic signing and road markings:</u></p> <p>Is the highway well signed to minimise the risk of errant vehicles (for example the use of bend warnings signs and chevron boards)? Is a double white line system in place? High friction surfacing?</p>
<p>5.0 <u>Traffic flow volumes and composition:</u></p> <p>Is it a low flow site with predominately local road users? Is the road being used by certain vulnerable users – for example popular motorcycling routes?</p>
<p>5.1 <u>Vehicle Speeds:</u></p> <p>Are the actual vehicle speeds notably above or below the posted speed limit? Are vehicle speeds appropriate for the geometry of the road?</p>
<p>6.0 <u>Stakeholder Engagement:</u></p> <p>Are there any records of issues in the location (for example speed compliance issues)? Are there any records of road user complaints?</p>
<p>7.0 <u>Weather:</u></p> <p>Is the location prone to fog or flooding that may increase the risk of road users leaving the carriageway?</p>
<p>8.0 <u>Details of roadside features needing protection and proximity to running traffic:</u></p> <p>Type of feature (structure, traffic sign(s), embankment, watercourse, etc...)</p>

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Size of feature.

Location in relation to the edge of the carriageway.

9.0 Rationale used in selecting risk assessment option and methodology applied:

See CD 377 WNAA clause W/2.3

See Table 3 in this guidance note.

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10.0 Example Risk Assessment Matrix

The use of Risk Assessment in highway scheme development is well established. The process involves categorising the nature of a risk in terms of its probability of happening and its likely consequence. Recommendations are then made to remove or reduce the risks that are identified. There is a degree of engineering judgement (see Table 1 in this document) in both estimating the probability of an incident occurring in a certain time period and the likely outcome of such a collision, using an evidence base (see Table 2 in this document) will help the designer to make informed decisions. The example Risk Assessment Matrix below is based on the commonly used “5 x 5” matrix frequently used with in the highway industry, however designers can derive their own Risk Assessment Matrix format for their scheme. To provide “control data”, designers and the Overseeing Organisation may find it useful to compare the risks of a proposed scheme against the risks of alternative options, a “do nothing” scenario, a fully compliant scheme or the existing highway layout, as appropriate.

Example method of recording hazard identification and analysis of safety risk, risk values and safety risk mitigations:

Activity / Decision: Decision Maker / Assessor:						Date: Contact Details:			
Ref.	Hazard/ Risk Description	Likelihood	Severity	Risk value	Response/ Control Measure	Likelihood	Severity	Risk value	Details/assumptions/ monitoring
1.									
2.									

Risk value, likelihood and severity of outcomes that may be assigned to qualitative data for the purposes of assessment:

Likelihood (L) x Severity (S) = Risk value (R)		Severity (S)				
		Minor harm; Minor damage or loss no injury	Moderate harm; Slight injury or illness, moderate damage or loss	Serious harm; Serious injury or illness, substantial damage or loss	Major harm; Fatal injury, major damage or loss	Extreme harm; Multiple fatalities, extreme loss or damage
Likelihood (L)	Very unlikely; Highly improbable, not known to occur	1	2	3	4	5
	Unlikely; Less than 1 per 10 years	2	4	6	8	10
	May happen; Once	3	6	9	12	15

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	every 5-10 years					
	Likely; Once every 1-4 years	4	8	12	16	20
	Almost certain; Once a year or more	5	10	15	20	25

Risk Value (R)	Required action
Low (1-9)	Ensure assumed control measures are maintained and reviewed as necessary.
Medium (10-19)	Additional control measures needed to reduce risk rating to a level which is equivalent to a test of "reasonably required" for the population concerned.
High (20-25)	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable.

11.0 Outcome of Risk Assessment:

The Risk Assessment should follow the principles set out within section 10.0 above and Appendix D where hazards should be listed and the risk is calculated based on probability and severity. This measure should be detailed within this section or attached as an appendix.

Outline passively safe posts / lower speed limit etc. solutions and level of risk as a result of each possible mitigation measure in line with CD 377 Chapter 2 (if resultant risk not within the 'broadly acceptable' region, a Departure from Standards will be required).

Mitigation options may involve:

1. Eliminating the risk (by removing the hazard);
2. Reducing the risk of impacting the hazard (by relocating the hazard to a
3. Position posing less overall risk and/or by redesigning the hazard to make it less aggressive e.g. by passively safe supports);
4. Informing road users, road worker and third parties of the risk posed by the hazard (by providing additional signage and lining, for example);
5. Controlling the risk (by the installation of a RRS).

It is preferable to eliminate the risk over reducing it. In turn, reducing the risk is preferred over informing road users, road workers and third parties of the risk and controlling the risk.

Other measures which also reduce the level of risk should be identified including:

1. Additional risk management requirements contained in the DfT report 'Managing the accidental obstruction of the railway by road vehicles' MAOR [Ref 20.N];
2. A lower speed limit or advisory speed limit;
3. Revision of the road layout and / or cross-section;
4. The installation of high friction road surfacing.

Should RRS provision be required – document length of need, performance specification and design aspects that support this outcome

Are there any temporary / permanent mitigation measures proposed which negate the need for a risk / RRRAPfW?

Can the cost of the proposed measures be included in the works within the budget allocation?

Is the cost associated with mitigating containment risk considered disproportionate to the scale of works and/or risk posed by any unprotected hazards?

Based on the Risk Assessment undertaken and the mitigation options available, it is recommended that.....

12.0 Actions - Select one of the three actions and seek the Overseeing Organisation's approval.

<p>Option 1</p> <p>If the risks assessed under section 10.0 and 11.0 are considered of an acceptable level to the Overseeing Organisation, the planned works may proceed and the need to RRRAPfW or provide RRS may be deferred until next planned intervention or added to relevant programme. Whichever option is recommended under section 10.0 and 11.0, and agreed by the WG Lead.</p> <p>The RRRAPfW or RRS works have been submitted via RRRAP@gov.wales for inclusion in a RRS programme for future years.</p>	Y/N	
<p>Option 2</p> <p>If the risks assessed under section 10.0 and 11.0 are considered unacceptable to the Overseeing Organisation and the proposed RRS / mitigation measures are considered affordable. Works may only proceed on the basis that the recommended RRS measures (permanent or temporary) are added to the scope of the planned works.</p> <p>The recommended mitigation measures from Section 10.0 and 11.0 have been acknowledged and passed to the designer to be implemented as part of the planned works.</p>	Y/N	
<p>Option 3</p> <p>If the risks assessed under section 10.0 and 11.0 are considered unacceptable to the Overseeing Organisation and the proposed RRS / mitigation measures cannot be funded as part of this scheme or considered disproportionate to scale of works a Departure from Standard for exclusion should be prepared and submitted to WG for approval.</p> <p>The recommended mitigation measures from Section 10.0 and 11.0 have been acknowledged and the designer is to prepare a Departure in line with WG policy.</p>	Y/N	
Position	Designer	WG Operational Lead
Purpose	Approval	Agreement
Name		
Date		

Appendix B: Justification for repair or replacement of RRS.

B1 Background

- B1.1 The safety fencing asset of the motorway and trunk road network is a large and disparate asset consisting of several different designs of safety fencing system which date back to the earliest designs in the 1960's and 1970's. Each system is made up of galvanised steel components of posts, rails, spacers, base plates, etc. some of which are unique to that particular system. Current systems are detailed in the MCHW.
- B1.2 Some of the earliest designs incorporate galvanised steel rails attached to timber posts. The posts are usually in a state of advanced deterioration and the Trunk Road Agents are under instruction to replace these systems whenever damage occurs or when funds allow.
- B1.3 The lack of spares for early designs has also been an issue which has required RRS replacement rather than repair in the event of damage.
- B1.4 The inspections to date have revealed many defective locations where either a repair or an alternative road restraint scheme is justified. The latter category includes, for instance, the replacement of a galvanised steel system by masonry walling, subject to structural, land and environmental considerations etc.

B2 Safety Fencing Replacement Restraint Schemes

- B2.1 Although there is a general presumption that the serviceable life of a galvanised steel system is 20 years it is not practicable or justifiable to assume that a 20 year old system is no longer fit for purpose. The current policy justifying a potential replacement scheme requires 1 or more of the following condition factors to be present:
- Severe corrosion where the safety fencing has a significant loss of functionality and is close to failure or has already failed.
 - Moderate corrosion where there is some loss of functionality over a minimum length of 100m.
 - A tensioned fence which is no longer able to be re-tensioned
 - Significant setback, working width, mounting height or other layout deficiencies, over a minimum section of 100m, where there has been at least 1 injury or damage only accident in the last 5 years (within the section under consideration).
 - Significant component or workmanship deficiencies, over a minimum section of 100m, where there has been at least 1 injury or damage only accident in the last 5 years (within the section under consideration).

Appendix C: Example of RRS Option Appraisal Template

1. Introduction

- Background
- Document purpose and scope

2. Site location

- Road name and designation
- Corridor / route
- Construction /opening date
- Any other additional information / local features
- Grid reference start and finish points
- Location Plan

3 Road Restraint Risk Assessment Process

- Key hazards and challenges
- Output from RRRAPfW

4. Technical options

- Compliant Option
- Alternative options
- Compliance / departure from Standards
- Delivery risks
- Value for Money
- Estimated option costs
- Options risk matrix (undertaken on all possible options using the Options Risk Matrix Appendix D).

5. Summary

- Summary of options, compliance and cost

6. Recommendation

Appendix

- A. Drawings
- B. Cost estimate
- C. Preliminary Environmental Assessment
- D. Option risk matrix table
- E. Register of reference document

Appendix D: Illustrative Options Risk Matrix

	<u>Compliance with Standards / Containment Level</u>	<u>Maintenance</u>	<u>Workforce Exposure</u>	<u>Buildability</u>	<u>Cost (Cost with risk)</u>	<u>Collective Risk Total</u>
Option 3 Retaining walls above the ditch to support an extended verge and a new RRS that does not affect visibility.	2 Proposed Retaining wall will have a masonry parapet and steel RRS on approach and departure ends of parapets.	4 Regular maintenance of retaining wall and regular inspections required to wall and RRS.	7 Potential access difficulties when inspecting retaining wall due to water levels in the ditch.	6 Consents required to work in the water course. Large quantity of imported fill required to construct the wide verges.	4 £204k (£385k)	23
Option 4 & 5 Extend the highway verge to accommodate a new RRS at a greater set-back that does not affect visibility.	2 Proposed RRS adequately protects hazards.	2 No regular maintenance required. Inspections of RRS required.	2 New RRS requires inspection every 5 years for the first 10 years and every 2 years thereafter. No significant risk to workforce.	9 Diversion of ditch will be required in some sections. Extension of box culvert will be required. Consent may be difficult to achieve.	5 Option 4 £216k (£407k) Option 5 £248k (£467k)	20
Option 6 Extending the highway verge to remove the requirement for a RRS	6 RRRAPfW indicates no RRS is required. Widened verge marginally within tolerance of complying with CD 377 RRRAPfW. No containment to stop errant vehicles from reaching water hazard and football club hazards. Widened verge reduces likelihood of reaching hazards.	2 No maintenance only routine highway maintenance (Grass cutting)	2 No increase to current workforce exposure	3 Verge extended to 6m overall. Half the amount of earthworks compared to options 3, 4 and 5.	2 £77k (£145k)	15
Option 7 Removing the water hazard by means of culverting the existing ditch	4 Culverting the ditch removes the water hazard. RRRAPfW would indicate no RRS is required. No containment to stop errant vehicles from reaching football club ground.	6 Regular maintenance to clean out the extended culvert will be required.	6 Additional workforce hours will be required to maintain the extended length of the culvert. Work will be in confined space.	9 Consents required to carry out work in the watercourse. Consent might be difficult to gain to extend the culvert due to loss of habitats / flood risks etc.	6 £383K (723k)	31
Option 8 Provide protection for the gas tank only	8 No containment at the edge of the highway.	2 No maintenance only routine highway	2 No increase to current workforce exposure	2	1 £12k	15

	Risk of errant vehicles entering water hazard. Does not comply with requirements of CD 377 RRRAPfW. Existing highway layout will remain the same with risk level remaining the same.	maintenance (Grass cutting)		Construction of masonry wall / RRS adjacent to gas tank.		
Combined Option 6 and 8	6 RRRAPfW indicates no RRS is required. Widened verge marginally within tolerance of complying with CD 377 RRRAPfW. No containment to stop errant vehicles from reaching water hazard. Widened verge reduces likelihood of reaching hazards. Containment wall or RRS to be installed in front of gas tank to further reduce likelihood of reaching this hazard.	2 No maintenance only routine highway maintenance (Grass cutting)	2 No increase to current workforce exposure	3 Verge extended to 6m overall. Half the amount of earthworks compared to options 3, 4 and 5.	2 £89k (£145k)	15
Option 9 Extend the existing RRS beyond the Concrete Box Culvert	5 Proposed RRS provides containment to errant vehicles from reaching the water hazard to the North of the box culvert, the football club grounds and the culvert headwalls. Widened verge removes requirement of RRS at southern end of scheme according to the RRRAPfW and reduces likelihood of reaching water hazard. Widened verge marginally within tolerance of complying	2 No regular maintenance required. Inspections of RRS required.	2 New RRS requires inspection every 5 years for the first 10 years and every 2 years thereafter. No significant risk to workforce.	3 Verge extended to 6m overall to the south of the box culvert, less in first 100m of scheme.	3 £115k (£217k)	15

	with CD 377 RRRAPfW. Relaxation to stopping site distance is required to one step below from 215m to 160m.					
	<u>Compliance with Standards / Containment Level</u>	<u>Maintenance</u>	<u>Workforce Exposure</u>	<u>Buildability</u>	<u>Cost (Cost with risk)</u>	<u>Collective Risk Total</u>

Risk Level Scoring

Low 1-3
Medium 4-6
High 7-9

Collective Risk Scoring

Low 1-15
Medium 16-30
High 31-45