Road Restraint Risk Assessment Process (RRRAP) v3.0 (cloud based tool).

User Guide *please note the on-line help within the tool is the primary source of help, this guide is a supplementary reference.*

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1 Introduction

1.1 Scope

This manual is intended to provide guidance and help to enable the Designer to navigate through the RRRAP in an efficient and effective way, so that appropriate decisions regarding provision of Vehicle Restraint Systems are made and documented. The guidance will also give the Designer a basic understanding of the mechanics of the RRRAP and how altering parameters such as location of hazard and VRS, length of VRS, etc affect the risk and benefit cost levels.

This manual is to be read in conjunction with TD 19/06 which contains some mandatory requirements and, in Chapter 2, general information and guidance on Risk and its Mitigation and particular information and guidance on the RRRAP in TD 19 Paragraphs and the following.

A list of abbreviations and definitions can be found in 1.4.

1.2 A précis of what the RRRAP covers and does not cover

1.2.1 The RRRAP covers

The RRRAP covers and enables an assessment to be made, based on risk, as to whether a vehicle restraint system (VRS) is warranted to prevent the occupants of an errant vehicle from hitting near side or offside hazards and the length of need in advance in the following situations.

1.2.1.1 Road type, speed and AADT

RRRAP supports Motorways, All Purpose Roads and Other Classified Roads having a speed limit of 50 mph or greater and AADT of 5,000 or greater in the following situations:

- **Motorways**
  - Motorway (D2M, D3M, D4M)– near side (N/S) verge and off side (O/S) but only where central reserve is wider than 10 m.
  - Motorway Slips and Link Roads – N/S and O/S verges
  - Smart Motorway modules covering D3M-HSR, D4M-HSR, D5M-HSR and D4M-ALR, D5M-ALR.
- **All Purpose Roads** (D2AP, D3AP, Single) - N/S verge and O/S but, on dual carriageways, O/S only where central reserve is wider than 10 m.
- **Other Classified Roads** (D2, D3, Single) - N/S verge and O/S but, on dual carriageways, O/S only where central reserve is wider than 10 m.
- **For single carriageways** the RRRAP calculates need for and the length of VRS beyond the hazard as well as that in advance.

Guidance is given in TD 19 Appendix 2 on how designers might deal with roads that are low flow (i.e. < 5,000 AADT) and or low speed (i.e. < 50 mph).

1.2.1.2 Temporary VRS

Temporary VRS requirements are covered in a different way to permanent hazards. The RRRAP contains a specific section for Temporary VRS requirements in which designers are required to complete a series of standard questions relating to the temporary circumstances. This allows the design thought process to be formally documented and recorded in a consistent manner.

The RRRAP calculation process is based on permanent situations and, although the RRRAP can be used as a guide to the temporary requirements in some circumstances, due to the wide variety of situations, scenarios and durations of deployment the RRRAP, it will only be a guide.

1.2.1.3 Gantries and Railway parapets

The RRRAP will give an indication only of the requirements for VRS provision at gantries and at Railway parapets. For gantries reference must be made to TD 19 Paragraph 3.34 and BD 51 and for parapets to Chapter 5 of TD 19 to confirm the containment level requirements.

1.2.2 Inappropriate Circumstances

The RRRAP does not allow or may not be appropriate for a direct assessment for the following circumstances.

In such circumstances designers should use the Hazard 'Comment' field to describe the process they have gone through in determining the provision of VRS and their conclusions.

1.2.2.1 Central reserves

The requirements for these are mandated by TD 19 Paragraphs 3.59 and the following. Note that for wide central reserves (i.e. those over 10 m in width) of both motorways and other roads, there may be a need to assess the protection of hazards such as lighting columns, street signs, trees, etc that are present. This can be done by selecting the offside verge option. Note that this option assumes that crossover incidents are not possible due to the width and does not make any assessment of crossover incidents within the calculation.

1.2.2.2 Roundabouts and junction areas

Generally, the RRRAP is not suitable for use at a roundabout or a junction. At a roundabout it could potentially be used by running the RRRAP as a Motorway Slip or Link road and using the N/S for hazards on the outer ring of the roundabout and O/S for the inner ring. This is not ideal and may at best only be a rough guide to VRS requirements. A safety barrier may not be appropriate at a roundabout, and may cause more of a hazard than was there without it, due to the angle at which vehicles may impact the barrier. Other solutions such as passively safe furniture may be appropriate. Engineering judgement will need to be used in these circumstances. The RRRAP will indicate the VRS requirements on the approach to the junction and therefore will assist the designer in coming to an appropriate solution.

1.2.2.3 Laybys and Emergency Refuge Areas (ERA)

Provision for hazards that lie to the rear of a layby or ERA. It is recommended that data is input as though the layby or ERA is not there, i.e. with verge at standard width, hazards at the back of the layby or ERA at their actual offset from Psb. The RRRAP will indicate whether VRS is required to protect the hazards based on the level of risk to motorists on the carriageway, not on the level of risk to users of the layby or ERA per se.

The RRRAP will calculate and show the set-back of the VRS based on its standard 1.2 m dimension (or 0.6 m if there is a hardshoulder or hardstrip). Having calculated the risk in the Collation and Reports tab, if the RRRAP shows that a VRS is required to protect a hazard at the rear of the layby or ERA, the designer will then need to change the set-back of the VRS to its actual location relative to the back of the layby or ERA and press 'Calculate Risk' again, so that the programme calculates correctly.

The designer will need to form an opinion as to whether the provision that the RRRAP shows as necessary to give an adequate level of risk for motorists on the carriageway is adequate for users of the layby or ERA as well and, if he considers it necessary, include additional VRS and or a pedestrian restraint to the rear of the layby or ERA. Background to the decision process made in respect of the provision should be made in the Hazard 'Comment' field.

1.2.3 **The RRRAP does not cover provision of the following**

- Pedestrian Restraint Systems
- Vehicle Arrester Beds
- Anti-Glare screens

The requirements for provision of these Restraint Systems are given in Chapters 9, 10 and 11 of TD 19.

The RRRAP does not calculate the difference in risk between Impact Severity Levels (ISL). Impact severity level A affords a greater level of safety for the occupant of an errant car than level B, and level B greater than level C.

1.3 Feedback

We would welcome feedback on the following items.

- The content and usefulness of the Guidance and where it could be improved, e.g. where additional examples may be of benefit
- Problems encountered in understanding the RRRAP or the Guidance
- Instances where the RRRAP has returned unexpected answers, e.g. unusually long length of provision, or no provision where some VRS would have been expected
- Situations where the RRRAP has been unable to provide a solution
- Areas where you consider that training would be of benefit

To send feedback, you have to be logged into the RRRAP website. For details on how to submit feedback, see section 2.4.7.

1.4 Abbreviations and Definitions

Reference should be made to the list of Terminology and Definitions contained in Paras 1.43 et seq of TD 19. A list of additional abbreviations and definitions used in the RRRAP is given below.

ALR All Lane Running (as used with a Smart Motorway scenario – under development and not currently available)

CDM	Construction (Design and Management) Regulations
DBFO	Design Build Finance Operate
EMAC	Enhanced Managing Agent Contractor
ERA	Emergency Refuge Area (e.g. as used in Smart Motorways All Lane Running)
HS File	Health and Safety File required under CDM 2015
HSR	Hard Shoulder Running (as used with a Smart Motorway/controlled Motorway scenario – under development and not currently available or when under temporary traffic management)
ISL	Impact Severity Level (refer to TD 19 Chapter 3 for further details)
MA	Managing Agent
MAC	Managing Agent Contractor
MM	Managed Motorway
TAA	Technical Approval Authority
TMC	Term Maintenance Contractor
Acceptable	Where the term 'Acceptable' or 'Acc' has been used in the text, this is equivalent to the term 'Broadly Acceptable'.
N/A or 'See TD 19'	Not applicable – either because that the term does not apply in the situation or, in the case of hazards such as Gantries, that the outcome of the RRRAP must be checked against the requirements in TD 19 or reference made to another Standard or to the TAA as there are factors that the RRRAP cannot take account of in determining appropriate level of VRS.
PFI	Private Finance Initiative
PPP	Public Private Partnership

Point of No Recovery –

The Point of No Recovery is the point at which the driver has no chance of getting the vehicle back on the carriageway and, unless he hits or is diverted by an intervening hazard, is going to end up on (in) the adjacent road, railway, water hazard, etc. This point may be the top of the road embankment slope or for example the top of the cutting to the railway or bank of a water hazard if the road is at grade. An assessment of the likelihood of reaching the adjacent hazard by virtue of the intervening topography (hence the need for site visit) is entered in the appropriate field in the RRRAP. The likelihood of reaching the hazard may change significantly over its length. If this is the case, the inputs need to be split into sections so that the likelihood of reaching is accurately reflected along the length. Refer to Paragraphs 5.3.2, 5.3.3 and 5.14 (Other Hazards Railways) and 5.15 (Other Hazards – Roads) and the following.

Psb	The point from which set-back is measured. (Refer to TD 27 for definition and to IAN 161 Smart Motorways – note that RRRAP cannot currently assess Smart Motorways). See also helps in RRRAP and Guidance Manual.
CSV	A comma separated value (CSV) file is used for the digital storage of data structured in a tabular fashion. Each line in the CSV file corresponds to a row in the table. Within a line, fields are separated by commas, each field belonging to one table column.

2 Overview of the RRRAP

The Road Restraint Risk Assessment Process (RRRAP) is used to record adjacent carriageway features and assist designers in determining the need for a vehicle restraint and associated performance requirements for each site/scheme in its proposed layout. It allows for optimisation or refinement of solutions using a selection of design mitigation measures: i.e. removal, re-positioning, reduction in aggressiveness of the roadside feature, trade-off between these and reduced land take / offset / hazard redesign, or implementation of roadside feature protection.

2.1 Software used and Version number of the RRRAP

The RRRAP is an online web-based application. An important function of the RRRAP is that of providing an audit trail for the Designer and Overseeing Organisation. The RRRAP requires the Designer to input information that is ancillary to the process of hazard identification and risk mitigation to provide background details for the audit trail.

Highways England may from time to time make available a revised version of the RRRAP, e.g. when there are improvements in its functionality, or changes in some of the parameters used within the RRRAP process.

The RRRAP website will indicate if a new version is available. The latest version of RRRAP should be used each time that a new project or section within the project is started.

Existing projects will be able to continue using the existing version of RRRAP that the project was started on until that part of the project is finished.

2.2 Accessing and using the RRRAP web application

To be able to access and fully use the RRRAP web application you must have the following enabled in your browser:

- JavaScript
- Pop-ups allowed for the RRRAP site. Depending on your browser settings you may have to grant permission to display pop-up dialogs for this site.

Some corporate firewalls may block certain features used by the application. If you experience any problems, please check with your local IT support that full access is configured.

The RRRAP site uses Secure Sockets Layer (SSL) to encrypt and secure all internet traffic from your browser to RRRAP.

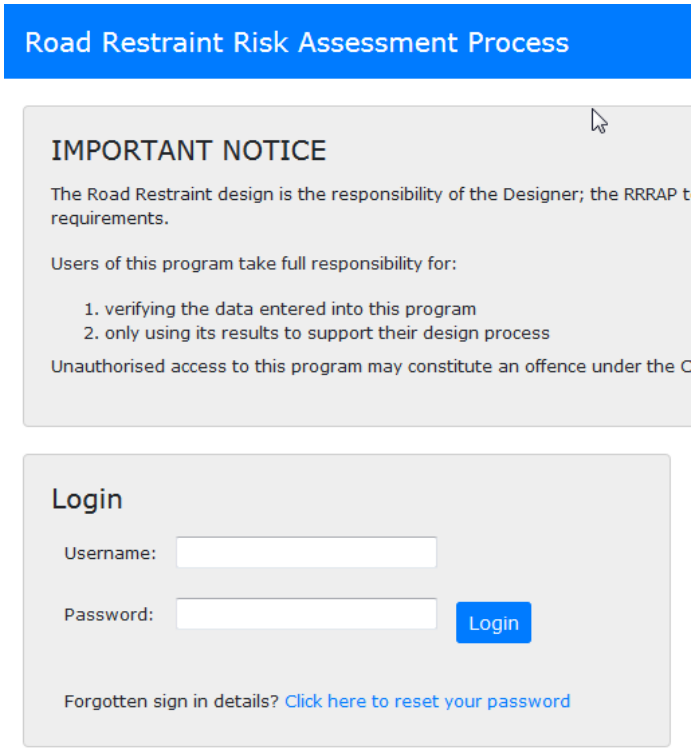


Figure 2-1 RRRAP Login Page

2.2.1 GDPR

On first time login to RRRAP, a GDPR privacy notice will be displayed. Clicking the Accept button will accept the privacy notice and display the RRRAP Home tab.

Clicking the Decline button will decline the privacy notice and automatically log you out of RRRAP and the Logout page will be displayed.

2.2.2 Resetting your password

If you have forgotten your password the RRRAP login page contains a link to a password reset page.

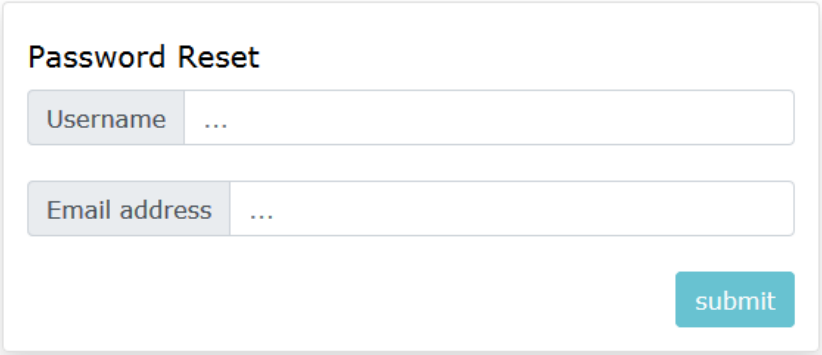


Figure 2-2 Password Reset request page

Enter your username and email address and click the submit button. A page will be displayed to confirm that an email has been sent to you.

Within the email is a link to reset your password. Clicking the link will display a reset password page in your browser. The reset email link is only valid for a limited time. If you exceed this time limit you will have submit another password reset request.

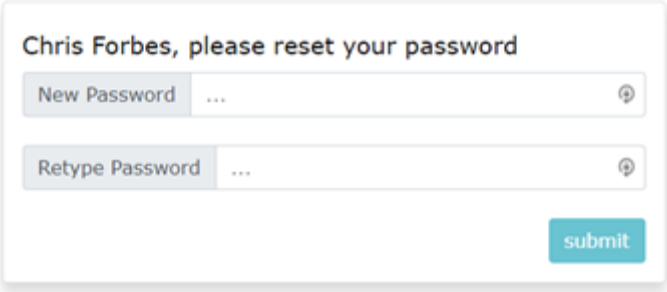


Figure 2-3 Password Reset page

Enter your new password, and then re-type your new password. See Section 2.4.6 for more details on valid password rules. Click the submit button to save your new password.

Once your new password has been saved, a password change success page will be displayed. This page has a link back to the RRRAP login page.

2.3 A Quick Guide to getting started with RRRAP

Previously, RRRAP was based on an Excel document. This web-based version is its replacement. An individual Excel file is now replaced by an individual RRRAP record.

- To create a new RRRAP record:
  1. Click the 'Create New Record' tab
  2. Enter the name for the record (think of this being equivalent to the name of a file)
  3. Select from the "Is this record related to Highways England funded work?" dropdown either Yes or No – depending on the work being undertaken. The purpose of this field is to allow the Highways England to measure how many RRRAP records are being used by its suppliers.
  4. Enter the name of the project – this should be the name of the real world project the record is related to.
  5. If desired, an optional text description can be entered to better identify / describe the record.
  6. Click the 'Create' button and your new record will be created and opened. In the top row of tabs there is now a tab representing the open record (displaying details of the record). A second row of tabs appears underneath and represents the different parts of the RRRAP record.
  7. When a record is created / opened the record status page is always displayed. From here, use the tabs to navigate through the different parts of the RRRAP record, e.g. Common Details, Hazards Overview, Collation and Reports, etc.

- To close an open record, click the ⊗ icon visible when moving the mouse over the top right corner of the tab representing the open record.
- To open an existing record, click the 'Records' tab in the top row of tabs. A table will list all your records. Click on a row in the table to open a record.

2.4 Key areas of the RRRAP web application

2.4.1 Home Page

When you log in to the RRRAP web application, you are always presented with the RRRAP home page. From here you can:

- View the latest news concerning RRRAP
- View 'Getting Started' introductory help
- Access RRRAP support contact details

2.4.2 Records Page

The records page allows you to locate and access all RRRAP records currently in use by your organisation. See section 3 for more details.

2.4.3 Create New Record

You can create a new RRRAP record by clicking on the 'Create New Record' tab that is available if no record is currently open. See section 3.7 for more details on creating a new RRRAP record.

2.4.4 Current Open Record

Once a RRRAP record has been opened (see section 3) or created (see section 3.7) the 'Create New Record' tab is replaced with the open record tab.

The open record tab is populated with the RRRAP record you currently have open (see section 2.5). The name of the tab is a combination of details from the record, including project name, record name, and the records road sub-type, verge and chainage details.

Only one RRRAP record can be open at any one time.

2.4.5 Help

Clicking the 'Help' link in the top right corner (available on every page) provides access to document downloads and useful links, a key to basic features, an overview of the RRRAP process and a list of Frequently Asked Questions (FAQ).

2.4.6 My Account

At the top right of every page in the RRRAP is the 'My Account' link (see Figure 2-4). Click this link to display your account details page. On this page are links that allow you to update some of your account details.

Also shown in your account page are the contact details of your organisation's main RRRAP contact. Should you have any RRRAP/TD-19 questions, this is the person you should try to contact first, before contacting the RRRAP support team (details available on the Home page).

<u>Update details</u>
Here, you can update some of your personal details, including forename, surname, job title, email address, and phone number.

Change password

You should change your password when you first receive your RRRAP account details.

To change your password, you must first enter your old password, and then enter your new password twice.

All RRRAP account passwords must adhere to the following conditions:

- Contain at least one numeric character
- Contain at least one upper case character
- Contain at least one lower case character
- Finally, all passwords must be between 6 and 12 characters in length

2.4.7 Feedback

To send feedback on the RRRAP, the guidance document, or to report any problems encountered in understanding the RRRAP or the Guidance, click the Feedback link available at the top right hand corner of the page. This assumes you have appropriate email client software pre-installed. Clicking the link will launch a new email window with the email address and subject line 'RRRAP Feedback' pre-populated.

If you have problems with this mechanism, you can go to the RRRAP Home page and send your comments to the email address listed for 'RRRAP Support Issues'. Please remember to use the subject line 'RRRAP Feedback'.

2.4.8 Logout

Once you have finished working with RRRAP, don't forget to Logout. Simply click the 'Logout' link and you will be logged out of the RRRAP web application. Logging out will also immediately remove any lock you have on any currently open RRRAP record.

If you do not logout of RRRAP properly and go on to close your web browser, you may not be able to log back into RRRAP for up to 15 minutes. This is because you are still logged into the RRRAP web application. After this time has elapsed, you will be able to log into the RRRAP as normal.

2.4.9 Navigation

The main ways to navigate round the RRRAP site and access its features include:

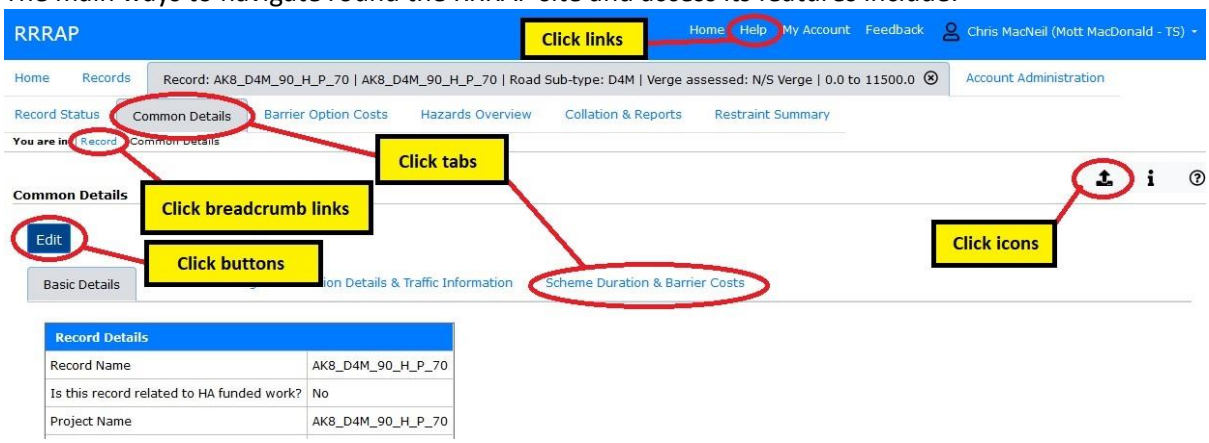


Figure 2-4 Web application navigation

"Breadcrumbs" provide a visual indication of which page is being viewed and its location within the site hierarchy. The breadcrumb trail is constructed of various hyperlinks allowing the end user to jump back to higher level sections.

2.4.10 **Common features on summary tables – paging and ordering**

There are many summary pages in the RRRAP that present lists of items, e.g. user records, all fencing hazards, etc. The items are presented in a paged table that can also be sorted (see Figure 2-5).

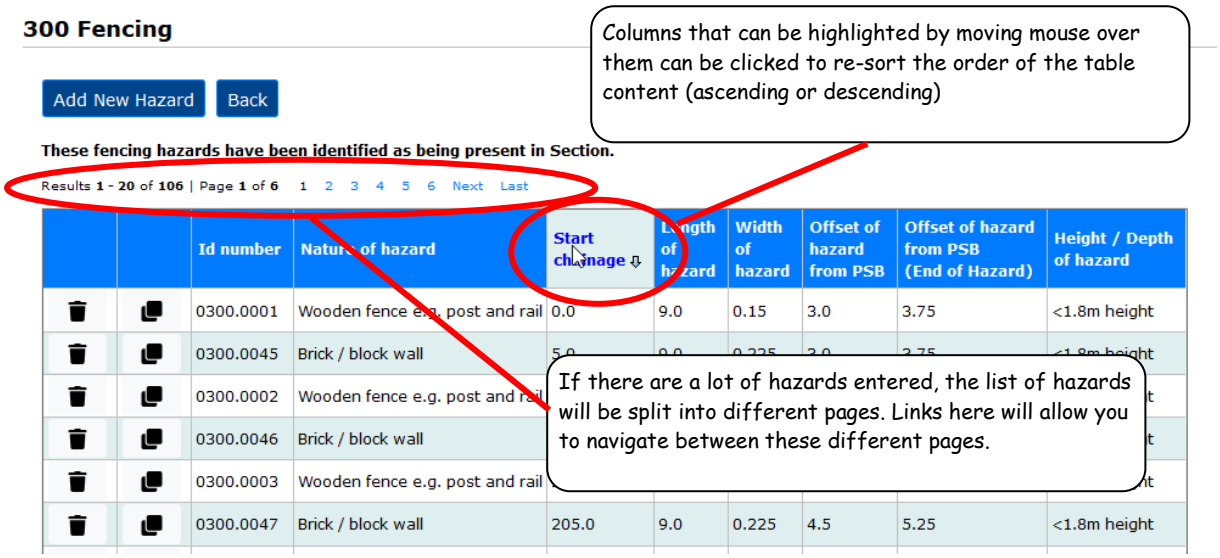


Figure 2-5 Summary table that is paged and can be sorted

2.4.11 **Data Entry**

Various data entry controls are used by the RRRAP:

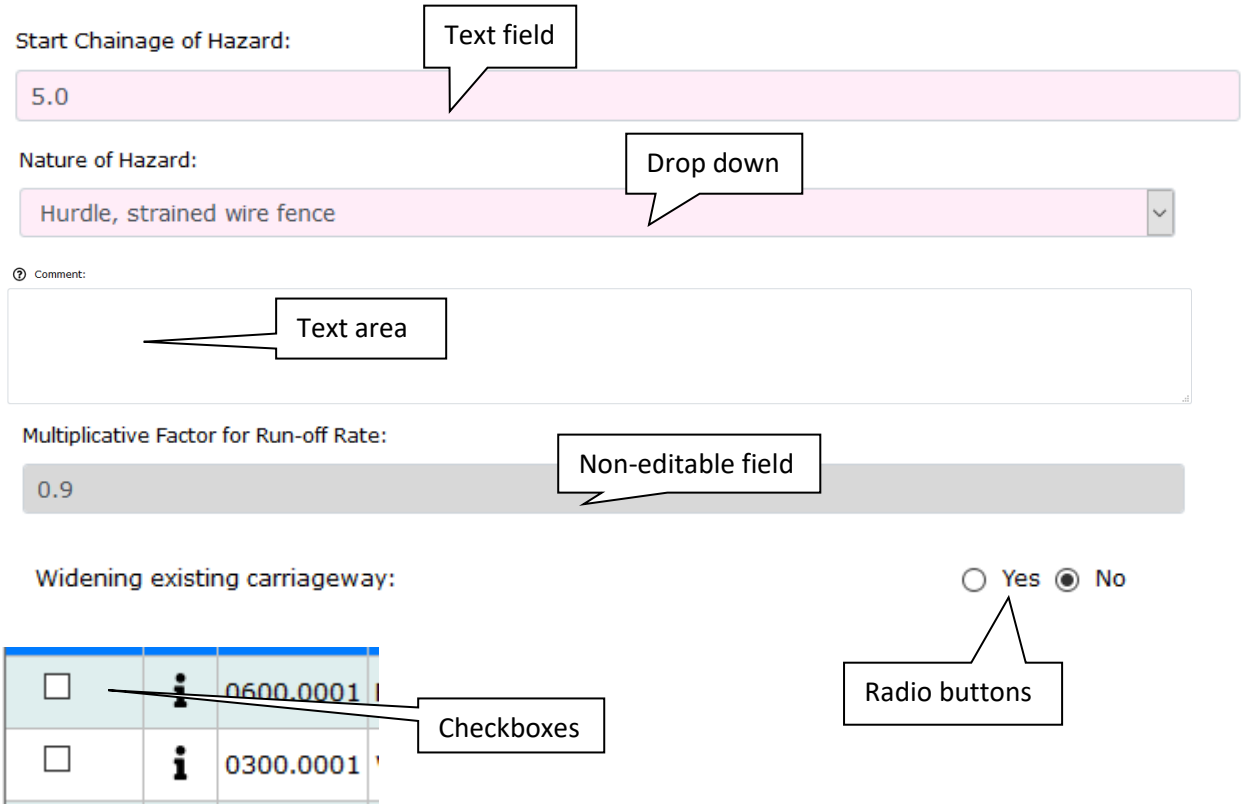


Figure 2-6 Web application data entry

- Text field – used to enter a short amount of text or numerical values
- Text area – used to enter more than just a few words of text
- Drop down – list of items to choose from
- Radio button – simple choice
- Checkbox – Either ticked or not ticked
- Non-editable field - These fields have a grey background and the value displayed cannot be changed
- Mandatory field - Some fields when entering data are mandatory. All mandatory fields must be completed on a form before it can be saved. A mandatory text field or drop-down is highlighted with a light red background colour. Mandatory radio buttons will be highlighted with a warning icon if not populated when saving data. Examples of mandatory field can be seen in the above diagram Figure 2-6 (Start chainage of Hazard & Nature of Hazard).

As you enter data and you move between fields on the form (either via use of the mouse or keyboard shortcuts) the content of the form is re-validated. If there are problems validating the content of fields, e.g. value out of range, entered text instead of a number, field missing a mandatory value, etc; then a warning icon is displayed next to the field. Moving the mouse over this icon will display a warning message that will hint at the problem with the field. An example is shown below (Figure 2-7).

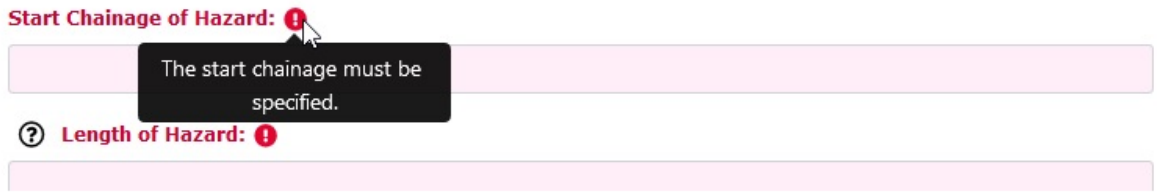


Figure 2-7 Data Entry Validation Warning

2.4.12 RRRAP Online Help

The RRRAP provides multiple access points to online help.

Clicking the 'Help' link in the top right corner (available on every page) provides access to useful links, a key to basic features, an overview of the RRRAP process and a list of Frequently Asked Questions (FAQ).

Clicking ⓘ will display dialogs with context sensitive help – providing details about the current page or even information about specific hazard fields. Note – depending on your browser you may have to grant permission to display pop-up dialogs for this site.

Clicking ℹ in the page title bar will display information aimed at helping new users navigate through the different parts of the RRRAP process.

Moving your mouse over ℹ will display a tooltip that contains additional descriptive text for record declarations in the Record Status page.

Clicking ℹ in the collation page will display a dialog that contains additional VRS and hazard details for a particular hazard in the Collation and Reports page. Note – depending on your browser you may have to grant permission to display pop-up dialogs for this site.

2.5 Arrangement of pages within an open RRRAP record

Once you have opened a record, a set of tabs will provide access to the different parts of the record where the information about the site and its hazards can be entered.

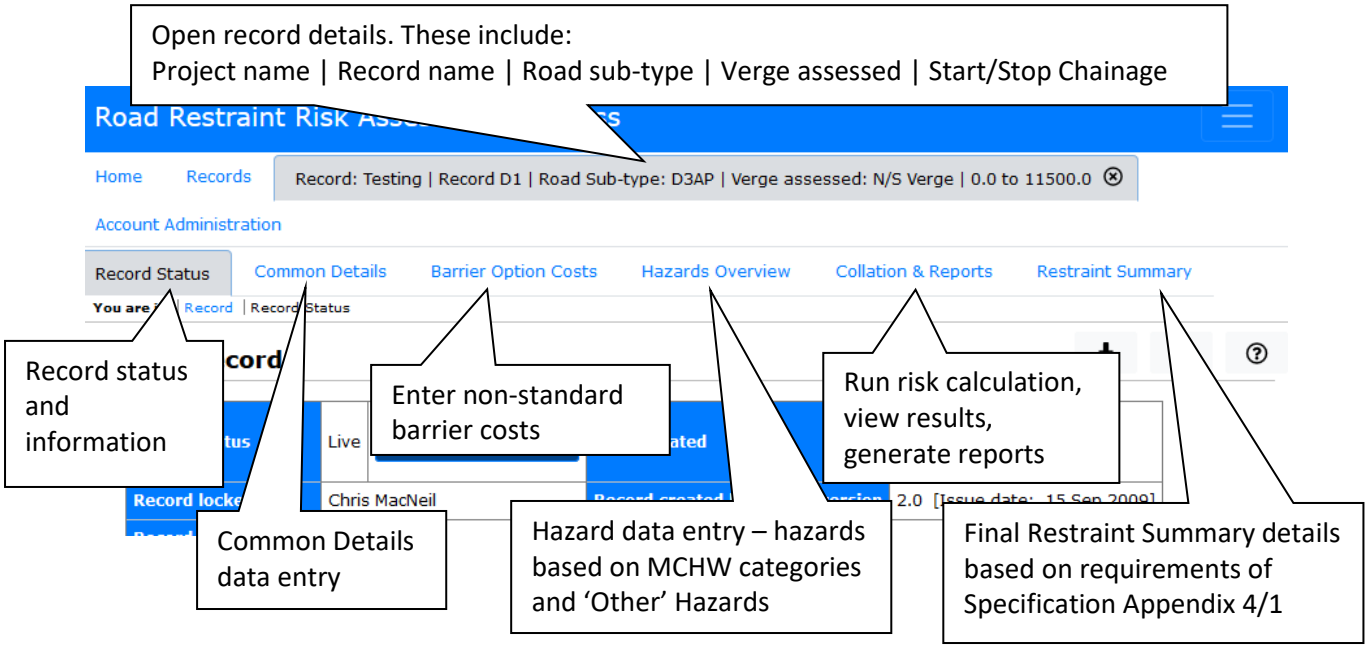


Figure 2-8 Open RRRAP Record and available sub-tabs

Figure 2-9Included in the next page, Figure 2-9 indicates how the web pages within the RRRAP inter-relate and gives an overview of the process.

Note that the 'Record Status' tab gives basic information about the RRRAP record. This includes the version number of the RRRAP the record was created with and the date that version of the RRRAP was released, the time data in the record was last updated, and the status level of the RRRAP record.

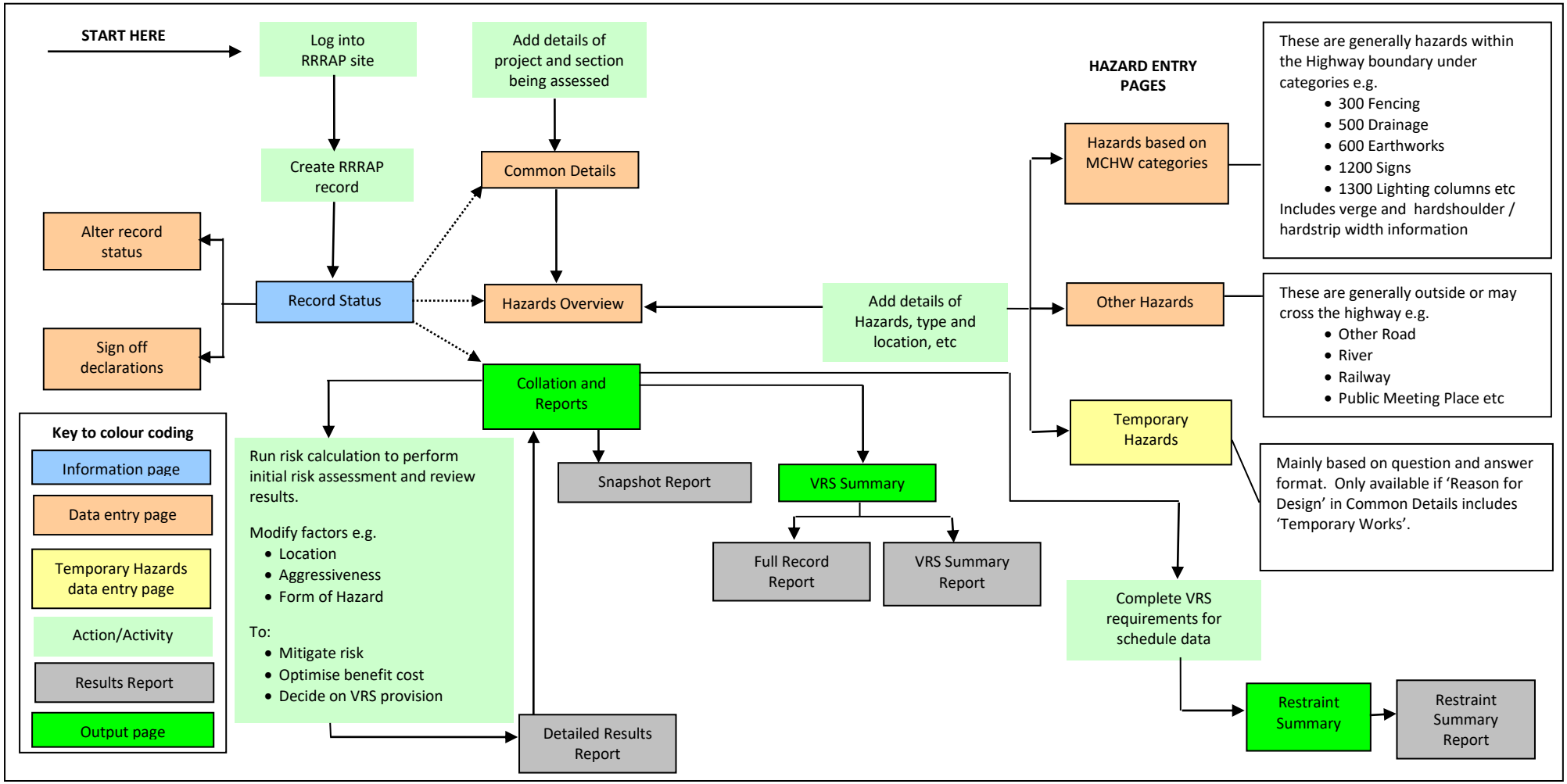


Figure 2-9 Overview of the RRRAP

2.6 How Permanent Hazards have been Categorized within the Various Worksheets

In the 'Hazards Overview' tab, the listing of all the Hazards typically likely to be found within the Highway and the individual pages for entering details of these Hazards are arranged around the MCHW Series numbers.

The hazards have been categorised in this way as it is considered that most design drawings will have been arranged around this numbering system, rather than being composite drawings that would show most or all of the hazard features. It is expected that it will speed up input of the data relating to each hazard.

Hazards that may affect 'Others' and which are typically outside the Highway boundary do not generally fall into the MCHW numbering regime. Details of these Hazards are entered in a separate series of pages e.g. Roads.

2.7 Colour coding of results on Collation page

After calculating risk for hazards several extra values are populated.

Is the risk without VRS acceptable?

Yes - no VRS is required

No - a VRS is required to protect this hazard

Level of risk with optimum length VRS

Acceptable - Risk is in the broadly acceptable region

Tolerable - Risk is in the tolerable region

Unacceptable - Risk is in the unacceptable region

There is a special case where the hazard has mandatory requirements. In this case, the RRRAP gives a Containment Level based on the risk to vehicle occupants only and the Designer must refer to the indicated Standard, e.g. TD 19, BD 68, etc, as appropriate and ensure that the level of provision that they specify is appropriate for this hazard. The designer must detail the factors that they have considered in the Comments field of the hazard.

Is risk without VRS acceptable?

No - a VRS is required to protect this hazard

Level of risk with optimum length VRS

Refer to TD 19 - The name of the document or guide that should be referred to for guidance

Another example of Level of risk with optimum length VRS includes:

Must be agreed with TAA

This can affect Gantries, e.g. for 1200 and 1500 hazard types. The Designer must detail the factors they have considered and the outcome of TAA agreements in the "Comment" field of individual hazards.

2.8 Temporary Hazards and Calculation of Risk and Benefit Cost for Temporary VRS

The RRRAP will calculate risk and benefit cost levels for permanent safety barrier provision. At present, due to the complexities of the risk and cost benefit analysis for temporary situations, temporary safety barrier provision has not been modelled within the RRRAP. Instead, the Designer is required to respond to a series of questions that prompt the designer to identify the various factors that he needs to consider, weigh up and take account of in deciding whether a temporary Road Restraint System is warranted. Refer also to IAN 142 Temporary Barrier Decision Tool (TBDT). See section 13 for more details on how to enter temporary hazards into the RRRAP.

2.9 How the RRRAP works

General guidance on the RRRAP and how it works is given in Chapter 2 of TD 19/06. The guidance below is in addition to that and describes the basic mechanism of the RRRAP and some of the factors that influence the outcome.

2.9.1 Risk

Risk is assessed by looking at a combination of likelihood (see section 2.9.2) and consequences (see section 2.9.3) and is expressed in equivalent fatalities per 100 million vehicle km.

1 fatal = 10 serious = 100 slight injuries.

2.9.2 Likelihood

(a) Probability of vehicle leaving road – this is based on road type, local factors such as alignment, traffic flow and type, accident history, junction location, etc.

(b) Probability of errant vehicle reaching object – this is affected by hazard location, topography, speed and type of vehicle, etc.

2.9.3 Consequences

(a) Effect on occupants of errant vehicle if it reaches the hazard – this is influenced by speed of errant vehicle, Aggressiveness of hazard, % LGV / MGVs

(b) Effect on Others e.g. using adjacent road or railway or occupying a building

Aggressiveness of the hazard is based on research, Stats 19 and engineering judgement and the aggressiveness value is automatically assigned by the RRRAP. Note that costs relating to the hazard itself or consequences arising due to the failure of the hazard are not included in the RRRAP risk calculation.

2.9.4 Total risk

Total Risk is the summation of

Risk to vehicle occupants in Cars +
Risk to LGVs (> 3.5 Tonnes) +
Risk to MGVs (> 1.5 Tonnes) +
Risk to Others

2.9.5 Thresholds used

The accident frequency is non-linear; the risk per vehicle changes with flow. At low flows the risk per vehicle is high, but the benefit / cost of providing a barrier will be low. At higher flows, the risk per vehicle is lower but, because overall there will be more accidents than on a low flow road, the benefit / cost is higher.

The thresholds used in the RRRAP are also curved. They are set such that the need for a VRS is independent of the flow on the road. The risk posed by a hazard having an aggressiveness of, say, 1.5 will be unacceptable over a range of offsets, the risk becoming acceptable if sufficiently far from the running lane of the carriageway, or when protected by a safety barrier. Different hazards will have different aggressiveness and will give rise to unacceptable levels of risk over different ranges of offsets.

Heavy vehicles may breach N2 containment safety barriers. H1 or H4A containment level may be needed where one or more of the following conditions holds:

(a) High run-off rate and
(b) High proportion of heavy vehicles and
(c) Hazard is aggressive and
(d) 'Others' involved

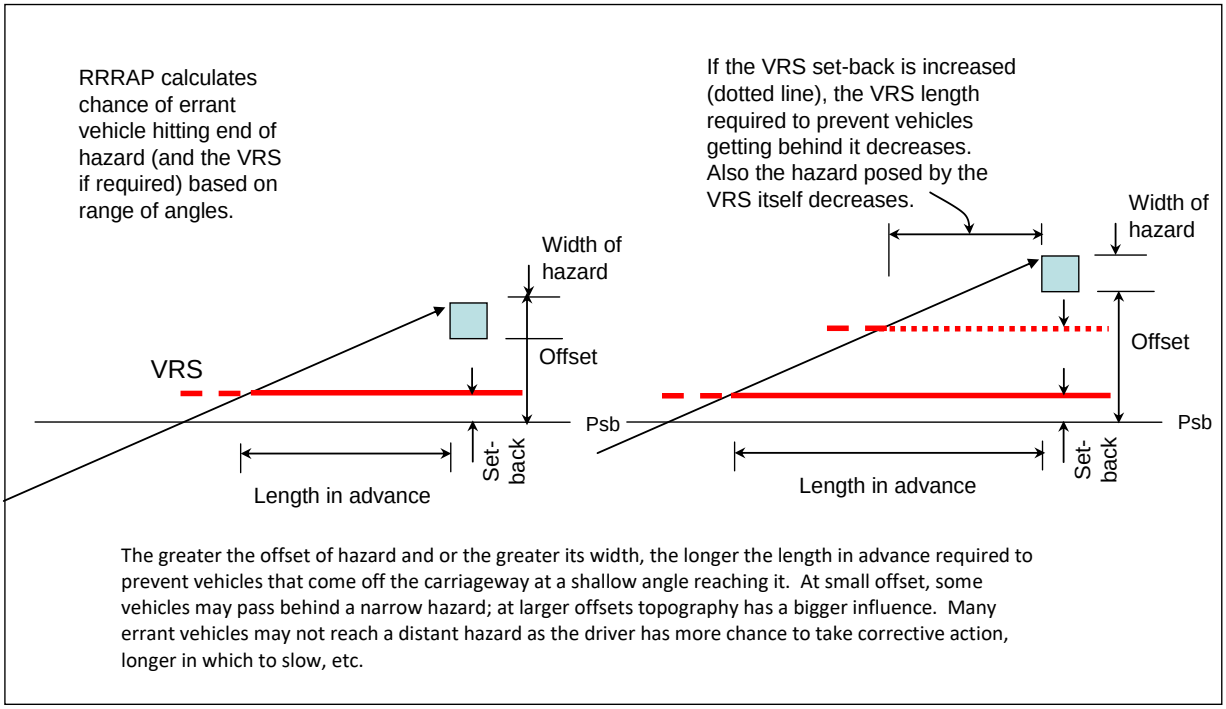


Figure 2-10 Relationship between Offset of Hazard and VRS, and length of VRS

The RRRAP works out whether the level of risk is acceptable, tolerable, or unacceptable with a certain containment level(s) and length(s) of VRS in advance of the hazard and, for single carriageway roads, where vehicles can approach the hazard from either direction, the length beyond. The Designer can use this information to determine the required containment level and length of need (i.e. the total length of safety barrier required in advance, alongside and beyond the hazard to give an acceptable level of risk.

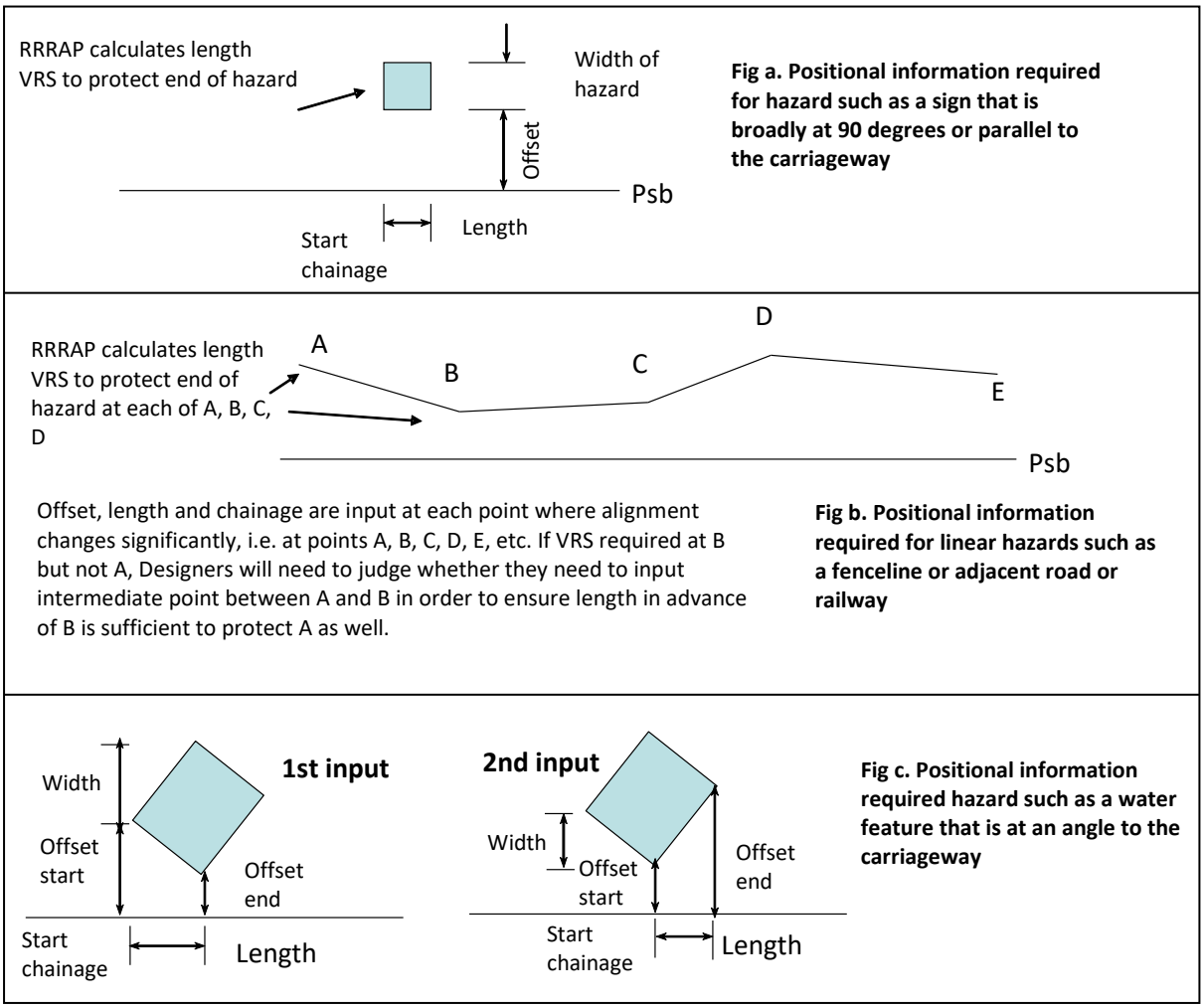


Figure 2-11 Positional information required by RRRAP in order to calculate VRS requirements

Note that this diagram gives typical details; further particulars are contained within each of the relevant sections.

At present the RRRAP cannot interpolate to ascertain whether VRS would be required at intermediate locations, the Designer should therefore review the information that he is inputting to ensure that the start point (and end point) of VRS requirement is being picked up properly by the RRRAP. The following figure illustrates the point.

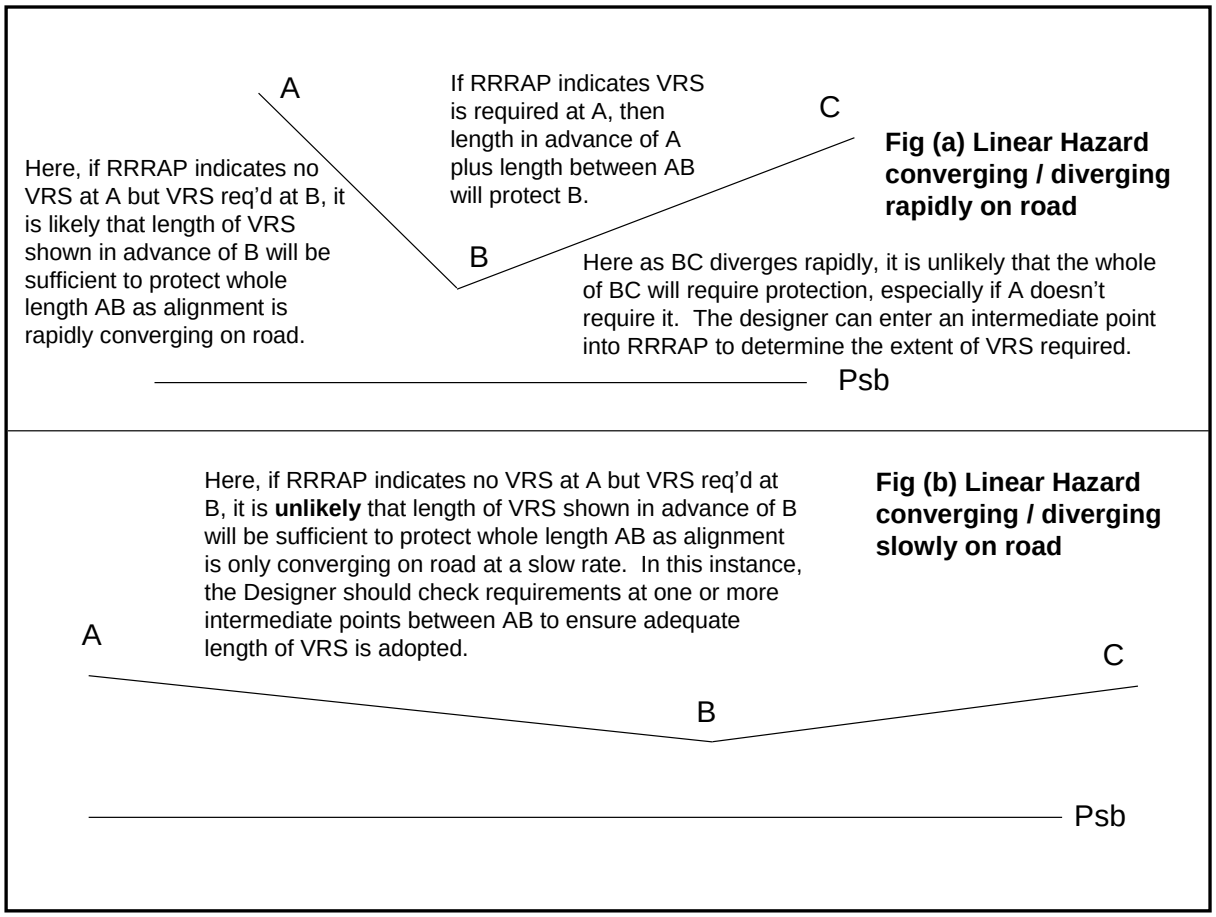


Figure 2-12 Influence of rate of convergence / divergence of hazard to Psb on VRS requirement calculation

2.10 Error and Warning messages

This section describes the various error / warning messages that may be returned at the various stages of the RRRAP.

2.10.1 Data Entry

When entering data into the RRRAP and as you move between fields on a page the content is re-validated. If there are problems validating the content of fields, e.g. value out of range, entered text instead of a number, field missing a mandatory value, etc; then a warning icon is displayed next to the field. Moving the mouse over this icon will display a warning message that will hint at the problem with the field. An example is shown below.

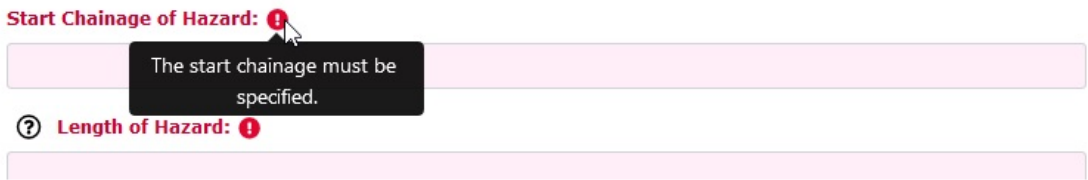


Figure 2-13 Data Entry Warning Message

All mandatory field data on a page must be entered before the page can be saved.

2.10.2 Record / Hazard Import

When importing either a RRRAP record (see section 3.8) or a CSV file (see section 1.4 for description of a CSV) with hazard data (see section 8.1.9) for an individual hazard category, any issues encountered will be displayed after the import process has completed.

There are two types of issue message that can appear:

- Error messages – For importing individual CSV files (e.g. hazard import, see section 8.1.9) these messages will stop the import from proceeding any further. For RRRAP record import (see section 3.8), only the affected file within the RRRAP record ZIP file (e.g. fencing hazard file) will be ignored, and the import process will try to import the rest of the files in the ZIP that define the RRRAP record.
- Warning messages. These indicate import issues for individual hazards. These issues may need to be resolved before the risk calculation can be run.

Error messages can include:

- File size too large (2Mb for RRRAP records, 1Mb for individual CSV's)
- Unexpected file type (ZIP for RRRAP record import, CSV for individual hazard import)
- ZIP missing files (the ZIP for RRRAP record import is missing CSV files for either hazards or common details)
- Invalid RRRAP version (only affects RRRAP record ZIP files)
- Unexpected number of columns in CSV import file
- Hazard has no start chainage
- Parse error (this occurs when the wrong format of data is encountered, e.g. text is found where a number is expected)

Warning messages can include:

- Drop-down values that have not been populated (reported for both mandatory and non-mandatory fields)
- Drop-down text could not be matched to those options currently available for that field
- Error(s) validating new hazard.

'Error(s) validating new hazard' can occur if an imported hazard fails the standard validation applied before saving a hazard. Validation commonly fails if mandatory fields are incomplete. The new hazard is still saved but is marked as invalid. Invalid hazards are indicated on the hazard view pages and the 'Collation & Reports' tab with the icon next to the Hazard Id.

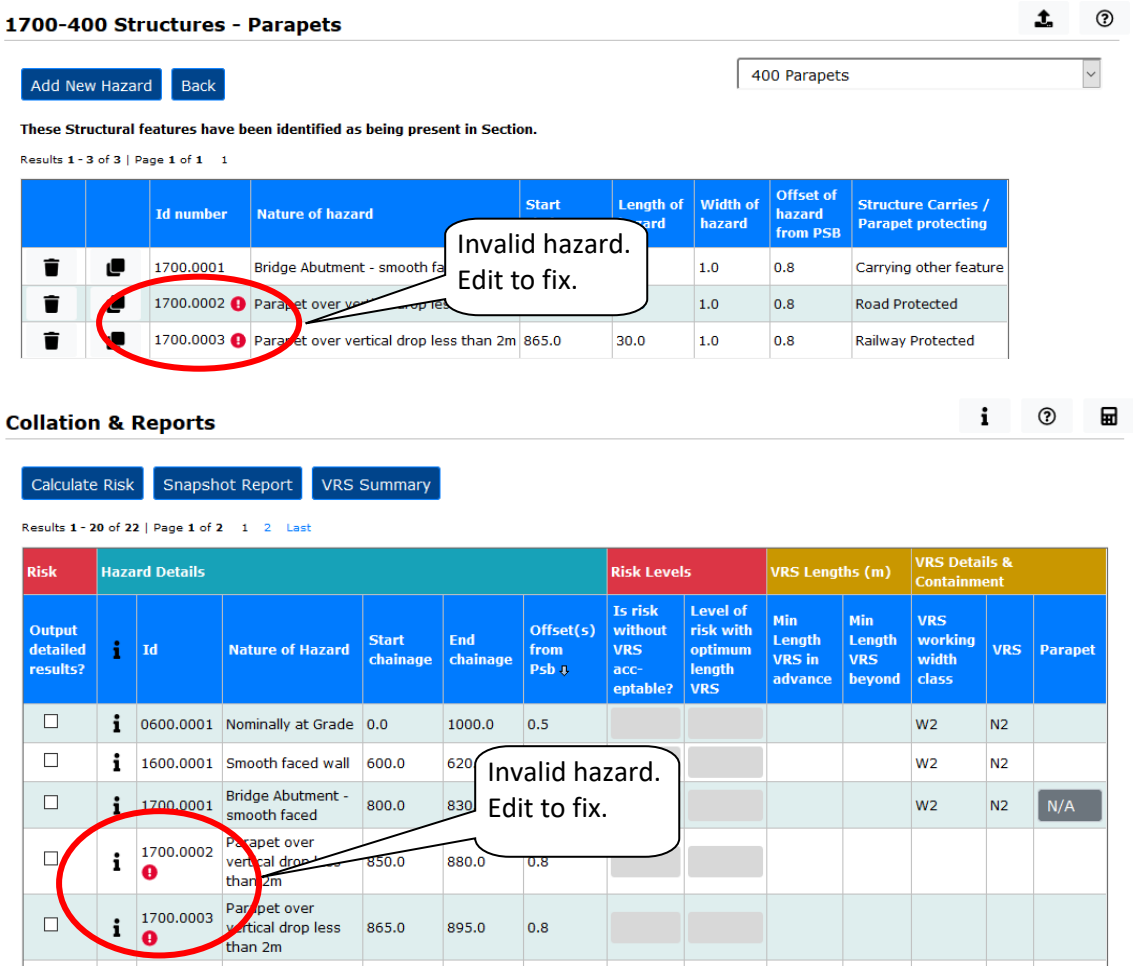
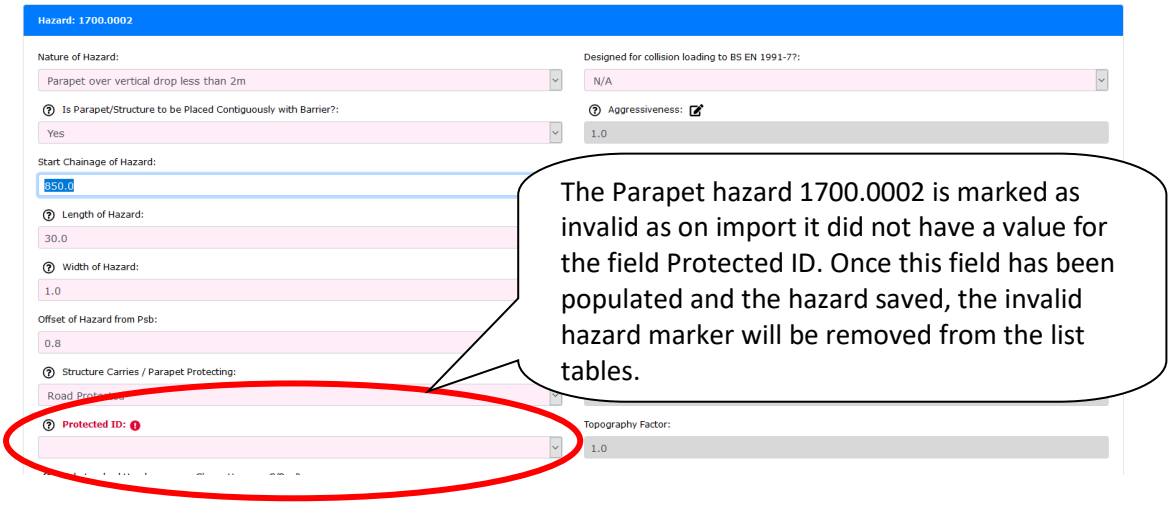


Figure 2-14 Invalid Hazard after Import indicator

The risk calculation will not run while there are invalid hazards in the record.

To remove the invalid hazard marker, edit the hazard and fix any fields with highlighted issues. Once the hazard has been saved, the invalid hazard marker should disappear.



2.10.3 Calculating Risk

Any issues when calculating risk will be displayed on the Risk Calculation Issue page. There are three types of message that can appear:

- Error messages – these will stop the risk calculation from proceeding any further. For the risk calculation to complete, these issues must be resolved.
- Warning messages – these indicate issues for individual hazards. Some issues stop risk being calculated for an individual hazard (e.g. hazard in front of barrier). Other issues such as when hazard is too close to barrier don't stop risk being calculated.
- Tall hazard message – these relate to hazards that could give rise to a significant secondary incident should they be impacted (see below). You are then asked to select either 'Yes' or 'No' if you accept or reject the calculated risk level. The question does not have to be answered here, but can be answered by editing the hazard via the Collation tab (see section 9.3).

2.10.3.1 Error Messages – Common Details

These can include:

- Mandatory fields in Common details have not been completed.
- In Common Details 'Scheme Duration and Barrier Costs', non-default safety barrier and parapet costs are being used but have not all been specified.

2.10.3.2 Error Messages – Full Chainage Definition

These can include:

- Full section chainage must be entered for Earthwork hazards
- Full section chainage must be entered for Verge hazards
- Full section chainage must be entered for Kerb hazards

These messages will be reported if the start and end chainages for Verge, Earthwork, or Kerbs do not match the start and end chainages for the Section (as entered in Common Details).

2.10.3.3 Error Messages – Hazard Categories

The following error message will appear for hazard categories that have been set as being present in the record (by editing Category Configuration on 'Hazards Overview' tab) but have not been marked as Completed:

- Hazards are required for hazard type 'X' - but the hazard type is not marked as Completed (Edit Category Configuration on Hazards Overview tab).

X can be any of the hazard categories listed in the 'Hazards Overview' tab.

To mark a hazard category as complete (i.e. all hazard data has been entered for that category), navigate to the 'Hazards Overview' tab and click the Edit Category Configuration button. Make the necessary changes and click the save button. For more details on category configuration see section 7.1.

2.10.3.4 Error Messages – Hazards

These can include:

- An Earthwork hazard cannot have zero length
- Hazard has validation issues (due to issues during hazard import).
- Hazards start chainage outside the section 'from' / 'to' chainage as defined in Common Details.

2.10.3.5 Warning Messages

These can include:

- End of long object - object is located in front of barrier. Note: this has prevented risk from being calculated for this hazard.
- Object is located in front of barrier. Note: this has prevented risk from being calculated for this hazard.
- End of long object - object is located within working width of barrier. The correction may be to move the hazard, change the working width class, barrier working width, set-back of barrier from Psb, or a combination of these. It may also be advisable to split the hazard into two parts. In this calculation run the effect of the barrier will be overestimated. You may need to apply for a Departure from Standard if the hazard is to remain within the working width. Please refer to TD 19/06 Paras 3.66 and the following and paragraphs 3.100 and the following which give further details and guidance.
- Object is located within working width of barrier. The correction to apply may be to move the hazard, change the working width class, barrier working width, set-back of barrier from Psb, or a combination of these. In this calculation run the effect of the barrier will be overestimated. You may need to apply for a Departure from Standard if the hazard is to remain within the working width. Please refer to TD 19/06 Paras 3.66 and the following and paragraphs 3.100 and the following which give further details and guidance.
- The object has an invalid working width. The working width value is less than that expected for the current working width class. This may be due to the risk calculation updating the working width value to show the maximum working width available as the object is located within the working width of VRS.

For more details concerning objects located within the working width of the barrier see section 2.10.4, and for objects located in front of the barrier see section 2.10.5.

2.10.3.6 Tall Hazards

The tall hazard message is:

- This hazard could give rise to a secondary incident should it be impacted. The calculated risk level does not cover the secondary risk. If you consider the risk level of a secondary incident to be significant, you may wish to consider moving the hazard, or use a higher level of containment, or both.

For more information on tall hazards that can give rise to a significant secondary incident see section 9.6.1.

2.10.4 Hazard located too close to barrier

If the hazard is located too close to the safety barrier, a warning message will be displayed (as highlighted in the previous section) on the Risk Calculation Issue page:

- Object is located within working width of barrier. The correction to apply may be to move the hazard, change the working width class, barrier working width, set-back of barrier from Psb, or a combination of these. In this calculation run the effect of the barrier will be overestimated. You may need to apply for a Departure from Standard if the hazard is to remain within the working width. Please refer to TD 19/06 Paras 3.66 and the following and paragraphs 3.100 and the following which give further details and guidance.

The risk calculation is completed for hazards that have this issue. When returning to the list of hazards in the 'Collation & Reports' tab, a highlight will be visible for hazards that have this issue.

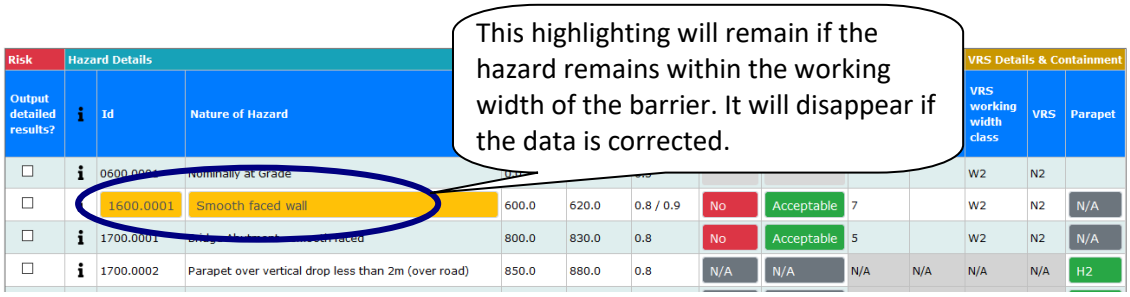


Figure 2-15 Hazard located too close to barrier warning on Collation page

When viewing and editing hazards through the 'Collation & Reports' tab this highlight is also visible, along with an additional highlight on the Barrier Working Width field (see Figure 2-16).

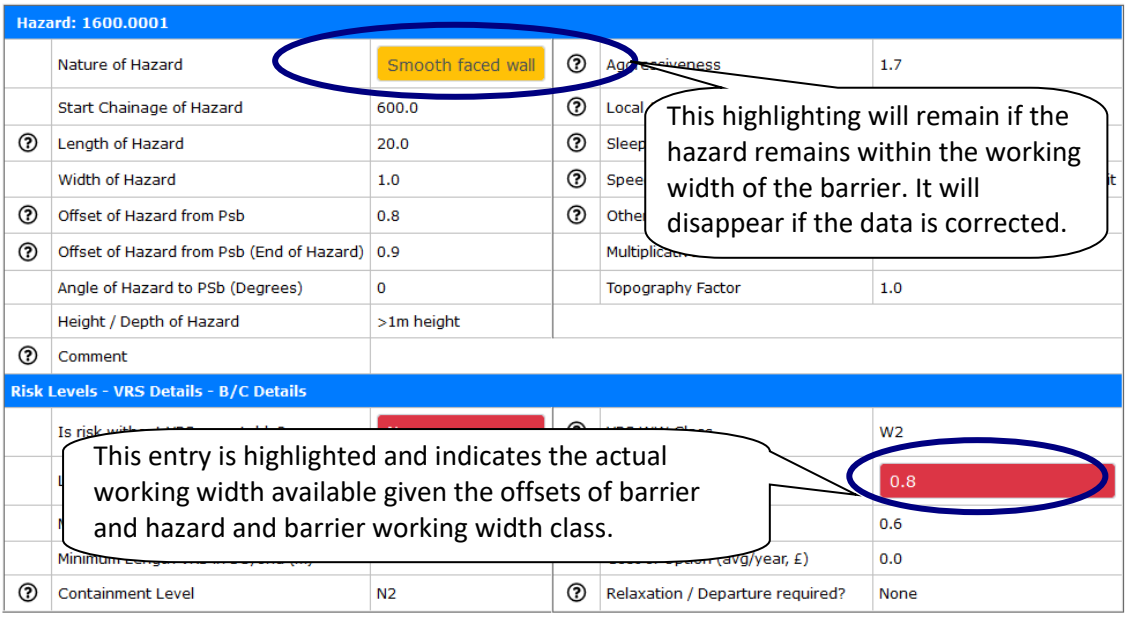


Figure 2-16 Hazard located too close to barrier warning on view hazard page

If the warning has been caused by a mistype in the appropriate data entry page, the data entry should be corrected and the risk calculation re-run.

If there was no mistype, you may wish to alter the VRS Working Width Class, VRS Working Width, Set-back of VRS from Psb, or a combination of these. If the offset of the item is changed or the VRS Working Width Class is changed in order to rectify the problem, the calculated value in VRS Working Width column (highlighted red) MUST also be deleted, otherwise RRRAP will not re-calculate the new working width, and the object will still be reported as within working width.

2.10.5 Hazard located in front of barrier

If the hazard is located in front of the safety barrier, a warning message will be displayed on the Risk Calculation Issues page:

- Object is located in front of barrier. Note: this has prevented risk from being calculated for this hazard.

This issue will cause the risk calculation to stop evaluating this hazard (and move on to the next hazard). When viewing the hazard via the Collation page, because no calculated risk values have been generated, none are visible (see Figure 2-17).

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Nominally at Grade	0.0	100.0	2.5	Yes						N/A
☐	i	0600.0002	Falling at 50%	100.0	140.0	2.5	Yes						N/A
☐	i	0600.0003	Falling at 50%	140.0	160.0	2.5	No	Acceptable	46		W2	N2	N/A
☐	i	1300.0001	Row of catenary lighting columns < 40m apart	355.0	355.0	0.5					W2		
☐	i	0600.0004	Falling at 50%	160.0	200.0	2.5	No	Acceptable	47		W2	N2	N/A
☐	i	0600.0005	Nominally at Grade	200.0	11500.0	2.5	Yes						

No risk results are available

Figure 2-17 Hazard located in front of barrier on Collation page

The error might have been caused by a mistype of data, in which case it should be corrected on the appropriate data entry page and the risk calculation re-run.

It might though be the case that the hazard is an existing one for which the designer needs to check whether VRS protection is warranted.

If this is the case, then the set-back of the barrier for the hazard (edit the hazard via the 'Collation & Reports' tab) should be manually altered to be the same as the offset of the hazard and the risk calculation should be re-run to ascertain the risk level and VRS requirements. If no VRS is required for that particular hazard and there is no VRS requirement for any other hazard nearby, then the hazard may remain. If however, the hazard requires protection, then the programme will highlight the entry as detailed in section 2.10.4, and the actual barrier working width will be shown as 0.01 m, (rather than 0.00, as programme would consider a zero here a problem).

Note that there may be another hazard or hazards nearby for which a safety barrier is required even though a safety barrier is not required for the hazard in question. This situation would be likely to result in the hazard in question being behind the safety barrier required for the other hazards, which is likely to be unacceptable. In most cases it would be necessary to move the hazard to lie outside the safety barrier working width. Please refer to TD 19/06 Paras 3.66 and the following and paragraphs 3.100 and the following which give further details and guidance.

2.10.6 Hazards where alternative VRS working width is available

When a new hazard is created the VRS gets a default working width of W2.

Safety barriers with smaller working widths are generally more expensive than those with larger working widths. It is therefore important that the Designer checks and specifies the greatest working width class that can practicably be achieved in the circumstances taking into account the requirements of set-back of the safety barrier, the location of the hazard and of other hazards adjacent to it, and the minimum distances to top or toe of slope (TD 19 Figures 3-1, 3-2 and 3-4).

To help highlight which hazards have a potential alternative VRS working width, when risk is calculated for the hazard, if an alternative VRS working width class is possible, RRRAP will highlight the working width class cell in tables (see Figure 2-18). The Designer should check and specify the greatest VRS working width class that can practicably be achieved for each of these hazards.

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Nominally at Grade	0.0	100.0	2.5	Yes						N/A
☐	i	0600.0002	Falling at 50%	100.0	140.0	2.5	Yes						N/A
☐	i	0600.0003	Falling at 50%	140.0	160.0	2.6	No	Acceptable	45		W2	N2	N/A
☐	i	0600.0004	Falling at 50%	160.0	200.0	2.5	No	Acceptable	44				N/A
☐	i	1200.0001	Sign on post(s)	170.0	170.2	2.0	No	Acceptable	27		W2	N2	N/A
☐	i	1200.0002	Sign on post(s)	170.0	170.2	3.0	No	Acceptable	27		W2	N2	N/A
☐	i	1200.0003	Sign on post(s)	170.0	170.2	3.0	No	Acceptable	27		W2	N2	N/A
☐	i	0600.0005	Nominally at Grade	200.0	11500.0	2.5	Yes						N/A

Alternative WW/VRS available i.e W5

Figure 2-18 Hazard with VRS working width highlight

Where a VRS working width class has been highlighted as having an alternative and the Designer wishes to accept the current VRS working width class, on the collation page click the Accept Working Widths button. The Accept Working Width page lists the Hazards where an alternative VRS working width is available.

i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	VRS working width class	Alternative class	Accept?
i	0600.0003	Falling at 50%	140.0	160.0	2.5	W2	W3	☐
i	0600.0004	Falling at 50%	160.0	200.0	2.5	W2	W3	☑
i	1200.0001	Sign on post(s)	170.0	170.2	2.0	W2	W4	☑
i	1200.0002	Sign on post(s)	170.0	170.2	3.0	W2	W6	☐
i	1200.0003	Sign on post(s)	170.0	170.2	3.0	W2	W5	☐

Figure 2-19 Accept Working Widths

If you wish to indicate the current VRS working width class is acceptable rather than using any alternative, click the check-box to accept the current VRS working width class. To save any changes to this page, click the Save button.

If you accept the current VRS working width class, the highlight on the VRS working width class cell in tables will change to indicate the current VRS working width has been accepted (cell is highlighted in blue).

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Nominally at Grade	0.0	100.0	2.5	Yes						N/A
☐	i	0600.0002	Falling at 50%	100.0	140.0	2.5	Yes						N/A
☐	i	0600.0003	Falling at 50%	140.0	160.0	2.5	No	Acceptable	39		W2	N2	N/A
☐	i	0600.0004	Falling at 50%	160.0	200.0	2.5	No	Acceptable	39		W2	N2	N/A
☑	i	1200.0001	Sign on post(s)	170.0	170.2	2.0	No	Acceptable	27		W2	N2	N/A
☐	i	1200.0002	Sign on post(s)	170.0	170.2	3.0	No	Acceptable	27		W2	N2	N/A
☐	i	1200.0003	Sign on post(s)	170.0	170.2	3.0	No	Acceptable	21		W2	N2	N/A
☐	i	0600.0005	Nominally at Grade	200.0	11500.0	2.5	Yes						N/A

Figure 2-20 Hazard with VRS working width accepted highlight

Note – if you change any of the following fields associated with a Hazard then the alternative VRS working width class and any acceptance will be cleared (and removed from the table cells). The designer will need to re-run the risk calculation to observe any changes and if necessary re-accept the current working width class:

- Offset of Hazard from Psb
- VRS Working Width Class
- VRS Working Width (m)
- VRS Set-back (m)

Also, the alternative VRS working width class and any acceptance will be cleared if you change the nature of an existing 1700 Structure / Parapet hazard.

2.10.7 Connection Problems

If there are any connection issues from your PC to the RRRAP server while using the site, a connection error message will be displayed (an example of one is shown in Figure 2-21).

Edit Common Details

Connection issue Id

Server Connection Issue [ECON4]

There was an error retrieving the response for this page.

This may be caused by internet connection problems.

Please check your connection before attempting to refresh this page or click on other links.

Figure 2-21 Connection Issue

Before raising any issues with the RRRAP Support, please make sure the problem is not with your internet connection.

- Can you access other external internet sites?
- Have you made sure any corporate firewall or internet filter your organisation uses has been updated to allow access and use of the RRRAP website. Failure to do this may cause connection errors and stop parts of the site working correctly.

If the problem persists, please contact the RRRAP Support. The email address is listed on the RRRAP home page. When reporting the issue, please include the following information:

- Connection issue Id (see Figure 2-21 for example)
- Time problem occurred
- A clear description of what actions you were performing at the time
- The name of any RRRAP record that was open when the problem occurred

2.10.8 Web Application Error

If there is a problem with the RRRAP web application, you may see a screen similar to that shown in Figure 2-22.

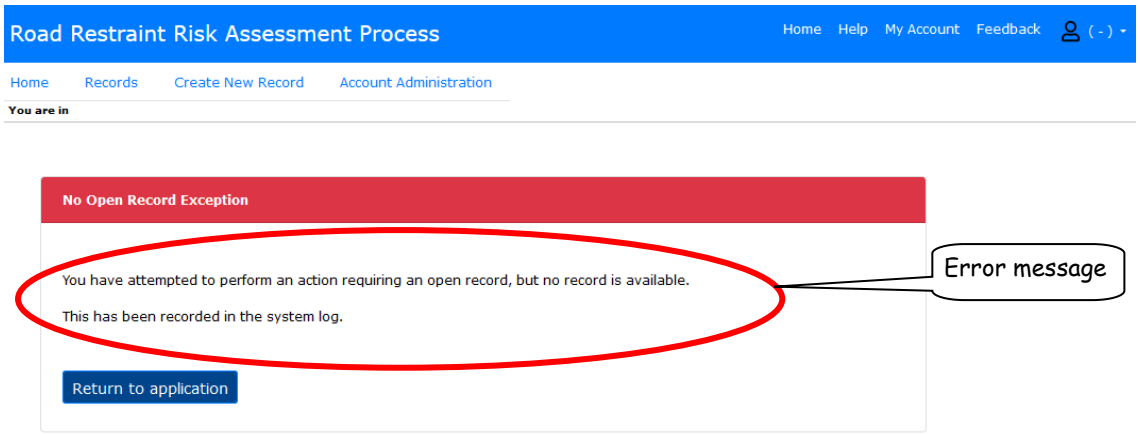


Figure 2-22 Web Application Error

If this occurs, please make a copy of the specific error message text.

Send any problems like this to the RRRAP Support. The email address is listed on the RRRAP home page. When reporting an issue, please include the following information:

- The details described above from the error page
- Time problem occurred
- A clear description of what actions you were performing at the time
- The name of any RRRAP record that was open when the problem occurred

2.11 Relaxations and Departures from Standard

Paragraphs 1.37 and 1.38, and Paragraphs 1.39 and 1.40 in Chapter1 (Introduction) of TD 19 give details of the general information that is required from the RRRAP in support of a Relaxation and of a Departure from Standard.

Paragraphs 3.36 to 3.39 in TD 19 Chapter 3 (Criteria and Guidance for the Provision of Permanent Safety Barriers) give guidance on Relaxations relating to locating a hazard within the working width or in front of a Vehicle Restraint System, and the circumstances under which a Departure from Standard may be considered to locate furniture meeting the requirements of BS EN 12767 in front of a single sided Vehicle Restraint System in the verge.

If a Relaxation or a Departure from Standard is required, edit the hazard via the 'Collation & Reports' tab and then update the 'Relaxation / Departure required?' field. By default, this field has the value 'None'. The drop-down for this field can be changed to 'Relaxation' or 'Departure'.

Risk Levels - VRS Details - B/C Details					
	Is risk without VRS acceptable?	No	?	VRS WW Class	W2
	Level of risk with optimum length VRS?	Acceptable	?	VRS WW (m)	0.8
	Minimum Length VRS in advance (m)	5	?	Set-back (m)	1.2
	Minimum Length VRS in beyond (m)			Cost of Option (avg/year, £)	0.0
?	Containment Level	N2	?	Relaxation / Departure required?	None

Figure 2-23 Relaxation / Departure required

Where the decision relating to a Relaxation is devolved onto the Designer, the Designer should ensure that the completed RRRAP record contains sufficient information to enable the Overseeing Organisation to review the decision made and options investigated should the need arise at some future date.

Designers should ensure that the completed RRRAP record contains the required information in sufficient detail to allow the Overseeing Organisation to form an opinion as to the acceptability of a Departure or Relaxation, and that the preferred option is compared against options that would meet full Standards. The Hazard 'Comment' field can be used to record the justification for the Departure or Relaxation.

A full RRRAP report should form part of the application for a Departure from Standard.

3 Records

3.1 Overview

The Records tab is the access point to locating, opening, copying deleting, and importing RRRAP records.

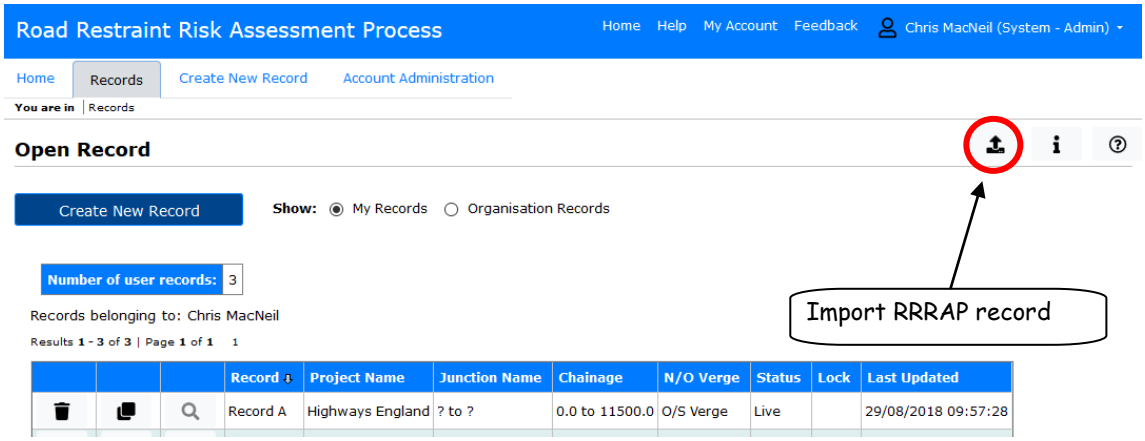


Figure 3-1 Records tab

When you first visit this tab, it will list the records that are registered against your user account (generally those records that you have created). If you have a lot of records, then the list may stretch over multiple pages. You can either click the page number links at the top/bottom of the table to access different pages of the list, or you can click on the column headers of the table (only those that highlight when you move the mouse into the header) and this will re-order the list of records accordingly.

To open a record, click on a row in the table. The record will be opened and the 'Record Status' tab will be displayed. If a record is already open when you try to open another record you will be asked if you wish to stay with your currently open record or if you wish to close it and open the selected record.

A RRRAP record ZIP archive that has been previously exported from the RRRAP web application (see section 4.4) can be imported into the RRRAP web application by clicking the Import RRRAP Record icon at the top right of the page (shown in Figure 3-1). For more details see section 3.8.

3.2 Organisation records

As a user, your account in the RRRAP is associated with an Organisation and an area within that organisation. As well as being able to open and edit your own records, you can open and edit records of other users that belong to the same organisation as you do.

To view the records belonging to other users in your organisation, click the show "Organisation Records" radio button. This will update the page to show all the records for users that belong to your organisation. You can filter this list further by selecting an organisation area from the additional dropdown.

3.3 Record Locks and Read-Only Records

If you open a RRRAP record, you will automatically lock the record for editing (assuming no other user already has the record open). Lock information shown on the 'Records' tab includes:

Record is locked for editing by you

(greyed out lock icon) Record is locked for editing by another user - moving the mouse over the icon will display the name of the user with the record lock.

If a record is locked by another user and you then open that record, it will be opened in a read only mode. You will be able to view all the details of the record and generate reports, but will not be allowed to create, edit or delete any data associated with the record.

You can also open a record in read-only mode directly without placing an edit lock on the record by clicking the icon in the records table (instead of clicking elsewhere on the row in the table).

3.4 Take Ownership

When viewing records that belong to users within your organisation, an additional column is displayed that allows you to take ownership of a record. This can be useful if a colleague is off sick or going on holiday and you are taking over responsibility for a record. By taking ownership of the record, the record will now appear when viewing the list of your records.

To take ownership of a record click . A dialog will be displayed asking if you are sure you wish to take ownership of the record. Clicking Ok will complete the process.

You cannot take ownership of a record that you are already the owner of, or a record that is currently locked for edit by a different user.

3.5 Copy Record

To copy a RRRAP record, click the icon in the appropriate row of the records list. A dialog will be displayed to check that you really want to copy this particular record. If you click the Ok button, a page similar to creating a new record is displayed. The details are populated with the details of the record being copied. These should be changed as is required for the new record.

Note: The 'Record Name' and the 'Project Name' in combination have to be unique within your organisation, e.g. you can use the same 'Project Name' for multiple RRRAP records so long as the 'Record Name' is different in each record.

The record copy process duplicates the following information in a RRRAP record:

- Common Details
- Option Costs
- Hazards Overview (category selection and completion)
- All individual hazards (not including any calculated risk values)

To ensure that this new record is processed correctly, the record copy process ***does not duplicate***:

- Sign off information
- Results of on page calculations for non-editable fields
- Results of risk calculations
- Generated detailed results
- Restraint summary details (appendix 4/1)
- Temporary Hazards

3.6 Delete Record

Each organisation has a finite amount of space on the RRRAP database, so old / completed RRRAP records will have to be deleted off the system from time to time. This will release record 'slots' for re-use.

To delete a RRRAP record, click the icon in the appropriate row of the records list. A dialog will be displayed to check that you really want to delete this particular record. Before deleting a RRRAP record you should have exported a copy of the RRRAP record data and printed off a full RRRAP report. An exported RRRAP record can be re-imported back into the RRRAP web application (see section 3.8).

Once the record is deleted all its associated data will be lost and cannot be retrieved.

You cannot delete a record if you do not have ownership of the record or another user currently has the record locked for editing.

3.7 Create New Record

You can create a new RRRAP record by either clicking the Create New Record button on the 'Records' tab, or if no record is currently open, click directly on the 'Create New Record' tab that is available.

When creating a new RRRAP record there are four fields:

- 'Record Name' – name of RRRAP record - think equivalent to the name of a file on your computer (maximum 60 characters, including spaces)
- 'Is this record related to Highways England funded work?' - Select either Yes or No depending on if the work is for a Highways England funded project.
- 'Project Name' – name of the real world project the record is related to (maximum 60 characters, including spaces)
- 'Description' – an optional text description of the record (maximum 255 characters, including spaces)

All but the 'Description' field are mandatory and must be completed before saving.

An important point to note is that the 'Record Name' and the 'Project Name' in combination have to be unique within your organisation, e.g. you can use the same 'Project Name' for multiple RRRAP records so long as the 'Record Name' is different in each record.

3.7.1 Create Record Notes

If when creating a new RRRAP record your organisation has no free record slots then an appropriate error message will be displayed. In the first instance you should identify old and / or complete RRRAP records that can be deleted, otherwise contact your organisation's RRRAP representative.

If you create a new record while you have one already open, once you click the 'Create' button (after entering the new record name, project name, etc.), you will be prompted if you wish to close your currently open record and open your new record. If you click the button to open the record, then your new record will be opened and the record you had open will be closed. If you decide to keep your existing record open, the new record is not opened, but can be accessed via the Records tab.

3.8 Import RRRAP Record

The following steps describe how to import a RRRAP record ZIP archive that has been previously exported from the RRRAP web application. For instructions on exporting a RRRAP record ZIP archive, see section 4.4.

Currently, an exported RRRAP record will contain:

- All common details
- The data entered for each of the hazard category types (not including any calculated risk values)

To import a RRRAP record ZIP file follow these steps:

1. Via the Records tab, click the import RRRAP record button (located at the top right).
2. The first of two record import pages is displayed. Enter the details for a new RRRAP record. A new RRRAP record must be created to import the RRRAP record data into. For more information on these fields see section 3.7 Create New Record.
3. Once all details of the new record have been entered, click the Next button.
4. The second record import page is displayed. Using the browse button on this page, specify the ZIP file to import from your local file system.
5. Click the upload button.
6. On upload, there are several possible outcomes:
    - There is a fatal error with the zip (too big, missing individual CSV files, etc). This will stop the import from completing. Error messages will be displayed to try and help identify issues.
    - There are no fatal errors with the zip. A new RRRAP record is created, and issues with individual CSV files (if there are any) are listed.
7. Click the 'Open New Record' button to open the new record with the imported content.

During RRRAP record import, CSV files within the ZIP are imported one at a time and are considered in isolation. If one CSV file fails to import due to a fatal error, this error will be reported in the results of the import process, but will not stop the attempted import of the other CSV files in the RRRAP record ZIP archive.

Warnings reported as part of the import process may indicate fields that require attention. Where appropriate, take action to fix these issues before attempting to perform the risk calculation.

4 Record Status

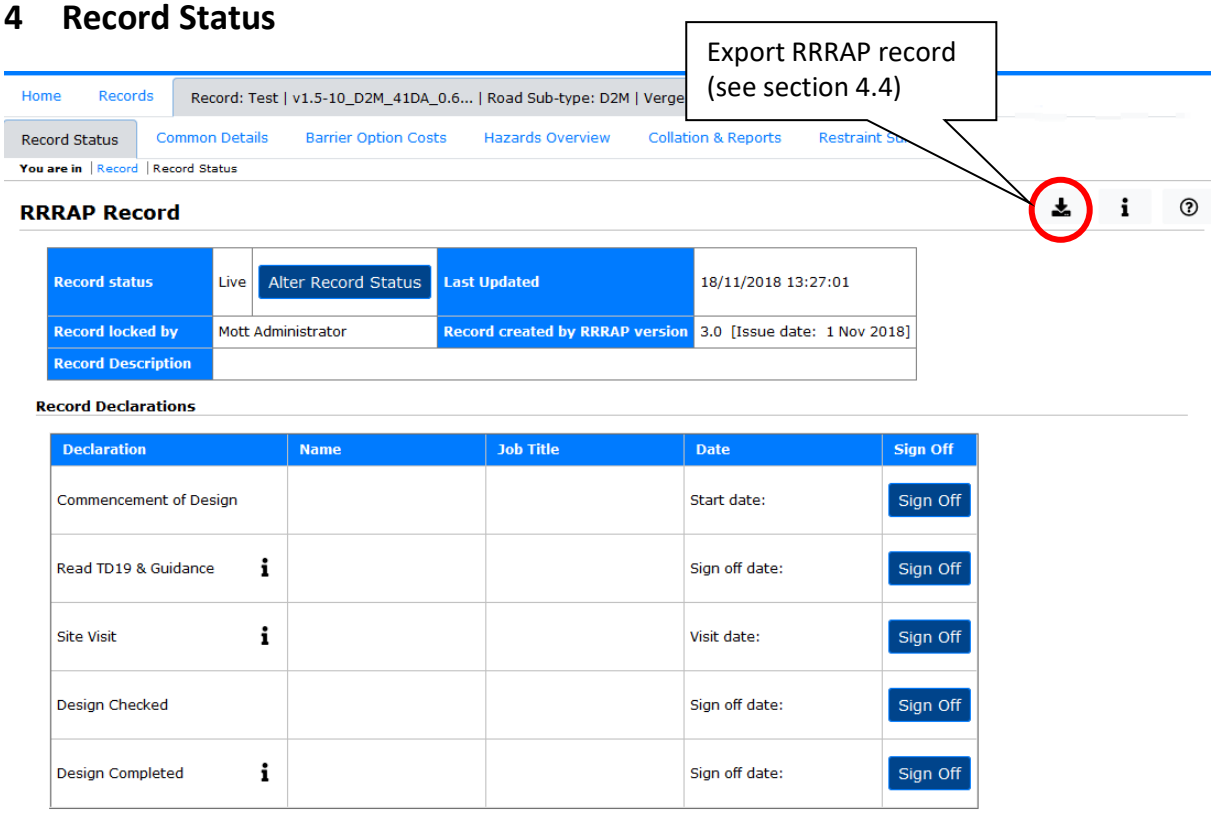


Figure 4-1 Record Status tab

The top part of this page presents a brief summary overview of the RRRAP record.

- Record status – the current status of the RRRAP record
- Last updated – when details of the record were last updated (see section 4.1)
- Record locked by – the name of the user who currently has the record locked for editing
- Record created by RRRRAP version – The version of the RRRAP used to create the record and the date that version of the RRRAP was made available
- Record description – an optional description of the record to provide more detail

The bottom part of the page presents a set of declarations that should be signed off at different points during the lifetime of the record (see section 4.2).

The record status can be altered by clicking the 'Alter Record Status' button (see section 4.3).

The RRRAP record can be exported by clicking the Export RRRAP Record icon at the top right of the page (see section 4.4).

4.1 Record Last Updated

The last updated date/time value will be updated when most data entry / manipulation events occur.

The following features of the RRRAP will NOT affect the last updated time:

- Opening or closing a RRRAP record

- Altering the record status
- Exporting a RRRAP record
- Generating a PDF report

4.2 RRRAP Record – Declarations

There are several declarations that should be signed off by an appropriate user for particular aspects of the RRRAP record, e.g. commencement of design, indicating that TD 19 and supporting guidance has been read by the designer, that a site visit has taken place, etc. The designer could be the Design Manager responsible for the team carrying out site surveys and the design and the RRRAP process.

The application imposes no restriction on which users sign off these declarations and when the sign off should take place. Only those users with the authority should sign-off parts of the RRRAP in line with their own company's procedures.

Some of the declarations require a date to be entered (commencement of design, when site visit occurred). Either click the Calendar image next to the entry field to display a calendar to pick a date or enter a date manually in the format 'dd/mm/yyyy'. For the declarations that do not require a date, the date will be taken from the current time when the Sign off button is clicked.

4.3 Record Status Page

Each RRRAP record has an assigned status. The following table describes the meaning of each status.

Status Level	Description
Live	Record created and ready for data entry
On hold	Design currently on hold
Abandoned	Scheme/Design abandoned or indefinitely postponed
Prelim. design	Preliminary/Feasibility Design
Detailed design	Data entry phase for detailed design
Complete	Design complete pending check and approval
Checked	Design is complete and checked
Approved	Design is complete, checked and approved
Archive	Inputs and outputs downloaded and saved
Closed	Design closed

Users should use the status alongside their own company's procedures to manage and monitor the progress of each RRRAP record.

4.4 RRRAP Record Export

The following steps describe how to export the raw hazard data that has been entered into the record as a RRRAP record ZIP archive. For instructions on importing a RRRAP record ZIP archive, see section 3.8.

The raw data exported includes:

- All common details
- The data entered for each of the hazard category types (not including any calculated risk values)

The record export does not export:

- Sign off details
- Option costs
- Hazard overview details (i.e. if a hazard category type is expected or has its data entry completed)
- Temporary hazards
- Restraint summary details for inclusion in Appendix 4/1.

The above information is captured in the full report (see section 11.3) and restraint summary report (see section 12.1) which can also be archived off the system.

It is **recommended** that you should use this export facility to backup your hazard data at key stages in the design process.

The export consists of a ZIP file containing CSV files. Within the ZIP file, the common details will be contained in a folder called 'Common_Details' and all the hazards will be in a folder called 'Hazards'. Each hazard category will have an individual CSV file.

To export a RRRAP record ZIP file follow these steps:

1. Via the 'Record Status' tab, click the export RRRAP record button (located at the top right).
2. To export a RRRAP record a filename (for the generated ZIP file) has to be provided. By default the name of the export file is the record name (x) plus the name of the project (y) and the date, i.e. x_y_dd_mm_yyyy.zip
3. Click 'Export Record' to generate the export file.
4. Once the export file has been generated, a dialog will be displayed by your browser. At this point you can save the file to an appropriate location on your computer.

5 Data Entry - Common Details

This tab records key details of the project for which the assessment of Road Restraint System requirements is being undertaken. The page is split into four sub-sections:

- Basic Details
- Reason for Design
- Section Details & Traffic Information
- Scheme Duration & Barrier Costs

To enter Common Details, click the 'Edit' button.

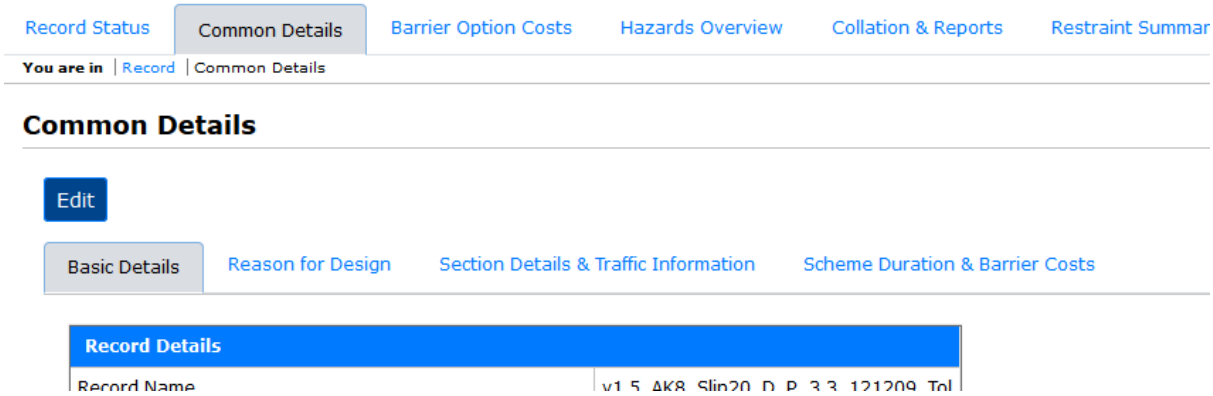


Figure 5-1 Common Details tab

Important Note – Saving Common Details

To save values entered for Common Details click the 'Save' button. Please note that Common Details cannot be saved until **all required mandatory fields** have been completed across all Common Details sub-tabs. Any sub-tab that has incomplete mandatory fields will be highlighted with the ! indicator.

It is also important to note that, whilst the mandatory fields are the minimum that must be completed before the Common Details can be saved, and only completing these can be useful if for instance a quick trial is being carried out, it is essential that data is entered in all the other fields so that a complete auditable record is maintained for the final design.

5.1 Basic Details

This section is used to record overall details of the Project. It records details such as: Project name; Designer and contract details; etc.

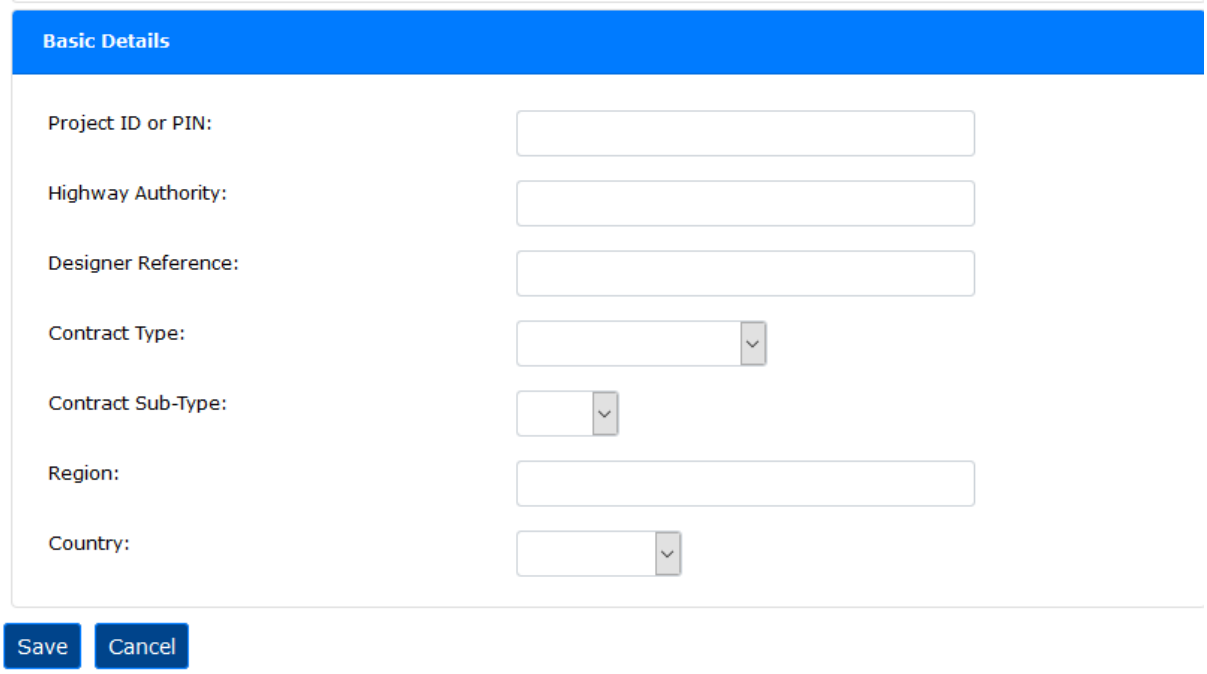


Figure 5-2 Common Details – Basic Details

Also included in the Basic Details tab are the Record Details, i.e. Record name, Project name, Record Description, etc. These values can be edited while editing the other Common Details values.

5.2 Reason for Design

This section is used to record details of why the Project it is being done. It records details such as: reason why the works are being done, e.g. upgrade or improvement to an existing carriageway or replacement of existing Restraint System; etc.

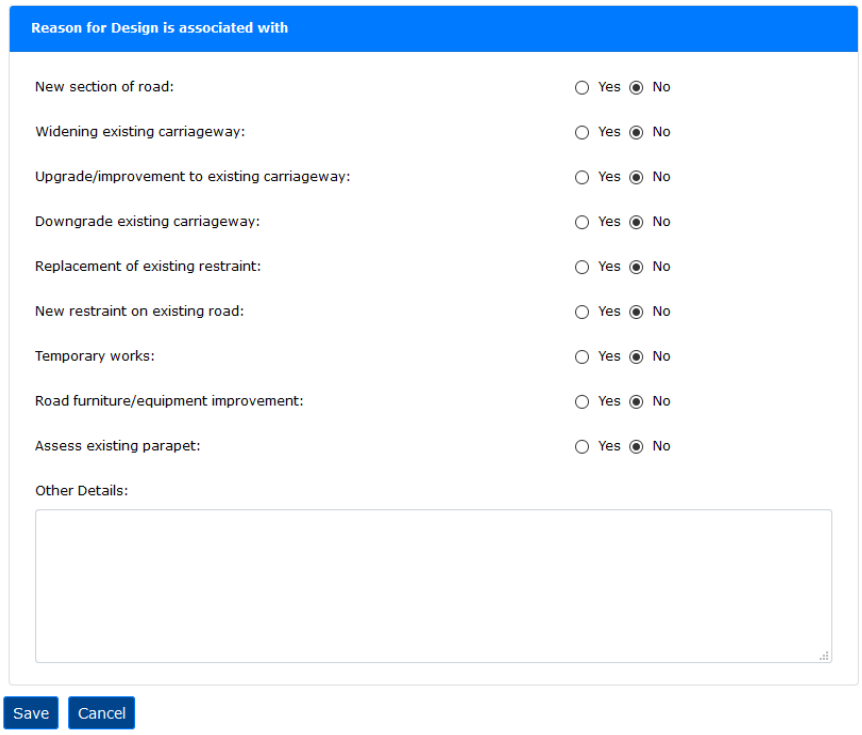


Figure 5-3 Common Details – Reason for Design

If you answer 'Yes' to Assess existing parapets, you will be prompted to fill in an additional set of 'Yes' / 'No' questions.

If none of the supplied reasons for the design are appropriate, then use the 'Other Details' text area at the bottom of the page to enter a the reason for the design.

Important Note – Temporary Works
If you select 'Yes' for 'Temporary Works', an additional Temporary Works tab will be displayed (once the Common Details are saved). Note that temporary hazards are dealt with differently to other hazards.

5.3 Section Details

This section is used to record details of the particular Section of the road that is under consideration, e.g. type of road; the road's location in terms of junction names or numbers, which side of the carriageway is being looked at, and start and end chainages of the section being assessed; etc.

A road that has a length of Slip Road and a length of Mainline will need to be split into two Sections, as the traffic flows and cross section, alignment and hence run-off and accident characteristics of the Slip and Mainline will be different.

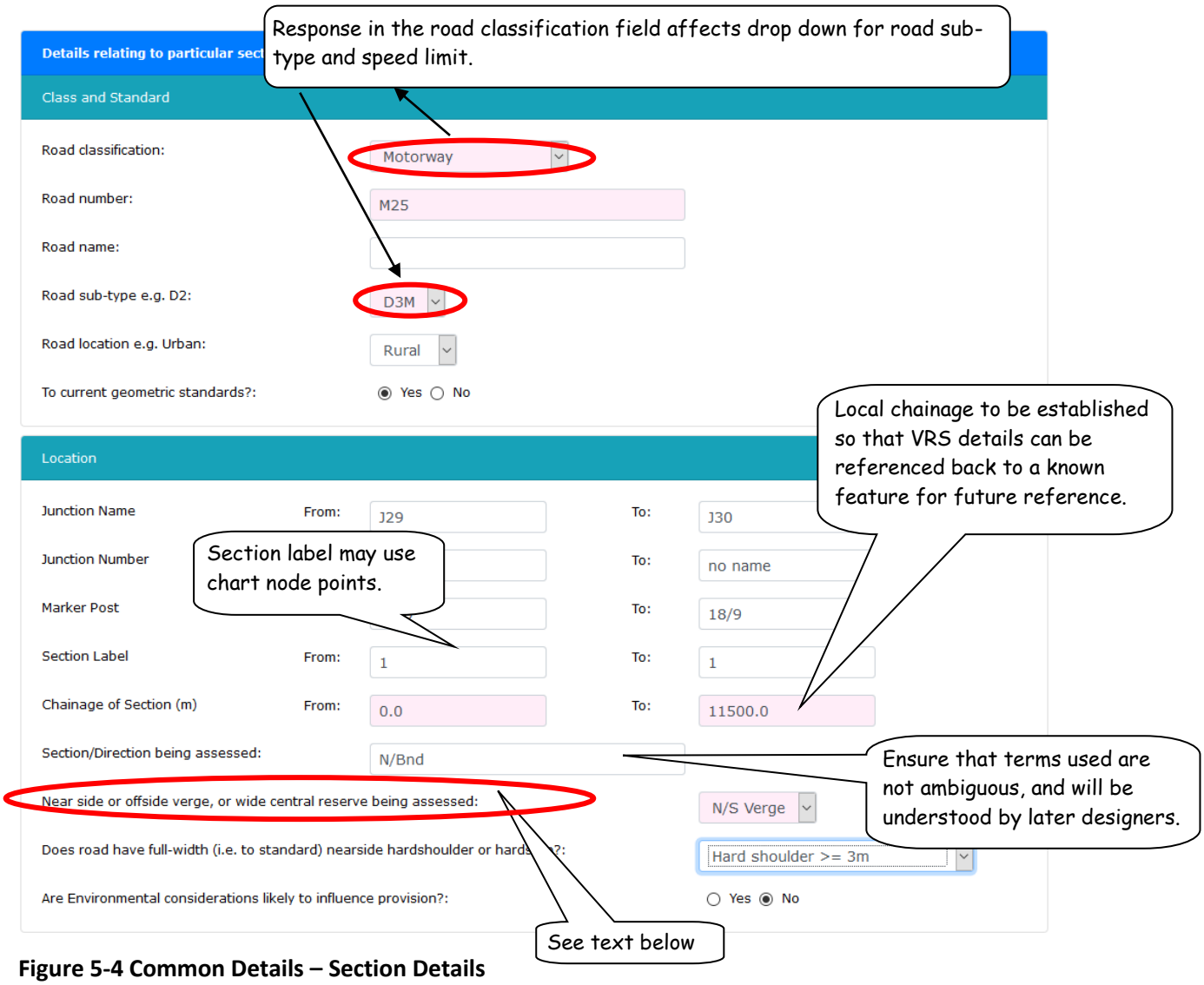


Figure 5-4 Common Details – Section Details

Note that if you are assessing a motorway with 5 or more lanes, use the D4M category.

The RRRAP is normally used for assessing the near side verge (N/S verge) of a single or dual carriageway. It can be used for assessing the offside (O/S verge) of a slip or link road, which are essentially one way roads. It can also be used for assessing whether hazards that are present in a wide central reserve (i.e. one that is more than 10 m wide) warrant protection by selecting the offside verge option. Note that this option assumes that crossover incidents are not possible due to the width and does not make any assessment of crossover incidents within the calculation.

5.4 Section Details - Chainage

The RRRAP can cater for Sections that are in decreasing chainage order.

If say a section of road is being assessed with increasing chainage in the northbound direction from, say, ch 0 m to ch 1200 m, then for hazards in the northbound verge the chainage will run from ch 0 to 1200, whilst for hazards in the southbound verge, the chainage will run from ch 1200 to ch 0. Each direction would require a separate RRRAP record.

In order that the RRRAP is meaningful and identifiable to maintenance and highway authorities years after a design has been completed it is essential that the local chainage that has been adopted for a design is referenced back to some known features e.g. node points or chart points or to a permanent structure such as a bridge. This should be captured via design drawings.

5.5 Section Details – Hard shoulder width

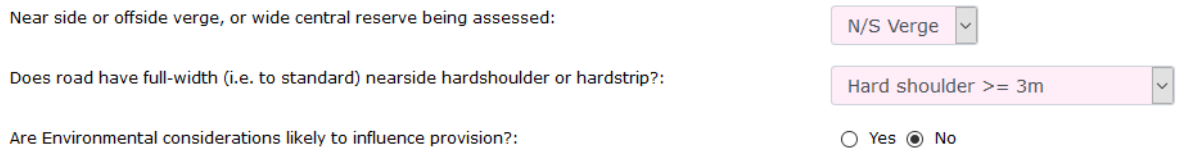


Figure 5-5 Section Details – Hard shoulder width

More details on defining hard shoulder widths can be found in section 8.2.

5.5.1 Motorways

For a Motorway, a standard nearside (n/s) full width hard shoulder is 3.3 m.

Where the hard shoulder is locally less than 3.0 m, it would normally be hatched and signed as having no hard shoulder in accordance with TD 27. If the n/s hard shoulder is generally full width, but locally is less than 3.0 m in width over lengths of less than 100 m, for the purposes of the RRRAP, indicate that the hard shoulder is >= 3 m in width.

Where the n/s hard shoulder is less than 3.0 m wide over a length greater or equal to 100 m then indicate that the road has a hard shoulder between 0.6 m and 3.0 m. Enter the actual hard shoulder widths in Width of adjacent Hardshoulder / Hardstrip (A) field in the Verge Widths hazards section.

For the offside (o/s), i.e. the central reserve, the Width of adjacent Hardshoulder / Hardstrip (A) & (B) fields should both be zero.

5.5.2 Smart Motorways

For All Lane Running (ALR) Sections, follow the help and guidance given in section 8.2. For Hard Shoulder Running (HSR) sections, again follow the help and guidance in section 8.2, running two separate RRRAPs: one with standard running, i.e. with hardshoulder in place and permanent speed limit; and the second with HSR and the proposed speed limit for this scenario. The outputs from the two scenarios can be compared and the VRS requirement for each hazard for the worst case selected.

For the offside (o/s), i.e. the central reserve, the Width of adjacent Hardshoulder / Hardstrip (A) & (B) fields should both be zero.

5.5.3 All Purpose Roads

For a Single or Dual All Purpose road, the standard n/s hardstrip width is 1.0 m. The drop downs are Hard strip >= 0.6 m and Hard strip < 0.6 m. If the hardstrip is generally full width, but locally is less

than 0.6 m in width over lengths of less than 100 m, for the purposes of the RRRAP, indicate that the Hard strip >= 0.6 m.

Where the hardstrip is less than 0.6 m wide over a length greater or equal to 100 m then indicate that the Hardstrip < 0.6 m.

For the offside (o/s), the Width of adjacent Hardshoulder / Hardstrip (A) field= h/s width, typically 0.7 m or 1.0 m, Width of adjacent Hardshoulder / Hardstrip (B) field = zero.

5.5.4 Slip and Link Roads

For a Slip Road or a Link Road where the standard n/s hard shoulder is 3.3 m, follow the guidance for a Motorway. For a Slip Road or Link Road where the standard hard shoulder is 2.8 m or standard hardstrip is 1.0 m in width, then indicate that the road had a hard strip/shoulder 0.6 m to 3.0m.

For the offside (o/s), the Width of adjacent Hardshoulder / Hardstrip (A) field= h/s width, typically 0.7 m or 1.0 m, Width of adjacent Hardshoulder / Hardstrip (B) field = zero.

5.5.5 All cases

The RRRAP defaults to a 0.6 m VRS set-back where full width n/s hard shoulder (>=3.0 m) or hardstrip (>=0.6 m) has been indicated, otherwise it defaults to 1.2 m set-back. The Risk calculations are pre-formed on the basis of the indicated hard shoulder width and the default set-back.

Should the local highway geometry not be sufficient for the default set-back values, it is possible, having run the RRRAP Risk Calculation, to overwrite the set-back values manually by editing hazards via the 'Collation & Reports' tab and to then recalculate the risk levels. If doing this, it is recommended that you generate detailed results for the hazard under investigation and either a snapshot or full report. This acts both as a record of previous values and to facilitate comparison.

In some circumstances, it is possible that only Tolerable results will be returned and it will not be possible to get an Acceptable level of risk. This is due to the way in which the equations and thresholds within the RRRAP operate. Where it is not possible to obtain an Acceptable level of risk, a Departure from Standard must be applied for accompanied by a RRRAP report and a summary of what the Designer has looked at (see section 2.11).

5.6 Section Details - Environmental Considerations

If Environmental considerations are likely to influence the decision on provision of VRS, e.g. snow build up on some forms of VRS may influence type to be specified, or the RRRAP indicates protection is required for a localised one off hazard on a low risk site within an Area of Outstanding Natural Beauty and the Designer considers that VRS should not be provided, then background to the Environmental issue(s) and how that has influenced the decision should be given in the 'Comment' field relating to the hazard. The response entered is purely used for audit purposes and the calculation is not affected in any way.

5.7 Traffic Information and Scheme Duration

The lower part of the page, shown below, requires traffic information details for the Section. These details are used by the RRRAP to calculate the run-off frequency and in the benefit / cost calculations and must be entered. The percentage of large vehicles (LGVs), i.e. those over 3.5 tonnes, and, to a

lesser extent, of medium vehicles (MGVs), i.e. those over 1.5 tonnes and less than or equal to 3.5 tonnes, will affect the benefit / cost ratios and, especially where Others may be involved, the Containment Level of the VRS.

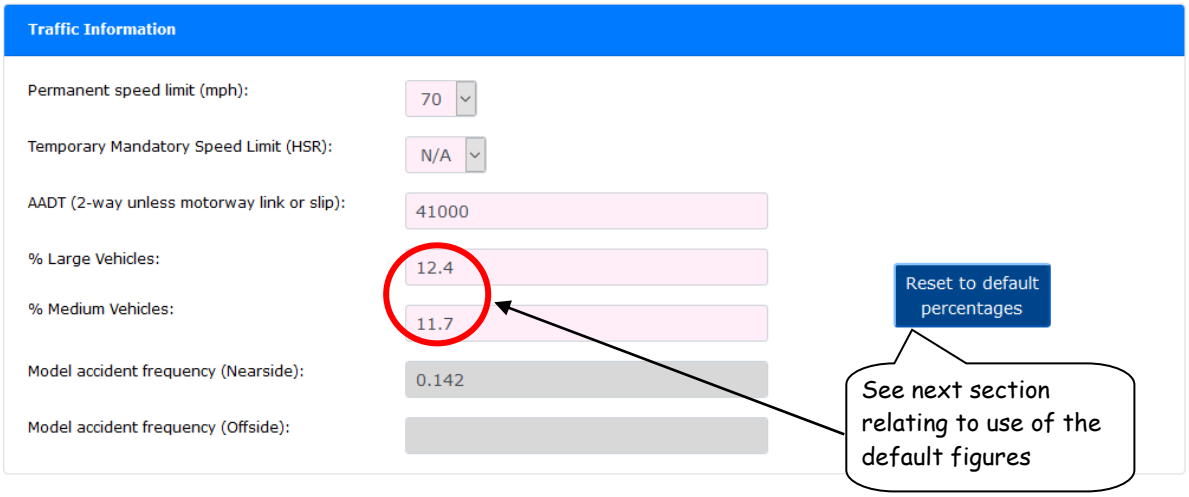


Figure 5-6 Common Details – Traffic Information

The page calculates default values for accident frequency and details are reported in the non-editable (grey) fields. Accident frequency is accidents per year per kilometre (1 fatal = 10 serious = 100 slight injuries). The default value takes into account the type of road and its AADT flow.

5.7.1 AADT, LGV and MGV

The AADT and percentage LGV and MGV values entered should be based on the predicted flow 5 years after the expected start of works date. If the LGV and MGV values are unknown, for instance because it is a new road, then the default values can be entered by clicking on the 'Reset to default percentages' button. For Motorway Link and Slip Roads, the 1-way AADT should be entered as they are in effect one way roads.

5.8 Scheme Duration & Barrier Costs

This section records the details of the scheme duration and whether default or non-default cost values are used for VRS.

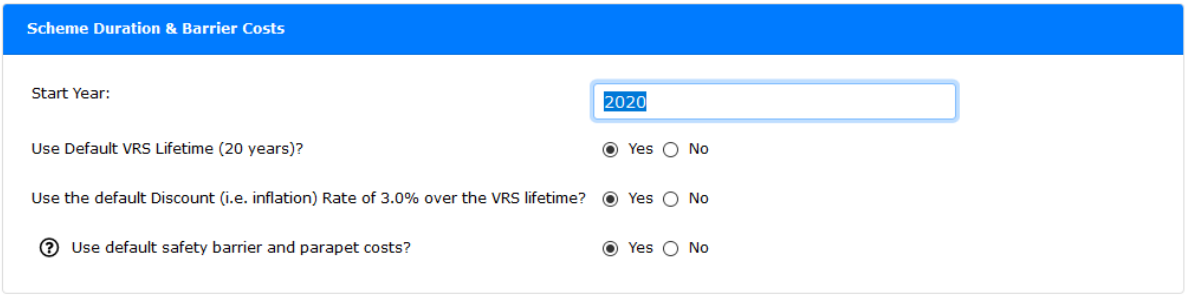


Figure 5-7 Common Details – Scheme Duration & Barrier Costs

The start year is for expected tender or start of works rather than design date.

The default VRS lifetime is normally 20 years. If this value is not suitable (e.g. DBFO schemes may be 30 years), answering 'No' to this question will display an additional field (see Figure 5-8) to enter a VRS lifetime (which must be a minimum of 20 years).

The default Discount (i.e. inflation) Rate of 3.0% is used over the VRS lifetime. If a different value is required, answer 'No' to this question and an additional field will be displayed (see Figure 5-8).

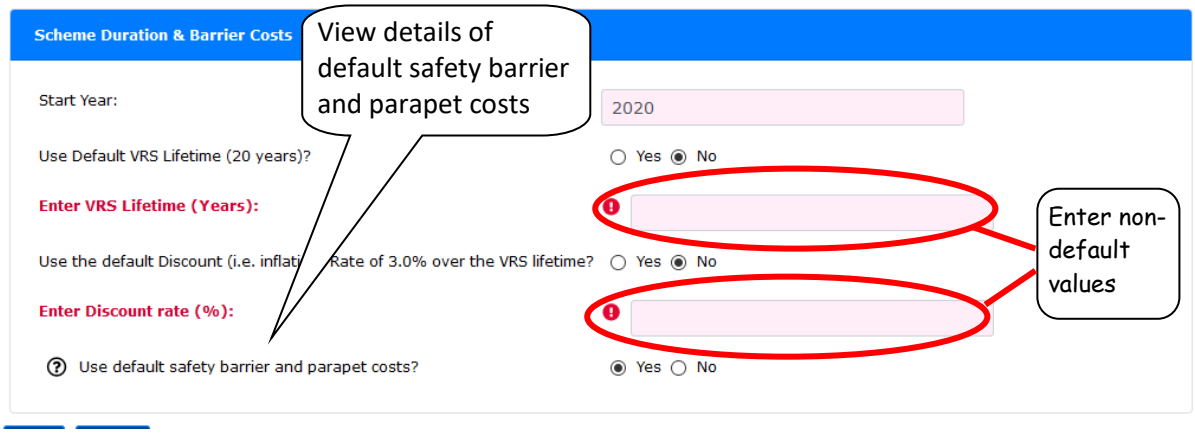


Figure 5-8 Scheme Duration & Barrier Costs – Non-default lifetime and discount rate

Unless otherwise specified, the RRRAP will use a set of default safety barrier and parapet costs (these can be seen by clicking on the nearby online help button). More detail on default costs can be found in section 6.1 and in the online help.

If for a whole project the default values are not considered to be appropriate, e.g. on a DBFO where very competitive rates can be obtained for VRS, enter 'No' for field 'Use default safety barrier and parapet costs?'. A further set of data entry fields are displayed to enter non-default costs.

Figure 5-9 Common Details – Non-default safety barrier and parapet costs

If you choose to enter non-default costs, the only value pre-populated is PVC.

This is based on the formula: (1-(1+D)^(-1*(N)))/D

Where:

- D is the discount rate (either the default value or as defined by the user)
- N is the life of the restraint system (either the default value or as defined by the user)

Note, if you are using non-default costs, all the fields for non-default costs must be completed before the risk calculation will run.

5.9 Common Details Import from CSV (previously exported from Web Version of RRRAP)

The following steps apply to CSV (comma separated value) files that have been generated by exporting a RRRAP record from the web version of RRRAP (see section 4.4).

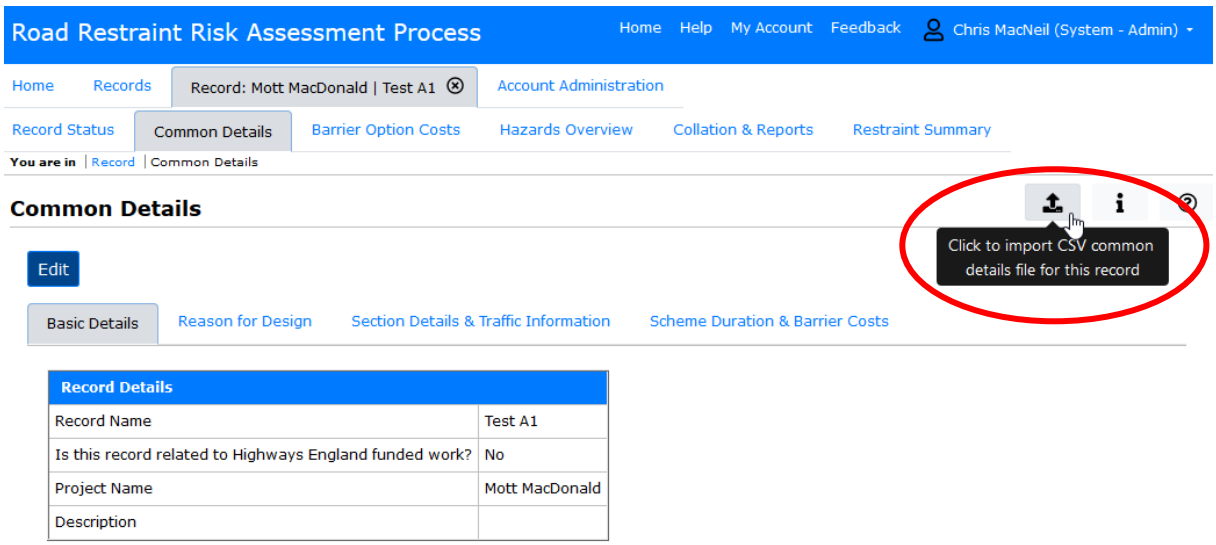


Figure 5-10 Importing a common details CSV file

To import Common Details from a CSV file follow these steps:

1. Through the 'Records' tab open a RRRAP record.
2. Via the 'Common Details' tab, click the import common details button (located at the top right).
3. Using the browse button on this page, specify the CSV file to import from your local file system.
4. Click the upload button.
5. If any errors are reported, these will have stopped the import from completing and no common details will be imported. The CSV file will have to be manually altered before trying again.
6. If only warnings are reported, then the import will have completed, but the common details page may have fields that require attention. Take appropriate action to fix these problems.
7. Click the 'Back to Common Details Overview page' button to go back and view the imported common details.

6 Barrier Option Costs

Where the cost of provision for an individual bridge parapet or a length of safety barrier is going to be significantly different to the default values (e.g. where significant strengthening of a bridge is needed to take the parapet (see TD 19 Appendix 3) or where an H1 or H4a safety barrier will require special footings due to poor ground conditions or its location on an embankment), then enter details for the revised cost in this tab for each separate installation.

Click the 'Add Option Cost' button to create a new Option Cost.

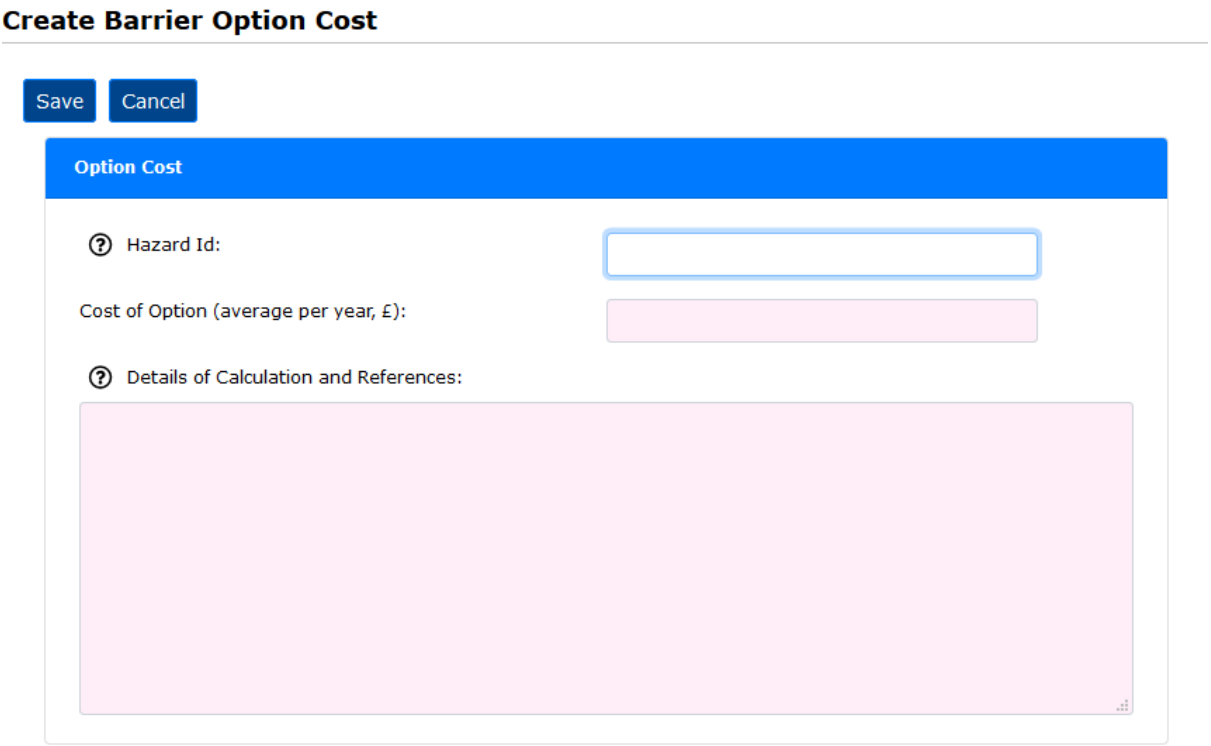


Figure 6-1 Create Barrier Option Cost page

The page displayed will allow you to record the details relating to the cost:

- Hazard Id – a cross reference to the affected Hazard (maximum 30 characters)
- Cost of option – average cost per year in pounds
- Details of calculation and references – provide details on the new cost (maximum 1000 characters)

The revised cost should also be set in the “Cost of Option” field for the affected hazard (edit the hazard via the Collation & Reports tab to access this field). This will ensure that the correct benefit cost ratio is determined when calculating risk. The benefit cost ratio can be viewed in the Detailed Results report.

6.1 Default Costs

The default costs are:

	N2	H1	H4A	N2 to H2 parapet upgrade	N2 to H4A parapet upgrade
Average Cost Per M (Current Year)	54.69	101.66	370.00	1000.00	2000.00
PVC	14.88	14.88	25.73	0.00	0.00
Average cost per year of maintenance	4.19	4.19	0	0	0
Cost of Terminal	510.17	510.17	481.72	0.00	0.00

These are maintained within the RRRAP and may change depending on the version of the RRRAP the web record was associated with when it was created.

The default values are generated from the following calculations:

	N2	H1	H4A	N2 to H2 parapet upgrade	N2 to H4A parapet upgrade
Average Cost Per M (Current Year)	See cost / m in Source Data section	See cost / m in Source Data section	See cost / m in Source Data section	Stated as 1000	Stated as 2000
PVC	(1-(1+D)^(-1*(N)))/D	(1-(1+D)^(-1*(N)))/D	(1-(1+D)^(-1*(N)))/D	Stated as 0	Stated as 0
Average cost per year of maintenance	See Maint / yr / min in Source Data section	See Maint / yr / min in Source Data section	See Maint / yr / min in Source Data section	Stated as 0	Stated as 0
Cost of Terminal	See Terminal in Source Data section	See Terminal in Source Data section	See Terminal in Source Data section	Stated as 0	Stated as 0

D is the discount rate (default 0.03)
N is the life of the restraint system (see Lifetime in 'Source Data' section below)

<u>Notes on derivation</u>

Net present Value (NPV) = PVB / PVC

PVB is the present value of benefits.
PVC is the present value of costs.

The lifetime cost of installing a road restraint system is:

PVC = C + M(1-(1+D)-n)/D) + Q

C is the installation cost (default £580 for the terminal and £5 per m for the restraint).
M is the annual maintenance cost (default £4.2 per m).
D is the discount rate (default 0.03).
N is the life of the restraint system (default 20 years).
Q is the installation delays (default 0).

Source Data

Costs taken from Spon 2006; maintenance values from MouchelParkman (M25); traffic mgt costs (not currently used) for installation taken from 25 costs supplied by MouchelParkman to TRL.

	Single sided	Cost of beam/m	Length	Cost/ post	Post spacing	No. of posts	Total	Cost/m	Maint/yr/m	Terminal	Life time	Traffic mgt costs per m during installation	Additional costs (e.g. resurfacing / drainage work	Total cost per m
N2	TCB	24.29	1000	41.6	3.2	312.5	37290	37.29	4.19	355.15	20	176.00		214.00
N2	OBB	37.36	1000	41.6	2.4	416.7	54693	54.69	4.19	510.17	20	176.00		231.71
H1	DROBB	84.33	1000	41.6	2.4	416.7	101663	101.66	4.19	510.17	20	176.00		278.68
H4A	Concrete	370	1000	0	0	0.0	370000	370.00	0	481.72	50	189.00		559.96

No. of posts = Length / Post spacing

Total = Cost of beam/m * Length + Cost per post * No. of posts

Cost / m = Total / Length

Total cost per m = (Total+2*Terminal)/1000+Traffic mgt costs per m during installation + Additional costs (e.g. re-surfacing / drainage work)

Notes:

- Traffic management costs for installation not currently included
- Repairs costs subsumed in maintenance costs
- Removal costs not included

7 Data Entry - Hazards Overview

This tab, shown in Figure 7-1, is used to identify whether or not any hazard listed in each category of hazard is present in the length of road verge (or central reserve) being assessed. The hazard categories are generally based around the numbering system used in the MCHW, Volume 1. Help buttons ⓘ are available to assist the user in determining what items are covered in each hazard category.

To pre-define what hazard categories are going to be populated, click the "Edit Category Configuration" button on the top left side of the page (see section 7.1).

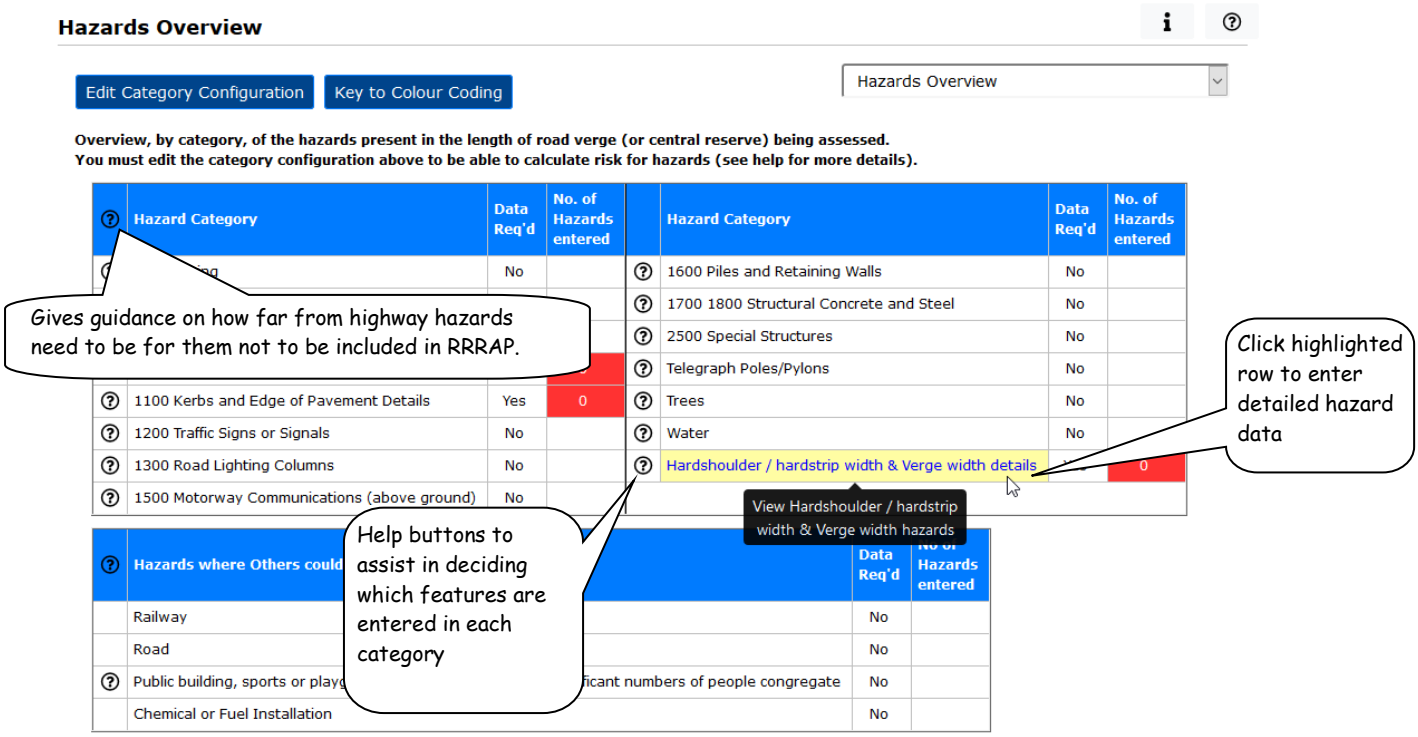


Figure 7-1 Hazards Overview

On the Hazards Overview page, two additional columns are shown for each hazard:

- Data Required: This indicates whether hazard data is expected to be entered for this hazard category
- No. of Hazards entered: This displays the current number of hazards entered for a hazard category

The No. of Hazards entered columns is also colour coded:

Red	No hazards have so far been entered for a category that is expecting hazards to be entered
Yellow	Entering of hazard data for this category is in progress
Green	All hazards have been entered for this category
Purple	Hazards have been entered for this category but none were expected
Clear	No hazards are expected to be entered for this category

Detailed hazard data is entered on the appropriate hazard pages which are accessed by clicking on the appropriate row in the Hazard Overview table - or by selecting a hazard category from the drop-

down list at the top right of the page. There is a button on each hazard page that returns to the Hazards Overview page.

Data is always required and must always be entered for:

- 600 Earthworks
- 1100 Kerbs and Edge of Pavement Details
- Hard shoulder / hardstrip width & Verge Width details

This is because of the way the RRRAP works. The RRRAP uses the earthworks information to calculate an 'effective offset' of the hazard; a cut slope, i.e. rising upwards from back of verge, making the hazard effectively further than its actual offset; a falling slope downwards from the back of the verge making the hazard effectively nearer. The 'Kerb and Edge of Pavement Details' currently do not alter the calculations, but need to be recorded for audit purposes and record completeness. The 'Hardshoulder / hardstrip width & Verge Width details' are particularly important as the RRRAP calculates the risk from the running lane under consideration. This will enable the designer to test for appropriate VRS provision where for instance the hard shoulder width is substandard, as is often the case where the road has been or is to be widened within the existing land-take, or its adequacy of provision when hard shoulder running for extended periods is contemplated.

If the start and end chainages for these three hazard categories do not match the start and end chainages for the Section under consideration, then an error message will be generated when trying to calculate risk, advising the user of the problem (see section 2.10.3).

7.1 Edit Category Configuration

To configure which hazard categories are going to be populated, click the "Edit Category Configuration" button on the top left side of the 'Hazards Overview' tab.

For each hazard there are two columns shown, "Present?" and "Completed?".

?	Hazard Category	Present?	Completed? i	No. of Hazards entered
?	300 Fencing	○Yes ◉No	☐	
?	400 Parapets	○Yes ◉No	☐	
?	500 Drainage Features	○Yes ◉No	☐	
?	600 Earthworks	Yes	☐	0
?	1100 Kerbs and Edge of Pavement Details	Yes	☐	0
?	1200 Traffic Signs or Signals	○Yes ◉No	☐	
?	1300 Road Lighting Columns	○Yes ◉No	☐	
?	1500 Motorway Communications (above ground)	○Yes ◉No	☐	

Figure 7-2 Edit Category Configuration

The first, "Present?" indicates whether hazard data is expected. Click 'Yes' if hazard data is to be entered, or click 'No' if none is expected. Because hazard data is always required for "600

Earthworks", "1100 Kerbs and Edge of Pavement Details", and "Hardshoulder / hardstrip width & Verge Width details" they are always set to 'Yes'.

The second column, "Completed?" indicates that the person editing the record believes that all hazards of this type have been entered for the record. If all hazards have been entered click the checkbox. If, at a later date, the situation changes and more hazards are to be entered for a category, simply click on the checkbox to remove the tick.

Once finished, click the Save button to save the changed hazard Category Configuration.

Important Note – Marking Categories as Complete

Any hazard category that has been set as being present (indicated by a 'Yes' value) must be marked as complete before running the risk calculation, otherwise it will fail to run. Error messages will be displayed for each category set as being present but not marked as complete.

7.2 Hazard Categories

There are broadly two groups of hazards, those that are generally within the Highway Boundary based on MCHW categories, and those that are generally outside or may cross the highway (hazards where Others could be affected).

7.2.1 Within Highway Hazards

Are any of these hazards present inside or within X m beyond the Highway Boundary along the length of carriageway under Consideration?

The value of X is 5m where the road is in cutting deeper than 3m on the side under consideration, and 15m in all other situations.

7.2.2 Hazards where Others could be affected

Are hazards where Others could be affected present that could potentially be reached by errant vehicle or falling object that is hit? Hazards up to 100m from the carriageway should be considered.

These features may be inside the Highway Boundary or outside it. They may be behind the Highway Boundary fence.

An errant vehicle can travel a considerable distance, especially on a downward slope and may break through simple boundary fencing. If in doubt, include and assess the requirements for protection.

Obviously if it is physically impossible for an errant vehicle to reach a hazard, e.g. due to intervening obstructions or topography, then there is no need to include it.

A site visit is required to confirm the reasonableness of the restraint provision proposed / determined by the Risk Assessment Tool.

7.3 Hazard Data Entry Completed

Once all hazard data has been entered, and hazard categories with data have been marked as complete (see section 7.1), click on the 'Collation & Reports' tab. This tab lists all the hazards that

have been entered and can have risk evaluated. From here the risk calculation can be run and hazards evaluated for risk.

Note that Verge and Kerb hazards do not have risk evaluated so do not appear in the 'Collation & Reports' tab (although Verge details are used as part of the risk evaluation for all other hazards). Also not included is the last Earthwork hazard. It is used purely as an end marker to define the slope width and height at the end chainage point for the section being assessed.

7.4 Saving a Copy

It is recommended that you export a copy of the RRRAP record (see section 4.4) once all the hazard data has been input and at key stages in the design process. This will allow the designer to get back to the situation prior to making any changes when evaluating hazards. This will backup only the common details and the data entered for each of the hazard category types. You can also generate a full PDF report that contains all the data entered in a human readable format.

An optional way to backup your data is to create a copy of the record via the Records tab (see section 3.5). This will create a copy of the record with common details, option costs, hazards overview, and all individual hazards (not including any calculated risk values). The restriction on this method is that it uses up a valuable record slot. It is recommended that this option only be used for short term backups.

7.5 Upper and lower limits to the number of hazards

There were a number of queries that arose during the trialling of the original RRRAP spreadsheet relating to whether it was necessary to input data relating to all existing hazards along the entire length of a road where for instance a small number of discrete communications signs and associated cabinets were to be installed as part of a small scheme. The Designer's attention is drawn to the need to comply with the mandatory Implementation paragraphs (1.18 and the following) of TD 19. It should be noted that the RRRAP is capable of being used to determine the VRS requirements for as few as one or two hazards plus the earthworks and other mandatory data, with information local to only these hazards being entered (say covering 100 m to 200 m in advance and 50 m beyond depending on circumstances) or over the entire length of a scheme (as long as the flow and road types are consistent throughout the length).

There is no limit to the total number of each hazard that can be entered.

8 Data Entry - Detailed Data on each Hazard

8.1 General Notes

8.1.1 Unique ID reference number

The RRRAP automatically assigns each hazard an ID Number.

8.1.2 Aggressiveness

The RRRAP automatically assigns each hazard a default aggressiveness factor depending on the type of hazard. The default aggressiveness values can be viewed by clicking the help button next to the aggressiveness field.

The aggressiveness value may be changed manually to see for example the effect on the VRS requirement of changing the hazard to a less aggressive type of hazard (apart for Earthwork hazards), but this will have an impact when calculating risk. To manually change the aggressiveness value, first click the button next to the aggressiveness field. This will make the field editable. If you wish to revert back to the RRRAP calculated aggressiveness value, click the button next to the aggressiveness field.

8.1.3 Dimensions

Chainages are in metres. Lengths, widths and offsets of hazards are in metres. Heights are in either metres or millimetres, e.g. sign height and cut or fill height is in metres, kerb height is in millimetres.

8.1.4 Hazard Data Entry Pages

Once a hazard category has been selected from the 'Hazard Overview' tab (see section 7), an overview page is displayed for that hazard category, listing all hazards entered so far (an example is shown in Figure 8-1). If no hazards have yet been entered, no summary table is shown and the text 'There are currently no items of this type. ' is displayed.

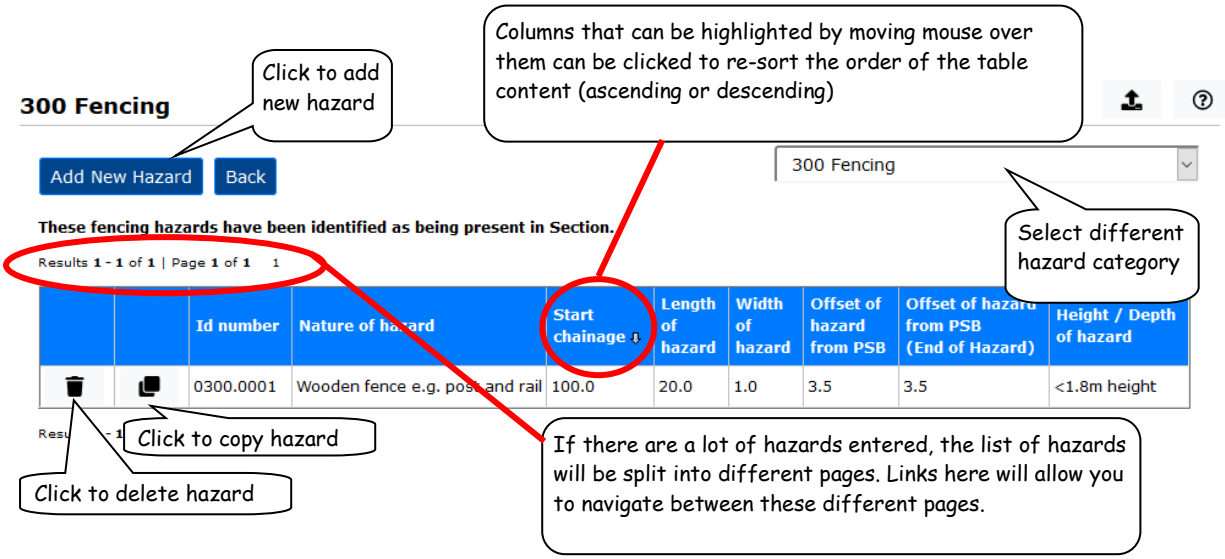


Figure 8-1 Fencing Hazard Data Entry Summary Page

The summary page allows you to:

- Create new hazards
- Edit non-risk calculation hazard values for existing hazards
- Delete hazards
- Copy a hazard (see section 8.1.5 for more details)

Once a hazard is deleted the information is permanently lost from the record.

8.1.5 Hazard Copy

In the hazard data entry summary page (see Figure 8-1), if you click the copy hazard button , a new hazard is created with all the selected hazards values, except for start chainage and risk calculated values. This mechanism is useful where many of the values do not change across similar hazards. Create the first hazard, and then use that as a template to derive the remaining hazards. If this method is chosen, care must be taken to ensure that the input reflects the situation accurately at chainages where one or more parameters do change. The parameters should reflect the general situation in the vicinity of each hazard.

8.1.6 Saving Hazards

When creating a new hazard or editing an existing hazard click the 'Save' button to make your changes permanent.

If you are creating a new hazard, a 'Save & Next' button is also available. Clicking this will save the hazard you have just defined, and once that has been completed, will display another blank data entry page so that you can enter details of another hazard.

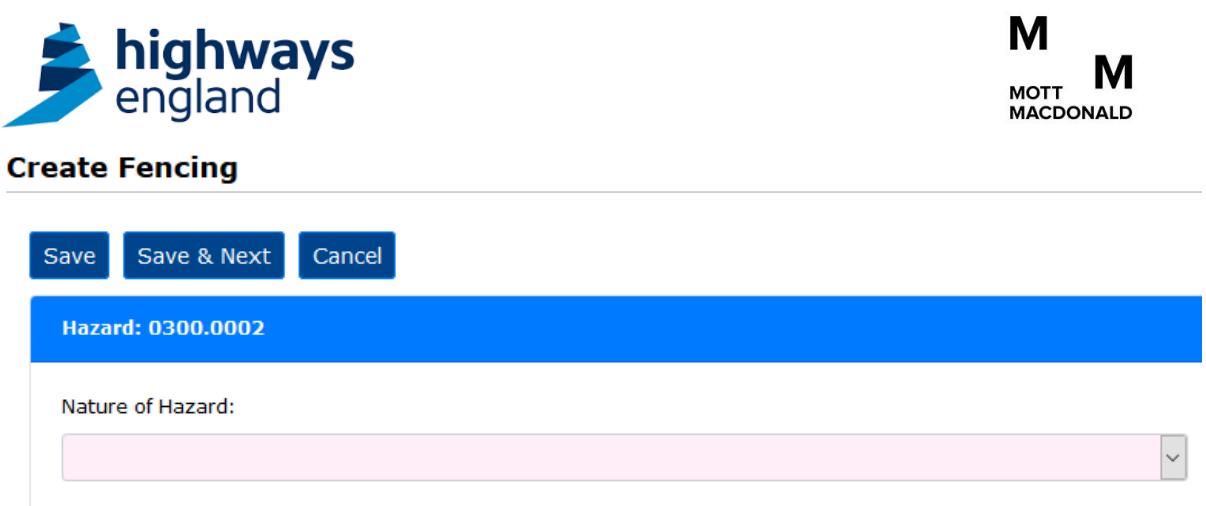


Figure 8-2 Using 'Save and Next' when entering hazard data

If you copy a hazard (as described in section 8.1.5), a 'Save & Next' button is also available. Clicking this will save the hazard you have just defined, and once that has been completed, will display another copy of the original selected hazard for copy (with the chainage field blank) so that you can enter details of another similar hazard quickly.

8.1.7 Drop down listings and Helps

Many of the fields in the right side of the hazard data entry pages are the same, e.g. Local Alignment, Sleep, Speed, etc. They have the same options and help (shown in Figure 8-3).

Where they differ, e.g. on the '600 Earthworks', '1100 Kerbs and Edge of Pavement Details', 'Railways', 'Roads', 'Buildings', and 'Chemical or fuel installation' data entry pages, details and guidance has been given within the appropriate section of this Guidance Manual.

Local Alignment (F2)

Local alignment (F2)	
Good alignment	Full standard sight stopping distance (SSD), full width lanes, straight and constant grade
Average alignment	Full standard sight stopping distance (SSD), some curves and undulations but standard horizontal and vertical alignments and lane widths.
Poor alignment	Sub-standard SSD or vertical or horizontal alignment or lane widths.

Sleep - related site (F3)

Sleep - related Site (F3)	
A	No obvious risk factor.
B	Site of featureless rural road with the minimal services and/or minimal distractions for drivers at the side of the roads.
C	Sweeping right hand bend or sweeping left hand bend, with no offside or central reserve safety barriers.
D	Site at the end of a long route.
E	Any combination of the above factors.

Speed (F4)

Speed should normally be set to "approximately equal to speed limit" for motorways and dual carriageways.

Site specific hazards increasing chance of RTA

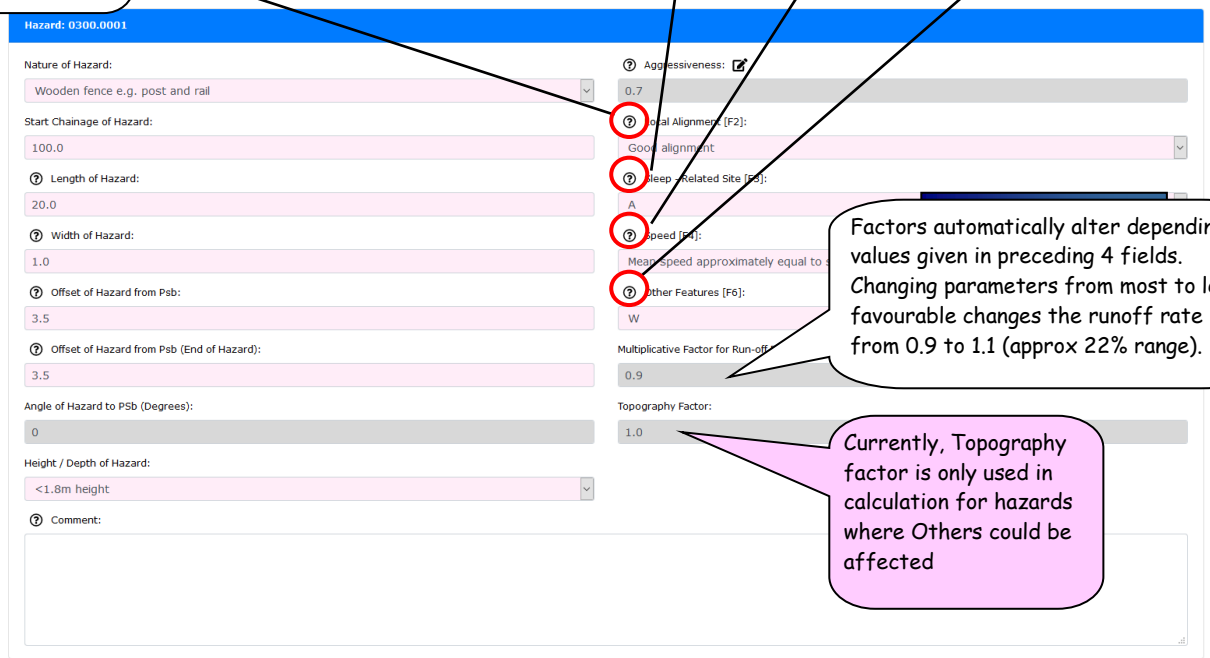
Site specific hazards increasing the likelihood of an RTA include the following features in the length of the section:

Farm access, road junction, private driveway, lay-by, bus stop, steep downhill slope, on approach, etc. Lack of adequate signage would also be included here.

W	No obvious hazards
X	Single site specific hazard
Y	Multiple minor hazards or single major hazard (e.g. junctions, steep slopes, sharp bends).
Z	Multiple major hazards

Help will assist decision on appropriate entry in field.

A sweeping bend is a long slow curve rather than a tight one.



Factors automatically alter depending on values given in preceding 4 fields. Changing parameters from most to least favourable changes the runoff rate from 0.9 to 1.1 (approx 22% range).

Currently, Topography factor is only used in calculation for hazards where Others could be affected

Figure 8-3 Common Hazard Fields

8.1.8 What to do if an existing hazard lies in front of the normal VRS location

Occasionally an existing hazard, e.g. a sign or perhaps in rural areas the start of an earthworks slope, will lie in front of the VRS position i.e.within the default VRS set-back of 0.6 m where there is a hard shoulder or hardstrip, or of 1.2 m where there is no hard shoulder or hardstrip.

In these cases, when the Calculate Risk button is pressed, the risk calculation will stop evaluating this hazard (and move on to the next hazard). In the Risk Calculation Issues page (displayed after all risk calculations have finished), a message will be displayed highlighting this problem for the affected hazards (see section 2.10.5 Hazard located in front of barrier). See also section 8.2.1 Substandard verges.

Via the 'Collation & Reports' tab, edit the affected hazard. To ascertain the risk level and VRS requirements for the hazard, either the set-back of the barrier should be manually altered (to the same value as the hazard offset, or to a lesser value); or the hazard offset increased so as to lie outside the VRS position. Risk should now be recalculated. If the hazard requires protection, then the programme will highlight the entry and the 'actual barrier working width' will be shown as either 0.01 m (rather than 0.00, as the programme would consider a zero here a problem) or as the actual value achievable based on the revised VRS location or on the revised hazard location.

The Designer can compare Detailed Results with the barrier at different set-backs and or hazard at different offsets. By generating Detailed Results, Snapshot and Full reports for different data sets, users can reference and compare results.

It is important to ensure that any permanent changes and the reasons for them are fully document in the hazard 'Comment' field.

A Departure from Standard will be required if the VRS set-back is maintained at the reduced value or, subject to the Relaxations allowed in TD 19 Paragraphs 3.66 and the following, a hazard is left within the safety barrier working width. See section 2.11 Relaxations and Departures from Standard.

8.1.9 Hazard Import from CSV (CSV exported from Web Version of the RRRAP)

The following steps apply to CSV (comma separated value) files that have been generated by exporting a RRRAP record ZIP from the web version of the RRRAP (see section 4.4). The entire RRRAP record can be imported back into the RRRAP (see section 3.8).

To import hazards for an individual hazard category (i.e. Fencing) from a single CSV file follow these steps:

1. Through the 'Records' tab open a RRRAP record.
2. Via the 'Hazard Overview' tab, click the desired hazard category row in the table.
3. Click the import hazard button (located at the top right).
4. Using the browse button on this page, specify the CSV file to import from your local file system.
5. Click the upload button.
6. If any errors are reported, these will have stopped the import from completing and no hazards will be imported. The CSV file will have to be manually altered before trying again.
7. If only warnings are reported, then the import will have completed, but some hazards may have fields that require attention. If a hazard has had a problem importing, it will be

highlighted via a warning icon on each of the hazard category overview pages (see section 2.10.2). Take appropriate action to fix these problems.

8. Click the 'Back to Hazard List page' button to go back and view the imported hazards.

CSV Note:

- When importing Structure/Parapet hazards, if there are parapets that protect Road or Railway hazards, these references will have to be re-established once parapet hazards are imported (on individual hazard import, hazard Id references cannot be guaranteed to be the same hazard so are left blank).

When importing this way, the hazards will be added to the list of hazards already available for the chosen hazard category.

8.1.10 Hazard Import from CSV (CSV generated from the RRRAP v1.3 Excel Spreadsheet)

Before following the steps in section 8.1.9, the steps described in this section must be completed to prepare the data for import into the RRRAP web application.

Important Note – RRRAP Excel Spreadsheets
This process only supports data extracted from RRRAP v1.3 Spreadsheets. Data cannot be extracted from older versions of the RRRAP Spreadsheet and imported into the RRRAP web application.

A CSV file has to be generated for each hazard category.

1. Open the RRRAP v1.3 Excel spreadsheet.
2. Navigate to the tab that contains the desired hazards.
3. Create a new empty spreadsheet (where the copied content will go).
4. Next, select the cells that contain the hazard data, stating with the ID Number column and including all other columns to the right, e.g. for 1300 Lighting Columns worksheet you would select columns A to N. The selection MUST also include as its first row the row that contains the column headings, e.g. ID Number, Nature of Hazard, Start chainage of hazard, Length of hazard, etc. For 1300 Lighting Columns worksheet, this is row 4.
5. Copy the selected cells. Move to the new empty spreadsheet. Via the Edit menu select Paste Special. Under the Paste heading select Values and click the Ok button. The content is now pasted into this new file.
6. Under the File menu, select Save As. In the save dialog change the Save As type to 'CSV (Comma delimited) (*.csv)'.
7. Excel then states that the selected file type does not support multiple sheets - click Ok button.
8. Excel then states that the csv file may contain incompatible features – click the Yes button.
9. The CSV file has now been saved. See section 8.1.9 for steps to import this CSV file.

CSV Notes:

- Roads. At step 5, once the content has been pasted into the new empty spreadsheet, some values need to be fixed. For the values under the 'Actual Speed of Traffic on Adjacent Road (F12)' column, replace the special 'less than or equal to' character with the two characters '<=' and replace the special 'greater than or equal to' character with the two characters '>='. If you try to save the CSV file without make this change the CSV file contains the '?' character and when imported the drop down value is not matched.

- When importing Structure/Parapet hazards, if there are parapets that protect Road or Railway hazards, these references will have to be re-established once parapet hazards are imported (on individual hazard import hazard Id references cannot be guaranteed to be the same hazard so are left blank).
- Hardshoulder / hardstrip width & Verge width hazards. The “Width of adjacent Hardshoulder / Hardstrip” column found in version 1.3 of the RRRAP spreadsheet has now been split into two separate columns - (A) and (B). Due to this, the “Width of adjacent Hardshoulder / Hardstrip” value will not be imported. The Designer will need to populate the Hardshoulder / Hardstrip (A) and (B) fields taking into account the previous single value and the new guidance for determining Hardshoulder / Hardstrip values.

8.2 Hard shoulder and Verge widths

Data must be entered for this hazard category in order that the RRRAP will run.

The first and last chainage entries must match the Start and End chainages for the section.

Create Hardshoulder / hardstrip width & Verge width details

Save | Save & Next | Cancel

Hazard:

Start Chainage of Hazard:

Width of Verge:

Width of adjacent Hardshoulder / Hardstrip (A):

Width of adjacent Hardshoulder / Hardstrip (B):

Total nearside runoff distance:

Carriageway Width from Psb Nearside to Psb Offside:

Total Offside Runoff Distance:

Comment:

Remember to include details for where the verge is locally increased or reduced adjacent to structures or where road has been widened and verge dimension has been altered.

For typical TD 27 cross section

Psb, h/s, L1, verge, 200 edge line

Col D figure = actual h/s width, typically 3.3 m
Col E figure = zero

Psb = Point from which set-back is measured

For typical MM HSR situation (IAN 111)

Psb, h/s, Lane below signal 1, Lane below signal 2, verge

Col D figure = Lane width below signal 1
Col E figure = h/s width (in diagram) + 150 mm edge line

RRRAP takes col E figure as hardshoulder width when HSR is operation (as specified in Basic Common Details).

To compare non-HSR situation, run same data set with equivalent motorway with h/s. RRRAP uses the sum of col D + col E.

For typical MM ALR Situation

Psb, h/s, Carriageway, verge

Col D figure = 0
Col E figure = actual width h/s or h/strip.

For offside (o/s) situations

Cols D & E = zero when the c/res is being considered.

For a link, slip or single carriageway road,
Col D figure = h/s width, typically 0.7 m or 1.0 m,
Col E figure = zero

Figure 8-4 Enter Hard shoulder / hardstrip width and Verge width details

It is important to ensure that hardshoulder and verge widths are entered for the whole length of the Section under consideration, even if for the o/s they are zero entries in the Width of adjacent Hardshoulder / Hardstrip fields. There is no need to identify every single change in verge width. It is normally sufficient to record the nominal verge width for the road (TD 27 gives the standard dimensions) but, at locations where the verge width is significantly less than the nominal width, for instance at pinch points, or where it is widened, for instance at the approaches to bridge parapets, it is important that the actual width is recorded to ensure that any safety barrier can be properly located in accordance with TD 19 Figure 3-1.

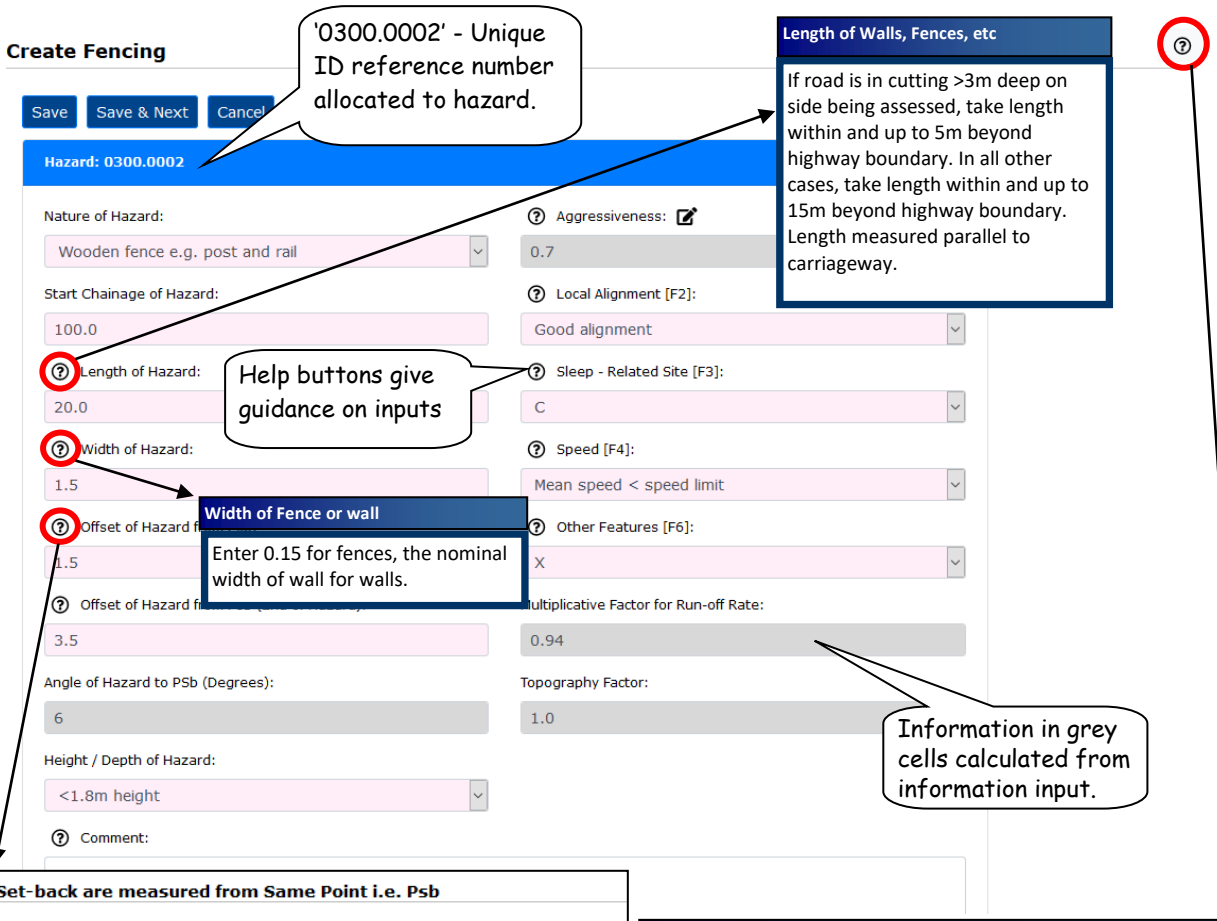
Note that the RRRAP assumes that the verge is nominally level and that the area beyond the verge until the top or toe of the earthworks slope (whichever is nearer) is reached is also broadly level. A 1 in 20 (or 5%) fall is considered broadly level in this context. The programme calculates the risk posed by the earthworks slopes and the effective offset of hazards that are on or beyond the earthworks slope based on the information in the Earthworks page, rather than on information in the Verge and Hardshoulder Widths page.

8.2.1 **Substandard verges**

Substandard verges typically occur in rural areas on old highway routes, or possibly on widened carriageways where additional land-take is problematical, and may result in the earthworks slope commencing in front of or very close to the standard safety barrier location. See section 8.1.8 and also Figures 3-1 and 3-2 in TD 19. The Designer may need to consider means of assuring stability and strength of the VRS support e.g. strip or piled footings for the VRS, earthworks strengthening or retaining structures to ensure the required stability of the VRS and carriageway.

8.3 300 Fencing and 500 Drainage

Note that each of these is broadly similar in content and layout.



Offset and Set-back are measured from Same Point i.e. Psb

Psb (i.e. the Point from which set-back is measured) is:

a) n/s: the back of the nearside h/strip (>600mm) or h/s

b) n/s: the kerb face for roads without a nearside h/strip (or h/strip < 600mm) or h/s

c) n/s: the trafficked edge of the edge line for roads without a h/strip (or h/strip <600mm), h/s or kerb

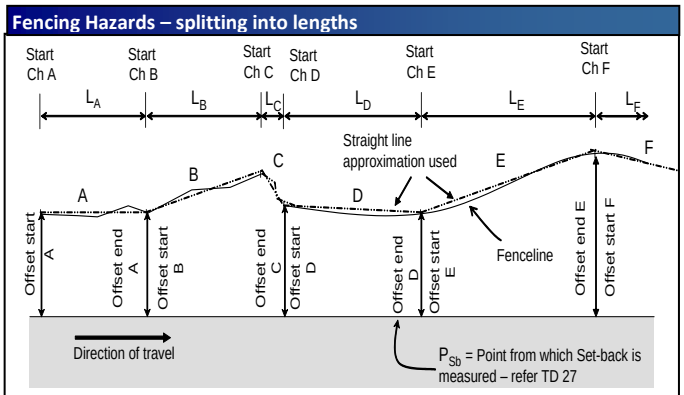
d) o/s: the trafficked edge of the edge line or the kerb face where there is no edge line.

On the nearside where there is no h/s and the h/strip < 600mm wide, then the set-back must be measured from the trafficked edge of the edge line.

refer to TD 27, IAN 111 and IAN161 for further details including available relaxations.

Abbreviations used:

n/s = nearside, o/s = offside, h/strip = hardstrip, h/s = hardshoulder



Notes:

1. Designers should take a broad-brush approach when inputting information on fencelines, and not take too much notice of minor changes in alignment.

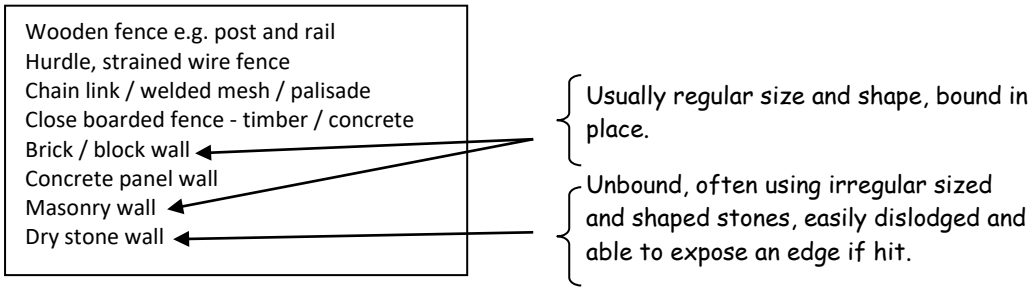
   E.g. over length of fenceline shown, alignment can reasonably be split into a series of straights A, B, … E, F above.

Diagram indicating how to split up Fencing hazards into lengths.

See also Figure 2-11 and Figure 2-12 and guidance sections 8.3 and 8.4

Figure 8-5 Fencing and Drainage data entry

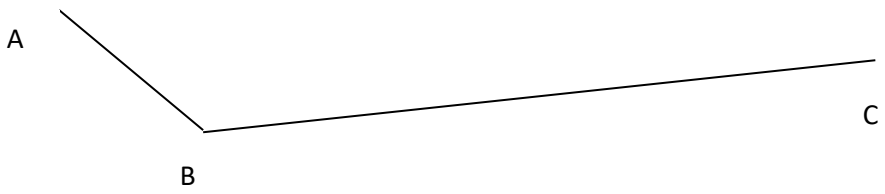
Drop down menu for Nature of Hazard



The RRRAP programme (shown in Figure 8-5) looks at the offset and hazard width at Start chainage A, and calculates the VRS need for the hazard over Length A (between Start chainage A and B). For a linear hazard such as a fenceline, the programme will then look at the offset and hazard width of Start chainage B and calculate if VRS is needed to protect at Start chainage B over Length B (between Start chainage B and C), and so on. Thus for a linear hazard, the Designer will know at each input point along the fenceline whether VRS is required to prevent an errant vehicle hitting the hazard.

8.3.1 Checking VRS requirement when fenceline / hazard offset changes significantly

See also Figure 2-11 and Figure 2-12 above. If the angle of the fence to the road approaches 90 degrees and say VRS is required at point B, but not at A, then the chances are that VRS placed in advance of B will be long enough to adequately protect the whole of length A to B. If the angle is shallow, then the designer may need to go back and check intermediate positions between A and B (say where the fence is 2 m further from Psb than point B, etc) in order to ensure adequate length of provision. The point at which the length of fenceline from B to C no longer needs to be protected can be ascertained. It is hoped that a future version of the RRRAP will automatically perform this calculation.



8.3.2 Drainage item at angle to the carriageway

If there is a drainage item such as a drainage lagoon that is at an angle to the carriageway, e.g. as shown in Figure 8-6, such that the difference in offset at A and B is significant, then the hazard should be entered twice, once to pick up chainage, offset and width at point A and second to pick up chainage, offset and width at point B. Where the offset at A and B are broadly similar, the data entered would be chainage A, nearer offset of A and B, and max width of hazard.

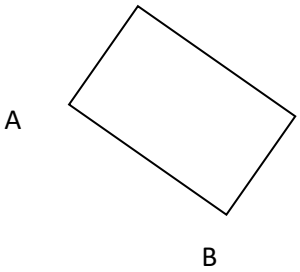


Figure 8-6 Drainage item that is at an angle to the carriageway

8.3.3 Data entry for culverts

These are typically for narrow bodies of water up to say 3 m overall width. Culverts should be entered in the drainage section; larger bodies of water, e.g. a river, lake, lagoon, etc. should be entered into the Water data entry page.

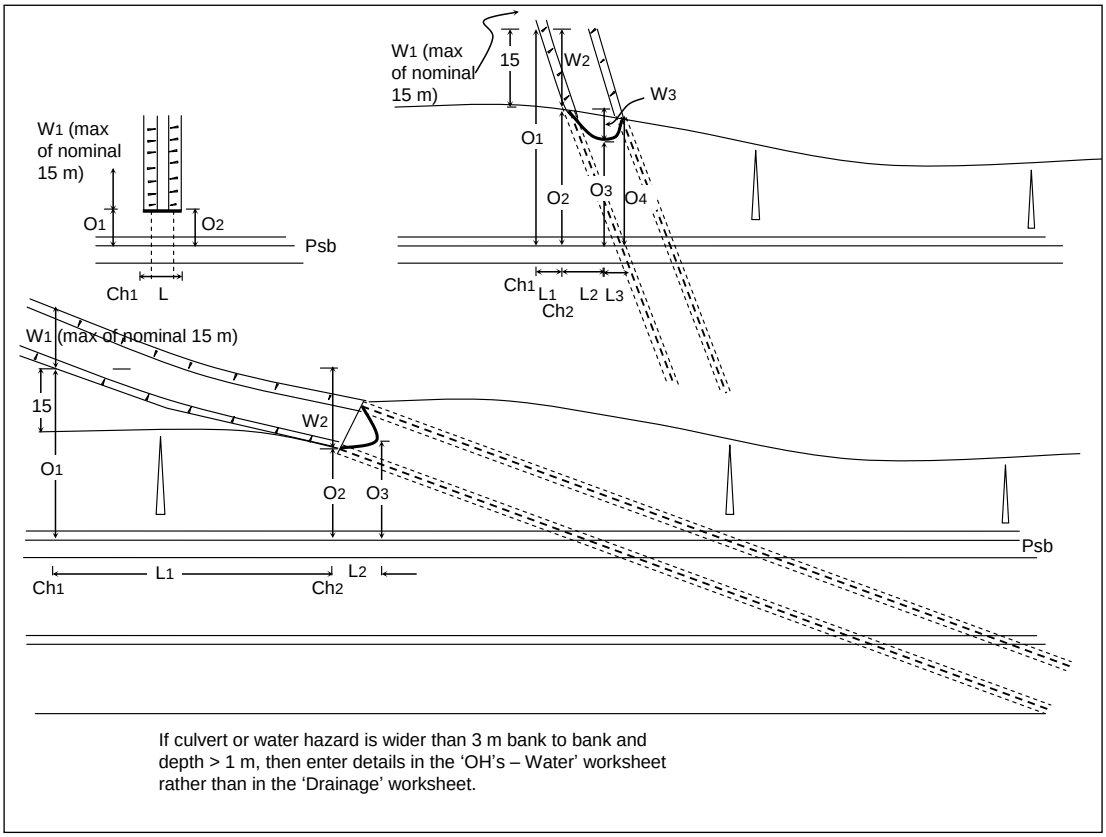


Figure 8-7 Input details for different culvert configurations

Putting the culvert details in the Parapets page would probably give a requirement for N2 containment even if the culvert headwall were very distant from the carriageway. This is because the parapets module assumes that the parapet is close to the carriageway, and typically at about the back of the standard verge.

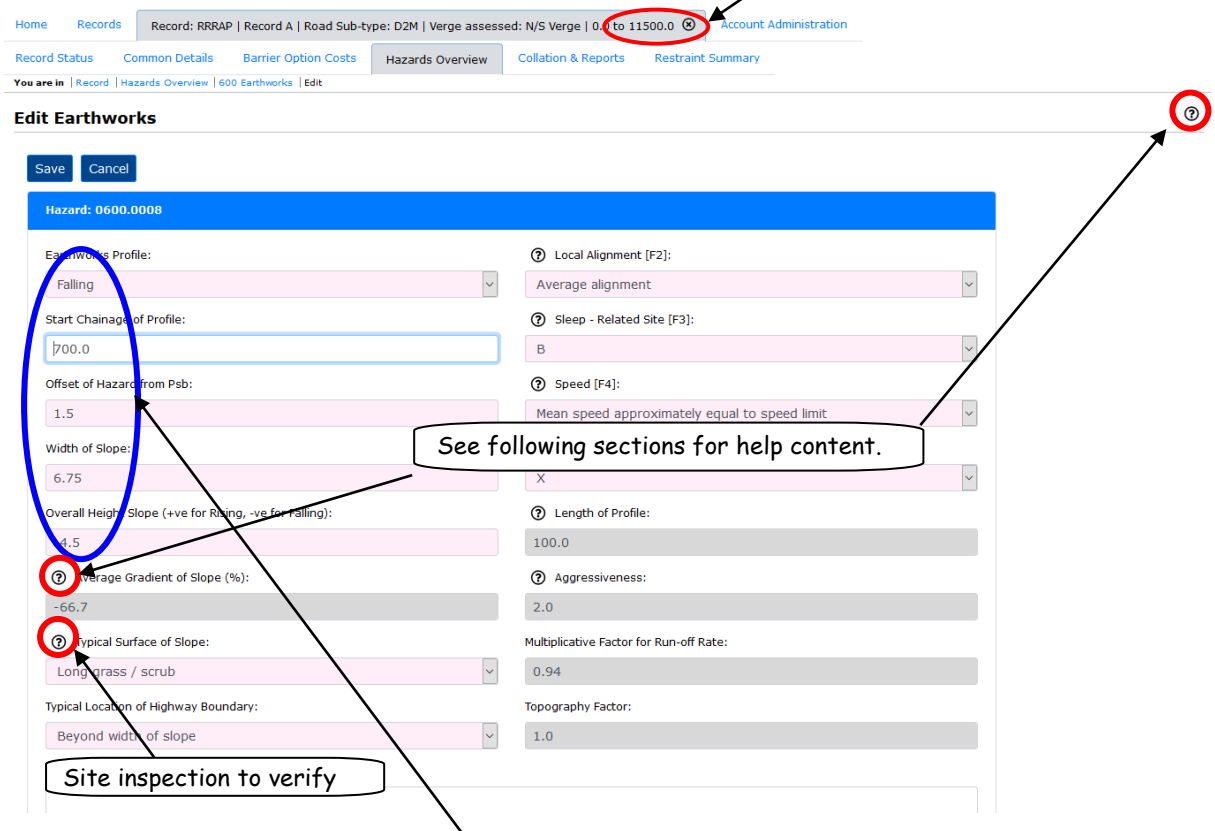
Note that for all the culvert situations, a pedestrian parapet / barrier may be required to stop people falling over a vertical drop regardless of whether a vehicle restraint is required.

8.3.4 Data entry for larger bodies of water, e.g. river, lake, lagoon, etc.

You should enter these into the Water hazards page.

8.4 600 Earthworks

Note that Earthworks details must be provided from Start Chainage to End Chainage of Section. There must be at least two Earthworks entries.



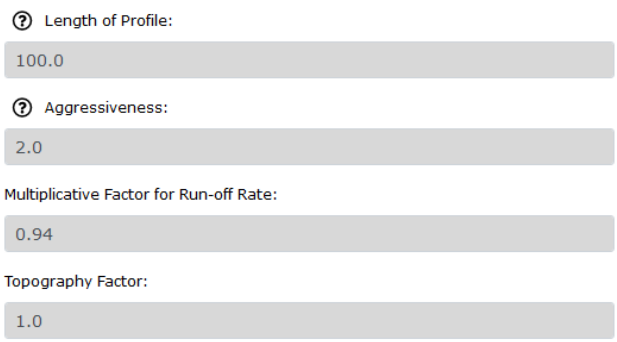
See following sections for help content.

Site inspection to verify

See section 8.4.7 for advice on inputs where earthworks are nominally at–grade and then change to a slope

Figure 8-8 Earthwork data entry

See section 8.4.1 for more on length of profile.



These fields are auto-filled based on earlier entries. Currently, Topography Factor is only used in calculation for hazards where Others could be affected

Figure 8-9 Earthwork data entry – non-editable fields

Important Note – Earthwork Chainage

No earthworks entries should be given the same chainage.

Drop down menu for Nature of Hazard

Falling
Nominally at Grade
Rising
Exposed rock face cutting

The RRRAP calculates the gradient as a % based earthworks inputs of width and height rather than e.g. 'falling 1:2 or steeper'. Note if at-grade, nominal width of slope 0.1 m and height 0.0 m must be entered.

Drop down menu for Typical surface of Slope and Location of Highway Boundary

Hardened
Short grass
Long grass / scrub
Small bushes / trees

In future versions, these factors will have an influence, albeit limited, on the rate at which errant vehicles will decelerate. Be aware that scrub and small bushes / trees may be cleared at some future date, depending on circumstances.

At back of verge
Within width of slope
Beyond width of slope

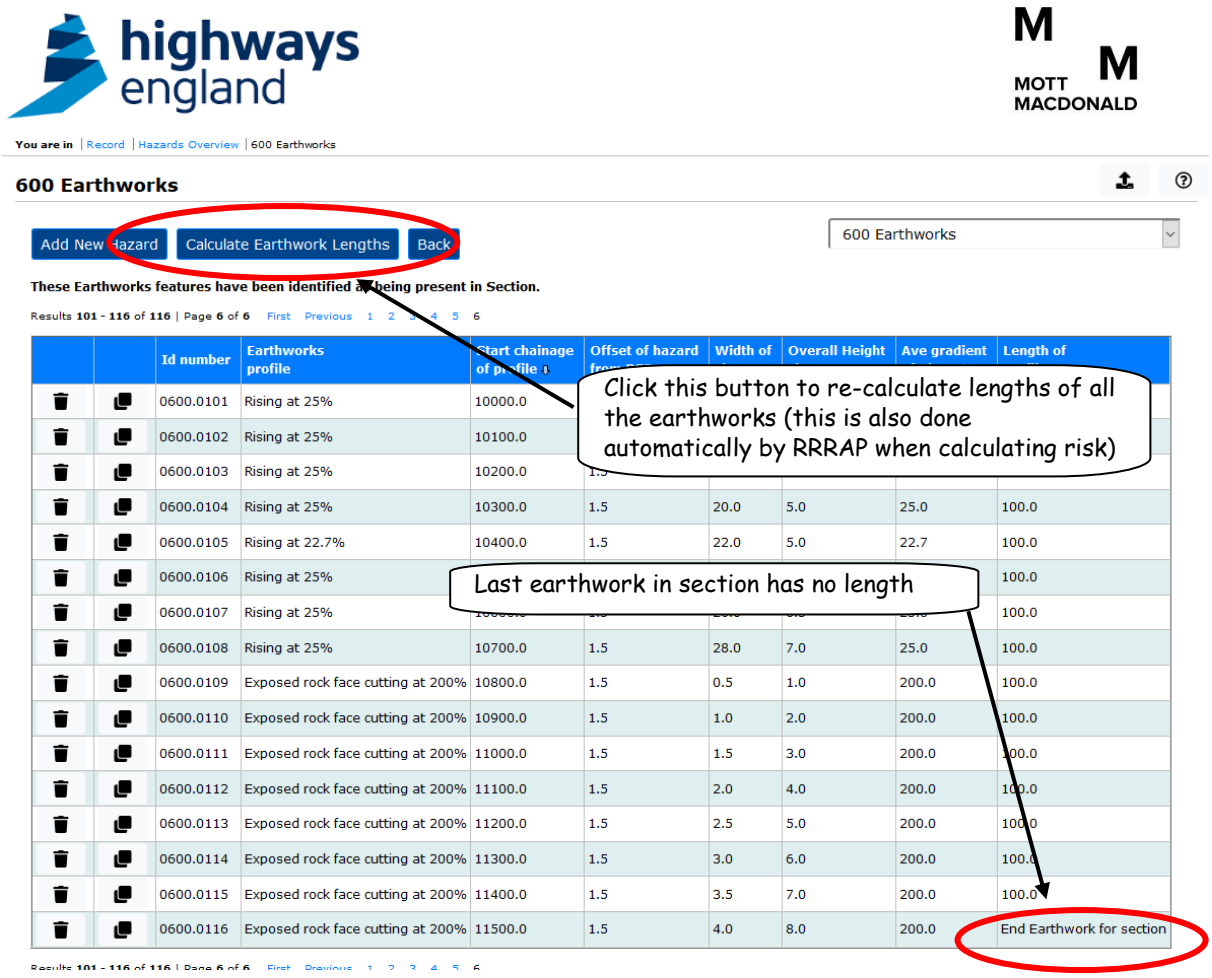
If the road is nominally at-grade, then use "Beyond width of slope".

8.4.1 Length of profile

This is the length of the earthwork in relation to its start chainage and the start chainage of the next earthwork. The length of the earthwork is a non-editable field (see Figure 8-9 'length of profile') and is not populated when entering the earthwork details. It can be populated:

- By clicking the 'Calculate Earthwork Lengths' button on the 600 Earthworks page. To access, navigate to the Hazards Overview page then click Earthworks.
- Automatically, by running the risk calculation on the Collation and Reports tab

The last earthwork in the section being assessed will not have a length. Instead the text 'End Earthwork for section' will be displayed. Risk is not calculated for this last earthwork.



Id number	Earthworks profile	Start chainage of profile	Offset of hazard	Width of	Overall Height	Ave gradient	Length of
0600.0101	Rising at 25%	10000.0					
0600.0102	Rising at 25%	10100.0					
0600.0103	Rising at 25%	10200.0					
0600.0104	Rising at 25%	10300.0	1.5	20.0	5.0	25.0	100.0
0600.0105	Rising at 22.7%	10400.0	1.5	22.0	5.0	22.7	100.0
0600.0106	Rising at 25%						100.0
0600.0107	Rising at 25%						100.0
0600.0108	Rising at 25%	10700.0	1.5	28.0	7.0	25.0	100.0
0600.0109	Exposed rock face cutting at 200%	10800.0	1.5	0.5	1.0	200.0	100.0
0600.0110	Exposed rock face cutting at 200%	10900.0	1.5	1.0	2.0	200.0	100.0
0600.0111	Exposed rock face cutting at 200%	11000.0	1.5	1.5	3.0	200.0	100.0
0600.0112	Exposed rock face cutting at 200%	11100.0	1.5	2.0	4.0	200.0	100.0
0600.0113	Exposed rock face cutting at 200%	11200.0	1.5	2.5	5.0	200.0	100.0
0600.0114	Exposed rock face cutting at 200%	11300.0	1.5	3.0	6.0	200.0	100.0
0600.0115	Exposed rock face cutting at 200%	11400.0	1.5	3.5	7.0	200.0	100.0
0600.0116	Exposed rock face cutting at 200%	11500.0	1.5	4.0	8.0	200.0	End Earthwork for section

Figure 8-10 Length of Earthwork

8.4.2 Earthworks - Splitting into sections, Slope Gradient and Critical Height

Earthworks – Splitting into sections and nomenclature

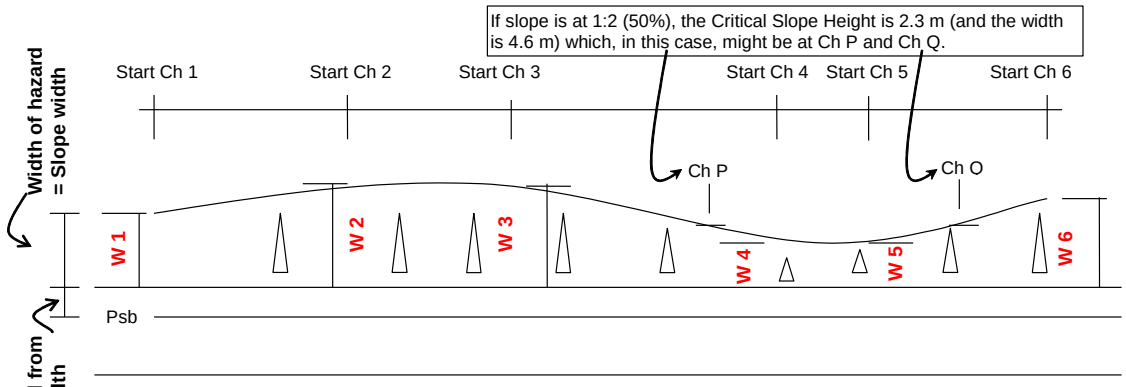
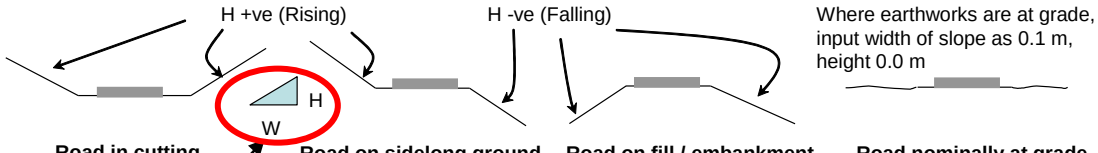


Diagram indicating how to split up earthworks hazards into sections.

Notes

1. Psb = point from which set-back is measured.
2. Designers should take a broad-brush approach when inputting information on slopes, and not take too much notice of minor changes in slope width. E.g. between Start Ch 2 and Start Ch 3 above, the width of slope is broadly the same, the length between Start Ch 3 and Start Ch 4 is changing broadly linearly and the length between Start Ch 4 and Start Ch 5 is again of broadly similar slope width.
3. Note that a new section is required where significant slope gradient changes occur, e.g. coming from an at-grade length into a length that is on a slope. The Designer must correctly identify the start point of the length on a slope.
4. Designers must also identify the chainage(s) at which the Critical Slope Height for the gradient of the slope is reached, see example above. Refer also to Help button for 'Slope Gradient Conversion and Critical Slope'.



Nomenclature

Slope conversion		Critical slope height
H : W	%	
Steeper than 1 : 1		1.0 m or higher
1 : 1	100	1.0 m
1 : 1.25	80	1.2 m
1 : 1.5	66.7	1.6 m
1 : 1.67	60	1.8 m
1 : 2	50	2.3 m
1 : 2.5	40	3.4 m
1 : 2.75	36	4.0 m
1 : 3	33	6.0 m
1 : 3.5	28.6	7.0 m
1 : 4	25	9.0 m
Shallower than 1 : 4		None

The nomenclature is important. The RRRAP calculates the gradient based earthworks inputs of width and height.

See sections 8.4.7 and 8.4.8 for advice on inputs where earthworks change to/from a slope or go from > or < critical slope height (see help above). In this example had for instance the gradient ref 0600.0001 been -50% rather than -25%, then the RRRAP would have indicated VRS is required from ch 5100 all the way to ch 5200, whereas in practice if there had been an entry where the critical height of 2.3 m for a 50% gradient occurred, say at ch 5150, the RRRAP would have indicated that VRS was only required to ch 5150.

Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %
0600.0001	Falling at 25%	5100.0	1.5	28.0	-7.0	-25.0
0600.0002	Nominally at Grade	5200.0	1.5	1.0	0.0	0.0

It is important to identify **all** points at which the critical height for the particular gradient are reached – see section 8.4.8, otherwise VRS may not start and end at correct points

Figure 8-12 Earthworks – Slope Gradient and Critical Height

8.4.3 Viaduct – Parapet and Earthworks Input

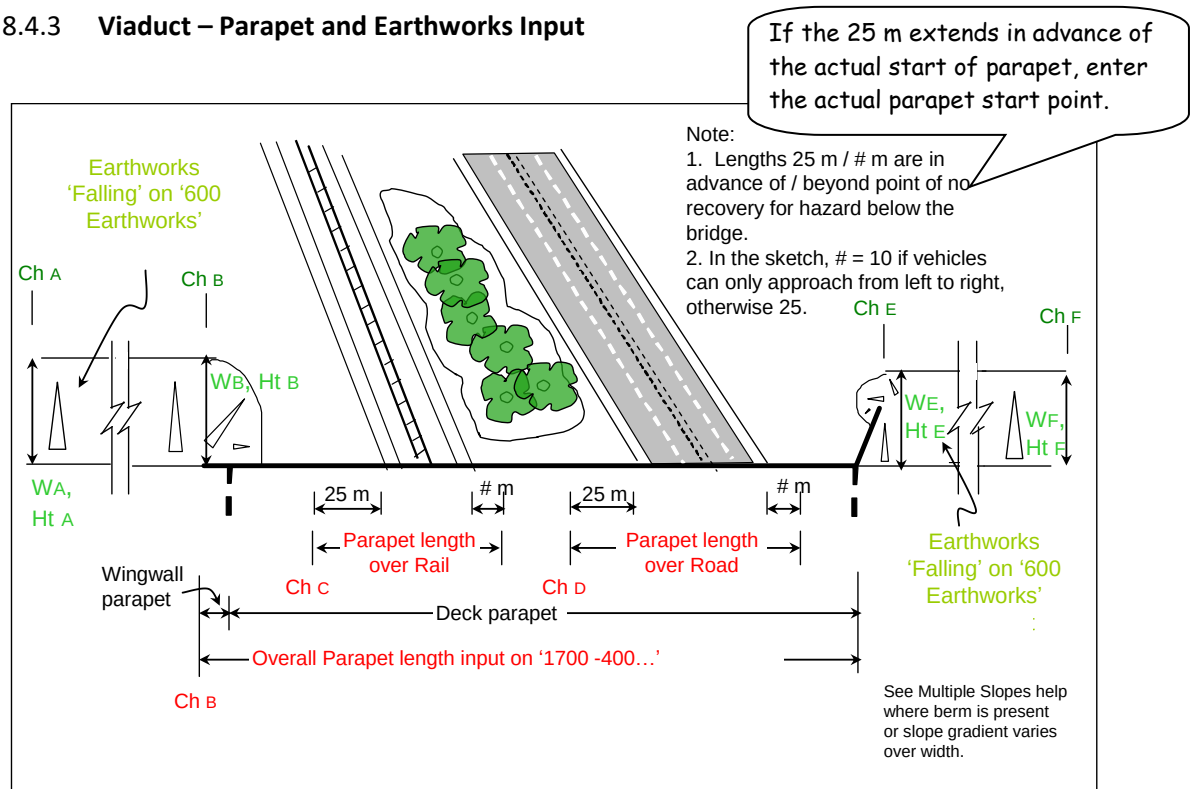


Figure 8-13 Viaduct – Parapet and Earthworks Input

Parapet details are entered in the 1700 – 400 Structures – Parapets page as indicated. See also the OH's Road and OH's Rail pages and Helps for how to input details relating to road and or railways.

8.4.4 Splayed Wingwall – Parapet and Earthworks Input

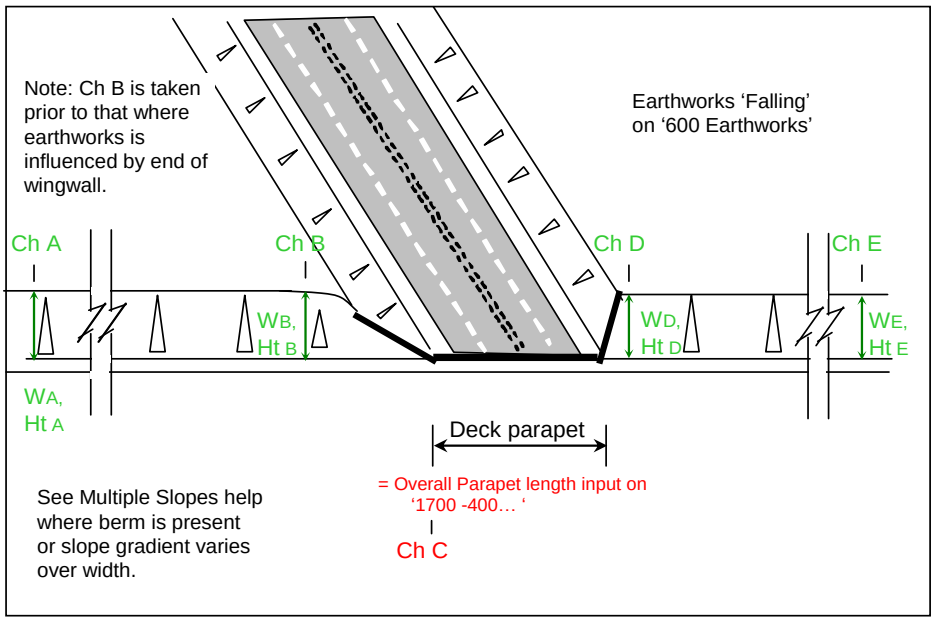
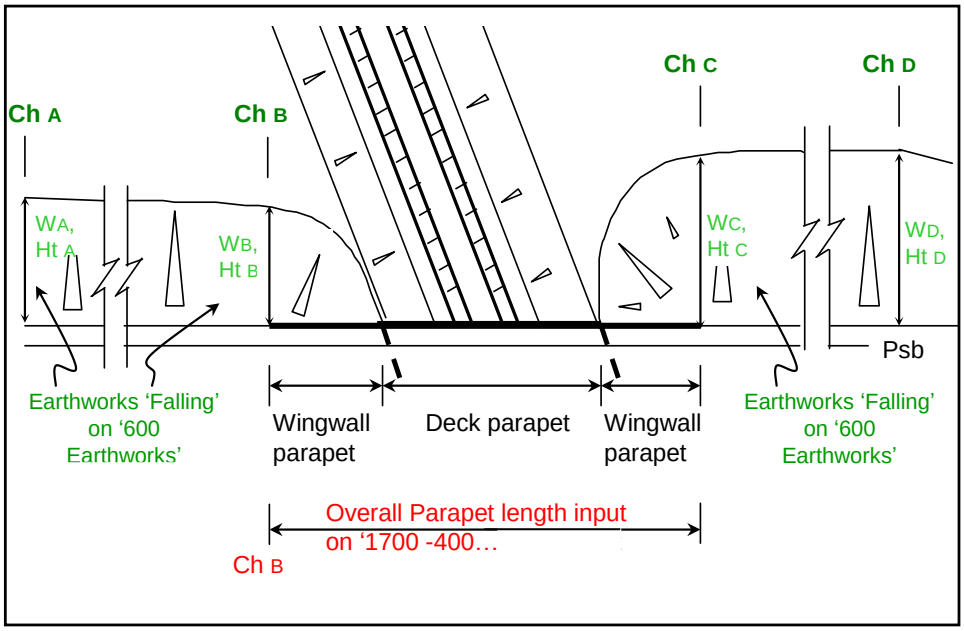


Figure 8-14 Splayed Wingwall – Parapet and Earthworks Input

Parapet details are entered in the 1700 – 400 Structures – Parapets page as indicated. See also the OH's Road page and Helps for how to input details relating to road.

8.4.5 Parallel Wingwall – Parapet and Earthworks Input



Parapet details are entered in the 1700 – 400 Structures – Parapets page as indicated. See also the OH's Railway page and Helps for how to input details relating to railway.

8.4.6 Parallel Wingwall – Parapet and At-Grade Earthworks Input

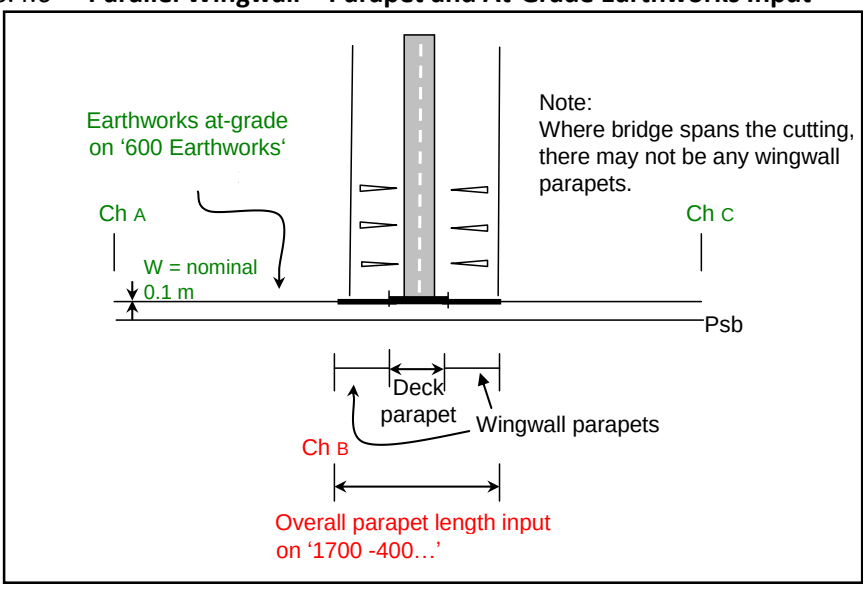


Figure 8-16 Parallel Wingwall – Parapet and At-Grade Earthworks Input

Parapet details are entered in the 1700 – 400 Structures – Parapets page as indicated. See also the OH's Road page and Helps for how to input details relating to a road.

8.4.7 Dealing with lengths that are nominally at-grade

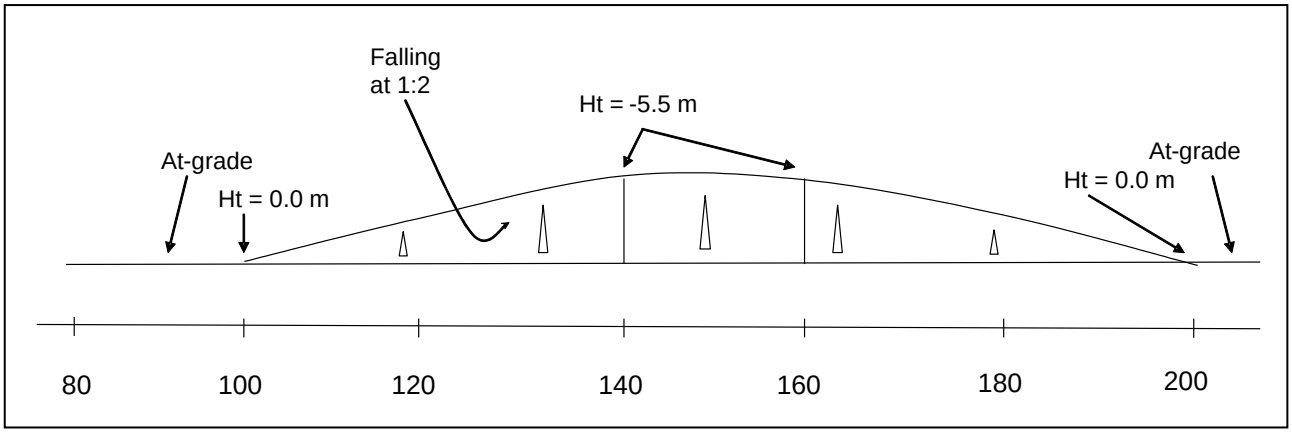
At locations where the road is nominally at-grade, the width of slope should be input as a nominal 0.1m (a zero value is not permitted). The RRRAP assumes that the ground beyond any slope or at-grade section is broadly level. In the example in Figure 8-11, the earthworks goes into a 1 in 2 cutting soon after the 1 in 2 embankment ending, with a short length at-grade in between.

It is important to ensure that the start of the earthworks slope after a length at-grade is assigned the correct Overall Slope Height, i.e. 0.05 m in this case to correlate with the width of 0.1 m and gradient of 1 in 2.

No earthworks entries should be given the same chainage, so in this instance had the earthworks gone directly from cut to fill or vice versa, then a dummy nominal at-grade length of say 1 m should be entered.

8.4.8 Critical height of slope

It is important that the chainages at which the critical height of slope for that slope gradient are identified, otherwise the RRRAP will potentially report incorrect start and end points for VRS. This is best demonstrated by the example below.



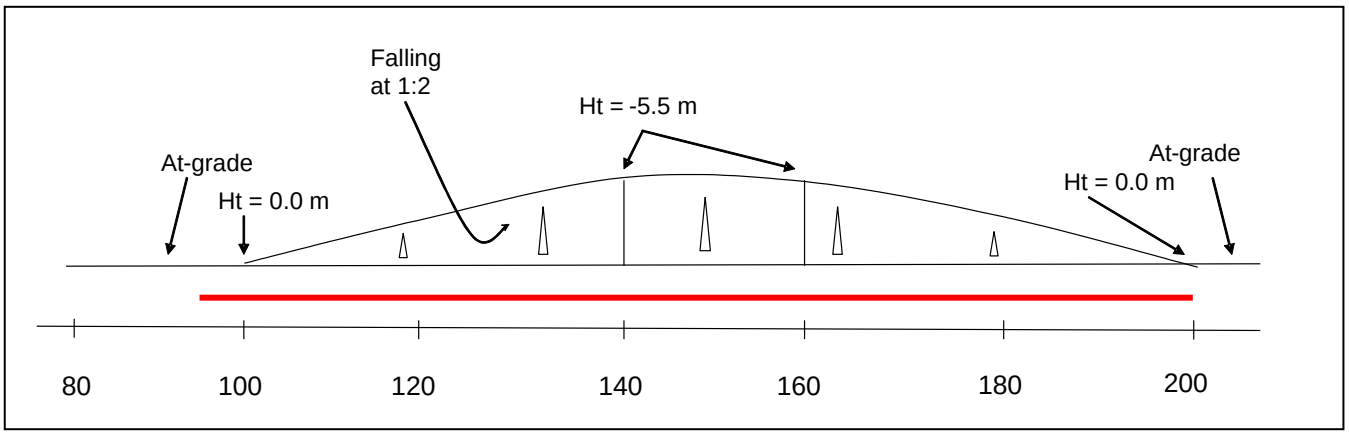
Suppose you input the information as follows (i.e. without noting critical height locations).

		Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %	Length of profile
		0600.0001	Nominally at Grade	0.0	2.5	0.1	0.0	0.0	95.0
		0600.0007	Nominally at Grade	95.0	2.5	0.1	0.0	0.0	5.0
		0600.0002	Falling at 50%	100.0	2.5	0.1	-0.05	-50.0	40.0
		0600.0003	Falling at 50%	140.0	2.5	11.0	-5.5	-50.0	20.0
		0600.0004	Falling at 50%	160.0	2.5	11.0	-5.5	-50.0	40.0
		0600.0005	Nominally at Grade	200.0	2.5	0.1	0.0	0.0	11300.0

The RRRAP might output:

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
	i	0600.0001	Nominally at Grade	0.0	95.0	2.5	Yes						N/A
	i	0600.0007	Nominally at Grade	95.0	100.0	2.5	Yes						N/A
	i	0600.0002	Falling at 50%	100.0	140.0	2.5	Yes						N/A
	i	0600.0003	Falling at 50%	140.0	160.0	2.5	No	Acceptable	46		W2	N2	N/A
	i	0600.0004	Falling at 50%	160.0	200.0	2.5	No	Acceptable	46		W2	N2	N/A
	i	0600.0005	Nominally at Grade	200.0	11500.0	2.5	Yes						N/A

Resulting VRS provision, which is incorrect as it commences and ends too late, is shown below. Only the results from the RRRAP have been plotted.



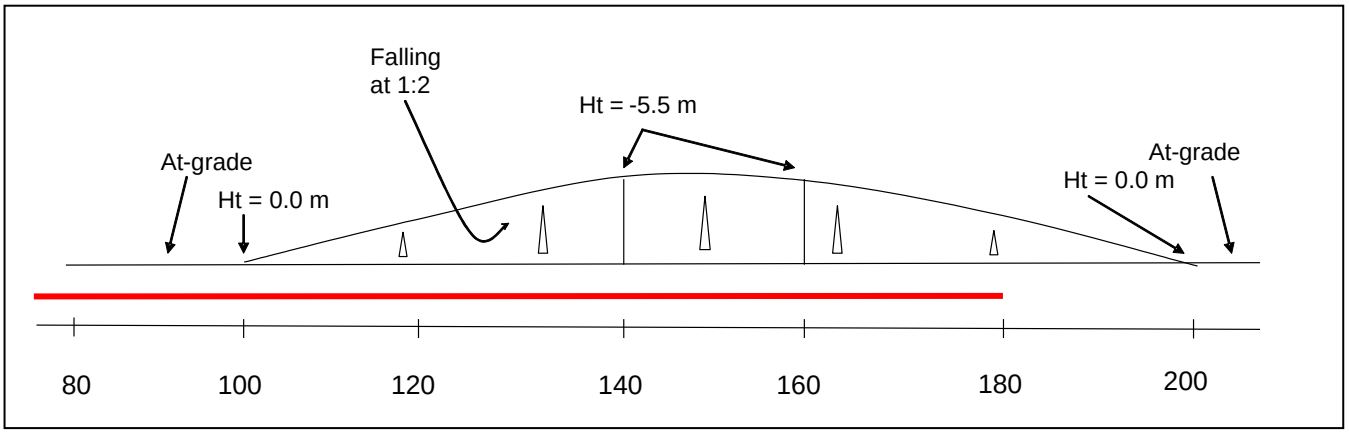
If the information is input correctly as follows (i.e. including critical height locations).

		Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %	Length of profile
		0600.0001	Nominally at Grade	0.0	2.5	0.1	0.0	0.0	95.0
		0600.0007	Nominally at Grade	95.0	2.5	0.1	0.0	0.0	5.0
		0600.0002	Falling at 50%	100.0	2.5	0.1	-0.05	-50.0	20.0
		0600.0008	Falling at 50%	120.0	2.5	5.5	-2.75	-50.0	20.0
		0600.0003	Falling at 50%	140.0	2.5	11.0	-5.5	-50.0	20.0
		0600.0004	Falling at 50%	160.0	2.5	11.0	-5.5	-50.0	20.0
		0600.0009	Falling at 50%	180.0	2.5	5.5	-2.75	-50.0	20.0
		0600.0005	Nominally at Grade	200.0	2.5	0.1	0.0	0.0	11300.0

The RRRAP might output:

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
	i	0600.0001	Nominally at Grade	0.0	95.0	2.5	Yes						N/A
	i	0600.0007	Nominally at Grade	95.0	100.0	2.5	Yes						N/A
	i	0600.0002	Falling at 50%	100.0	120.0	2.5	Yes						N/A
	i	0600.0008	Falling at 50%	120.0	140.0	2.5	No	Acceptable	46		W2	N2	N/A
	i	0600.0003	Falling at 50%	140.0	160.0	2.5	No	Acceptable	46		W2	N2	N/A
	i	0600.0004	Falling at 50%	160.0	180.0	2.5	No	Acceptable	46		W2	N2	N/A
	i	0600.0009	Falling at 50%	180.0	200.0	2.5	No	Acceptable	46		W2	N2	N/A
	i	0600.0005	Nominally at Grade	200.0	11500.0	2.5	Yes						N/A

Resulting correct VRS provision is as follows – note that this will prevent an errant vehicle running down the slope where it is equal to or higher than the critical height of 2.3 m. Only the results from the RRRAP have been plotted. In practice, the greater of the lengths in advance and beyond the hazard from TD 19 Table 3-1 and the RRRAP will have to be provided.



8.4.9 Earthworks profile having multiple slope gradients

Figure 8-17 indicates the method of inputting earthworks information where there are multiple slopes.

In Figure 8-17 (a) where the gradient of the lower slope is both shallower than 1:4 and shallower than the upper slope, then it should be disregarded.

Figure 8-17 (b) and (c) show a situation where a false cutting has been created. This is often done to create a noise and or visual barrier to a feature or features beyond the highway boundary.

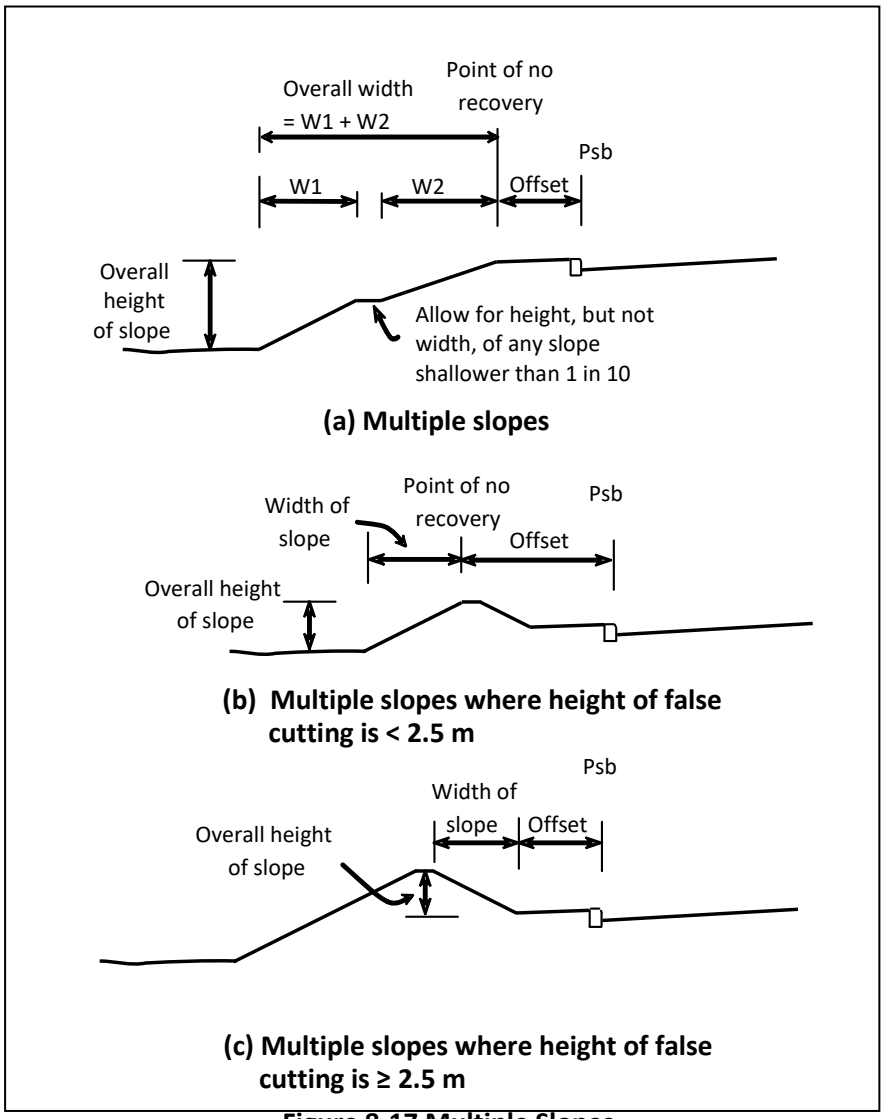


Figure 8-17 Multiple Slopes

It is considered unlikely that an errant vehicle would be able to traverse an uphill slope of more than about 2.5 m height, but may be able to reach the crest of a slope that is less high and, if there is an embankment slope beyond the crest, then to run down or roll down that slope and hit a hazard that is on that slope or possibly even beyond it (e.g. a railway). The chance of the errant vehicle reaching the top depends on a number of factors such as speed, type of vehicle, gradient, etc and whether there are any hazards on the slope, such as trees, that might inhibit or prevent the vehicle reaching the crest.

The programme assumes that the area between Psb and the start of the earthworks slope is broadly level, and that the area beyond the earthworks slope is broadly level. For a hazard that is part way up a cutting slope, the programme assumes it has an effective offset that is further from the Psb than its actual position and for a hazard on an embankment, that it is effectively closer.

The earthworks module of the RRRAP is not sophisticated enough to be able to handle the effects of an initial upward slope followed by a downward slope, so where the height of the false cutting varies between say 2-3 m, the input data following Figure 8-17 (b) and (c) is at best a compromise. A way round the problem is to run the RRRAP twice, once with the earthworks input for the cutting slope

(i.e. Rising) along the whole length, i.e. assuming that the embankment slope beyond does not exist, and the second time with the earthworks Rising up to the chainage where the height rise starts to drop below 2.5 m, and Falling up to the chainage where the height of false cutting again reaches 2.5 m. The verge width would be constant throughout both runs. The first run would under-report VRS requirements, and the second over-report them. The appropriate VRS provision would be based on the outputs and engineering judgement. The Designer should generate and keep as evidence a copy of the hazard details at each run (and any generated detailed results) by generating a full report (see section 11.3). An explanation of the conclusions reached should be entered into the hazard 'Comment' field as a record of the decision process.

8.4.10 **Strengthened Slopes**

Inputting information where the slope has been strengthened to steepen it may either be entered in the 600 Earthworks page or in the 2500 Special Structures page. The decision as to which largely depends on the length involved. If the length is substantial, then it is easier to enter the slope details in the Earthworks, if the length is localised, say round an obstacle, it is easier to enter it in the Special Structures page, see also Section 8.11.

8.4.11 **Retaining walls supporting an embankment or sidelong ground**

Where these occur, they should be entered in the Earthworks page as a 'Falling' with a nominal width and the height to match that of the drop. See also Figure 8-17 Multiple Slopes (a).

In the case of a crib wall that is retaining a carriageway, the RRRAP does not take into account the special requirements of BD 68 in respect of prevention of accidental wheel loading that might lead to the crib wall failure; it is only assessing the risk to vehicle occupants posed by the drop formed by the crib wall. The designer should indicate his reasoning in respect of any decision made on VRS provision at such locations in the hazard 'Comment' field.

8.5 1100 Kerbs

Note that details **must** be entered from Start Chainage to End Chainage of Section, even if there is no kerb or channel present.

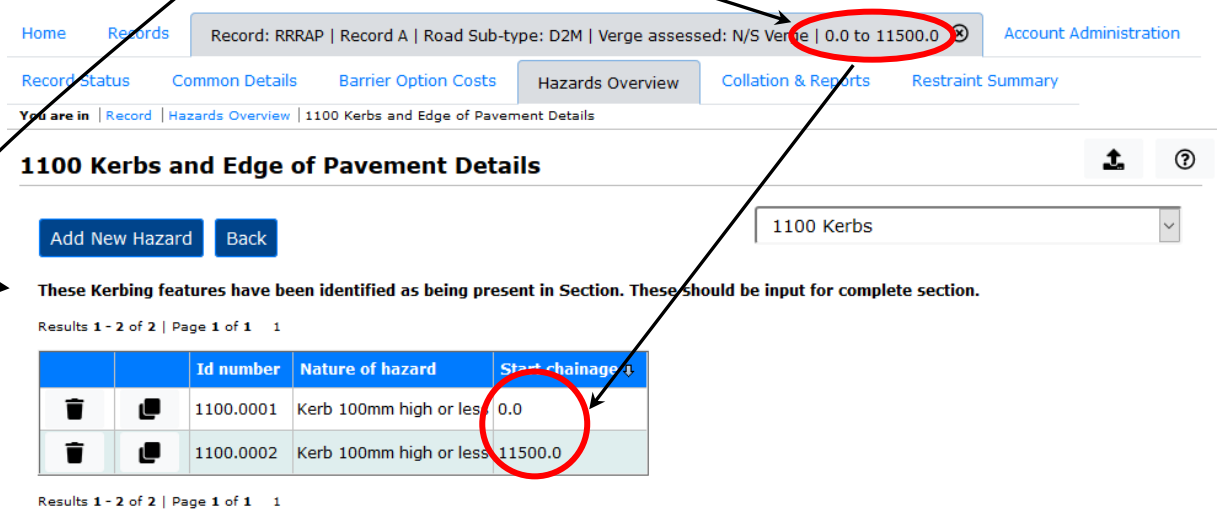


Figure 8-18 Kerbs and Edge of Pavement Details

Drop down menu for Nature of Hazard

No kerb or channel
Channel lined
Channel unlined
Kerb 100mm high or less
Kerb >100mm up to 250mm high
Kerb > 250mm high

At present, these factors do not influence the risk calculation. In future versions, they may do.

8.6 1200 Traffic Signs and Signals

See section 8.6.2 below for further information on Passively Safe and Small Posts.

See sections 8.6.1 to 8.6.3 for further information relating to Gantries.

Offset and Set-back are measured from Same Point i.e. Psb

Psb (i.e. the Point from which set-back is measured) is:

a) n/s: the back of the nearside h/strip (>600mm) or h/s

b) n/s: the kerb face for roads without a nearside h/strip (or h/strip < 600mm) or h/s

c) n/s: the trafficked edge of the edge line for roads without a h/strip (or h/strip <600mm), h/s or kerb

d) o/s: the trafficked edge of the edge line or the kerb face where there is no edge line.

On the nearside where there is no h/s and the h/strip < 600mm wide, then the set-back must be measured from the trafficked edge of the edge line.

refer to TD 27, IAN 111 and IAN161 for further details including available relaxations.

Abbreviations used:

n/s = nearside, o/s = offside, h/strip = hardstrip, h/s = hardshoulder

Edit Traffic Signs or Signals

Save Cancel

Hazard: 1200.0001

Nature of Hazard: Sign on gantry	Width of Sign Face: 3.6
Start Chainage of Hazard: 5.0	Aggressiveness: 2.0
Length of Hazard: 0.2	Local Alignment [F2]: Poor alignment
Width of Hazard: 2.5	Sleep - Related Site [F3]: E
Offset of Hazard from Psb: 2.0	Speed [F4]: Mean speed approximately equal to s
Cluster of Hazards: Individual hazard	Other Features [F6]: Z
Height / Depth of Hazard: >3m	Multiplicative Factor for Run-off Rate: 1.06
Mounting Height: >1.5m mounting ht	Topography Factor: 1.0
Designed for Collision Loading? : Yes	
Comment:	

What to do if Cluster of Hazards?

If you have a cluster of similar hazards within say 10 m or 15 m distance, treat as one hazard, the length of the cluster.

Give the width as the width of the widest single hazard in the cluster, and the offset of the nearest of the hazards to Psb.

Pick the hazard description that returns the highest aggressiveness of the possible descriptions for the hazards in the cluster.

Note that it is a cluster of hazards in 'Cluster of hazards' field.

Collision Loading

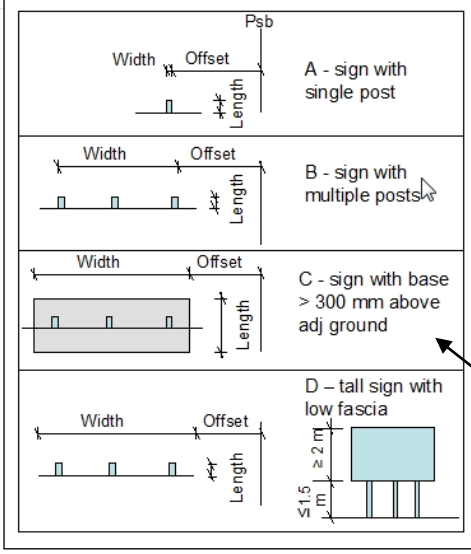
For collision loading requirements of Portal and Cantilever Sign and/or Signal Gantries see BD 51 (DMRB 2.24).

Gantry will either be passively safe or non-passively safe with VRS requirements being either TAA or TD 19 determined.

See also RRRAP Guidance Manual.

Normal and passively safe signs are not designed for collision loading.

Help for width, length and offset for Signs



This entry will influence the containment level of the safety barrier. The designer must check that appropriate containment level is

Where base of sign may be hit rather than / as well as the sign itself

Figure 8-19 Traffic Signs and Signals data entry

Drop down menu for Nature of Hazard

Sign on post(s)
Sign on gantry
Sign on gantry to BD 51/14
Sign on p.s. gantry
Sign on p.s. gantry to BD 51/14
Sign on p.s. post(s)
Sign on small post
Sign store
Signal on gantry
Signal on gantry to BD 51/14
Signal on p.s. gantry
Signal on p.s. gantry to BD 51/14
Signal on p.s.post(s)
Signal on post(s)

Passively safe (p.s.) signs and gantries may not require VRS protection on their own merit, but may be close to another hazard that may warrant protection or alter the cost benefit ratio in favour of protection of both hazards.

8.6.1 **Gantries**

Note: This also applies to Gantries in 1500 Comms

Details of any risk ranking assessment carried out in accordance with the National Annex to BS EN 1991-7 to determine the sensitivity of the structure to collision required by BD 51 should be cross referred to in the User Comments and included within the HS File.

8.6.2 **Use of Passively Safe Supports for signs or Gantries**

Note: This also applies to Passively Safe Supports for Gantries in 1500 Comms worksheet

It may be beneficial in many situations to consider using passively safe supports for a sign or a passively safe gantry rather than conventional posts or gantry, especially where the RRRAP indicates that VRS is only required to protect the one hazard and the hazard can be changed to be passively safe. It should be noted however that passively safe supports or gantries may not be suitable for all locations, e.g. where the sign could fall onto another carriageway or become a hazard to other vehicles. The Designer should check that the criteria and failure mechanism of the passively safe support structure is suitable for the proposed location and what is being supported. Additionally, the Designer should consider the importance of the sign(s), the message portrayed and its significance, and the implications of it being missing in the event of a knock down. Refer to BD 51 Portal and Cantilever Signs/Signal Gantries for further information relating to the design of these structures. The provision of any vehicle restraint system for a passively safe gantry must be agreed with the Technical Approval Authority.

When a drop down for a passively safe support structure is chosen, the item must meet the requirements of one of the three BS EN 12767 categories i.e. High Energy absorbing (HE), Low Energy absorbing (LE), or Non-Energy absorbing (NE). Note that Class O is not acceptable as a passively safe support (the Class has no performance requirements and no test is required). Standard supports fall into this Class.

8.6.3 Results for Gantries

The output relating to Gantries and Gantry mounted signs in the Collation page will be as per the example shown below (relevant extract only has been shown). Where the offset from Psb of a gantry that does not meet the requirements of BD 51/14 in respect of collision loading exceeds 4.5 m, an N2 containment level will be returned, otherwise H4a or H1 depending on offset. The Designer is required to check the requirements of TD 19 figure 3-9, and adjust the Barrier Containment level in the Collation page accordingly and use the minimum lengths of barrier in advance and beyond required by TD 19 Table 3-1 to ensure that the mandatory requirements of the TD are met. Where a gantry (or passively safe gantry) has been designed to meet the requirements of BD 51/14 in respect of collision loading, the RRRAP returns an N2 containment and a length of VRS before and after the hazard that give an acceptable level of risk to the vehicle occupants. Details of the vehicle restraint system must be agreed with the Technical Approval Authority.

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0032	Falling at 33.3%	3100.0	3200.0	2.5	Yes						N/A
☐ i	i	1500.0029	Gantry	3105.0	3106.5	2.5	No	Refer to TD 19				H4A	N/A
☐	i	1500.0043	MS3/MS4 sign	3107.0	3108.5	2.5	Yes	Must be agreed with TAA					N/A
☐ i	i	1500.0030	Gantry	3110.0	3111.5	3.0	No	Refer to TD 19				H4A	N/A
☐ i	i	2500.0002	Police ramp	3112.0	3122.0	4.0	No	See RRRAP manual				N2	N/A
☐	i	1500.0044	Posts (passively safe)	3112.0	3113.5	3.0	Yes	Must be agreed with TAA					N/A
☐ i	i	1500.0031	Gantry	3115.0	3116.5	3.5	No	Refer to TD 19				H4A	N/A
☐	i	1500.0045	Gantry p.s. to BD 51/14	3117.0	3118.5	3.5	Yes	Must be agreed with TAA					N/A
☐ i	i	1500.0032	MS3/MS4 sign to BD 51/14	3120.0	3121.5	4.0	No	Refer to TD 19				H4A	N/A
☐	i	1500.0046	Gantry p.s. to BD 51/14	3122.0	3123.5	4.0	Yes	Must be agreed with TAA					N/A
☐ i	i	1500.0033	Gantry	3125.0	3126.5	4.5	No	Refer to TD 19				H4A	N/A
☐	i	1500.0041	Gantry to BD 51/14	3127.0	3128.5	4.5	Yes	Must be agreed with TAA					N/A

Typical outputs for gantries and MS3/MS4 signs, and gantries and MS3/MS4 signs designed to BD51/14.

Passively Safe (p.s.) Posts or Supports and 'Small' posts

A passively safe sign post or support is one which meets the requirements of BS EN 12767. A small post is one which is deemed to meet the requirements of BS EN 12767.

A single small post is one which does not exceed the equivalent section properties of a tubular steel post having an external dia. of 89 mm and a nominal wall thickness of 3.2 mm.

If two or more posts, perpendicular to the carriageway, are used for one sign, the Designer must check that the sign post spacing and post dimension criteria of the National Annex to BS EN 12767 (Nov 09 or subsequent update) will be complied with when selecting 'Sign on small post', 'Sign on p.s. post(s)' or 'Sign on post'.

Where these criteria, including the recommended sign plate mounting height, are not met, the post(s) will be standard posts, and use the caption 'Sign on post(s)'.

A passively safe gantry is one that meets the requirements of BD 51.

The adjacent definition of a small post that is deemed to be passively safe has been taken from the National Annexe of BS EN 12767.

Figure 8-20 Passively Safe and Small Posts help

8.6.4 Standard Posts with widened base section for housing electrical equipment

These will tend to have a higher moment of resistance than a 'small post' described above. The dimensions described in the 'Help for width, length and offset for Signs' should be taken to the widened section of the post.

8.7 1300 Lighting Columns

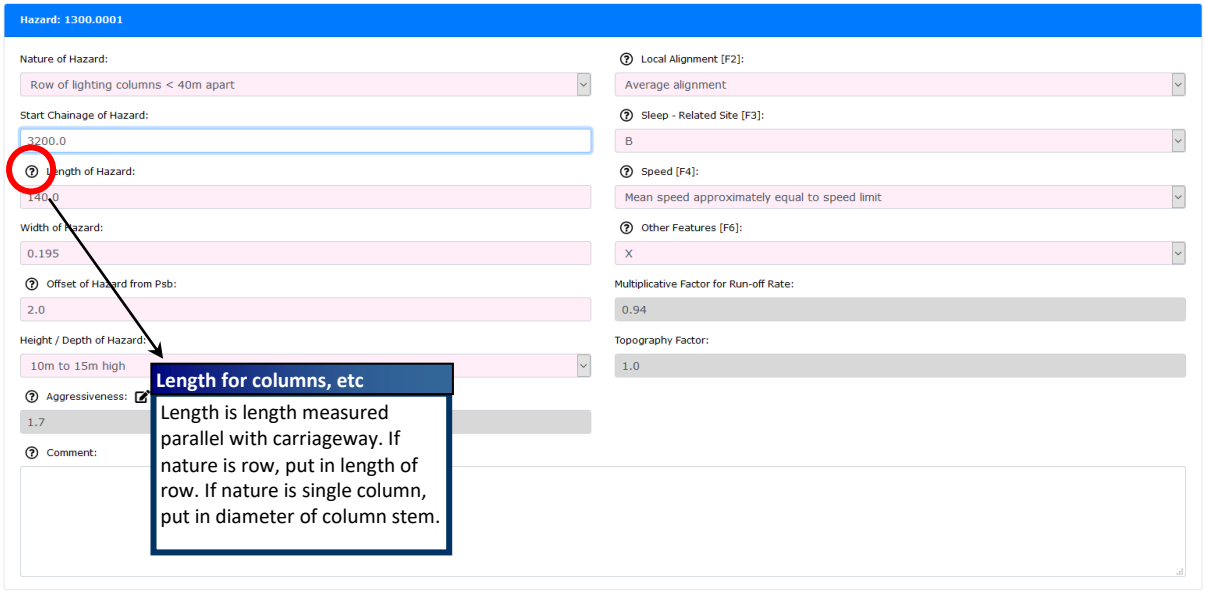


Figure 8-21 Road Lighting Columns data entry

Drop down menu for Nature of Hazard

Single catenary lighting column
Row of catenary lighting columns < 40m apart
Single catenary lighting column (passively safe)
Row of catenary lighting columns (passively safe) < 40m apart
Single lighting column
Row of lighting columns < 40m apart
Single lighting column (passively safe)
Row of lighting columns (passively safe)
Single high mast lighting column
Row of high mast lighting columns < 40 m apart
Electricity supply cabinet

Passively safe columns may not require VRS protection on their own merit, but may be close to another hazard that may warrant protection or alter the cost benefit ratio in favour of protection of both hazards.

8.7.1 High Masts

A high mast is one that exceeds 18m in height.

8.7.2 Spacing of columns

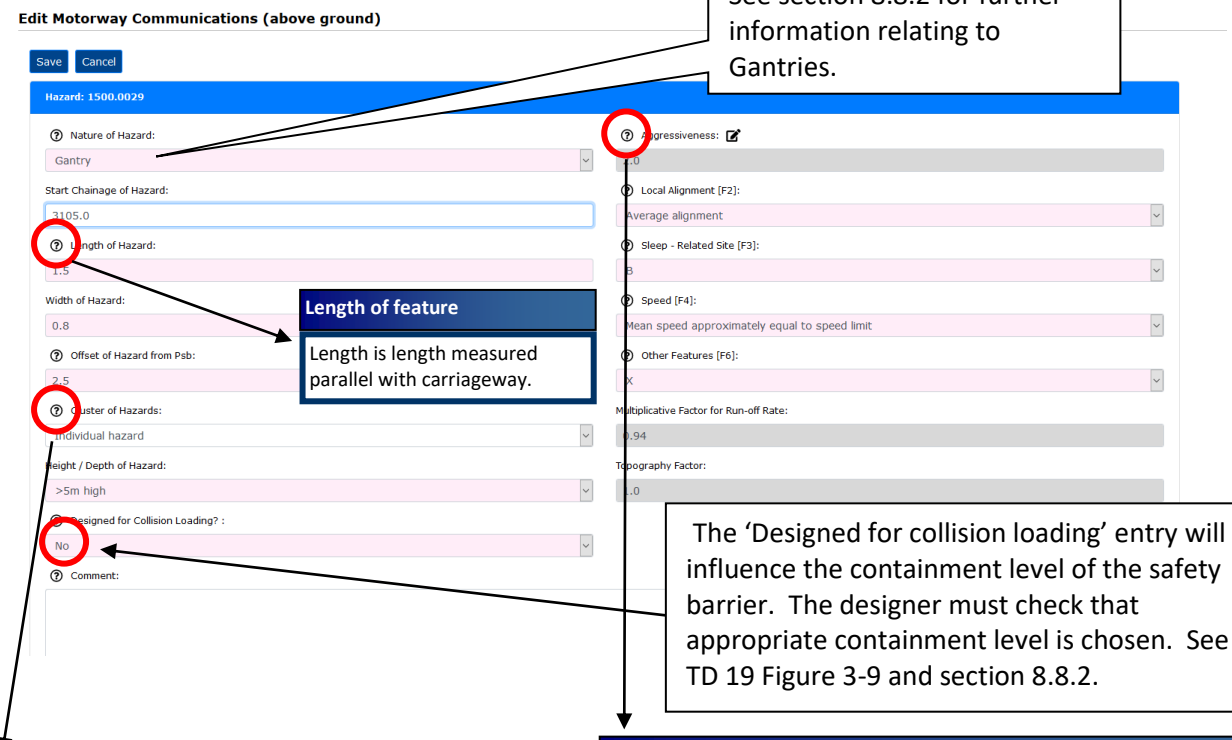
Note that at present, the RRRAP assesses the risk of the first column in a row. It assumes that, if there is a need to protect it, then each column in the row will similarly need to be protected. The spacing of the columns is not currently taken into account. In practice, a line of closely spaced columns will in effect become akin to a continuous hazard and will therefore pose a greater risk than a widely spaced line which is more akin to a line of discrete hazards. It is intended that a future version of the RRRAP will automatically take account of the change in risk associated with the

spacing. In the current version if there is a line of columns at broadly similar spacing of around 40 m or less, then enter as a row of columns, rather than enter each one separately.

8.7.3 **Passively safe columns**

There may be merit in considering the use of passively safe lighting columns that meet the requirements of BS EN 12767, especially if the RRRAP indicates that a single column or row of columns requires VRS protection and that there is no other hazard within the length that warrants protection. It should be noted that not all locations are suitable for passively safe columns, e.g. where the column could fall onto another carriageway. For more details see section 8.6.2.

8.8 1500 Motorway Communications



See section 8.8.2 for further information relating to Gantries.

Length of feature

Length is length measured parallel with carriageway.

The 'Designed for collision loading' entry will influence the containment level of the safety barrier. The designer must check that appropriate containment level is chosen. See TD 19 Figure 3-9 and section 8.8.2.

What to do with clusters of objects

If you have a cluster of similar hazards within say 10 m or 15 m distance, treat as one hazard, the length of the cluster. Give the width as the width of the widest single hazard in the cluster, and the offset of the nearest of the hazards to Psb. Pick the hazard description that describes at least one of the hazards in the cluster and returns the highest aggressiveness of the possible descriptions for the hazards in the cluster.

Note that it is a cluster of features in 'Cluster of Objects?' column.

Aggressiveness of Comms Hazards

The aggressiveness factor for communications equipment such as cabinets has been based on the hazard having no effect on Others, and without consideration of maintenance workers.

Some equipment (or items in a cluster) may have a significant effect on, for instance, the safety of Others if it were to be out of action for a period, or will require regular and or time consuming maintenance.

In such cases, the Designer must consider these additional factors and decide whether the VRS provision resulting from the RRRAP is sufficient. The outcome of these considerations should be documented in the Comments field for the hazard.

The aggressiveness factor can be altered from its default value (see section 8.1.2) say to 2.5 to reflect the higher risk. If in doubt, it is better to protect than not protect. If the aggressiveness is altered and risk has already been calculated for the hazard, then risk will have to be re-calculated on the 'Collation and Reports' page in order that the correct result is displayed. See also section 8.8.1.

Edit Motorway Communications (above ground)

Save Cancel

Hazard: 1500.0029

Nature of Hazard: Gantry	Aggressiveness: 2.0
Start Chainage of Hazard: 3105.0	Local Alignment [F2]: Average alignment
Length of Hazard: 1.5	Sleep - Related Site [F3]: B
Width of Hazard: 0.8	Speed [F4]: Mean speed approximately equal to speed limit
Offset of Hazard from Psb: 2.5	Other Features [F6]: X
Cluster of Hazards: Individual hazard	Multiplicative Factor for Run-off Rate: 0.94
Height / Depth of Hazard: >5m high	Topography Factor: 1.0
Designed for Collision Loading? : No	
Comments	

Passively Safe (p.s.) Posts or Supports and 'Small' posts

A passively safe sign post or support is one which meets the requirements of BS EN 12767. A small post is one which is deemed to meet the requirements of BS EN 12767.

A single small post is one which does not exceed the equivalent section properties of a tubular steel post having an external dia. of 89 mm and a nominal wall thickness of 3.2 mm.

If two or more posts, perpendicular to the carriageway, are used for one sign, the Designer must check that the sign post spacing and post dimension criteria of the National Annex to BS EN 12767 (Nov 09 or subsequent update) will be complied with when selecting 'Sign on small post', 'Sign on p.s. post(s)' or 'Sign on post'.

Where these criteria, including the recommended sign plate mounting height, are not met, the post(s) will be standard posts, and use the caption 'Sign on post(s)'.

A passively safe gantry is one that meets the requirements of BD 51.

Collision Loading

For collision loading requirements of Portal and Cantilever Sign and/or Signal Gantries see BD 51 (DMRB 2.24).

Gantry will either be passively safe or non-passively safe with VRS requirements being either TAA or TD 19 determined.

See also RRRAP Guidance Manual.

Normal and passively safe signs are not designed for collision loading.

Offset and Set-back are measured from Same Point i.e. Psb

Psb (i.e. the Point from which set-back is measured) is:

a) n/s: the back of the nearside h/strip (>600mm) or h/s

b) n/s: the kerb face for roads without a nearside h/strip (or h/strip < 600mm) or h/s

c) n/s: the trafficked edge of the edge line for roads without a h/strip (or h/strip <600mm), h/s or kerb

d) o/s: the trafficked edge of the edge line or the kerb face where there is no edge line.

On the nearside where there is no h/s and the h/strip < 600mm wide, then the set-back must be measured from the trafficked edge of the edge line.

refer to TD 27, IAN 111 and IAN161 for further details including available relaxations.

Abbreviations used:

n/s = nearside, o/s = offside, h/strip = hardstrip, h/s = hardshoulder

Figure 8-22 Motorway Communications (above ground) data entry

Drop down menu for Nature of Hazard

Comms or CCTV Mast
Comms or Power Cabinet
Emergency Telephone
Gantry
Gantry (passively safe)
Gantry (passively safe) to BD 51/14
Gantry to BD 51/14
MS3/MS4 sign on plinth <= 300mm ht.
MS3/MS4 sign on plinth > 300mm ht.
MS3/MS4 sign to BD 51/14
Posts
Posts (passively safe)
Steps (metal handrail)
Steps (no handrail)
Steps (wooden handrail)
Transmission Station

Notes:
In BD 51, 'Gantry' is a generic term for a structure supporting signs, signals, VMS and other equipment. It includes single or multiple portals, single and double cantilevers and combinations of these.

8.8.1 Results for Comms Cabinets and Equipment

The results for Communications (Comms) cabinets and equipment will indicate the level of risk from an errant vehicle hitting the hazard and whether a safety barrier is required to reduce this risk. Increasing the aggressiveness manually will have a limited effect on the offset to which a cabinet or equipment will require protection and the length of need. A safety barrier may be provided where none is indicated or the containment increased if it is felt that there is an additional risk to (i) any road workers maintaining the Comms cabinet or equipment or (ii) due to its effects on the Network if the Comms cabinet or equipment were damaged. These increased risks are not calculated within the programme and, if the provision is altered as a result, a note should be made in the 'Comment' field of the relevant hazards.

Designers also need to consider the working space required for maintenance workers working on the cabinets and equipment and the like. Ideally the cabinets and equipment should be located such that the working space around them as well as the cabinets and equipment lies fully beyond the working width of the safety barrier.

8.8.2 Results for Gantries

See guidance paragraph 8.6.3 above.

8.8.3 Steps

Steps are generally regarded as relatively low risk. However care needs to be taken with regard to some preformed metal step units to ensure that they are installed in such a way as to minimise that chances of an errant vehicle snagging and dragging the assembly. If properly detailed, such installations can be a cost effective and low risk solution. Care also is required when detailing the handrails alongside steps: to avoid the inclusion of relatively stiff braced assemblies that could become a potential hazard to the occupants of vehicles; and, if there is a safety barrier passing in front of the steps, that the handrails are not within its working width.

8.9 1600 Retaining Walls

The following are included under 1600 Retaining Walls: Sheet / Piled retaining walls; Brick / Stone retaining walls; Gabion walls; Crib walls; etc.

And under 2500 Special Structures the following: Corrugated buried structures; Reinforced soil structures; Reinforced clay / brick retaining walls; Dwarf retaining walls around e.g. services chambers, etc; Environmental barriers such as bunds and noise fences; etc.

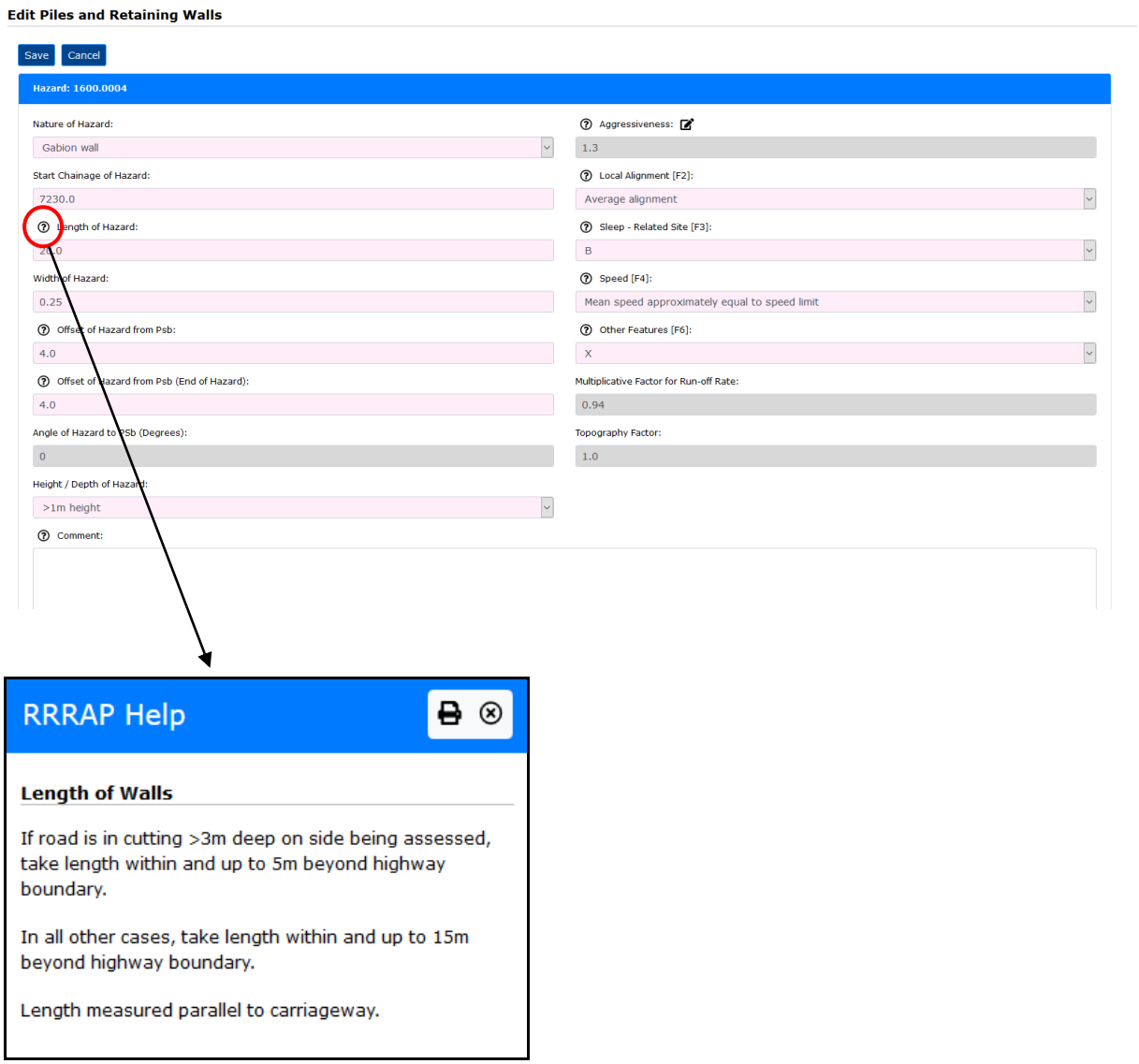


Figure 8-23 Retaining Walls data entry

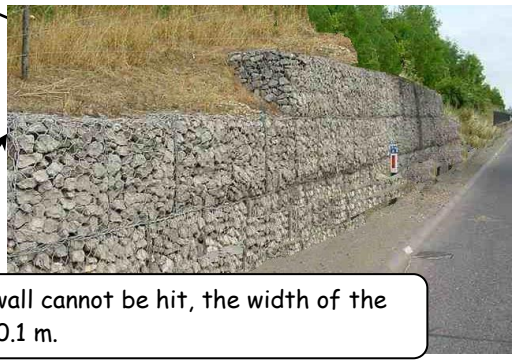
Drop down menu for Nature of Hazard

Smooth faced wall
Profiled wall (shallow features)
Profiled wall (deep features)
Sheet Piled wall
Concrete Piled wall
Rough faced wall
Gabion wall
Crib wall retaining a c'way
Crib wall toe adj. to c'way

Refer to TD 19 paragraph 3.12 for guidance on what constitutes a 'smooth' face.

Vehicles hitting a wall are more likely to be snagged by features that are wide and deep than they are when the features are shallow. There are therefore differences in aggressiveness assigned to the various types of wall. The Designer should choose the description that best matches the type of wall.

Figure 8-24 Crib Wall



If the leading end of the wall cannot be hit, the width of the hazard should be input as 0.1 m.

Figure 8-25 Gabion Wall

In the case of a crib wall that is retaining a cutting slope, the RRRAP does not take into account the special requirements of BD 68 in respect of preventing vehicle collision with the face of the wall that might lead to the crib wall failure; it is only assessing the risk to vehicle occupants posed by impact with the crib wall.

Similarly, with gabion walls the RRRAP does not assess the likelihood or implications of the wall collapsing or maintenance requirements should it be impacted.

The Designer should indicate his reasoning in respect of any decision made on VRS provision in the 'Comment' field of the relevant hazard.

8.9.1 Smooth Face Walls

A smooth faced wall over 1.5 m in height should not require safety barrier protection to prevent errant vehicles impacting the face of the wall and may be suitable as a vehicle restraint, but a safety barrier may be required to prevent errant vehicles from impacting the leading end of the wall. It should be noted that the Impact Severity Level (ISL) of a vertical wall is generally similar to that of a vertical concrete safety barrier and is higher than that for a proprietary profiled concrete safety barrier of similar height (see the list of EN1317 Compliant Road Restraint Systems available on the DfT Standards for Highways online resources web site for details). Note that TD 19 requires that the use of a vehicle restraint with an ISL greater than Class B (i.e. Class C) must be with the agreement of the Overseeing Organisation and justified within the RRRAP.

8.10 1700 - 400 Structures and Parapets

This includes parapets and pedestrian restraints, bridge abutments and piers and other structures. Note that the RRRAP will output containment levels for parapets including those over or adjacent to railways, but will not differentiate between new and existing situations nor location, e.g. if within Northern Ireland. The Designer must check the RRRAP output against the requirements of TD 19 Chapter 4 to ensure correct provision.

Note that for existing parapets, the assessment should follow the IAN 97 procedure with the details and outcome of the assessment entered into the 'Comment' field of individual hazards in RRRAP and included in the HS File.

Can VRS be contiguous with structure or parapet

Refer to TD 19/06
- Figures 3-8 and 3.10
- Paragraphs 3.30 to 3.33, 3.102 and 3.103, and 4.20.

It has been assumed that Abutments and other hazards that are 'rough' are not suitable for the VRS to be contiguous, hence for these, the drop down option is only 'No'.

Length of Structures, etc

Length of Structure is length measured parallel with carriageway. If abutment or pier is made up of row of columns or pillars, take overall length. If base of abutment or pier is > 0.25 m above adjacent ground level, take length of structure as length of base.

Parapet Width

Take nominal width of parapet to be 0.25 m regardless of parapet type.

Edit Structures - Parapets

Save Cancel

Hazard: 1 00.0047

Nature of Hazard:	Designed for collision loading to BS EN 1991-1-7:
Parapet over vertical drop less than 2m	No
Is Parapet/Structure to be Placed Contiguously with Barrier?:	Aggressiveness:
No	1.0
Start Chainage of Hazard:	Local Alignment [F2]:
1805.0	Average alignment
Length of Hazard:	Sleep - Related Site [F3]:
10.0	B
Width of Hazard:	Speed [F4]:
0.25	Mean speed approximately equal to speed limit
Offset of Hazard from Psb:	Other Features [F6]:
2.0	X
Structure Carries / Parapet Protecting:	Multiplicative Factor for Run-off Rate:
Culvert or Ditch Protected	0.94
Protected ID:	Topography Factor:
	1.0
Substandard Headroom over C'way, Verge or C/Res?:	
Headroom adequate over all C'way	
Comment:	

If headroom is Substandard

If headroom to structure is substandard over any part of the paved carriageway (e.g. hardshoulder or hardstrip), over the verge or over the central reserve, then refer to Figures 3-8 and 3-10 in TD 19.

For a Parapet, offset is to the outside face of the Parapet or to the outside of the edge beam supporting the parapet, whichever is smaller.

Main Hazard(s) that Parapet is protecting?

Name from the drop-down list the major hazard or hazards of those that are present.

If the structure is a long one, there may be a number of different hazards from the drop down list that the parapet is protecting. If this is the case, then split the total length of the parapet into discrete sections, each section protecting the hazard listed, see Guidance Manual for more advice and example.

If the parapet is protecting a Road or a Railway, information about these hazards **must be** entered in the appropriate 'Other Hazards' pages, and the correct ID is cross referenced in this page. Note that other hazards, such as 'Substantially open land' and 'Culverts or Ditches', are not cross referenced in this way.

Figure 8-26 Structures and Parapets data entry

See following sections for more guidance

Drop down menu for Nature of Hazard

Parapet over vertical drop less than 2 m
Parapet over vertical drop > 2 m
Pedestrian Guardrail
Bridge Abutment - smooth faced
Bridge Abutment - rough faced
Bridge Pier
Other structure - smooth faced
Other structure - rough faced

Refer to TD 19 paragraph 3.12 for guidance on what constitutes a 'smooth' face and RRRAP Guidance section 8.9.1 relating to Smooth Faced Walls and ISL levels.

Designed for collision loading to BS EN 1991-7?:

No

The RRRAP assesses the level of risk on the basis of the risk to the vehicle occupants from hitting a structure and returns the VRS requirements to give an acceptable level of risk to the occupants. Where the structure has not been designed for the collision loading, the designer will have to make an assessment of the likely implication and decide on an appropriate containment level to mitigate the risk this might pose.

Drop down menu for what the Parapet is protecting or Structure carries

Waterway e.g. Canal or River Protected
Culvert or Ditch Protected
Built up area or building Protected
Footway, Bridleway or Farm Track Protected
Railway Protected
Road Protected
Substantially open land Protected
Vertical drop over 2 m Protected

Bridleway or Farm Track carried
Footpath carried
Railway carried
Road carried
Services pipe carried
Waterway carried
Carrying other feature

8.10.1 Minimum length of VRS to prevent direct impact with approach end of parapet

Note that there may be some situations where the RRRAP will indicate the containment level required for the parapet, but will show that the level of risk for the feature the parapet is protecting is acceptable without a VRS. A typical example would be where the parapet is protecting a vertical drop to a bridleway or small culvert. In such an instance the Designer should refer to Paragraph 3.30 of TD 19 and ensure appropriate provision of VRS to prevent direct impact with the end of the parapet.

8.10.2 Selecting protected road or railway hazard Id

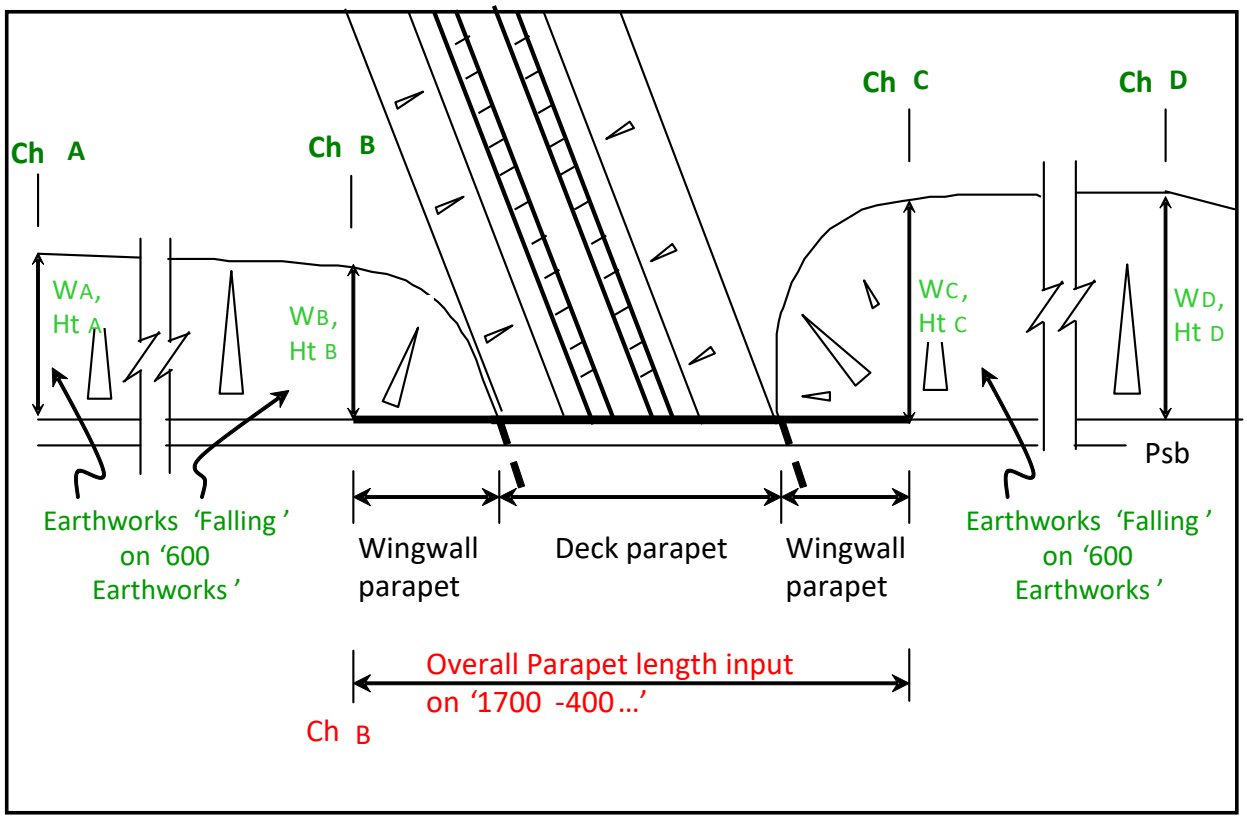
When the Nature of hazard is a "Parapet" and the Structure carries / Parapet protecting field is set as "Road Protected" or "Railway Protected", then the Protected ID field is populated with either the list

of Road or Railway hazard IDs that are available in the RRRAP record. Under these conditions the Protected ID field is mandatory and a hazard ID must be selected from the list provided.

If the Nature of hazard or the Structure carries / Parapet protecting fields do not match the cases above then the list of Protected ID's will be empty and the field will not be mandatory.

8.10.3 **Guidance on inputting data for Parapets**

The following figures identify how information relating to Parapets, Earthworks and Railway or Road is input into the respective data entry pages.



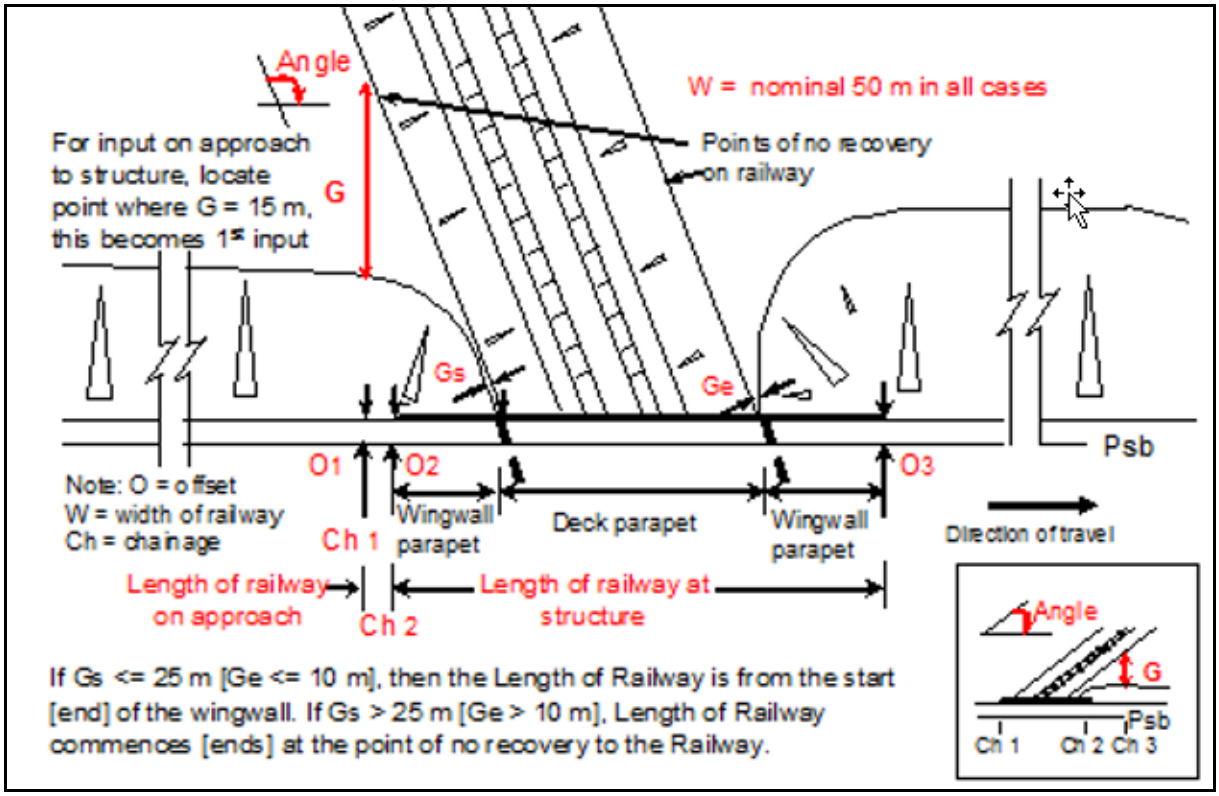
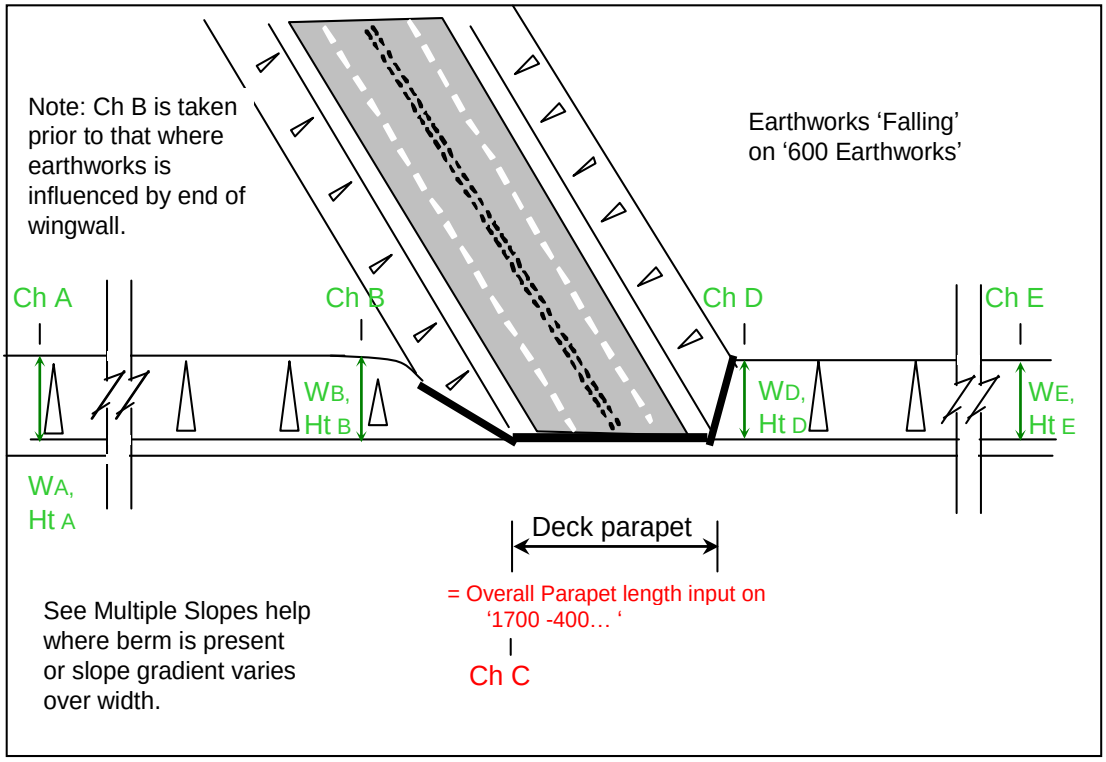


Figure 8-27 Parapet, Earthworks and Railway Inputs at Underbridge with Parallel Wingwalls (Road Inputs broadly similar)



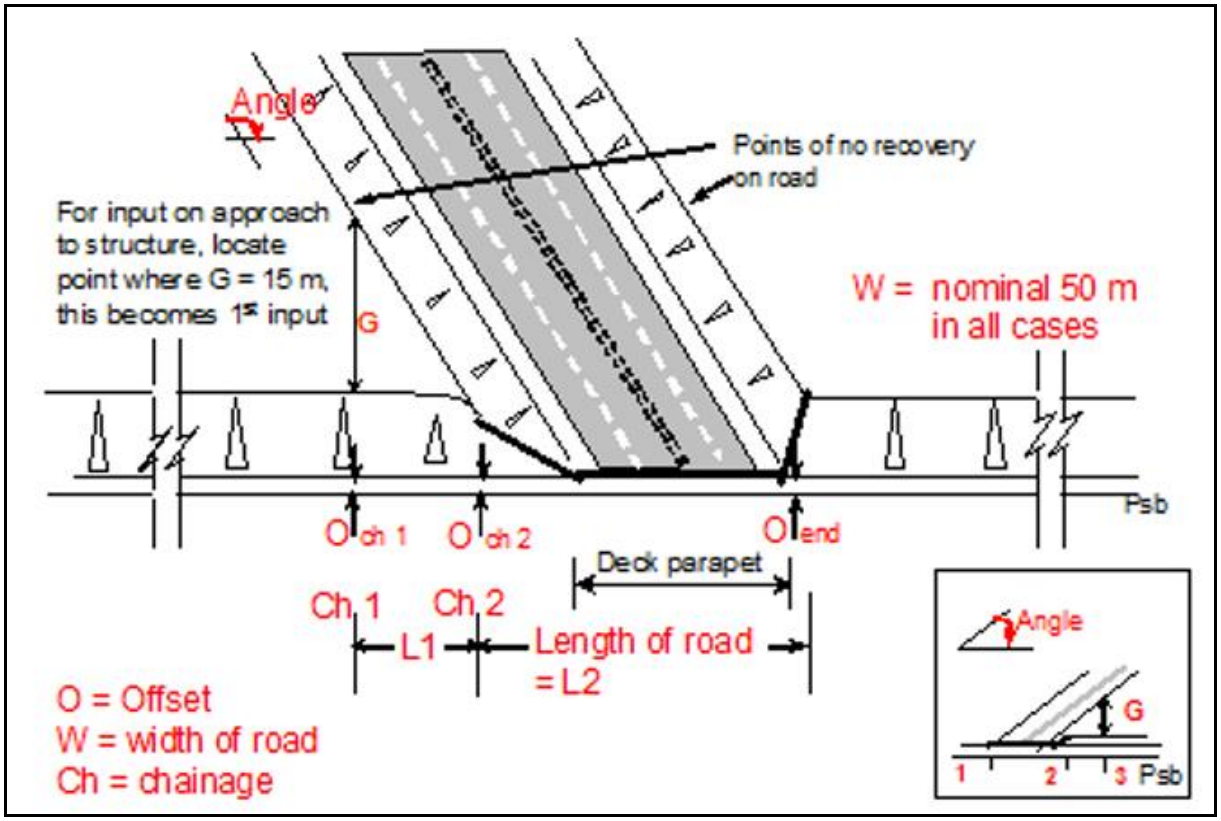
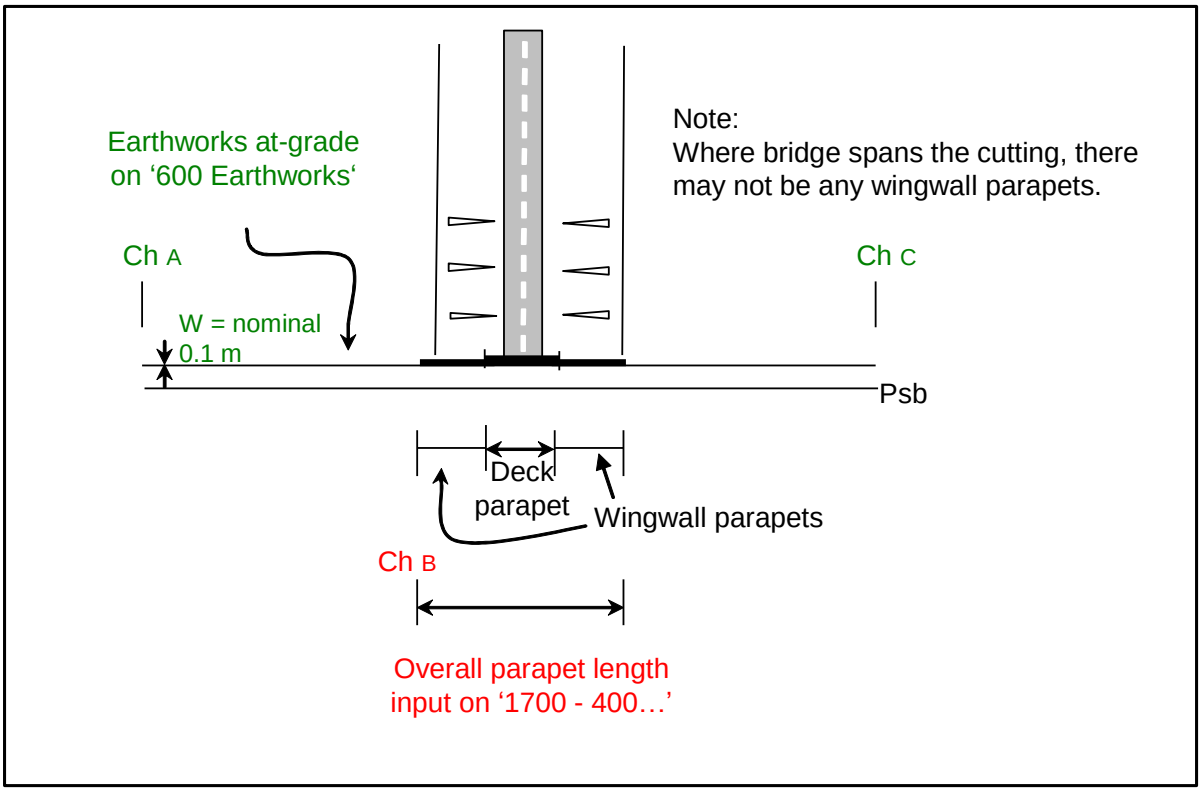


Figure 8-28 Parapet, Earthworks and Road Inputs at Underbridge with Splayed Wingwalls (Railway input broadly similar)



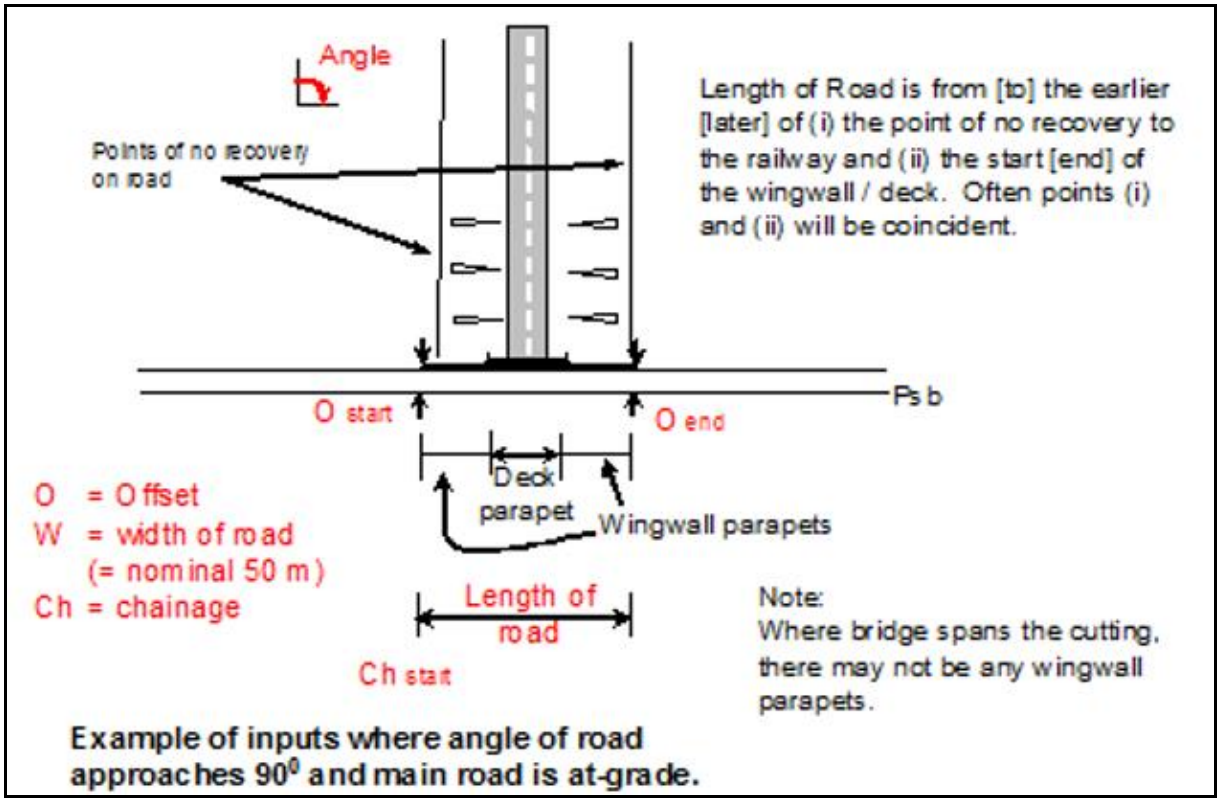
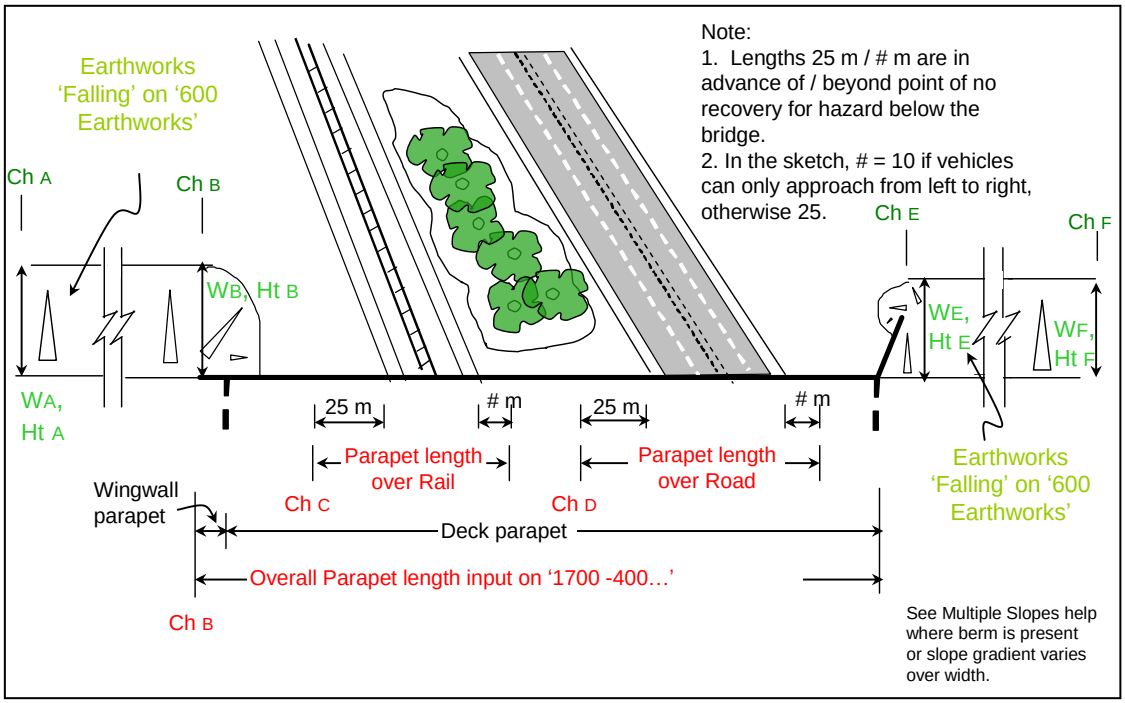


Figure 8-29 Parapet, Earthworks and Road Inputs at Underbridge when road is at-grade (Railway input broadly similar)

8.10.4 Parapet details on a Viaduct or other long structure

If the structure is a long one, e.g. a viaduct, it is possible that it will span one or more of the categories listed in the drop down menu. If this is the case, then the parapet should be split into sections to differentiate each category, as indicated in Figure 8-30 (see also the following photograph by way of an example). The RRRAP will indicate the containment level required for each section of parapet. Remember to allow for transitions between parapets having different containment levels.



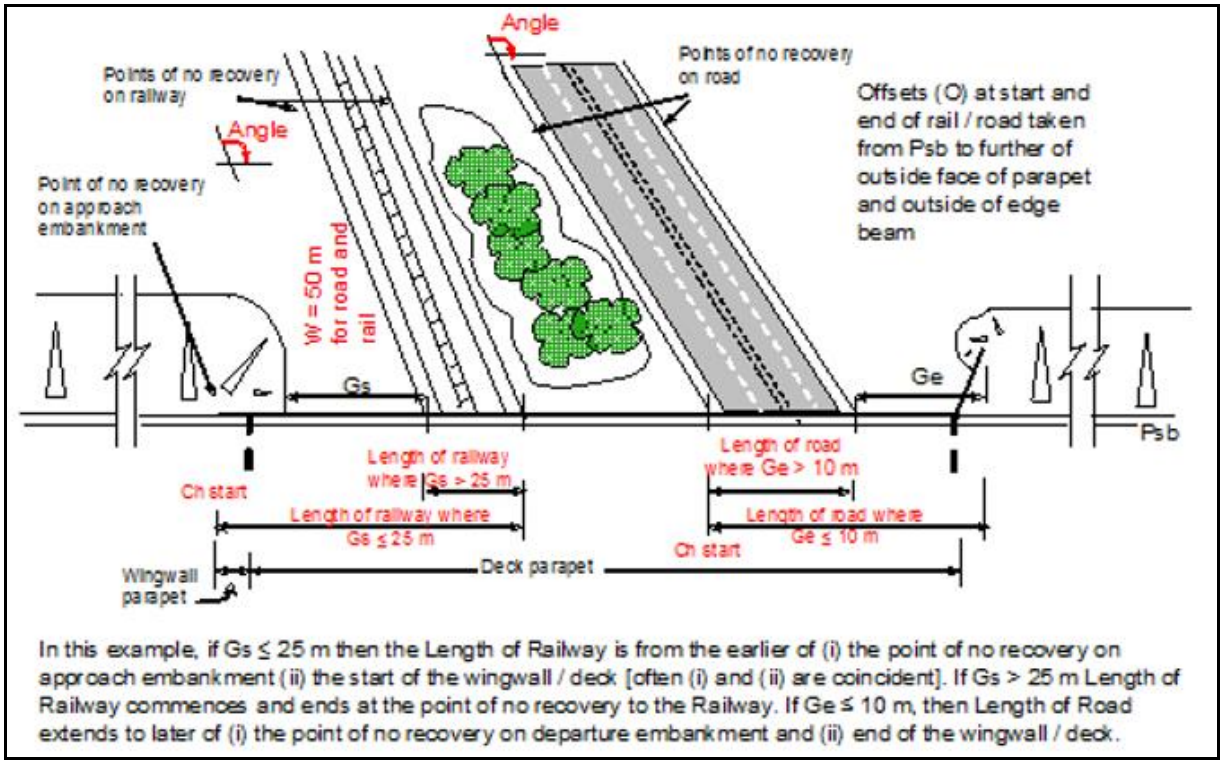
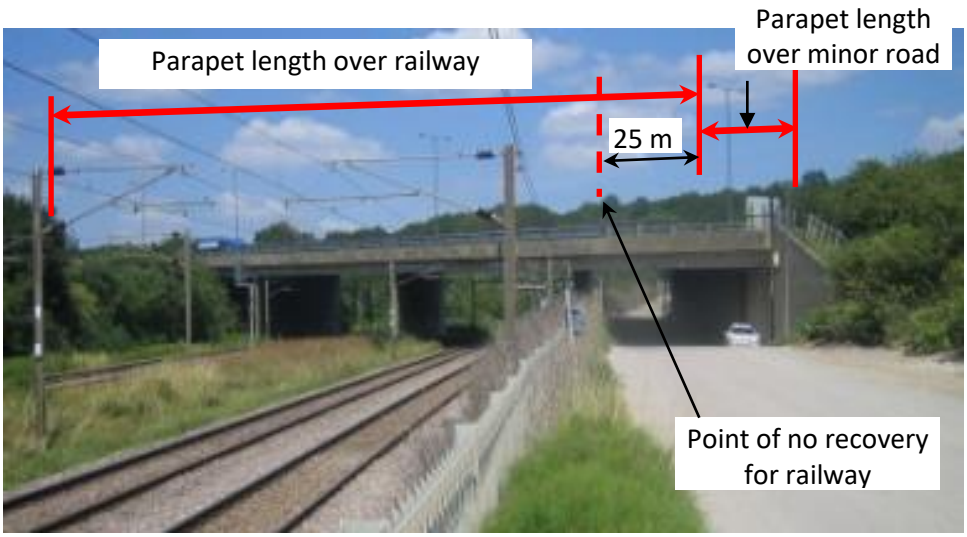


Figure 8-30 Parapet, Earthworks and Road/Rail inputs on a Viaduct or other long structure



If the lengths in between P_{Rail} / P_{Road} / Parapet ends are relatively short, it may be impracticable to have different containment levels from that required at P_{Rail} and or P_{Road}. In which case, the parapet having the higher of the two containment level requirements should be continued.

Similarly, in other instances, the length in advance of one section of parapet may overlap the length beyond the adjacent section.

There may be instances where, due to the local layout, either the length in advance and or the length beyond the point of no recovery would extend beyond the overall limit of the parapet. In this event, the actual end point of the respective parapet would be input in the RRRAP.

Note that only hazards that are high risk, namely roads, railways or built up areas are likely to require higher containment parapet (or higher containment safety barrier if placed in front of an existing low containment parapet). Due to the very varied factors that apply with built up areas, the RRRAP cannot calculate the containment level required and the Designer therefore must decide the appropriate level taking account of all the relevant circumstances.

8.10.5 **Note about how the RRRAP calculates Parapet risk**

In the calculation process, the RRRAP assumes that a parapet is relatively close to the carriageway. This is normally the case for instance on a motorway bridge. However there are instances, e.g. with a culvert, where the vertical drop may be a significant distance from the carriageway. Entering a culvert as a 'Parapet with vertical drop < 2 m (or > 2 m)' will result in N2 containment regardless of how far from the carriageway the parapet and vertical drop are. Hence it is better to input culverts in the drainage page (refer to Section 8.3.3). There may be a need to install a pedestrian restraint system to prevent falls over the vertical edge.

8.10.6 **Parapet Working Width**

Designers should check and specify the greatest working width that meets the requirements of Paragraphs 4.14 and 4.15 of TD 19 which may be greater than the default of W2 that the RRRAP returns. Note that parapets (and safety barriers) that have a low working width are likely to be more

costly than those with a high working width and potentially require modifications to the supporting structure to take the higher loads that might be realised.

8.10.7 **Pedestrian Restraints**

Pedestrian Restraints may take the form of pedestrian parapets, pedestrian guardrails, or pedestrian protection in the form of post and rail fence. Pedestrian Restraints may in themselves not warrant vehicle restraint provision, however their presence is recorded as it may affect the nature and location of the vehicle restraint that is required to protect other hazards. Designers should ensure that pedestrian restraints are sited such that they do not interfere with the action of an adjacent parapet or safety barrier. Reference should also be made to TD 19 Para 9.5 regarding pedestrian guardrails.

8.10.8 **Structural Collision Loading and Collapse**

Designers should check the requirements of IAN 91 'Advice on the identification of 'Particularly at Risk' Supports' and BS EN 1991-1-7: 'National Annex to Eurocode 1: Actions on structures – Part 1-7: Accidental actions' when determining the appropriate containment level for the VRS at structures. The background to decisions made in respect of VRS provision should be included in the hazard 'Comment' field.

8.10.9 Example layout and corresponding inputs for Earthworks, Parapet and Road and Rail

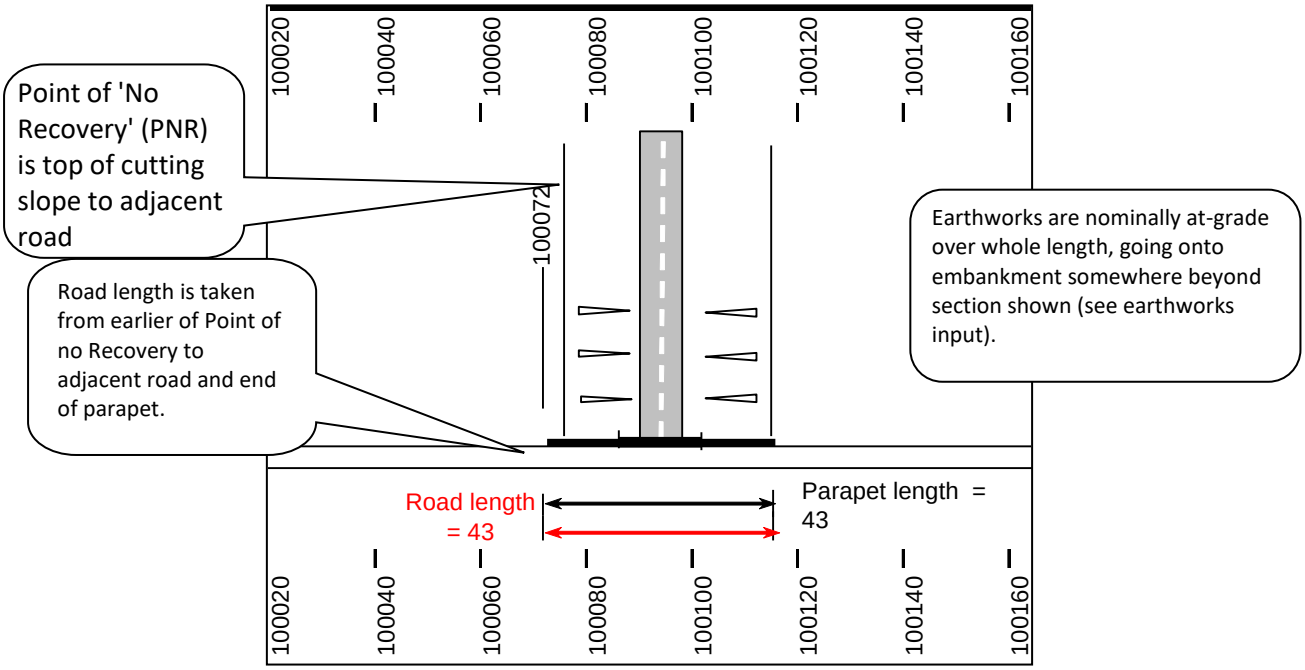


Figure 8-31 Adjacent Road crossing at-grade and or at around 90 degrees

600 Earthworks

		Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %	Length of profile
		0600.0001	Nominally at Grade	100000.0	1.5	0.1	0.0	0.0	296.0
		0600.0002	Falling at 50%	100296.0	1.5	0.1	-0.05	-50.0	22.0

This entry row is for next section of earthworks (not shown in diagram above).

1700 – 400 Structures - Parapets

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Structure Carries / Parapet protecting
		1700.0001	Parapet over vertical drop >2m (over road)	100072.0	43.0	0.25	1.75	Road Protected

Viewing the details of hazard 1700.0001 shows the Id of the road hazard protected:

?	Is Parapet/Structure to be Placed Contiguously with Barrier?	Yes

...

?	Structure Carries / Parapet Protecting	Road Protected
?	Protected ID	8200.0001

Check that these match

8200 OH's - Roads

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Offset of hazard from PSB (End of Hazard)
		8200.0001	Adjacent Road Single	100072.0	43.0	50.0	1.75	1.75

Note that a copy of the output from this and the following examples relating to Figure 8-31, Figure 8-32, Figure 8-33, and Figure 8-34 are shown at the end of this section in Figure 8-35 and Figure 8-36.

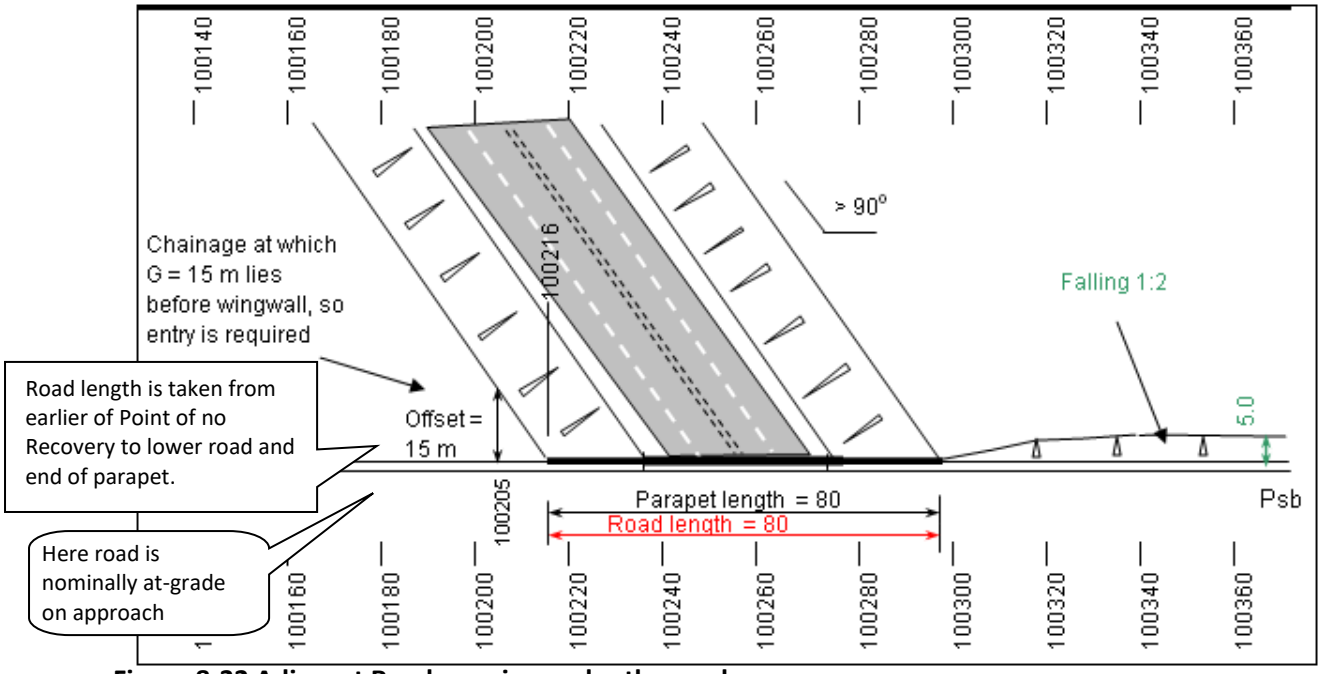


Figure 8-32 Adjacent Road crossing under the road

600 Earthworks

Note that RRRAP is not overly sensitive to changes in angle, width and or offset in these situations, so no need to be too precise.

		Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %	Length of profile
		0600.0001	Nominally at Grade	100000.0	1.5	0.1	0.0	0.0	296.0
		0600.0002	Falling at 50%	100296.0	1.5	0.1	-0.05	-50.0	22.0
		0600.0003	Falling at 50%	100318.0	1.5	3.0	-1.5	-50.0	20.0
		0600.0004	Falling at 50%	100338.0	1.5	4.6	-2.3	-50.0	2.0
		0600.0005	Falling at 50%	100340.0	1.5	5.0	-2.5	-50.0	940.0

Here the start of section that is falling is picked up

1700 – 400 Structures - Parapets

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Structure Carries / Parapet protecting
		1700.0002	Parapet over vertical drop >2m (over road)	100216.0	80.0	0.25	1.75	Road Protected

Viewing the details of hazard 1700.0002 shows the Id of the road hazard protected:

?	Is Parapet/Structure to be Placed Contiguously with Barrier?	Yes

...

?	Structure Carries / Parapet Protecting	Road Protected
?	Protected ID	8200.0003

Check that these match

8200 OH's - Roads

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Offset of hazard from PSB (End of Hazard)
		8200.0001	Adjacent Road Single	100072.0	43.0	50.0	1.75	1.75
		8200.0002	Adjacent Road D3M	100205.0	11.0	50.0	1.75	1.75
		8200.0003	Adjacent Road D2M	100216.0	80.0	50.0	1.75	1.75

Refer to Adj Road help on page for details of how measurements are determined.

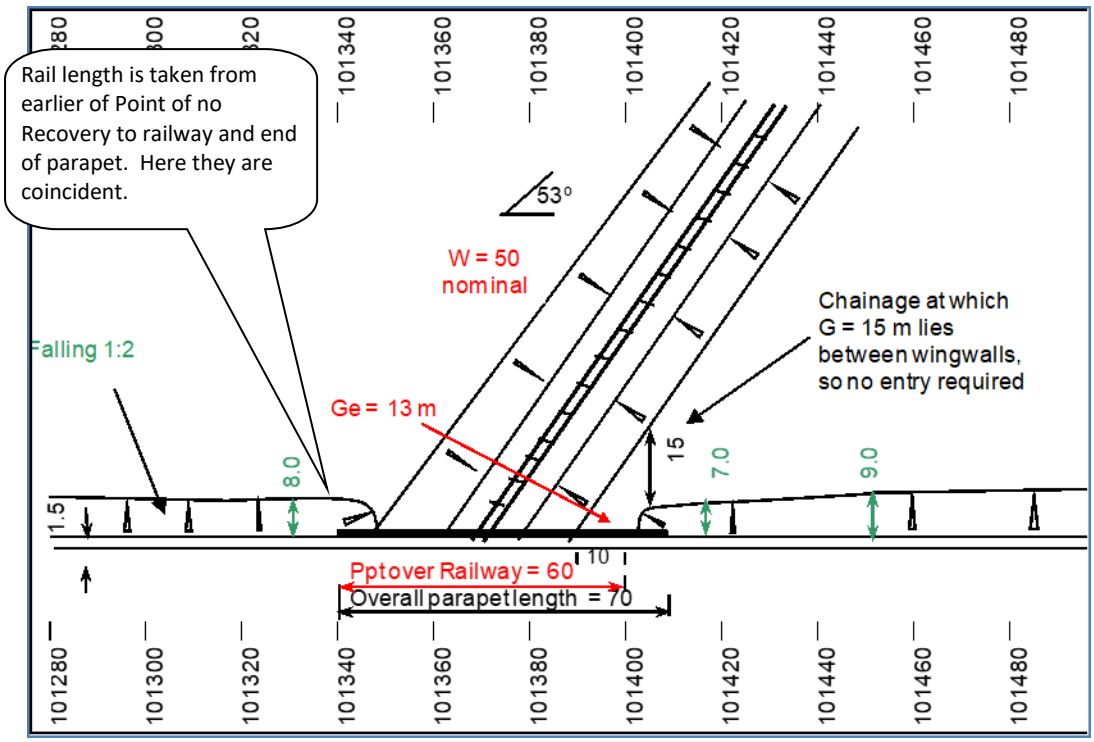


Figure 8-33 Adjacent Railway crossing under Road

600 Earthworks

		Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %	Length of profile
		0600.0006	Falling at 50%	101280.0	1.5	7.0	-3.5	-50.0	40.0
		0600.0007	Falling at 50%	101320.0	1.5	8.0	-4.0	-50.0	90.0
		0600.0008	Falling at 50%	101410.0	1.5	6.0	-3.0	-50.0	10.0
		0600.0009	Falling at 50%	101420.0	1.5	7.0	-3.5	-50.0	30.0
		0600.0010	Falling at 50%	101450.0	1.5	9.0	-4.5	-50.0	268.0
		0600.0011	Falling at 50%	101718.0	1.5	9.0	-4.5	-50.0	208.0

1700 – 400 Structures - Parapets

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Structure Carries / Parapet protecting
		1700.0003	Parapet over vertical drop >2m (over railway)	101340.0	60.0	0.25	1.75	Railway Protected
		1700.0004	Parapet over vertical drop >2m	101400.0	10.0	0.25	1.75	Substantially open land Protected

?	Is Parapet/Structure to be Placed Contiguously with Barrier?	Yes

Parapet protects railway

8100 OH's - Railways

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Offset of hazard from PSB (End of Hazard)
		8100.0001	Railway	101340.0	70.0	50.0	1.75	1.75

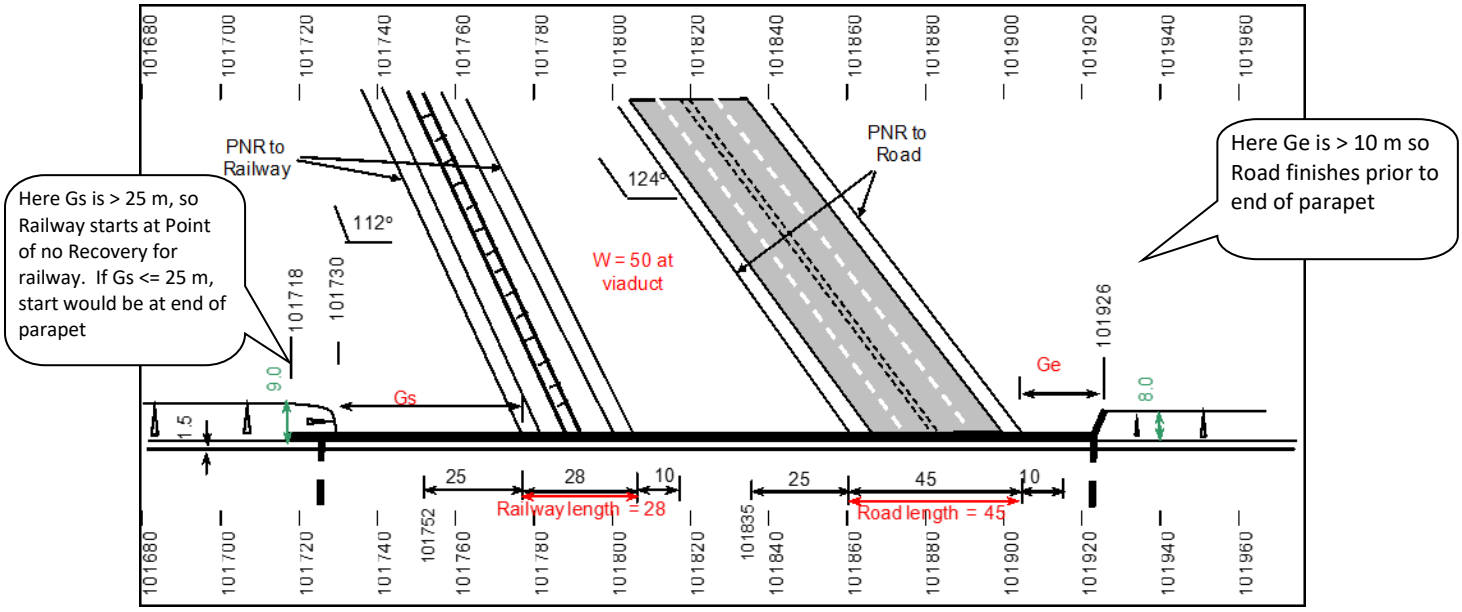


Figure 8-34 Adjacent Railway and Road crossing under Viaduct

600 Earthworks

		Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %	Length of profile
		0600.0010	Falling at 50%	101450.0	1.5	9.0	-4.5	-50.0	268.0
		0600.0011	Falling at 50%	101718.0	1.5	9.0	-4.5	-50.0	208.0
		0600.0012	Falling at 50%	101926.0	1.5	8.0	-4.0	-50.0	34.0
		0600.0013	Falling at 50%	101960.0	1.5	8.0	-4.0	-50.0	End Earthwork for section

1700 – 400 Structures – Parapets

Offset is to the outside face of the Parapet or to the outside of the edge beam supporting the parapet, whichever is greater.

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Structure Carries / Parapet protecting
		1700.0005	Parapet over vertical drop >2m	101718.0	208.0	0.25	1.75	Substantially open land Protected
		1700.0006	Parapet over vertical drop >2m (over railway)	101752.0	63.0	0.25	2.75	Railway Protected
		1700.0007	Parapet over vertical drop >2m (over road)	101835.0	80.0	0.25	1.75	Road Protected

8100 OH's - Railways

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Offset of hazard from PSB (End of Hazard)
		8100.0002	Railway	101777.0	28.0	50.0	2.75	2.75

Parapet protects railway / road

8200 OH's - Roads

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Offset of hazard from PSB (End of Hazard)
		8200.0004	Adjacent Road D2AP	101860.0	45.0	50.0	1.75	1.75

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Contai		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Nominally at Grade	100000.0	100296.0	1.5	Yes						N/A
☐	i	8200.0001	Adjacent Road Single	100072.0	100115.0	1.75 / 1.75	No	Acceptable	40		W2	N2	N/A
☐	i	1700.0001	Parapet over vertical drop >2m (over road)	100072.0	100115.0	1.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	8200.0002	Adjacent Road D3M	100205.0	100216.0	1.75 / 1.75	No	Acceptable	46		W2	N2	N/A
☐	i	8200.0003	Adjacent Road D2M	100216.0	100296.0	1.75 / 1.75	No	Acceptable	39		W2	N2	N/A
☐	i	1700.0002	Parapet over vertical drop >2m (over road)	100216.0	100296.0	1.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	0600.0002	Falling at 50%	100296.0	100318.0	1.5	Yes						N/A
☐	i	0600.0003	Falling at 50%	100318.0	100338.0	1.5	Yes						N/A
☐	i	0600.0004	Falling at 50%	100338.0	100340.0	1.5	Yes						N/A
☐	i	0600.0005	Falling at 50%	100340.0	101280.0	1.5	No	Acceptable	43		W2	N2	N/A
☐	i	0600.0006	Falling at 50%	101280.0	101320.0	1.5	No	Acceptable	43		W2	N2	N/A
☐	i	0600.0007	Falling at 50%	101320.0	101410.0	1.5	No	Acceptable	42		W2	N2	N/A
☐	i	8100.0001	Railway	101340.0	101410.0	1.75 / 1.75	No	Acceptable	39		W2	N2	N/A
☐	i	1700.0003	Parapet over vertical drop >2m (over railway)	101340.0	101400.0	1.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	1700.0004	Parapet over vertical drop >2m	101400.0	101410.0	1.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	0600.0008	Falling at 50%	101410.0	101420.0	1.5	No	Acceptable	42		W2	N2	N/A
☐	i	0600.0009	Falling at 50%	101420.0	101450.0	1.5	No	Acceptable	43		W2	N2	N/A
☐	i	0600.0010	Falling at 50%	101450.0	101718.0	1.5	No	Acceptable	42		W2	N2	N/A
☐	i	0600.0011	Falling at 50%	101718.0	101926.0	1.5	No	Acceptable	42		W2	N2	N/A
☐	i	1700.0005	Parapet over vertical drop >2m	101718.0	101926.0	1.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	1700.0006	Parapet over vertical drop >2m (over railway)	101752.0	101815.0	2.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	8100.0002	Railway	101777.0	101805.0	2.75 / 2.75	No	Acceptable	42		W2	N2	N/A
☐	i	1700.0007	Parapet over vertical drop >2m (over road)	101835.0	101915.0	1.75	N/A	N/A	N/A	N/A	N/A	N/A	H2
☐	i	8200.0004	Adjacent Road D2AP	101860.0	101905.0	1.75 / 1.75	No	Acceptable	49		W2	N2	N/A
☐	i	0600.0012	Falling at 50%	101926.0	101960.0	1.5	No	Acceptable	43		W2	N2	N/A

The length beyond only populates if there is 2 way flow on the road under consideration. Refer to Table 3-1 in TD 19/06 for min requirements.

Requirements for single c'way situation in Figure 8-31

Requirements for D2M situation in Figure 8-32

Approach and departure embankment requires VRS

Requirements for single track railway situation in Figure 8-33. But see TD 19/06 requirements.

Approach embankment requires VRS

Requirements on viaduct and for single track railway and dual carriageway road situation in Figure 8-34. But see TD 19/06 requirements relating to railways.

Departure embankment requires VRS

Requirements for road and railway approaches and parapet containment depend on input factors (not shown here) relating to likelihood of reaching, flow speeds and rates on the road and railway, as well as the AADT and % LGV and MGV road type, etc on the road being considered.

Figure 8-35 Extract from Collation of Data relating to the situations shown in the previous examples

Road Restraint Risk Assessment Process (RRRAP) VRS Summary

Id	Nature of Hazard	Start chainage	End chainage	Offset from Psb at start	Min Length VRS in advance (m)	Min Length VRS beyond (m)	Containment Level	VRS working width class	Parapet Containment	VRS working width (m)	Set-back of VRS from PSb	Relaxation / Departure required?
8200.0001	Adjacent Road Single	100072.0	100115.0	1.75	40.0		N2	W2		0.8	0.6	None
1700.0001	Parapet over vertical drop >2m (over road)	100072.0	100115.0	1.75					H2		1.75	
8200.0002	Adjacent Road D3M	100205.0	100216.0	1.75	46.0		N2	W2		0.8	0.6	None
8200.0003	Adjacent Road D2M	100216.0	100296.0	1.75	39.0		N2	W2		0.8	0.6	None
1700.0002	Parapet over vertical drop >2m (over road)	100216.0	100296.0	1.75					H2		1.75	
0600.0005	Falling at 50%	100340.0	101280.0	1.5	43.0		N2	W2		0.8	0.6	None
0600.0006	Falling at 50%	101280.0	101320.0	1.5	43.0		N2	W2		0.8	0.6	None
0600.0007	Falling at 50%	101320.0	101410.0	1.5	42.0		N2	W2		0.8	0.6	None
8100.0001	Railway	101340.0	101410.0	1.75	39.0		N2	W2		0.8	0.6	None
1700.0003	Parapet over vertical drop >2m (over railway)	101340.0	101400.0	1.75					H2		1.75	
1700.0004	Parapet over vertical drop >2m	101400.0	101410.0	1.75					H2		1.75	
0600.0008	Falling at 50%	101410.0	101420.0	1.5	42.0		N2	W2		0.8	0.6	None
0600.0009	Falling at 50%	101420.0	101450.0	1.5	43.0		N2	W2		0.8	0.6	None
0600.0010	Falling at 50%	101450.0	101718.0	1.5	42.0		N2	W2		0.8	0.6	None
0600.0011	Falling at 50%	101718.0	101926.0	1.5	42.0		N2	W2		0.8	0.6	None
1700.0005	Parapet over vertical drop >2m	101718.0	101926.0	1.75					H2		1.75	
1700.0006	Parapet over vertical drop >2m (over railway)	101752.0	101815.0	2.75					H2		2.75	
8100.0002	Railway	101777.0	101805.0	2.75	42.0		N2	W2		0.8	1.2	None
1700.0007	Parapet over vertical drop >2m (over road)	101835.0	101915.0	1.75					H2		1.75	
8200.0004	Adjacent Road D2AP	101860.0	101905.0	1.75	49.0		N2	W2		0.8	0.6	None
0600.0012	Falling at 50%	101926.0	101926.0	1.5	43		N2	W2		0.8	0.6	None

Figure 8-36 Extract from VRS Summary relating to the situations shown in the previous examples

8.11 2500 Special Structures

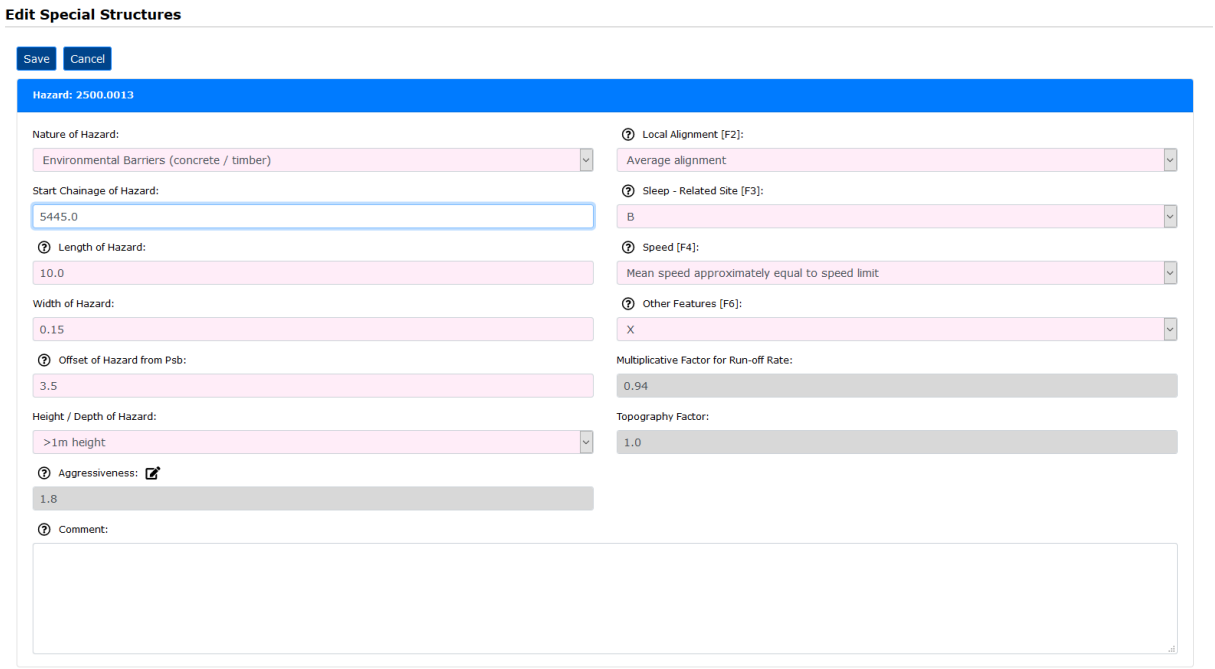


Figure 8-37 Special Structures data entry

Drop down menu for Nature of Hazard

Corrugated buried structures (exposed ends)
Reinforced soil structures
Reinforced clay brickwork retaining walls
Short dwarf wall
Environmental Barriers (concrete / timber)
Environmental Barriers (earth bunding), gradient > = 1:1.5
Environmental Barriers (earth bunding), gradient < 1:1.5
Police Ramp

Used to steepen a slope – see section below.

A low wall, typically surrounding a manhole or sometimes a cabinet, that is supporting an adjacent cutting slope'.

Often referred to as 'noise fence'.

8.11.1 Reinforced soil slopes

Where there is a section of earthworks where the slope has been steepened by use of reinforced soil techniques, there are two ways of inputting the information into the RRRAP depending upon the circumstances.

(i) If the reinforcing is over a relatively long length of carriageway, then it is best to input the slope information in the '600 Earthworks' page. The overall width and height of the slope are entered in the normal way. There is no entry of a hazard in the 2500 Special Structures page.

(ii) If the reinforcing is only over a relatively short length, say 50 m, e.g. where the cutting or embankment locally steepened due to land-take difficulties, it may be easiest to assume the earthworks continue past the strengthened section at its normal gradient (i.e. that the strengthening

is not there) and enter the earthworks information into the '600 Earthworks' page, and then to add the details for the strengthened length into the 2500 Special Structures section.

Figure 8-38 illustrates the situation.

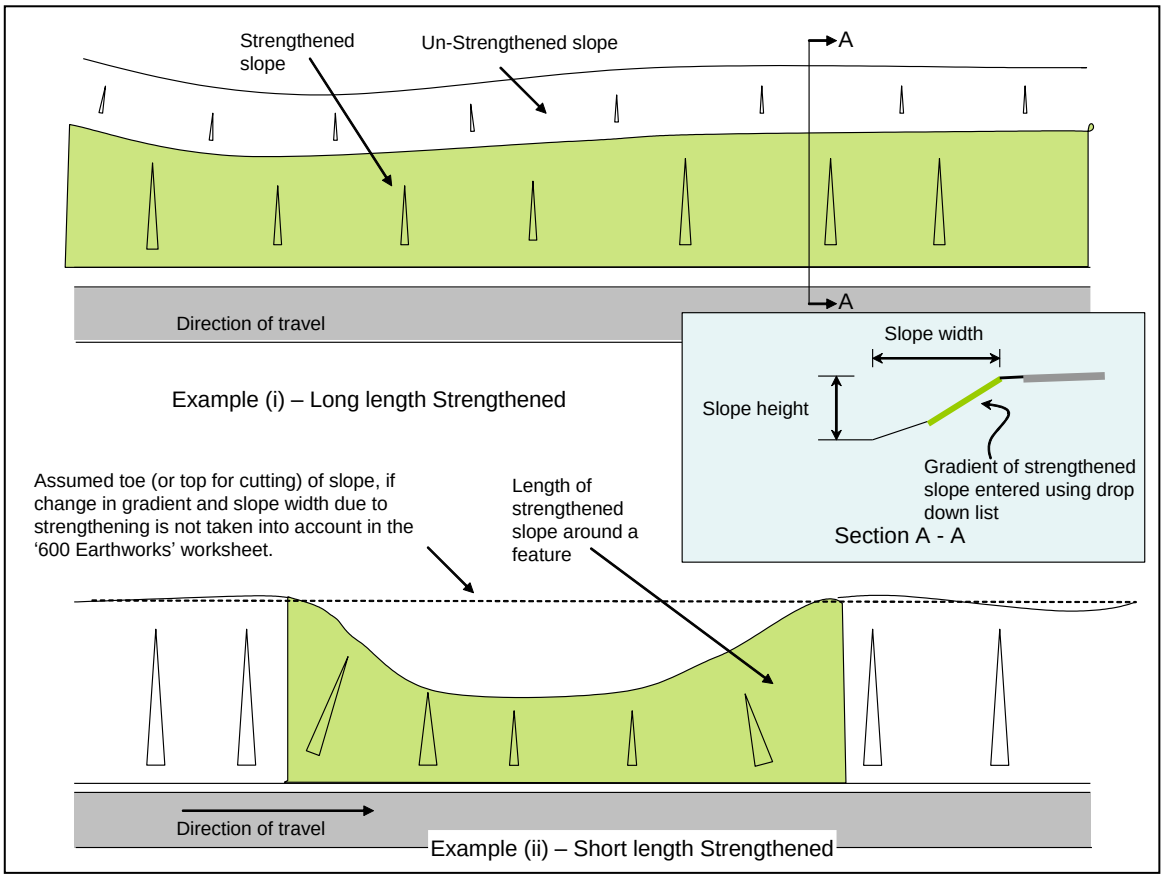


Figure 8-38 Strengthened Slopes

8.11.2 Police Access Ramps

Police access ramps are included in the nature drop down. This is because the Police require VRS, but the variety of configurations of police access ramps makes it difficult to be specific on the length of need in advance of the hazard.

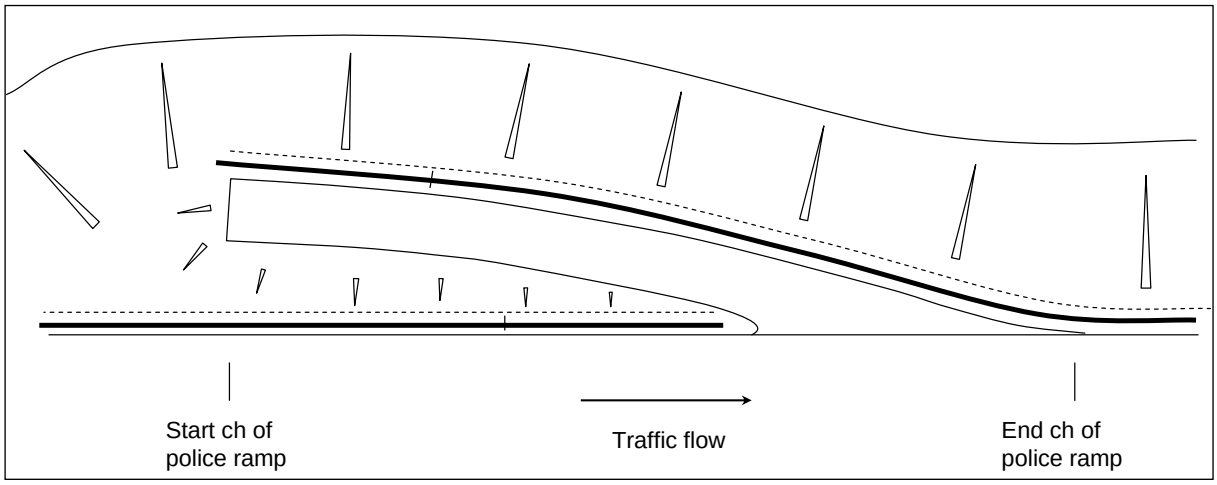


Figure 8-39 Police Access Ramps

The RRRAP does not quantify the risk; it flags the presence of the ramp, that the level of risk without VRS is unacceptable and, under the heading of "Level of risk with optimum length VRS", it refers the user to the Guidance Manual. N2 containment VRS is indicated in the 'Collation & Reports' and 'VRS Summary' pages. Very often there is a need to link VRS provision for the ramp with adjacent lengths that are required to protect other hazards. Figure 8-39 illustrates a typical layout.

8.11.3 Environmental Barrier

It is assumed that Environmental Barriers will be installed either on Nominally At-Grade ground or at the top of a cutting slope, rather than at the bottom or part way down an embankment (their noise attenuating effectiveness will be greatly reduced in these latter locations).

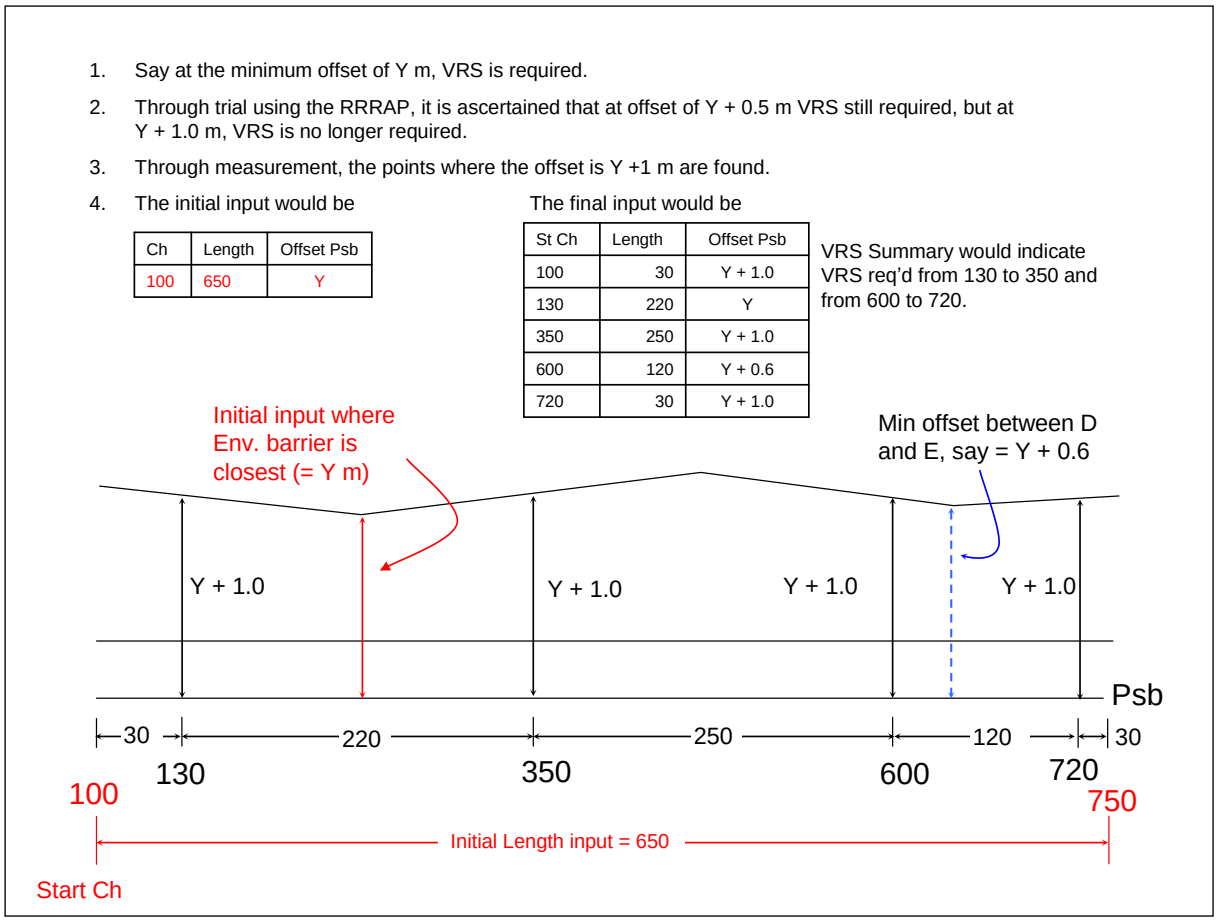


Figure 8-40 Environmental Barrier example

Data entry requires the start chainage, length, width and one offset value for an Environmental Barrier. It is therefore necessary to initially record the closest offset to Psb and to see, for this offset, whether VRS is required. If it is not required at this offset, then it will not be required at greater offsets. If it is required, then further points should be entered, say at 0.5 m increments and the RRRAP risk calculation re-run to ascertain the offset at which at which VRS is no longer required. Using this information, the corresponding chainages can be ascertained. Entries should then be put

into the RRRAP for the start chainage and length of each section that does not require and that does require VRS, as indicated in Figure 8-40.

8.12 Poles or Pylons

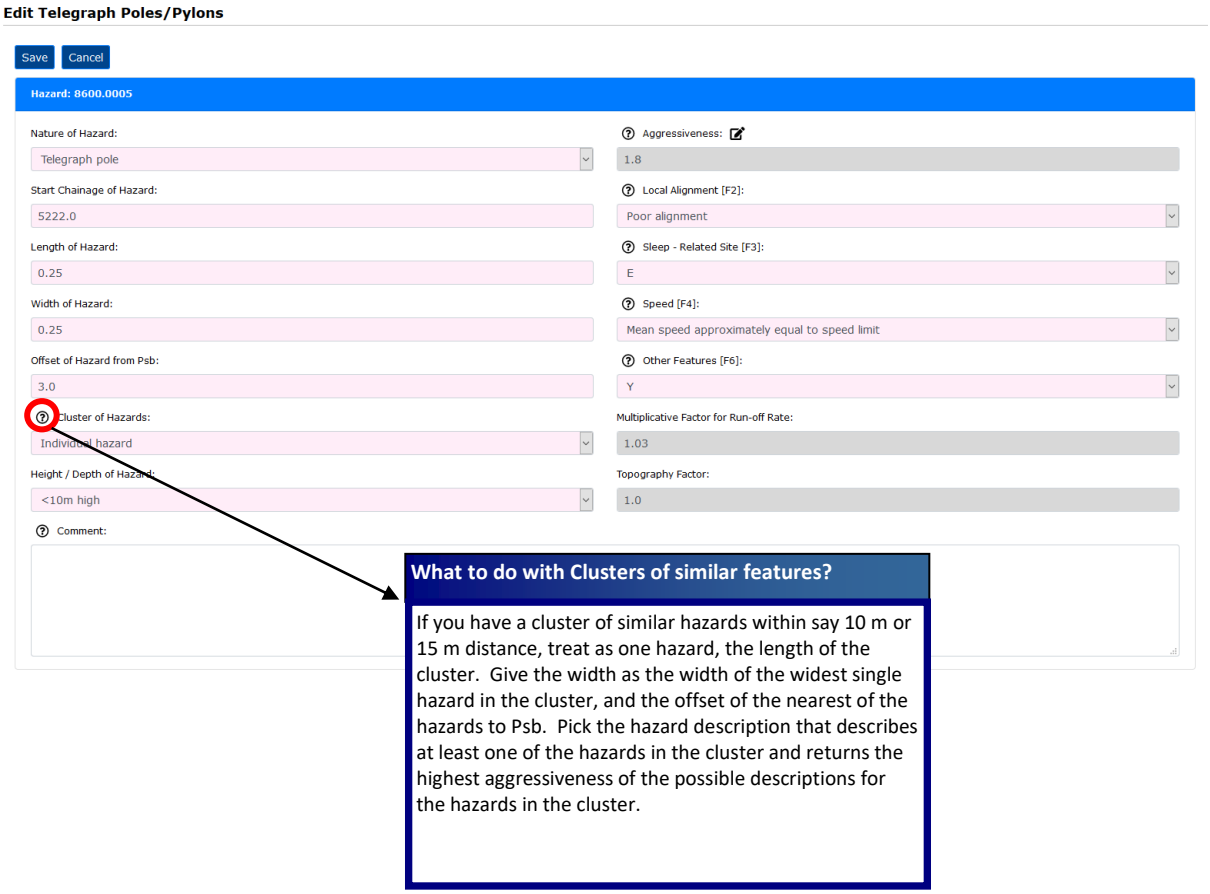


Figure 8-41 Telegraph Poles / Pylons data entry

Drop down menu for Nature of Hazard

Electricity station
Gas substation
Telegraph pole
Pylon
Electricity pole
Post e.g. TrafficMaster
Post e.g. TrafficMaster (Passively Safe)

For guidance on passively safe signs, see section 8.6.2.

8.12.1 Utility Poles

Utility poles may or may not have supporting cable stays. A typical cable stay will not break when struck by a vehicle moving at moderate speeds. Unless the ground anchor fixing is weak and fails, or there is a frangible connection between the stay and anchor or stay and pole, the pole itself may fail before the stay. If the ground anchor and connections hold, the pole may be either pulled directly

toward the vehicle or the tensioned cable stay may slice through the vehicle, or there may be a combination of the two actions. This creates a serious potential for injury to the vehicle's occupants.

With this in mind, the cable stay should be entered as a pole in the RRRAP, with the offset being to the anchor position and the width / length being to where 1.5 m height clearance is reached. The pole itself should be entered as a separate hazard. A note should be added in the hazard 'Comment' field to explain that in this instance it is the stay rather than the pole that is the nearer hazard. The stay may require a longer length of VRS in advance than would a pole at the same offset, this will be due to the greater width of hazard.

If the pole itself at its current offset does not warrant protection, but the stay does, and there is no other requirement for safety barrier, it would be worthwhile investigating the possibility of installing a frangible connection to the stay or seeing if the stay itself could be moved so as not to pose a hazard. If a frangible stay connection is put in place, then the stay will not be classed as a hazard (the pole will remain a hazard) and a note should go in the hazard 'Comment' field to explain that the stay has a frangible connection.

The RRRAP does not take into account the effect of the overhead powerlines or other cables falling onto the carriageway. The Designer should therefore consider all the circumstances and decide whether a safety barrier is warranted where the RRRAP suggests that one may not be needed.

8.12.2 **Pylons**

The RRRAP will indicate whether the pylons require protection but, as there is no easy way of automatically estimating or calculating the risk to Others e.g. if pylon and or cables were to fall, it will not be able to calculate whether normal containment level N2 is sufficient. The Designer should therefore consider all the circumstances and decide whether a higher containment level H1 or possibly H4a safety barrier is warranted. Details of the factors considered and the decision process should be entered in the hazard 'Comment' field.

8.13 Trees

The important thing is to identify the significant trees / tree features that are currently or may in the future pose a hazard. Areas of planting can be picked up as a cluster.

Trees

Add New Hazard | Back

These significant Trees that might be reached have been identified as being present in Section.

Results **1** - **20** of **22** | Page **1** of **2** 1 2 Last

		Id number	Nature of hazard	Start chainage	Length of hazard	Width of hazard	Offset of hazard from PSB	Cluster of Hazards
		8700.0001	Tree less than 250 mm girth expected in lifetime	530.0	0.24	0.24	5.5	Individual hazard
		8700.0002	Tree >= 250 mm girth expected in lifetime	557.0	6.5	0.13	5.0	Cluster of hazards
		8700.0003	Tree >= 250 mm girth expected in lifetime	934.0	0.16	0.16	4.5	Individual hazard

Girth of a Tree

For the purpose of the RRRAP, the girth (i.e. the perimeter) of a tree is taken to be the expected girth at maturity or within the life of the safety barrier and is measured at a height of 300 mm above ground level.

On steeply sloping ground, take the measurement on the uphill side. A girth of 250 mm equates approximately to a diameter of 80 mm.

Refer to TD 19 for further details.

What to do with Clusters of similar objects

If you have a cluster of similar hazards within say 10 m or 15 m distance, treat as one hazard, the length of the cluster. Give the width as the width of the widest single hazard in the cluster, and the offset of the nearest of the hazards to Psb. Pick the hazard description that describes at least one of the hazards in the cluster and returns the highest aggressiveness of the possible descriptions for the hazards in the cluster.

Figure 8-42 Trees details

Drop down menu for Nature of Hazard

Tree >= 250 mm girth expected in lifetime
Tree less than 250 mm girth expected in lifetime

If the tree or trees may grow to more than 250 mm in life, then it must be entered as Tree >= 250mm girth. If in doubt, assume it will.

Drop downs are given for trees that are both greater and less than 250 mm in girth. This is to allow clusters or groups of trees that are individually less than 250 mm girth expected in the life of the tree to be input, because as a group, they may present a sufficient hazard to warrant protection.

Hedges are not normally considered a hazard and there is no need to input details. However, the Designer should take note that there may be individual trees within the hedgerow that could pose a significant hazard to an errant vehicle; often these trees are relatively isolated within the length. Such trees should be entered into the RRRAP as individual trees of the appropriate size and offset (as a cluster if close together).

8.14 Water

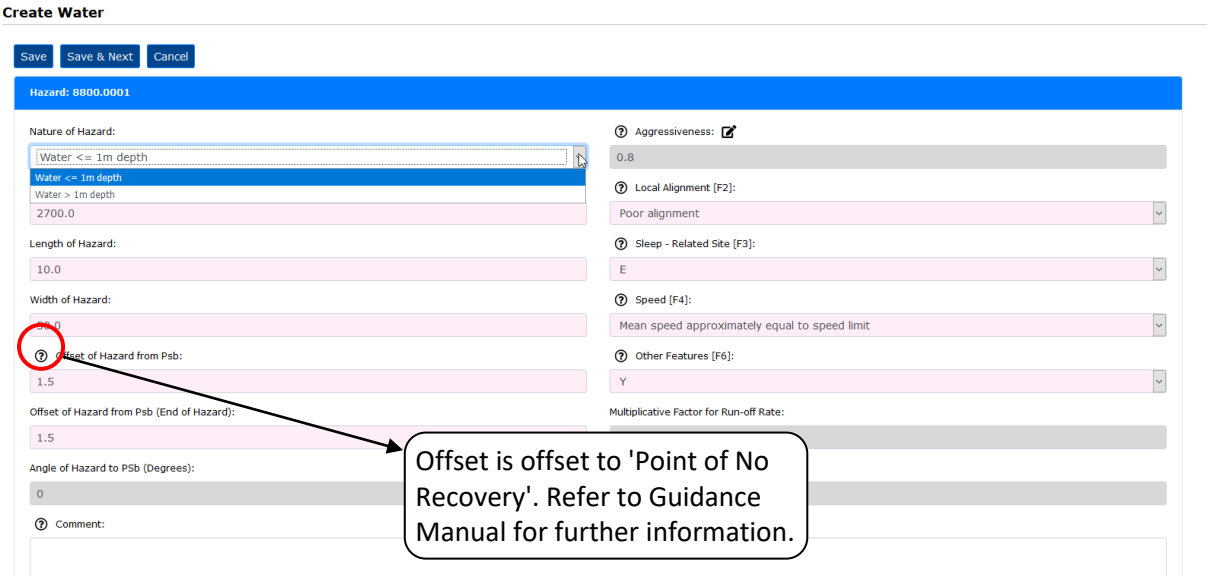


Figure 8-43 Water data entry

Include standing, running and tidal water hazards. Water hazards have been split into depth ranges (as indicated in Figure 8-43). Water that is not expected to exceed 250 mm in depth at any time need not be considered, unless it is close to the running lane and is considered likely to lead to skidding or aquaplaning of an errant vehicle.

8.14.1 Point of No Recovery for Adjacent Water situations

Point of No Recovery - Water

1. Where the road is on embankment or sidelong ground falling towards the body of water or there is a false cutting of height < 2.5 m prior to an embankment or sidelong ground that falls towards the body of water follow the 'Offset for Adjacent Road' and 'Point of No Recovery' helps for OH's Roads.
2. Where the road is nominally at grade, and the water hazard less than 15 m from Psb, take the offset to the water hazard as being the offset to the point of No Recovery of the water hazard itself (e.g. to the top of the bank or slope leading into the water hazard).

Figure 8-44 Point of No Recovery for Adjacent Water situation

8.15 Other Hazards – Railways

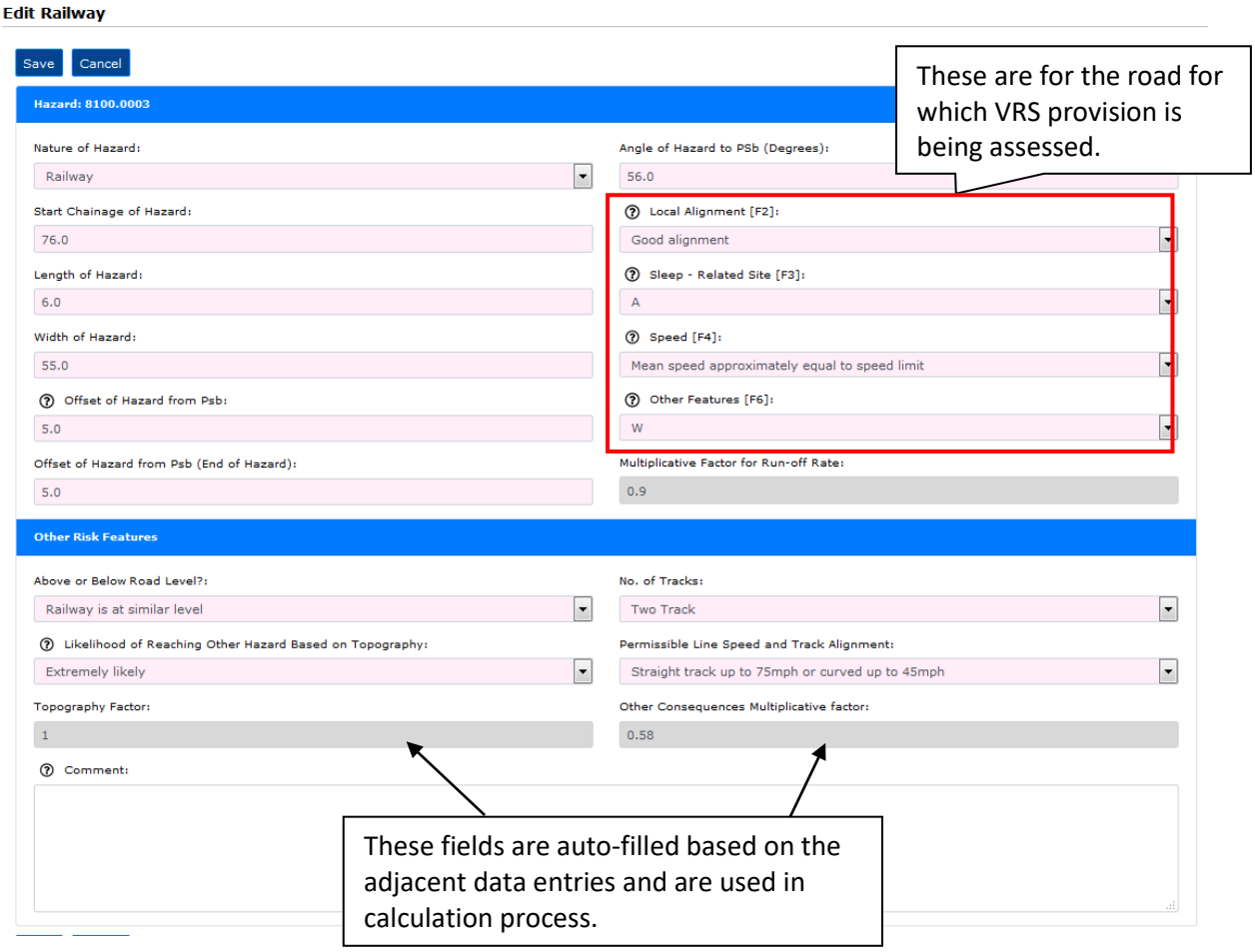


Figure 8-45 Record data entry

The various factors input on this page are used to calculate the length of need and containment level of the VRS (safety barrier and or parapet) to protect the railway based on the parameters that are entered into the RRRAP.

The various Railway specific help menus are shown on the next several pages.

Drop down lists for Permissible Line Speed and Track Alignment, and No of Tracks

Straight track up to 45mph
Straight track up to 75mph or curved up to 45mph
Straight track up to 90mph or curved up to 75mph
Straight track up to 100mph or curved up to 90mph
Straight track up to 125mph or curved up to 100mph
Straight track up to 140mph or curved up to 125mph
Straight track above 140mph or curved above to 125mph

Single track
Two Track
Multiple Track

8.15.1 **Likelihood of reaching the hazard**

The Designer must assess the circumstances and assess the likelihood of an errant vehicle reaching the hazard from the Point of No Recovery. Steeply sloping ground leading directly to the hazard will be easier to traverse than shallow sloping ground or a slope that is running at an angle to the hazard.

The following will reduce the likelihood of the hazard being reached, but may not prevent it being reached.

- A ditch more than 1 m deep and 3 m wide.
- Heavy vegetation, e.g. trees greater than 500 mm girth at spacings less than 2 m, but be aware, especially on Network Rail property, trees may be cut to reduce incidence of leaves and branches on the line.
- Shallow gradient, with rough ground
- Bunds or uphill gradients especially when near to the adjacent railway, where vehicle speeds are likely to be reduced.

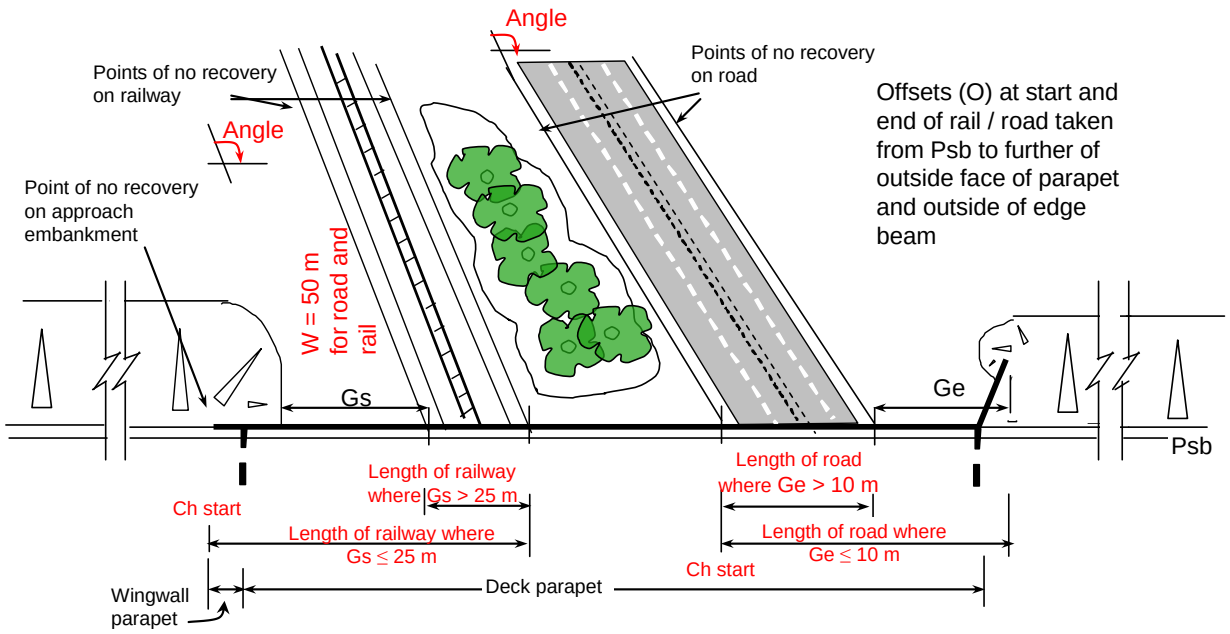
Likelihood of reaching?

Likelihood of reaching the Hazard Typical examples / combinations of situations	
Extremely likely	Slope leads directly to hazard; no intervening features to inhibit or divert vehicle passage; hazard very close.
Fairly likely	Slope tends towards hazard; intervening features may inhibit or divert passage; hazard near.
Reasonable chance	Intervening features may inhibit or divert passage, but might reach if travelling fast enough and no avoiding action.
Fairly unlikely	Intervening features make it difficult to reach; might reach in exceptional circumstances.
Cannot reach hazard	Intervening features that would prevent reaching.

The Designer must assess the circumstances and assess the likelihood of an errant vehicle reaching the hazard (i.e. the point of no recovery to the railway). Steeply sloping ground in advance of the point of no recovery will be easier to traverse than shallow sloping ground. The situations in the main parts of Figures Figure 8-47 & Figure 8-48 will make it more likely that the hazard will be reached than the situation in the inset diagrams where the railway is skewed away from the approaching vehicle and distance travelled is greater. On the structure itself, the likelihood of reaching is 'Extremely likely'.

It is recommended that the sensitivity of the outcome to changes in factor is looked at and a note regarding this is made in the hazard 'Comment' field.

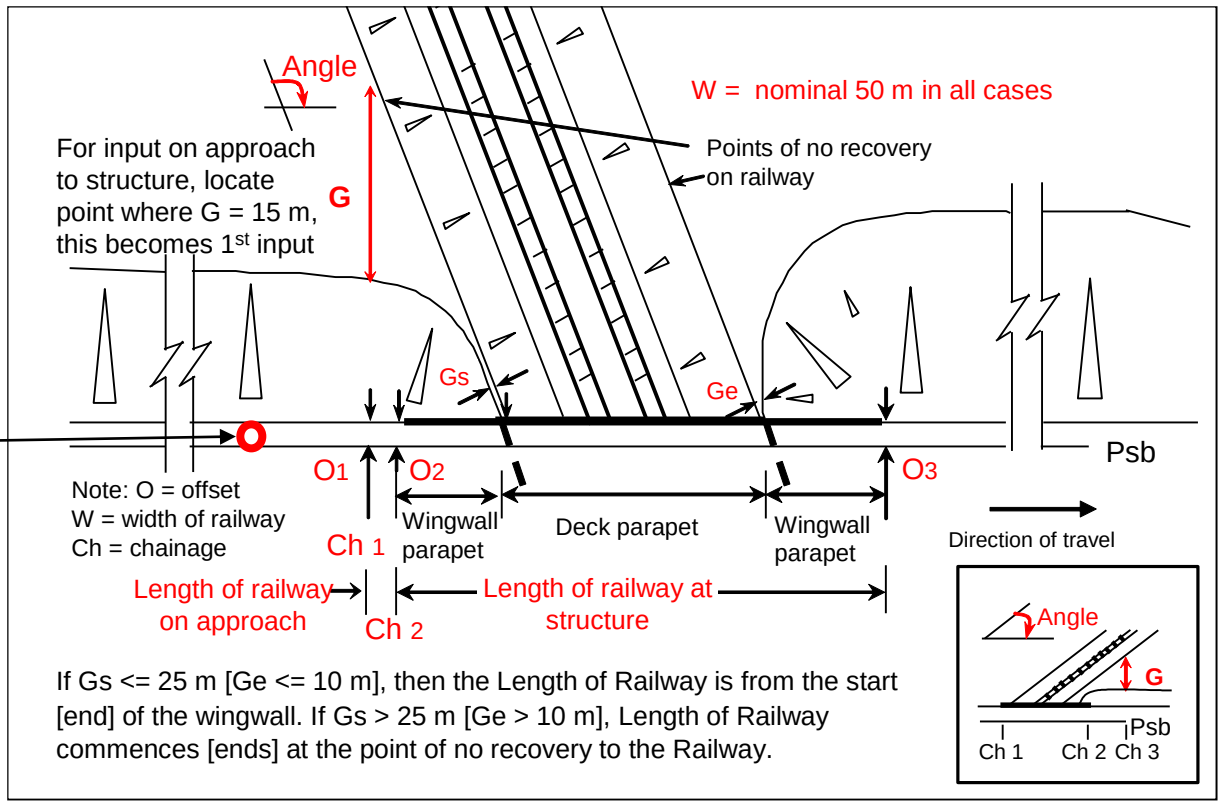
On the structure itself, the likelihood of reaching is 'Extremely likely'; on the approach to and departure from the structure the factor will change according to the factors outlined above. See also Figure 8-47 below.



In this example, if Gs ≤ 25 m then the Length of Railway is from the earlier of (i) the point of no recovery on approach embankment (ii) the start of the wingwall / deck [often (i) and (ii) are coincident]. If Gs > 25 m Length of Railway commences and ends at the point of no recovery to the Railway. If Ge ≤ 10 m, then Length of Road extends to later of (i) the point of no recovery on departure embankment and (ii) end of the wingwall / deck.

Figure 8-46 Viaduct with Railway and Road crossing under the Road

See also Section 8.10.4 of the Guidance for treatment and examples of inputs for long span structures such as viaducts that cross one or more hazards.



Verge may need to be widened locally to accommodate safety barrier on approaches to parapet. If so, ensure that 'H-S & Verge Widths' page reflects requirements.

Figure 8-47 Railway crossing under Road at structure with parallel wingwalls

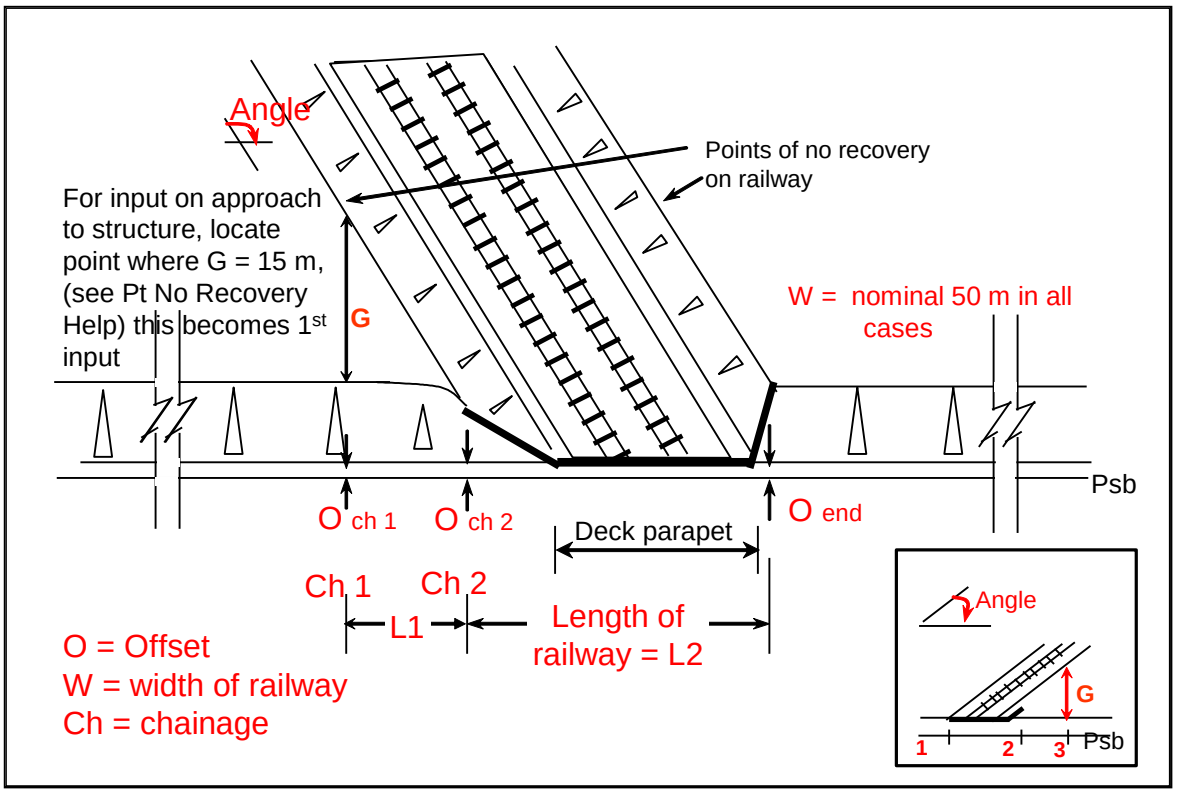


Figure 8-48 Railway crossing under Road at structure with splayed wingwalls

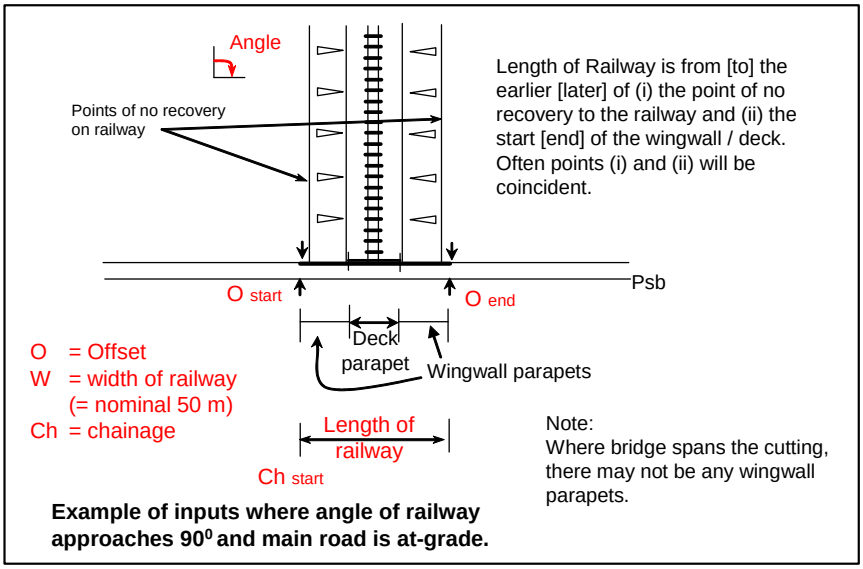
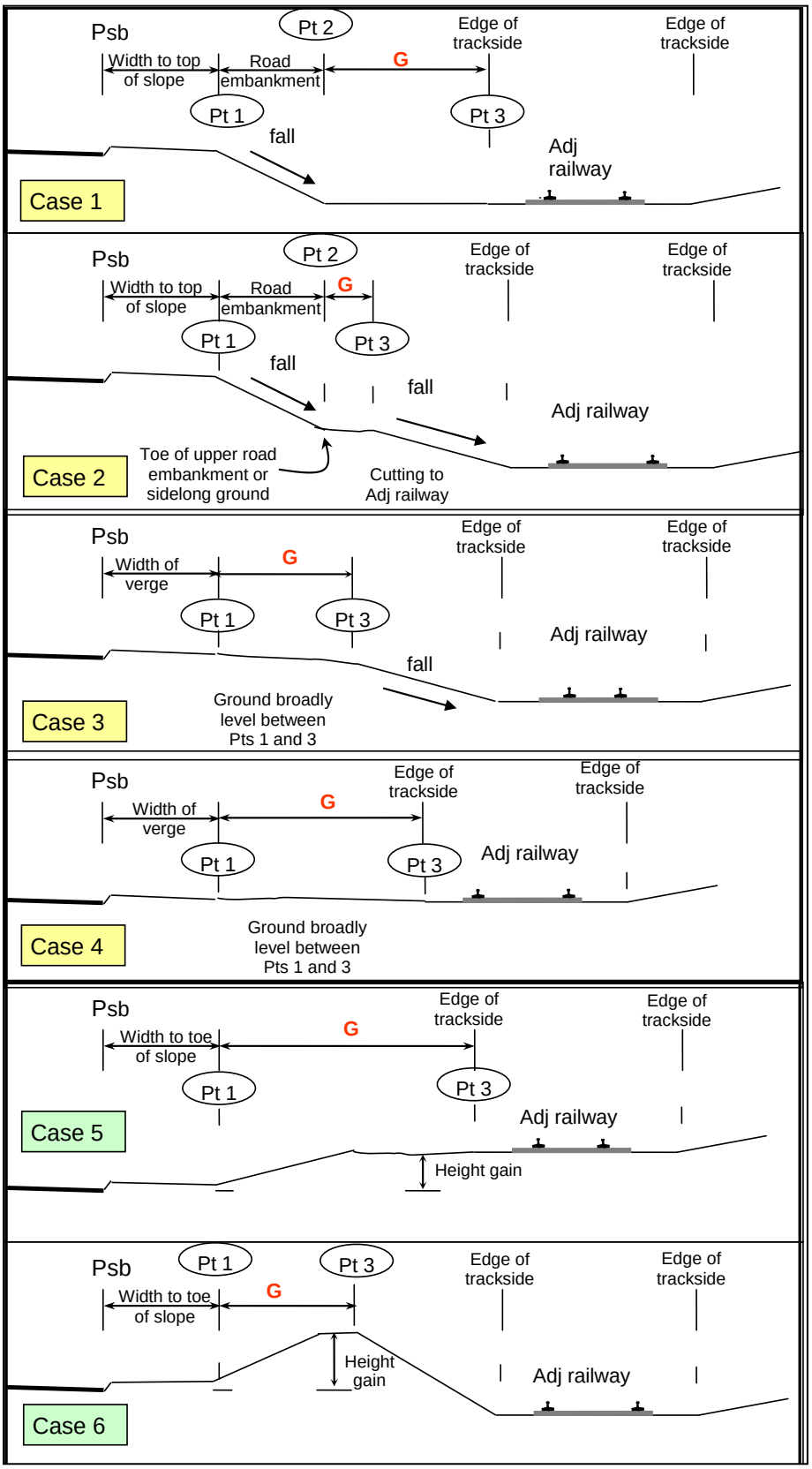


Figure 8-49 Railway crossing under Road where at-grade and or at 90 degrees



In cases 1 to 4 where G <= 15 m offset to railway becomes offset to Pt 1. (PNR = Pt 1).

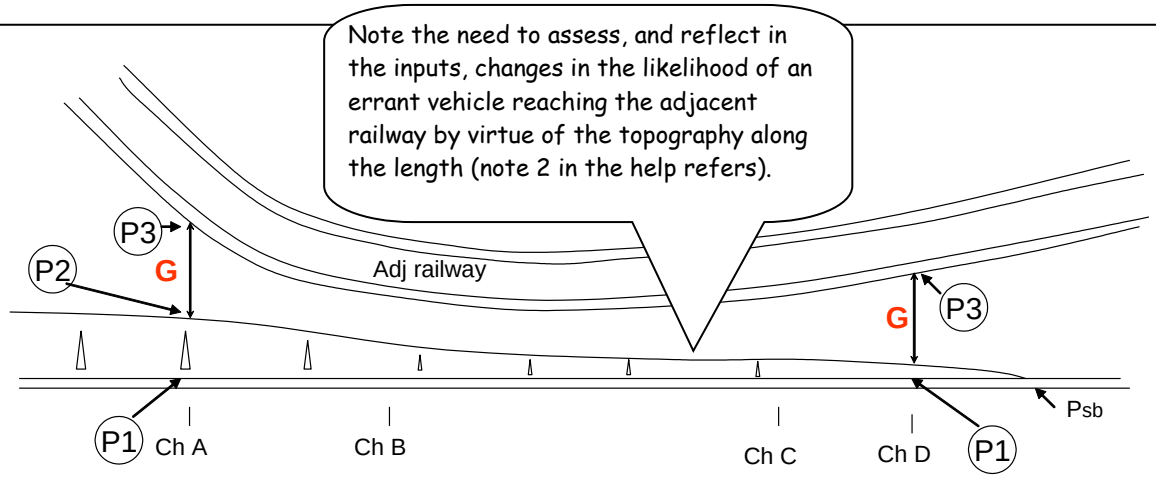
Where G> 15 m offset to railway becomes offset to Pt 3 (PNR = Pt 3).

PNR = Point of No Recovery

In cases 5 and 6 where G<= 15 m offset to railway (PNR) becomes closer of offset to P3, and
Pt 1 + 4x height gain.

Where height gain > 2.5 m and or G > 15 m no need to assess; add note in the hazard 'Comment' field to confirm this is the case.

Figure 8-50 Offset and Point of No Recovery for Adjacent Rail for Various Typical Scenarios



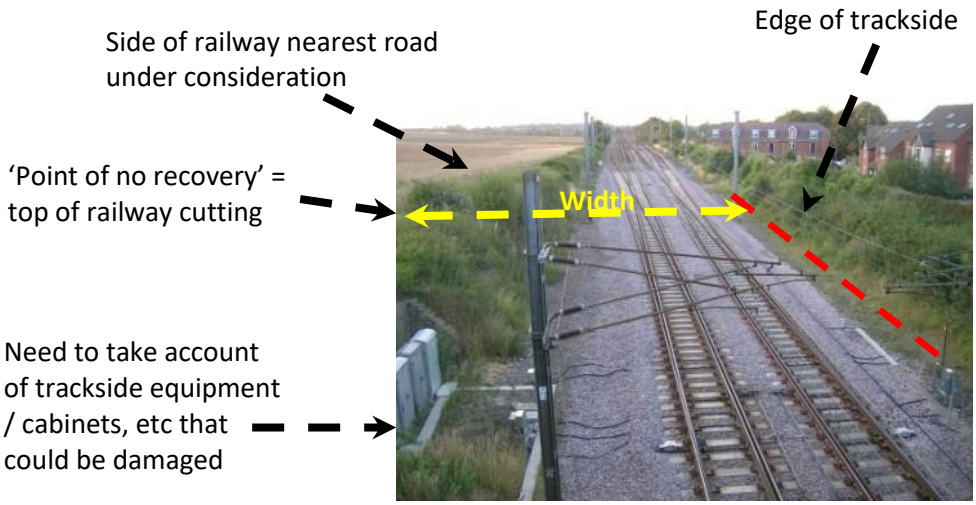
Notes

1. Essentially when G > 15 m, then Point of No Recovery is at P3; when G<= 15 m, then it is at P1. In this case if G = 15 m, the Point of No Recovery is at P1 from Ch A to Ch D and offset to the adjacent railway is offset to P1 over this length.
2. Over the length B to C, the 'Likelihood of reaching the adjacent railway based on topography' factor is probably the broadly the same. All other things being equal, the Likelihood of it being reached over the length A to B is likely to be higher and, over the length C to D, lower than this. Entries would therefore be required at each of the chainages A, B, C and D to ensure that the level of provision is appropriate.

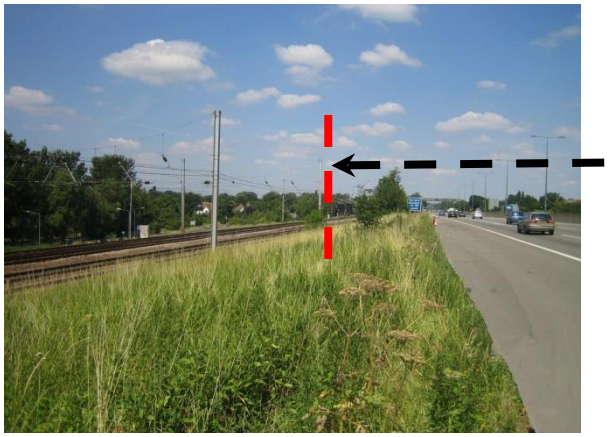
Illustration of Point of No Recovery (Case 1) and use of topography factors in plan.

Figure 8-51 Point of No Recovery for Parallel Road/ Rail situation

8.15.2 **Examples of 'Point of No Recovery'**



Example 1 – Railway in cutting



Example 2 – Railway adjacent to bottom of road embankment

If the railway is within 10 m of the bottom of such an embankment (shown in Example 2), the Point of no recovery should be regarded as the back of the road verge.

Example 3 – Railway adjacent to road at similar level

8.15.3 Mandatory TD 19 requirements and DfT assessments relating to Railways

Where a structure takes the road over or adjacent to a railway, the Designer must follow the mandatory requirements of TD 19, Paragraphs 4.5 to 4.7 and 4.10, and use the output from the RRRAP as a guide only. Furthermore the results of the assessments required under the DfT document "Managing the accidental obstruction of the railway by road vehicles", dated February 2003 and, where applicable for an existing parapet, IAN 97 must be taken into account in determining VRS and parapet requirements and other mitigation measures.

8.15.4 Additional note regarding parallel road / rail situations

In Section 2 of this Guidance, the way in which the RRRAP calculates requirements for VRS was outlined. At present the RRRAP cannot accurately determine the level of risk of a very long hazard, it looks at the level of protection required to protect the leading edge of the hazard at each of the various points along its length. Where the road and railway run close together over a long length, say in excess of 500 m, if the RRRAP indicates that N2 containment is required, it is worthwhile looking at the Detailed Risk results for each of the N2, H1 and H4a containment provisions, and forming a judgement on the merits of providing a higher containment. The outcome of such investigation should be recorded by retaining each of the Detailed Results outputs; details of the decision process can be added to the hazards "Comment" field. Note that when Other parties are involved, as in the case of railways, there will often be a reduction of risk level by providing a higher containment, though the benefit cost of so doing may be low. If the initial risk level is low, there will be little reduction in risk from using higher containments, and in some instances the level of risk will increase with the higher containment safety barrier, as it is a hazard in itself. It is also recommended that the sensitivity of the outcome to changes in factors is investigated to provide a level of assurance that the correct level of protection has been ascertained.

8.15.5 If H1 or H4a containment is required on embankments

If the RRRAP indicates that either H1 or H4a containment level safety barrier is required on the approach embankment, the default cost of the safety barrier must be checked and altered if appropriate. This is to ensure that it accurately reflects the actual cost of installing the safety barrier in this situation where special footings may be required and the correct benefit cost ratio is obtained in the Detailed Results reports.

8.16 Other Hazards – Roads

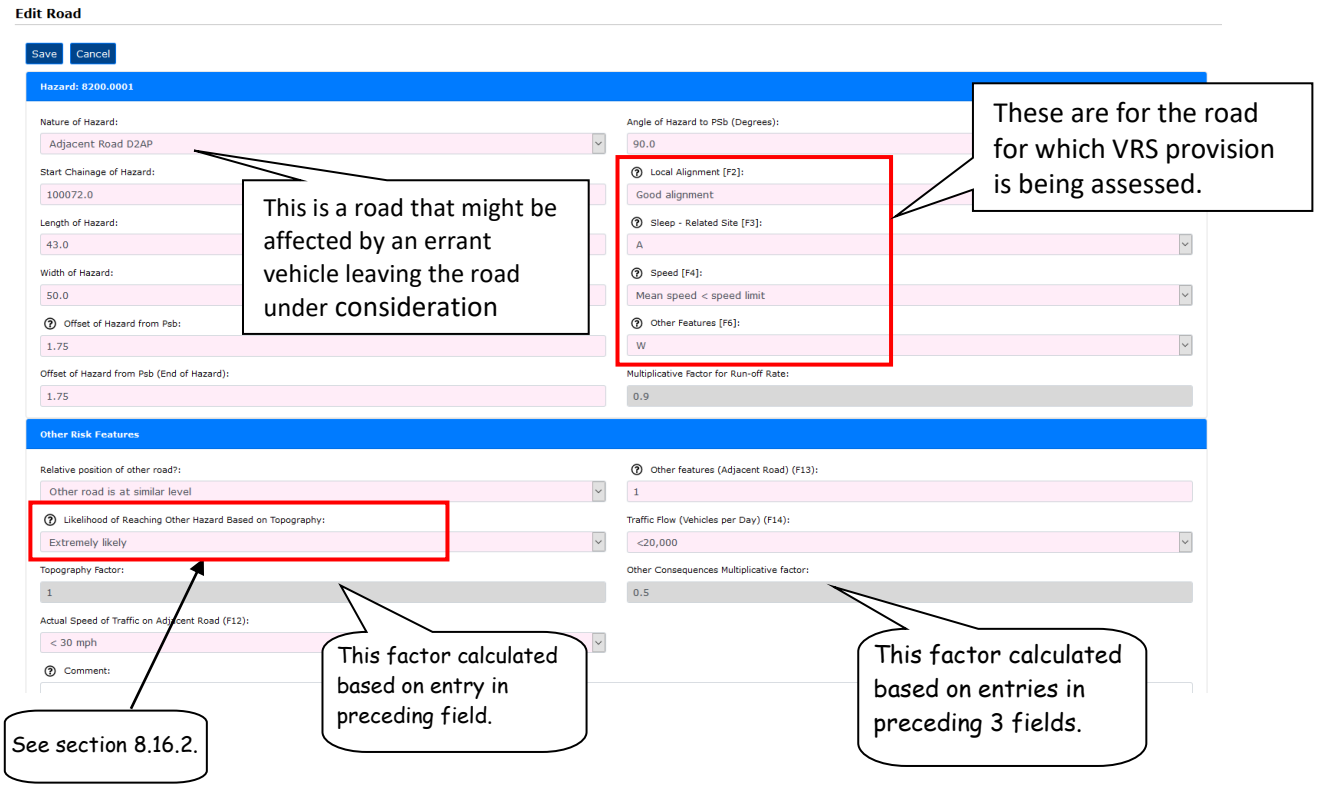


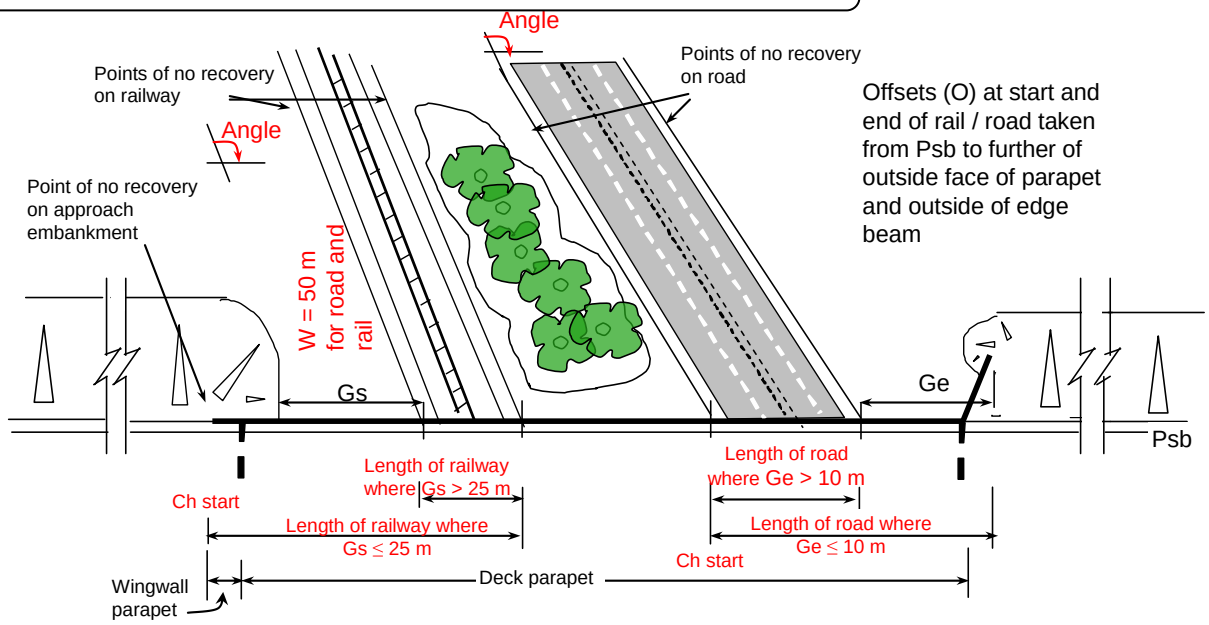
Figure 8-52 Road data entry

Drop down lists for Nature of Hazard

Adjacent Road	D2M
Adjacent Road	D3M
Adjacent Road	D4M
Adjacent Road	Smart Motorway (MM ALR or MM HSR)
Adjacent Road	Motorway Slip
Adjacent Road	Motorway Link
Adjacent Road	D2AP
Adjacent Road	D3AP
Adjacent Road	Single

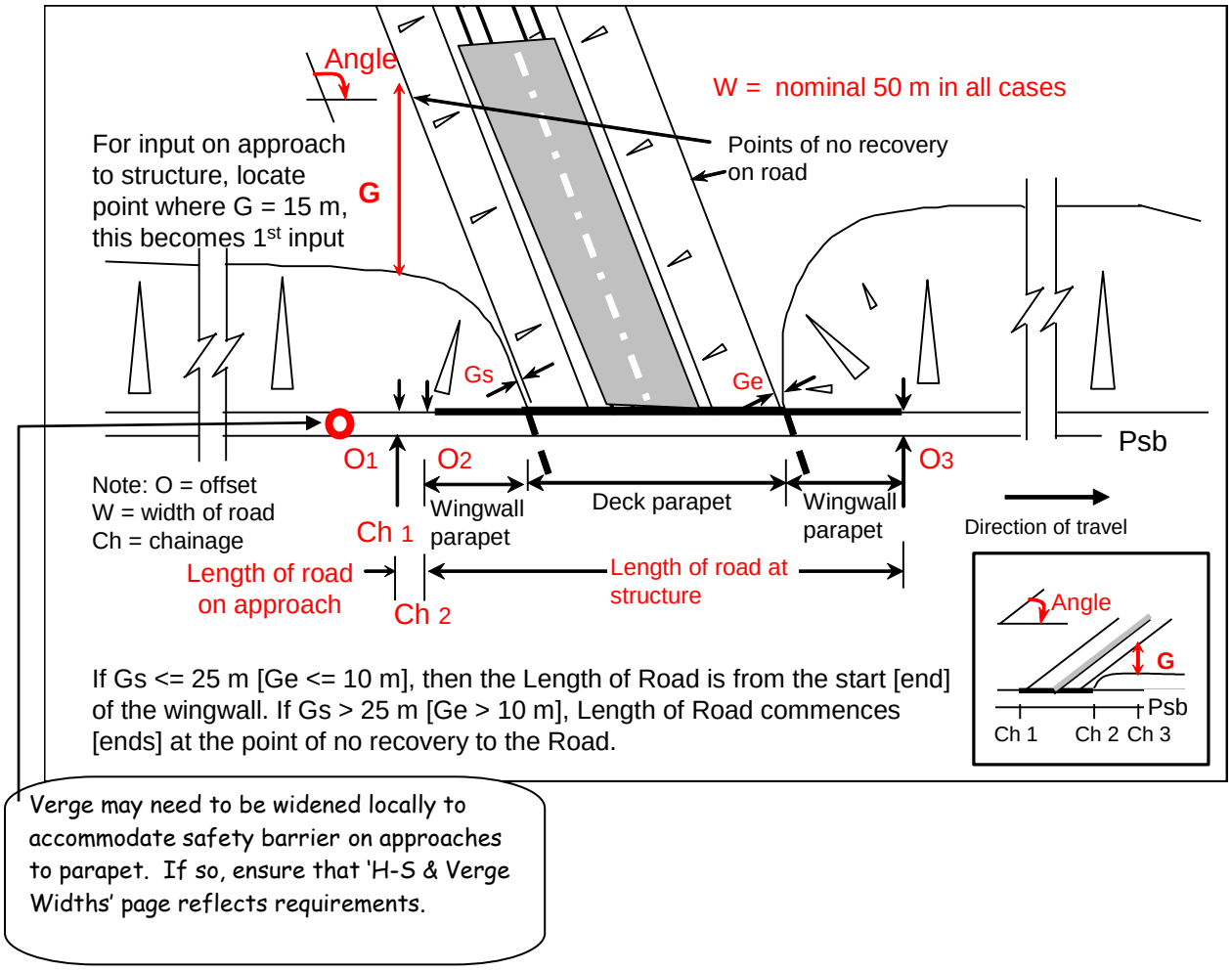
The various help menus available for Roads are shown on the following pages.

See also section 8.10 of the Guidance for treatment of long span structures such as viaducts that cross one or more hazards.



In this example, if Gs ≤ 25 m then the Length of Railway is from the earlier of (i) the point of no recovery on approach embankment (ii) the start of the wingwall / deck [often (i) and (ii) are coincident]. If Gs > 25 m Length of Railway commences and ends at the point of no recovery to the Railway. If Ge ≤ 10 m, then Length of Road extends to later of (i) the point of no recovery on departure embankment and (ii) end of the wingwall / deck.

Figure 8-53 Viaduct with Road and Railway crossing under the Road



Verge may need to be widened locally to accommodate safety barrier on approaches to parapet. If so, ensure that 'H-S & Verge Widths' page reflects requirements.

Figure 8-54 Road crossing under Road at structure with parallel wingwalls

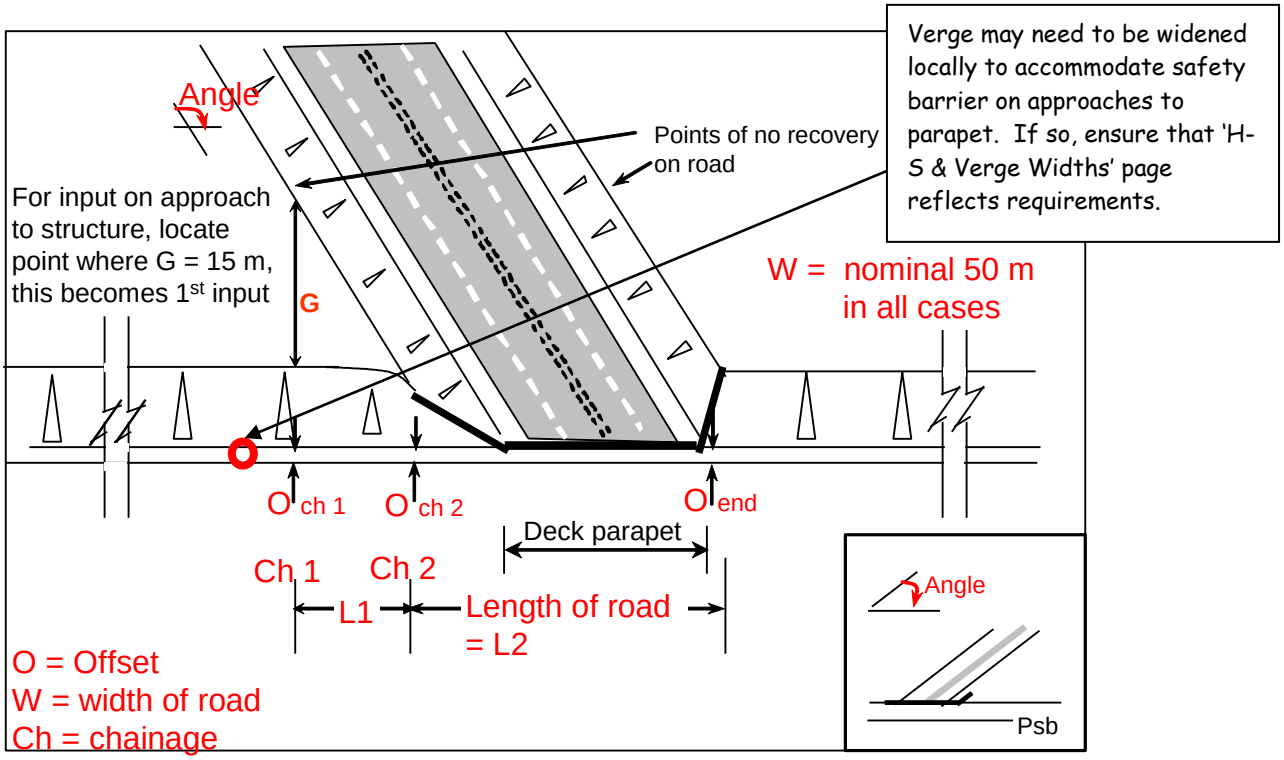


Figure 8-55 Road crossing under Road at structure with splayed wingwalls

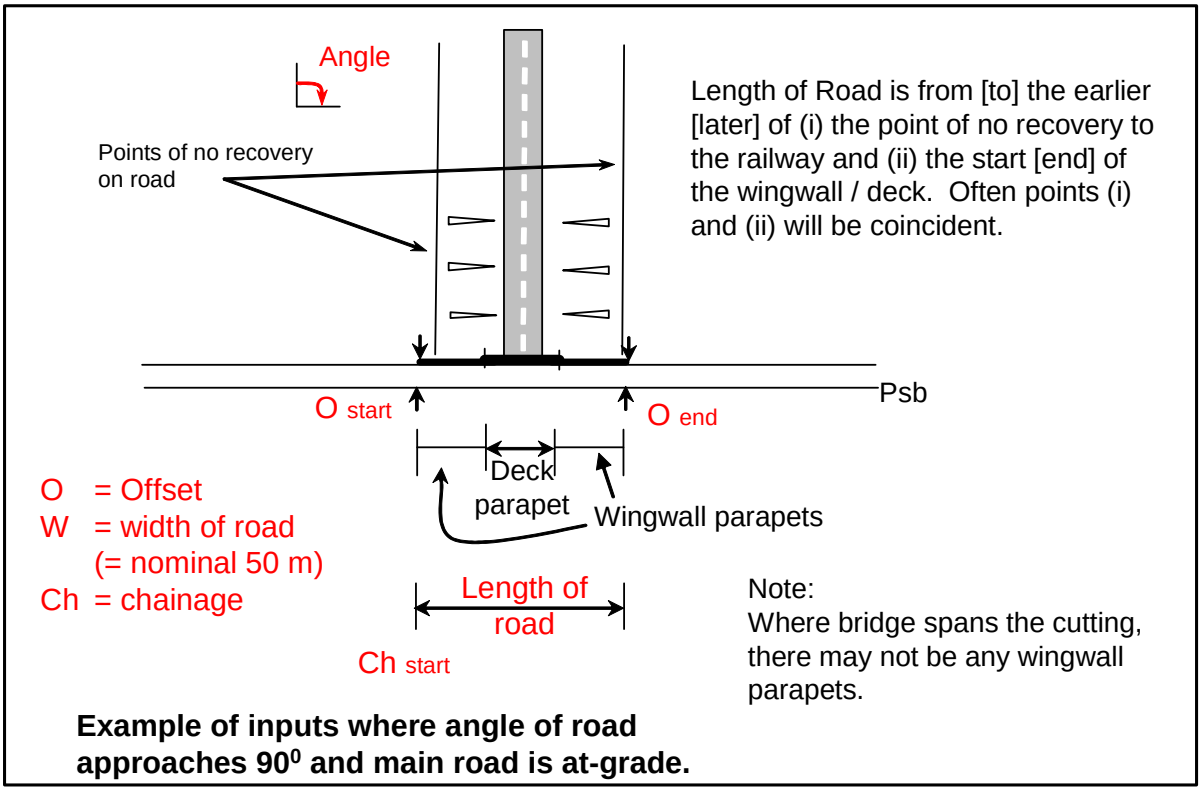
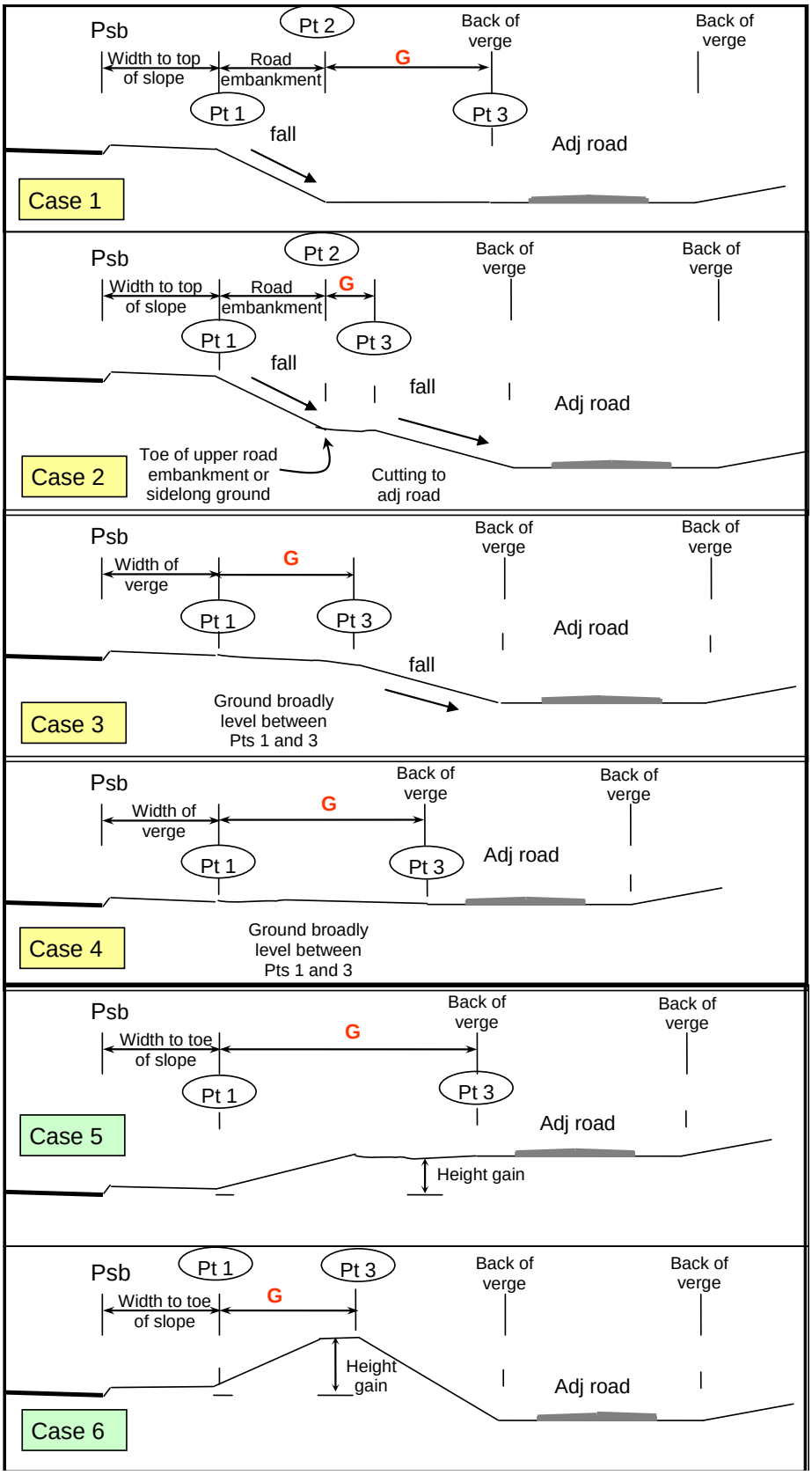


Figure 8-56 Road crossing under Road where at-grade and or at 90 degrees

8.16.1 Point of no recovery for adjacent road situation



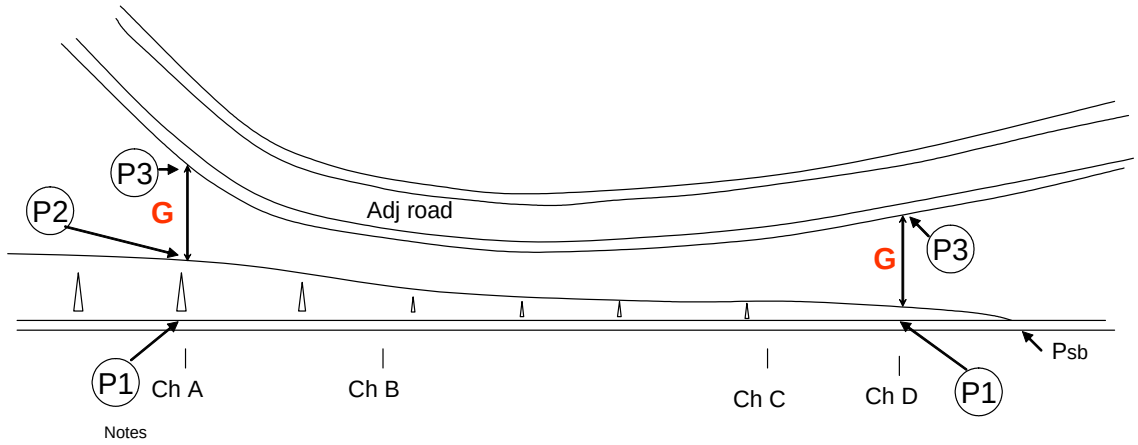
In Cases 1 to 4 where G <= 15 m offset to road becomes offset to Pt 1. (PNR = Pt 1).

Where G> 15 m offset to road becomes offset to Pt 3. (PNR = Pt 3).

In Cases 5 and 6 where G<= 15m, offset to road (PNR) becomes closer of offset to Pt 3 and Pt 1 + 4x height gain.

Where height gain > 2.5 m and or G > 15 m no need to assess; add note in the hazard 'Comment' field to confirm this is the case.

Figure 8-57 Offset and Point of No Recovery for Adjacent Road for Various Typical Cross-Section Scenarios



Notes

1. Essentially when G > 15 m, then Point of No Recovery is at P3; when G<= 15 m, then it is at P1. In this case if G = 15 m, the Point of No Recovery is at P1 from Ch A to Ch D and offset to the adjacent road is offset to P1 over this length.
2. Over the length B to C, the 'Likelihood of reaching the adjacent road based on topography' factor is probably the broadly the same. All other things being equal, the Likelihood of it being reached over the length A to B is likely to be higher and, over the length C to D, lower than this. Entries would therefore be required at each of the chainages A, B, C and D to ensure that the level of provision is appropriate.

Illustration of Point of No Recovery (Case 1) and use of topography factors in plan.

Figure 8-58 Point of No Recovery for Parallel Road situation - Typical plan

8.16.2 Likelihood of reaching the hazard

The Designer must assess the circumstances and assess the likelihood of an errant vehicle reaching the hazard from the Point of No Recovery. Steeply sloping ground leading directly to the hazard will be easier to traverse than shallow sloping ground or a slope that is running at an angle to the hazard.

The following will reduce the likelihood of the hazard being reached, but may not prevent it being reached.

- A ditch more than 1 m deep and 3 m wide.
- Heavy vegetation, e.g. trees greater than 500 mm girth at spacings less than 2 m, but be aware, trees may be cut to maintain clear zones or visibility or due to disease.
- Shallow gradient, with rough ground
- Bunds or uphill gradients especially when near to the adjacent railway, where vehicle speeds are likely to be reduced.

Likelihood of reaching?

Likelihood of reaching the Hazard Typical examples / combinations of situations	
Extremely likely	Slope leads directly to hazard; no intervening features to inhibit or divert vehicle passage; hazard very close.
Fairly likely	Slope tends towards hazard; intervening features may inhibit or divert passage; hazard near.
Reasonable chance	Intervening features may inhibit or divert passage, but might reach if travelling fast enough and no avoiding action.
Fairly unlikely	Intervening features make it difficult to reach; might reach in exceptional circumstances.
Cannot reach hazard	Intervening features that would prevent reaching.

It is recommended that the sensitivity of the outcome to changes in factor is looked at and a note regarding this is made in the hazard 'Comment' field.

On the structure itself, the likelihood of reaching is 'Extremely likely'; on the approach to and departure from the structure the factor will change according to the factors outlined above.

Site Specific Hazards Increasing Consequences of Event on the Adjacent Road

	1 way roads	Two-way roads
No hazards	Score 1	Score 1
Single Hazard	Score 3	Score 5
Two hazards	Score 5	Score 7
Three or more hazards / queuing	Score 7	Score 9

The hazards on the adjacent road leading to increased consequences could include the presence of pedestrians, road and or verge width (inability to avoid a vehicle blocking the road), poor or no lighting, reduced sight lines (e.g. bends or vegetation) and adjacent land use (e.g. housing, schools), likelihood of queues, etc.

Figure 8-59 Adjacent Road Hazard Marking

8.16.3 Note regarding parallel road situations

In Section 2 of this Guidance, the way in which the RRRAP calculates requirements for VRS was outlined. At present the RRRAP cannot accurately determine the level of risk of a very long hazard, it looks at the level of protection required to protect the leading edge of the hazard at each of the various points along its length. Where the adjacent road runs close together over a long length, say in excess of 500 m, if the RRRAP indicates that N2 containment is required, it is worthwhile looking at the Detailed Risk results for each of the N2, H1 and H4a containment provisions, and forming a judgement on the merits of providing a higher containment. The outcome of such investigation should be recorded by retaining each of the Detailed Results outputs; details of the decision process can be added in the hazards 'comment' field. Note that when Other parties are involved, as in the case of adjacent roads, there will often be a reduction of risk level by providing a higher containment, though the benefit cost of so doing may be low. If the initial risk level is low, there will be little reduction in risk from using higher containments, and in some instances the level of risk will increase with the higher containment safety barrier, as it is a hazard in itself. It is also recommended that the sensitivity of the outcome to changes in factors is investigated to provide a level of assurance that the correct level of protection has been ascertained.

Farm access tracks are unlikely to be sufficiently trafficked to pose a risk requiring vehicle restraint systems on the main road.

8.16.4 If H1 or H4a containment is required on embankments

Refer to Section 8.15.5 above.

8.16.5 Slip Roads in the vicinity of Nosings

In general a slip road will not pose a hazard to traffic on the main carriageway and a main carriageway will not pose a hazard to traffic on a slip road. This is the case as long as the two flows of

traffic are running more or less parallel and in the same general direction. Where the alignments start to converge to produce a situation where the traffic is flowing towards each other, then it may become a significant hazard and should be entered into the RRRAP. Figure 8-60 below illustrates a typical situation.

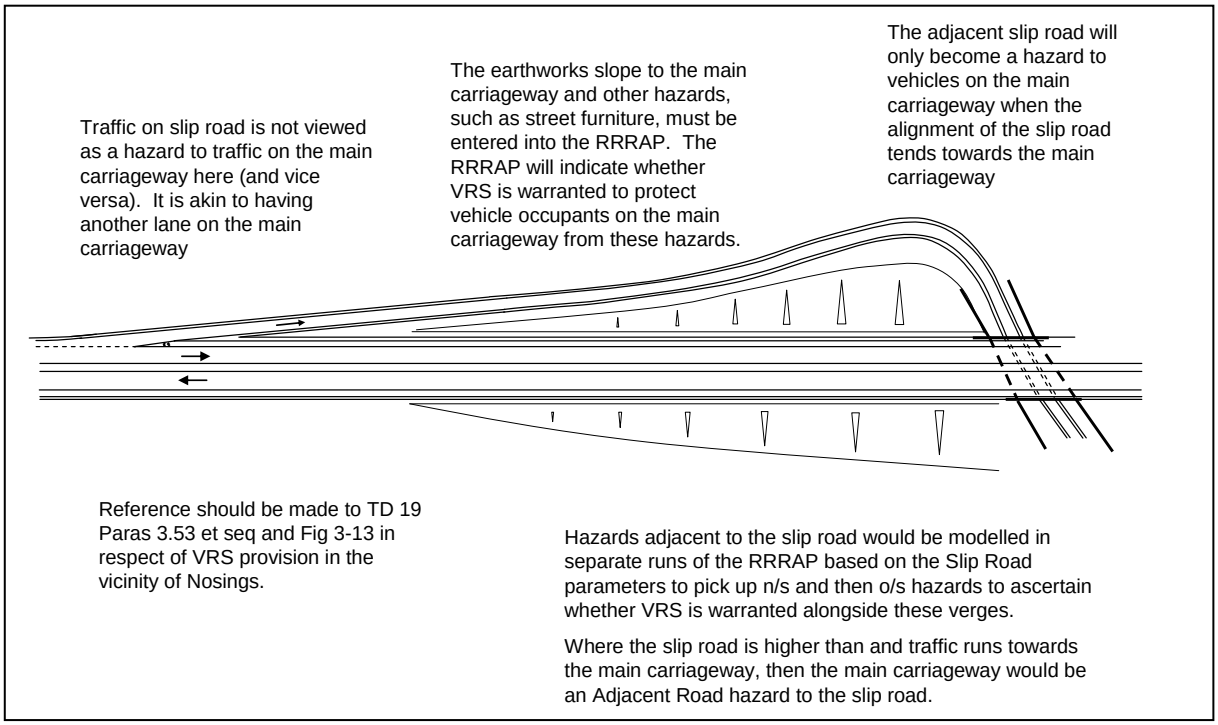


Figure 8-60 When a Slip Road is viewed as a Hazard, and when it isn't.

8.17 Other Hazards Buildings and also Other Hazards – Chemical or Fuel

Create Public building or place where people congregate

Save | Save & Next | Cancel

Hazard: 8300.0001

Nature of Hazard: Public building	Aggressiveness: 1.3
Start Chainage of Hazard: 0.0	Local Alignment [F2]: Good alignment
Length of Hazard: 4.0	Sleep - Related Site [F3]: A
Width of Hazard: 6.0	Speed [F4]: Mean speed approximately equal to speed limit
Offset of Hazard from Psb: 9.5	Other Features [F6]: X
Description of Vulnerable Wall: Building Wall	Multiplicative Factor for Run-off Rate: 0.91

Other Risk Features

Likelihood of Reaching Other Hazard Based on Topography: Fairly likely	Average Time Each Person is Exposed to Risk (Hours per Year): 2000
Topography Factor: 0.75	Total Number of People at Risk: 0.46
Average Number of People Exposed to Risk: 2	Other Consequences Multiplicative factor: 1

Comment:

Likelihood reaching hazard

Likelihood of reaching the Hazard Typical examples / combinations of situations	
Extremely likely	Slope leads directly to hazard; no intervening features to inhibit or divert vehicle passage; hazard very close.
Fairly likely	Slope tends towards hazard; intervening features may inhibit or divert passage; hazard near.
Reasonable chance	Intervening features may inhibit or divert passage, but might reach if travelling fast enough and no avoiding action.
Fairly unlikely	Intervening features make it difficult to reach; might reach in exceptional circumstances.
Cannot reach hazard	Intervening features that would prevent reaching.

Number of people at risk

It is the responsibility of the user to estimate the number of people exposed to risk of injury from an errant vehicle. This will depend on whether people are at risk only from the direct impact, or from possible subsequent explosion or building collapse which would affect a wider area.

Estimates should reflect not only the number of people in the area likely to be affected, but also the time they are in the building i.e. if 3 people were anticipated to be in the path of the direct impact, but only for 8 hours per day, then on average only 1 person would be at risk in any particular impact.

Usually, only a relatively small area of a building will be affected by the direct impact, and only some of those at risk will sustain serious injuries. In the absence of better information, the number of people assumed to be at risk from an impact by a car should be 1 for a house, 5 for an office building, 10 for a large block of flats, 3 for a restaurant, 5 for fuel or chemicals. If the building is expected to be occupied for 24 hours rather than just the working day, the number at risk should be increased proportionately.

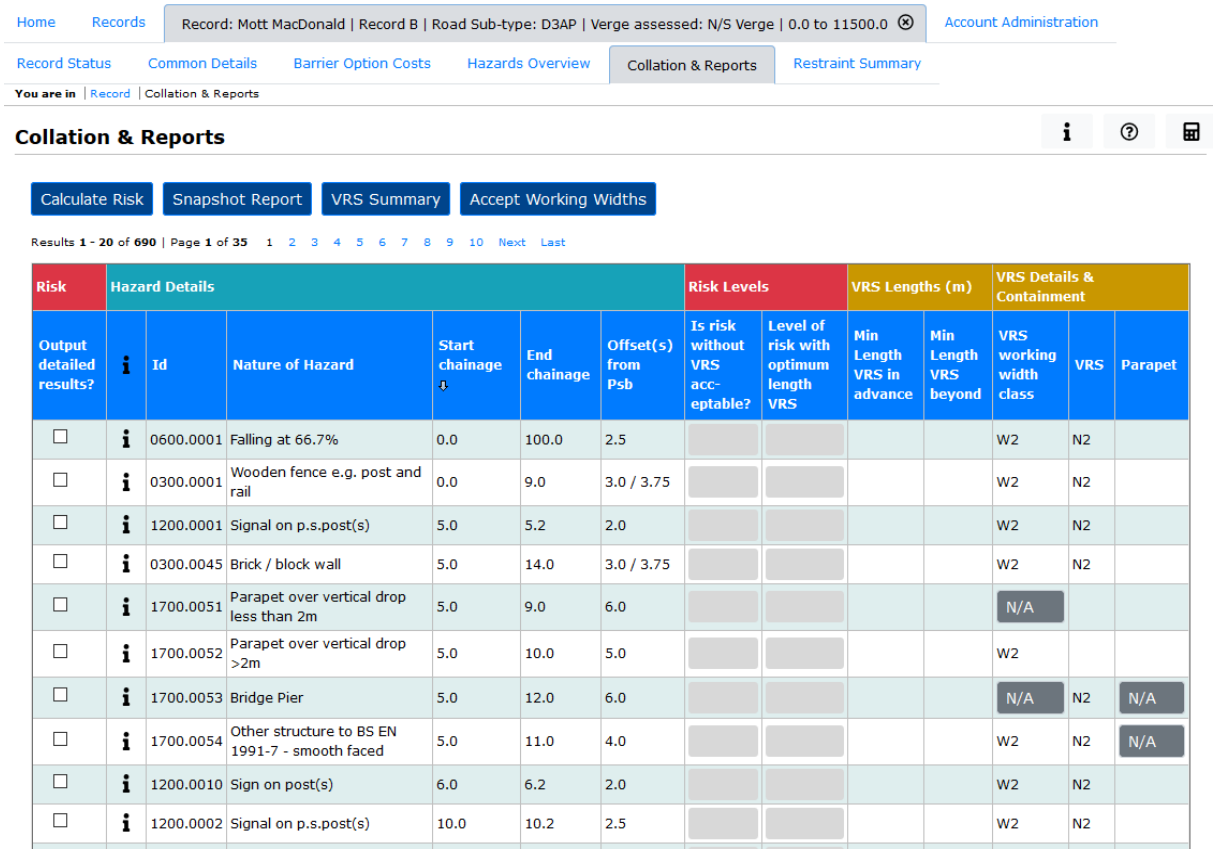
If a public building is likely to be less resistant to impact, or the impact might be particularly severe, as for example with a vehicle leaving a flyover and falling onto a building, the number at risk should be increased. Users should assume the outcome for impact by a car.

Figure 8-61 Building data entry

9 Collation of Data on Hazards, Calculation of Risk and Detailed Results

9.1 Hazard Collation

All hazard data previously entered via 'Hazards Overview' page (see section 7) is automatically collated and listed on the 'Collation & Reports' page (shown in Figure 9-1), except for Kerb and Verge hazards.



Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Falling at 66.7%	0.0	100.0	2.5					W2	N2	
☐	i	0300.0001	Wooden fence e.g. post and rail	0.0	9.0	3.0 / 3.75					W2	N2	
☐	i	1200.0001	Signal on p.s.post(s)	5.0	5.2	2.0					W2	N2	
☐	i	0300.0045	Brick / block wall	5.0	14.0	3.0 / 3.75					W2	N2	
☐	i	1700.0051	Parapet over vertical drop less than 2m	5.0	9.0	6.0					N/A		
☐	i	1700.0052	Parapet over vertical drop >2m	5.0	10.0	5.0					W2		
☐	i	1700.0053	Bridge Pier	5.0	12.0	6.0					N/A	N2	N/A
☐	i	1700.0054	Other structure to BS EN 1991-7 - smooth faced	5.0	11.0	4.0					W2	N2	N/A
☐	i	1200.0010	Sign on post(s)	6.0	6.2	2.0					W2	N2	
☐	i	1200.0002	Signal on p.s.post(s)	10.0	10.2	2.5					W2	N2	

Figure 9-1 Collation & Reports page

By default the hazards are listed by increasing chainage order. If you wish to view the hazards in a different order (if for instance the Section is in decreasing chainage order), click the table headings to alter hazard ordering (see section 2.4.10).

To view and edit a hazard, click on a row in the table (see section 9.3).

To calculate risk, click the 'Calculate Risk' button (see section 9.4).

To generate a summary report that contains information on all the hazards in the record and all hazard detailed results that are available, click the 'Snapshot Report' button (see section 9.7).

To view VRS Summary details, click the 'VRS Summary' button (see section 11).

To accept the current barrier working width class when an alternative has been suggested, click the 'Accept Working Width' button (see section 2.10.6).

9.2 Overview of Collation of Data on Hazards

Prior to pressing the 'Calculate Risk' button, the 'Collation & Reports' page looks as in Figure 9-2.

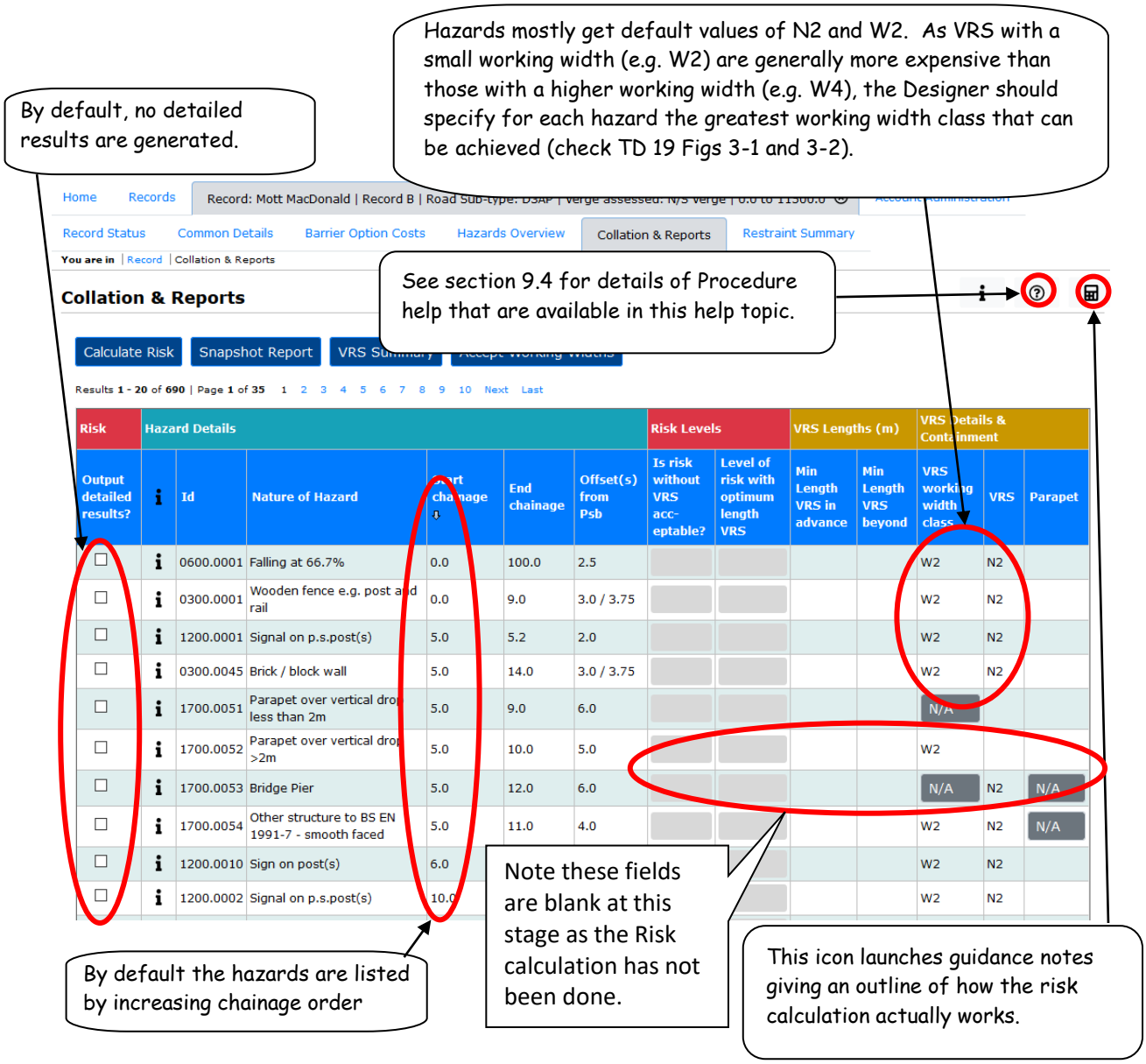


Figure 9-2 Collation & Reports page before calculating risk

By default, no detailed results are generated for hazards. For more details see section 9.5.

9.3 View and Edit Hazards

Clicking on a row in the table on the 'Collation and Reports' page will display a page showing all the values associated with the hazard, including both the original data entered to define the hazard and any data generated via the risk calculation. From here, clicking the Edit button will allow you to modify the hazard.

In Figure 9-3 below,

1. The original data entered via the 'Hazards Overview' page to define the hazards in the section being assessed is displayed initially.
2. If the hazard could give rise to a significant secondary incident, after calculating risk the user can indicate whether the risk level is accepted in this section.
3. Risk levels and VRS Details. Values are populated by running the risk calculation. Some of these values can be altered when investigating different options to protecting a hazard, e.g. altering working width class, barrier containment, or barrier set-back.

Important Note – Saving Common Details

In the RRRAP web application, there is only one set of data that represents a hazard. If you edit a hazard via the 'Hazards Overview' page or via the 'Collation & Reports' page, you are editing the same underlying hazard data. This differs from previous versions of the RRRAP spreadsheet.

Before starting to edit hazards to determine optimal risk levels and barrier requirements, you may wish to either export a copy of the record (see section 4.4) or generate a full report to capture a copy of the original data entered (see section 11.3).

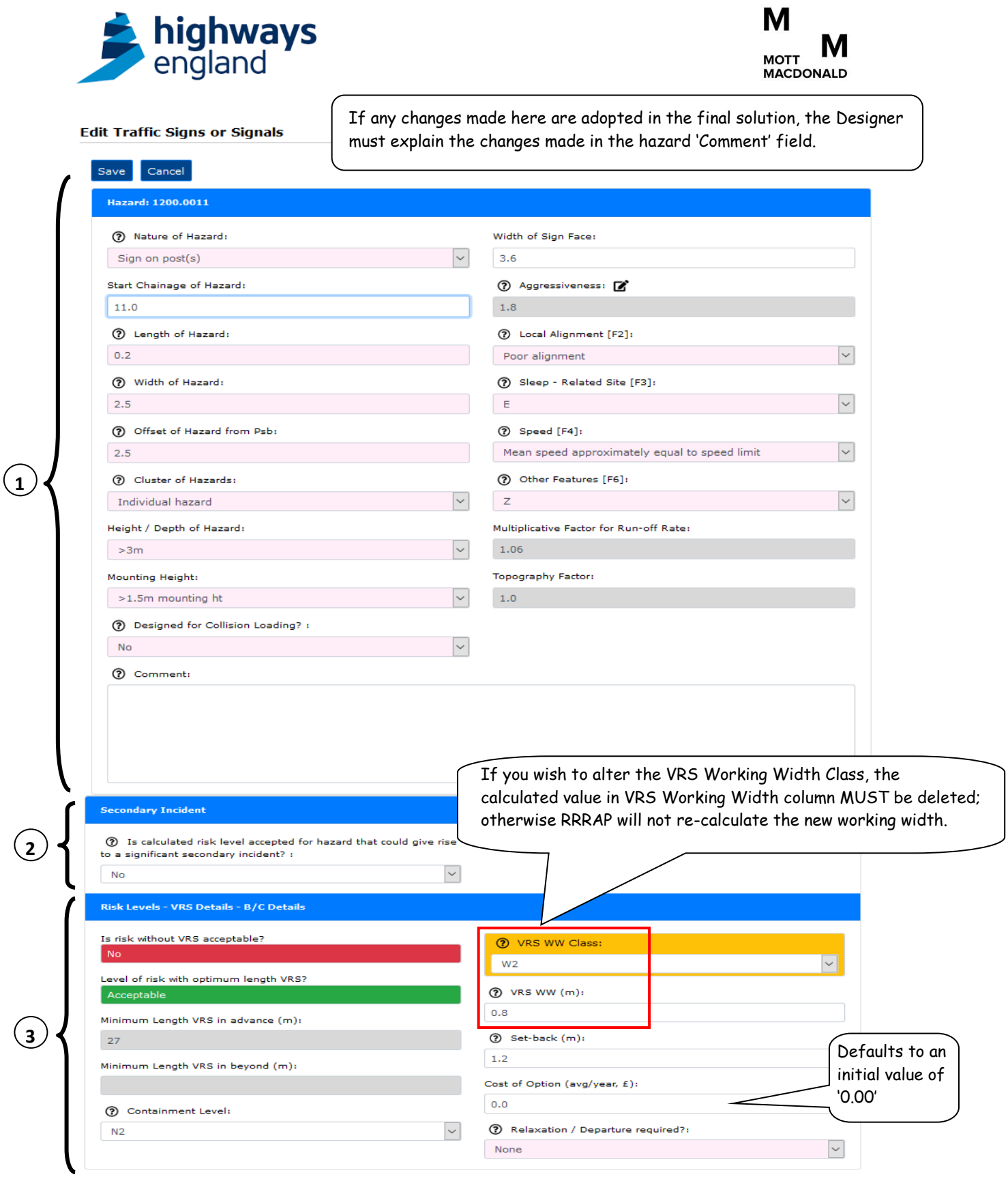


Figure 9-3 Edit a hazard via the 'Collation and Report' page

9.4 Calculation of Risk

9.4.1 Procedure Help

When entering the 'Collation and Reports' page, the hazards are listed in increasing chainage order. This ordering can be changed by clicking on the column headers.

If the risk calculation has never been performed for this record or there are hazards that have been added since the last time risk was calculated then there will be no details relating to the level of risk or safety barrier requirements other than the default barrier containment N2 and working width class W2.

Calculate Risk button
When the 'Calculate Risk' button is pressed, the RRRAP automatically calculates the risk level due to the presence of each hazard. If the level of risk without provision of VRS is 'acceptable', a 'Yes' is displayed in the 'Is risk without VRS acceptable?' column and no VRS or safety barrier details are given in the columns further to the right. If however, the level of risk without VRS is 'unacceptable', a 'No' will be returned and, in the column to the right, it will indicate whether the level of risk with optimum length VRS having the default N2 containment level is 'Acceptable', 'Tolerable', or 'Unacceptable'.

If 'Acceptable' has been returned, the RRRAP will indicate the minimum length of need of safety barrier in advance of the object that will give an acceptable level of risk. Note that Paragraphs 3.26 et seq. and Table 3-1 of TD 19 may require a longer minimum length be actually provided.

Re-calculating Risk
Once risk has been calculated for all hazards, subsequent runs of the risk calculation will in general only calculate risk for those hazards that have been edited, added, or now require the generation of Detailed Results. The following are exceptions to this and will cause the RRRAP to re-calculate risk for all hazards:

- Edit the record Common Details
- Add, edit or delete an Earthwork hazard
- Add, edit or delete a Hard shoulder and Verge Width hazard

Detailed Risk and Benefit Cost Results
The Designer is then able to review the detailed risk and cost benefit results for any one or all of the hazards. For the hazards to be looked at in more detail, this is done by clicking the checkbox in the 'Output detailed results?' column - which should now show a tick. In practice, situations where the risk level is acceptable without VRS and where the risk level with N2 containment VRS is acceptable are unlikely to warrant further investigation, leaving just those entries for which the risk is 'Tolerable' or 'Unacceptable' to be looked at.

Having put a tick in the checkbox in the 'Output detailed results?' column, press the 'Calculate Risk' button. Once the calculation has completed, an icon will appear in the 'Output detailed results?' column for each hazard that has a Detailed Results to view. Clicking the icon will display a dialog that will ask if you wish to open or save a PDF file. This contains the Detailed Results. See section 9.5 for more details.

Changing Containment Level
Where the risk is either 'Tolerable' or 'Unacceptable', the Designer can investigate the effect of changing the containment level of the safety barrier from N2 to either H1 or H4a. Click on a row in the table on the collation page to view the hazard and then click the edit button to edit the hazard details. In the edit page, change the barrier containment level. Save the altered hazard. Back on the 'Collation & Reports' page, when the 'Calculate risk' button is pressed, the RRRAP will calculate the new risk level with the optimum length of VRS.

Changing other parameters in the Collation of Data worksheet
The designer can edit hazards via the 'Collation & Reports' page by clicking on a row in the table to view the hazard and then click the edit button to edit the hazard details. The Designer can edit any hazard values at this point. When modifying hazards due to results from the risk calculation, fields traditionally focused on include safety barrier set-back, working width class, offset of hazard, etc.

If, based on the data in the 'Detailed Results' output, the Designer proposes to use a VRS length in advance of the hazard that is different from the minimum proposed, the proposed length and the reasoning for the difference must be added to the hazards 'Comment' field. This can be done by editing the hazard via the collation page (click a row in the table to view the hazard and then click the edit button). Similarly with any other changes that are made, such as to working width class, additional notes should be added to the hazards 'Comment' field.

Working Width Classes
Safety barriers with smaller working widths are generally more expensive than those with larger working widths. It is therefore important that the Designer checks and specifies the greatest working width class that can practicably be achieved in the circumstances taking into account the requirements of set-back of the safety barrier, the location of the hazard and of other hazards adjacent to it, and the minimum distances to top or toe of slope (TD 19 Figures 3-1, 3-2 and 3-4 refer).

To help highlight which hazards have a potential alternative VRS working width, when risk is calculated for the hazard, if an alternative VRS working width class is possible, RRRAP will highlight the working width class cell in tables (see section 2.10.6 for more detail). The Designer should check and specify the greatest VRS working width class that can practicably be achieved for each of these hazards.

9.4.2 Risk Calculation Issues

If there are any issues that occur during the risk calculation, these are displayed on the 'Risk Calculation Issues' page shown once the risk calculation process has completed (an example is shown in Figure 9-4).

See sections 2.10.3 and 9.6.1 for more details on the types of messages that can appear here.

If no changes are made to the record data, then clicking the 'Calculate Risk' button again on the 'Collation and Reports' page will not re-calculate risk for any hazards, but the Risk Calculation Issues page will be re-displayed if there are any existing issues.

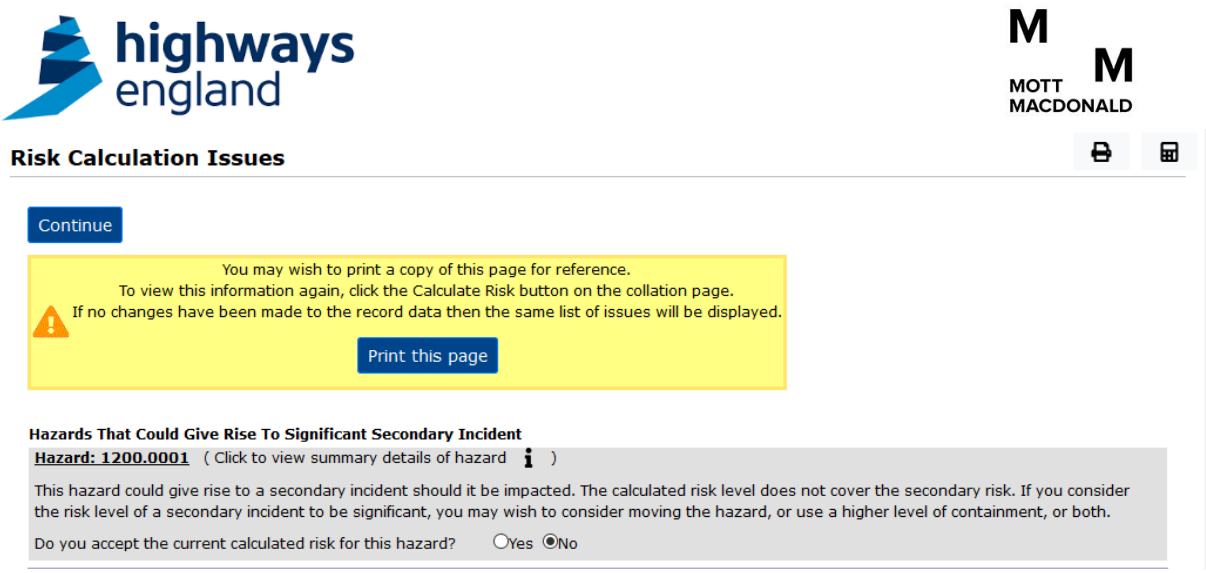


Figure 9-4 Risk Calculation Issues page

9.4.3 Risk Calculation Results

Pressing the 'Calculate Risk' button for the first time automatically calculates whether the risk level at the hazard is acceptable without VRS protection, displaying the information in the 'Collation & Reports' page. If it is not, the risk level with the optimum length of N2 containment level VRS in advance of the hazard is shown as either 'Acceptable', 'Tolerable', or 'Unacceptable'. For single carriageways only, the optimum length of VRS beyond the hazard is also reported.

highways england

MOTT MACDONALD

Home | Records | Record: Mott MacDonald | Record B | Road Sub-type: D3AP | ...ministration

Record Status | Common Details | Barrier Option Costs | Hazards Overvie...

You are in | Record | Collation & Reports

When Single c/way, this column may also contains results

Collation & Reports

Calculate Risk | Snapshot Report | VRS Summary | Accept Working Widths

Results 1 - 20 of 690 | Page 1 of 35 1 2 3 4 5 6 7 8 9 10 Next Last

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Falling at 66.7%	0.0	100.0	2.5	Yes						N/A
☐	i	0300.0001	Wooden fence e.g. post and rail	0.0	9.0	3.0 / 3.75	Yes						N/A
☐	i	1200.0001	Signal on p.s.post(s)	5.0	5.2	2.0	Yes						N/A
☐	i	0300.0045	Brick / block wall	5.0	14.0	3.0 / 3.75	No	Acceptable	5		W2	N2	N/A
☐	i	1700.0051	Parapet over vertical drop less than 2m	5.0	9.0	6.0	N/A	N/A	N/A	N/A	N/A	N/A	N2
☐	i	1700.0052	Parapet over vertical drop >2m	5.0	10.0	5.0	N/A	N/A	N/A	N/A	W2	N/A	H2
☐	i	1700.0053	Bridge Pier	5.0	12.0	6.0	No	Acceptable	5		N/A	N2	N/A
☐	i	1700.0054	Other structure to BS EN 1991-7 - smooth faced	5.0	11.0	4.0	No	Acceptable	40		W2	N2	N/A

Here the first hazard [0600.0001] does not require VRS protection.

The fourth hazard, Brick / block wall, requires 5 m of N2 barrier in advance to give an acceptable level of risk. The level of risk brought about by vehicles approaching from the other direction is acceptable with no VRS provided.

In practice the minimum length required by TD 19 para 3.26 et seq. must be provided in advance of and beyond the hazard.

Figure 9-5 Hazards and their protection requirements

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Falling at 50%	200.0	224.0	2.5	No	Acceptable	39		W2	N2	N/A
☐ i	i	1200.0001	Sign on gantry	210.0	215.0	2.0	No	Refer to TD 19				H4A	N/A

Figure 9-6 Typical output for Sign on Gantry

Safety barrier containment and length for Gantry is determined by TAA or TD 19 requirements rather than through the RRRAP.

Collation & Reports

Calculate Risk | Snapshot Report | VRS Summary | Accept Working Widths

Results 261 - 280 of 690 | Page 14 of 35 First Previous 9 10 11 12 13 14 15 16 17 18 Next Last

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0047	Falling at 25%	4600.0	4700.0	2.5	Yes						N/A
☐	i	0300.0017	Wooden fence e.g. post and rail	4600.0	4609.0	3.75 / 3.0	Yes						N/A
☐	i	2500.0001	Police ramp	4600.0	4610.0	3.5	No	See RRRAP manual				N2	N/A
☐	i	1600.0001	Crib wall retaining a c'way	4600.0	4620.0	2.5 / 2.5	No	Refer to BD 68				H4A	N/A
☐	i	8000.0001	Chemical	4600.0	4610.0	22.0	No	Acceptable	16		W2	N2	N/A
☐	i	0300.0061	Brick / block wall	4605.0	4614.0	3.75 / 3.0	No	Acceptable	6		W2	N2	N/A

For the Police Ramp, users are referred to the RRRAP Guidance Manual as the Police require VRS for their own protection, rather than due to the need to protect motorists from injury.

Crib walls indicate refer to BD 68 for special requirements.

Figure 9-7 Risk results for Police Ramps and Crib Walls

Here the RRRAP has indicated that the risk for the **Public building** that is at the bottom of a steep slope is 'Tolerable' with 30 m of N2 containment VRS in advance.

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Falling at 50%	200.0	224.0	2.5	No	Acceptable	39		W2	N2	N/A
☐	i	8300.0001	Public building	221.0	246.0	18.0	No	Tolerable	30		W2	N2	N/A
☐	i	0600.0002	Falling at 50%	224.0	250.0	2.5	No	Acceptable	39		W2	N2	N/A

Figure 9-8 Risk results for Public Building

In Figure 9-8, the RRRAP has indicated that the risk at the Public Building hazard is 'Tolerable' with 30 m of N2 containment safety barrier in advance. This will need to be investigated further by generating a Detailed Results report containing the risk and benefit cost calculation information (for more details see section 9.5).

Click the checkbox in the 'Output detailed results?' column - the checkbox should now have a tick. Click the 'Calculate Risk' button. Once the calculation has completed, a magnifying glass icon will appear in the 'Output detailed results?' column. Clicking the icon will display a browser specific dialog that will ask if you wish to open or save a PDF file. This contains the detailed result (see section 9.5.2 for the detailed results for the hazards shown in Figure 9-8).

For the Public Building hazard, changing the Barrier Containment from N2 to H1 and pressing 'Calculate Risk' again will calculate the new level of risk with the higher containment safety barrier (shown in Figure 9-9).

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Falling at 50%	200.0	224.0	2.5	No	Acceptable	39		W2	N2	N/A
☐	i	8300.0001	Public building	221.0	246.0	18.0	No	Acceptable	26		W2	H1	N/A
☐	i	0600.0002	Falling at 50%	224.0	250.0	2.5	No	Acceptable	39		W2	N2	N/A

Figure 9-9 Risk result for Public Building hazard after changing barrier containment

Here the risk is shown as Acceptable with 26m of H1 barrier containment in advance of Public Building.

The Detailed Results for the revised Public Building hazard are the second set of Detailed Results shown in section 9.5.2.

9.5 Generating Detailed Results

Detailed Results for a hazard are generated via the 'Collation & Reports' page. To generate a Detailed Results report for a hazard, click the checkbox in the 'Output detailed results?' column in the row of the hazard you are interested in. The checkbox should now have a tick.

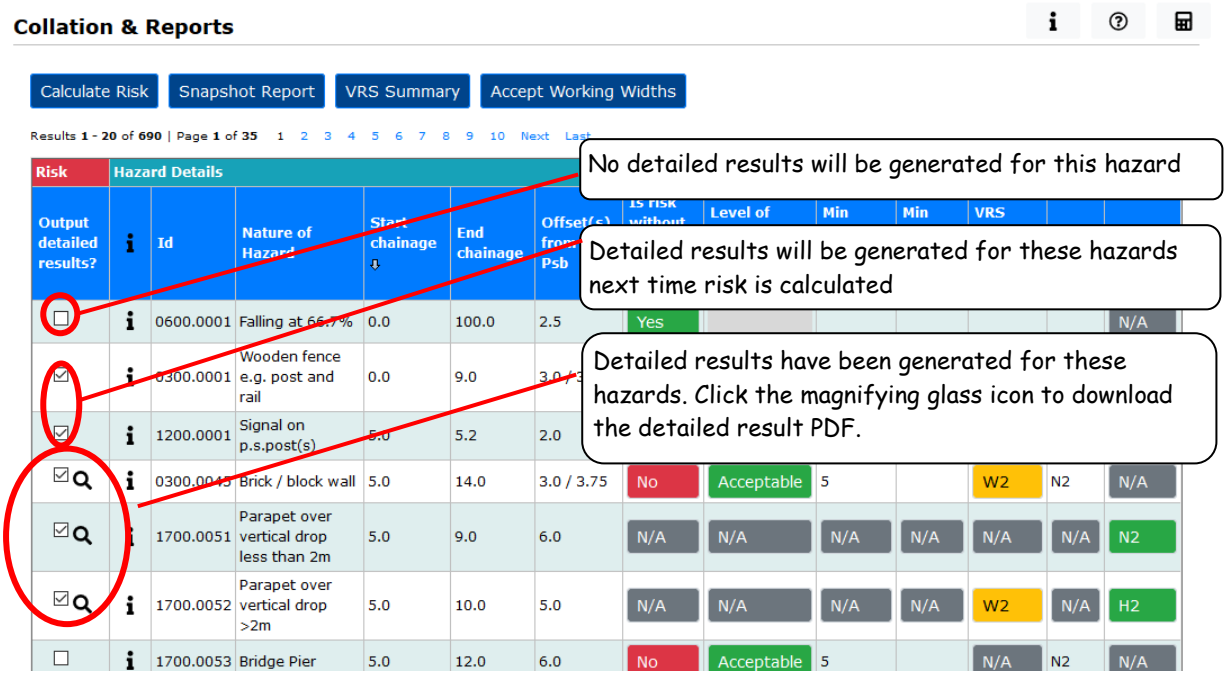


Figure 9-10 Generating Detailed Results for a hazard

Having put a tick in the checkbox in the 'Output detailed results?' column, press the 'Calculate Risk' button. Once the calculation has completed, an icon will appear in the 'Output detailed results?' column for each hazard that has a Detailed Result report to view. Clicking the icon will display a browser specific dialog that will ask if you wish to open or save a PDF file. This contains the detailed result.

9.5.1 Comparing Detailed Results

If a hazard is edited and already has Detailed Results from a previous risk calculation run, then the next time risk is calculated, the old Detailed Results data is superseded by the new data.

If you want to compare Detailed Results as you change specific values of a hazard, you should generate and save Detailed Results reports locally. You can then either open both up to view on your screen or print them out.

If for evidential reasons, you need to maintain the Detailed Results for different risk calculation runs for a particular hazard, you should generate and keep multiple Detailed Results files. You can also generate either a snapshot report (see section 9.7) or full report (see section 11.3) which contains both all hazard data and any currently generated Detailed Results.

9.5.2 Detailed Results Report

If the level of risk without VRS is 'Tolerable' or 'Unacceptable', the detailed risk and cost benefit levels of VRS provision must be looked at. Click the checkbox in the 'Output detailed results?' column - the checkbox should now have a tick. Click the 'Calculate Risk' button. Once the calculation has completed, a magnifying glass icon will appear in the 'Output detailed results?' column. Clicking the icon will display a browser specific dialog that will ask if you wish to open or save a PDF file.

The example shown is for a D2AP All Purpose Road from section 9.4.3.

Road Classification	Road sub type	Nearside or Offside Verge being assessed?	Permanent Speed Limit (mph)	AADT
All Purpose Road	D2AP	N/S Verge	70	17000

ID Number	Nature of Hazard	Cost of Option	Offset from PSb	Aggressiveness	Containment Level	Set-back(s) of VRS from PSb
8300.0001	Public building		18.0	1.3	N2	

Barrier length is length of VRS in advance of Hazard

Barrier Advance

Barrier Length	0	10	20	30	40	50	60	70	80	90	100	110
Est risk: Vehicle occupant	0.15216	0.13842	0.08387	0.05463	0.03934	0.03177	0.02845	0.02747	0.02779	0.02882	0.03025	0.0319
Est risk: Other	0.22238	0.20125	0.13546	0.10697	0.09899	0.09899	0.09899	0.09899	0.09899	0.09899	0.09899	0.09899
Estimated B/C	0	0.98	1.96	2.94	3.82	3.53	3.24	2.95	2.66	2.37	2.08	1.78

1st column shows risk and benefit cost levels with no length of VRS in advance of Hazard

Figure 9-11 Public Building hazard detailed result with default N2 barrier containment

The first run of Detailed Results with N2 containment for the VRS on the approach to the Public Building shows that risk to vehicle occupants increases with a short length of VRS, then initially decreases as the length of VRS increases, before rising again, as the VRS provides no additional risk benefit.

The risk to the Public Building only ever gets to Tolerable for both vehicle occupants and Others.

Changing the Barrier Containment for the **Public Building** hazard from N2 to H1 and then clicking on the 'Calculate Risk' button again will calculate the risk with H1 safety barrier. Here the risk is shown as acceptable with 26 m of H1 containment barrier in advance.

Road Classification	Road sub type	Nearside or Offside Verge being assessed?	Permanent Speed Limit (mph)	AADT
All Purpose Road	D2AP	N/S Verge	70	17000

ID Number	Nature of Hazard	Cost of Option	Offset from PSb	Aggressiveness	Containment Level	Set-back(s) of VRS from PSb
8300.0001	Public building		18.0	1.3	H1	

Barrier Advance

Barrier Length	0	10	20	30	40	50	60	70	80	90	100	110
Est risk: Vehicle occupant	0.15216	0.13756	0.08266	0.05306	0.03742	0.02949	0.02581	0.02448	0.02445	0.02513	0.0262	0.02749
Est risk: Other	0.22238	0.18897	0.11091	0.07015	0.04989	0.04092	0.03815	0.03815	0.03815	0.03815	0.03815	0.03815
Estimated B/C	0	0.74	1.48	2.22	2.89	2.67	2.44	2.22	1.99	1.77	1.55	1.32

Figure 9-12 Public Building hazard detailed result with altered H1 barrier containment

The second run of Detailed Results with H1 containment for the VRS on the approach to the Public Building shows that this time Risk to both vehicle occupants and building users is acceptable with H1 containment VRS on the approach to the building. There is also a reasonable benefit cost of providing a VRS.

If the 'Cost of Option' field is blank, this shows that the default cost of the H1 containment VRS has not been overridden yet – see sections 8.15.5 and 8.16.4.

Shown below is an example of a Parapet detailed result.

Road Classification	Road sub type	Nearside or Offside Verge being assessed?	Permanent Speed Limit (mph)	AADT
Motorway	D2M	N/S Verge	70	90000

ID Number	Nature of Hazard	Cost of Option	Offset from PSb	Aggressiveness	Set-back(s) of VRS from PSb
1700.0006	Parapet over vertical drop >2m		2.75		

Parapet containment	N2	H2
Est risk: Vehicle occupant	0.0408	0.0121
Est risk: Other	0.0764	0.0227
Estimated B/C		0.39

Parapet risk and benefit cost levels with N2 and H2 containment.

Figure 9-13 Parapet hazard detailed result

9.5.3 Example of Detailed Results output on a single carriageway

Figure 9-14 shows the output contained within a detailed result for a hazard on a single carriageway.

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
	i	1200.0011	Sign on post(s)	240.0	245.0	2.5	No	Acceptable	27	7	W2	N2	N/A

Detailed Results

Road Classification	Road sub type	Nearside or Offside Verge being assessed?	Permanent Speed Limit (mph)	AADT
All Purpose Road	Single	N/S Verge	70	6967

ID Number	Nature of Hazard	Cost of Option	Offset(s) from PSb	Aggressiveness	Containment Level	Set-back(s) of VRS from PSb
1200.0011	Sign on post(s)		2.5	1.8	N2	0.6

Barrier Advance

Barrier Length	0	10	20	30	40	50	60	70	80	90	100	110
Est risk: Vehicle occupant	0.04099	0.02897	0.01658	0.01184	0.01041	0.01039	0.01098	0.01184	0.01281	0.01383	0.01487	0.01592
Est risk: Other	0											
Estimated B/C	0	0.11	0.22	0.25	0.23	0.2	0.17	0.15	0.12	0.09	0.07	0.04

Barrier Beyond

Barrier Length	0	10	20	30	40	50	60	70	80	90	100	110
Est risk: Vehicle occupant	0.01865	0.01217	0.00654	0.00479	0.00446	0.00466	0.00506	0.00553	0.00602	0.00652	0.00703	0.00754
Est risk: Other	0											
Estimated B/C	0	0.05	0.1	0.12	0.11	0.09	0.08	0.07	0.05	0.04	0.03	0.02

Figure 9-14 Detailed results for a hazard on a single carriageway

The 'Barrier Beyond' result table shown at the bottom of the report is only returned when a single carriageway is being assessed, i.e. where vehicles are able to approach the hazard from either direction. Here, the risk is 'Tolerable' with no VRS. It becomes Acceptable level with between 0m and 10 m of N2 containment VRS. In practice the minimum length required beyond from Table 3-1 of TD 19 must be provided. This minimum length is required to ensure that the safety barrier system will work properly rather than due to risk requirements.

The risk in advance of the hazard is 'Unacceptable' with no VRS and with up to 10 m of N2 containment VRS. It reduces to a 'Tolerable' level with 20 m VRS, and becomes Acceptable level with between 20 m and 30 m of N2 containment VRS. The minimum length of N2 containment shown in Table 3-1 of TD 19 i.e. 30 m must be provided in advance of the sign. In this case the optimum benefit cost ratio is also best at around 30 m length (although it remains very low).

9.6 Hazard Groupings

The information presented by the RRRAP via the 'Collation & Reports' and 'VRS Summary' pages, as well as through the risk calculation, differs for hazards depending on the hazard category and the nature of the hazard. The following highlights what additional details you should expect, and which hazards are affected.

9.6.1 Hazards with Secondary Knock-on effect

Tall hazards can potentially have secondary knock-on effects if the hazard is hit. Tall hazards include:

- 1200 Traffic Signs or Signals: all categories (excluding those with 'Gantry' in nature or sign store) where height is over 3 m
- 1300 Lighting columns: all categories apart from Electricity supply cabinet
- 1500 Motorway Comms: 'Comms or CCTV Mast', 'Posts', 'Posts (PS)' where height is over 2 m
- 8600 Poles and Pylons: Telegraph and electricity poles, pylons, posts – all heights.

If any of these hazards are in a RRRAP record, once risk has been calculated, on the Risk Calculation Issues page, you will be prompted to answer a question for each tall hazard (shown in Figure 9-15).

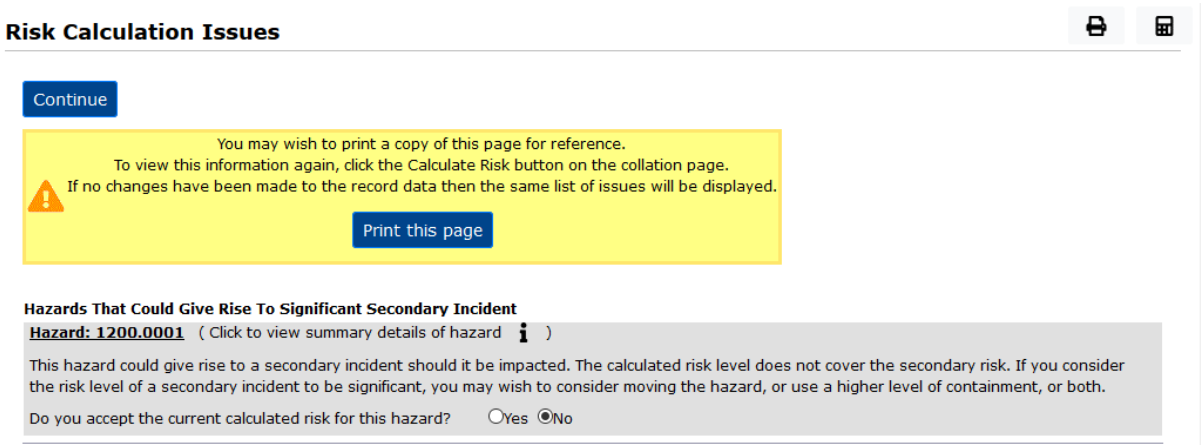


Figure 9-15 Hazard with secondary knock-on effect

By default, the question has the answer 'No'. You can leave this default value and continue back to the Collation page. The tall hazard warning will continue to appear on the Risk Calculation Issues page (and as an issue related to the hazard in any generated full report) until answered 'Yes'.

An additional field is visible for these hazards on the view / edit hazard pages accessed via the Collation page, where the question can also be answered.

The question response is included in the snapshot and full reports.

9.7 Snapshot Report

You may wish to generate snapshot reports at different stages during the RRRAP process, e.g. initial data entry record, details of a particular calculation run, etc.

Click the 'Snapshot Report' button on the 'Collation & Reports' page to generate the report at any time.

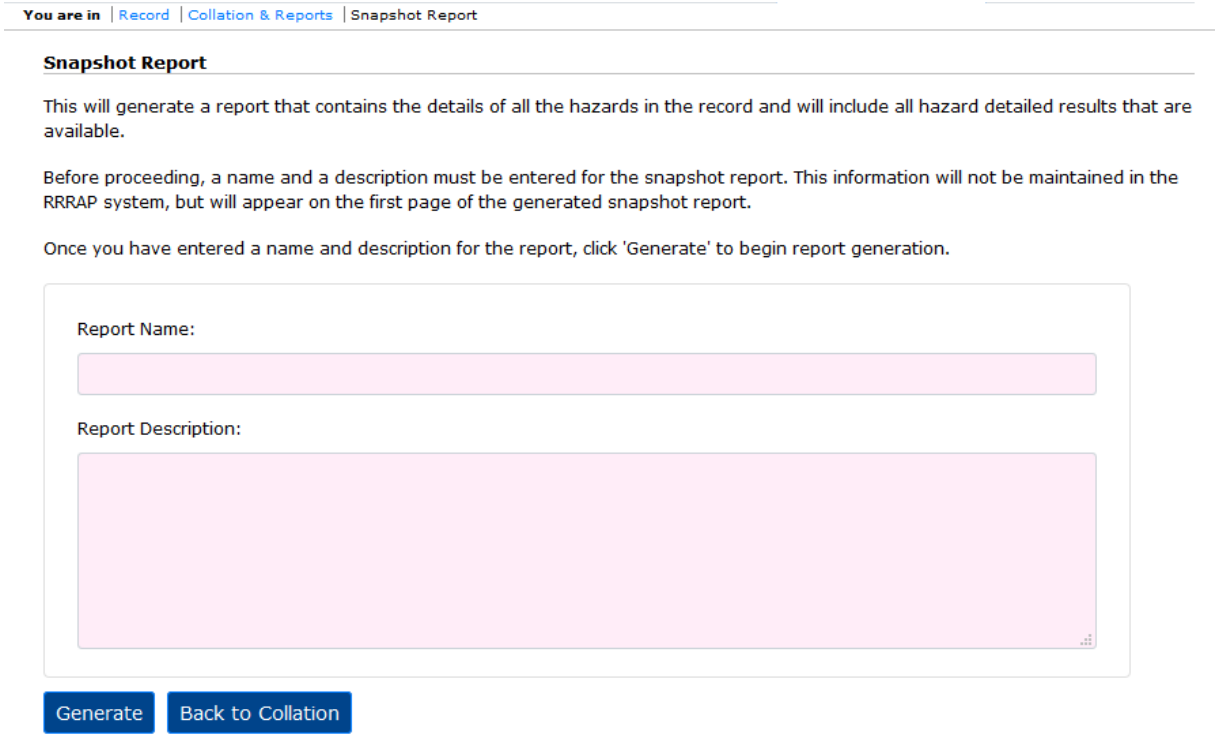


Figure 9-16 Snapshot Report page

The snapshot report contains the details of all the hazards, as well as any detailed results that are available.

Before you can generate a snapshot report, you must enter a name and a description for the report. This information will not be maintained within the RRRAP, but will appear on the first page of the generated report. The name and description should be sufficient to identify the reasons for the snapshot report generation (e.g. calculation run X with Y changed).

9.8 Calculation of Risk – Option Testing and Selection

In the Collation & Reports page, once the risk has been calculated, the designer can investigate for instance the effect of the level of risk or on the length of safety barrier required by changing one or more of the values relating to a hazard or the values relating to the safety barrier, and the recalculate risk. View and then edit the hazards on the Collation & Reports page to make those changes.

The effect for instance of changing the aggressiveness from 1.7 to that of a passively safe column (0.25) could be tried.

If the working width class is altered from the default of W2, the Designer must manually change the barrier working width and check that the hazard lies outside the safety barrier working width.

Hazard: 1300.0001					
	Nature of Hazard	Row of lighting columns < 40m apart	?	Local Alignment [F2]	Good alignment
	Start Chainage of Hazard	40.0	?	Sleep - Related Site [F3]	A
?	Length of Hazard	140.0	?	Speed [F4]	Mean speed < speed limit
	Width of Hazard	0.2	?	Other Features [F6]	W
?	Offset of Hazard from Psb	2.5		Multiplicative Factor for Run-off Rate	0.9
	Height / Depth of Hazard	<10m high		Topography Factor	1.0
?	Aggressiveness	1.7			
?	Comment				
Secondary Incident					
?	Is calculated risk level accepted for hazard that could give rise to a significant secondary incident?				No
Risk Levels - VRS Details - B/C Details					
	Is risk without VRS acceptable?	No	?	VRS WW Class	W2
	Level of risk with optimum length VRS?	Acceptable	?	VRS WW (m)	0.8
	Minimum Length VRS in advance (m)	9	?	Set-back (m)	0.6
	Minimum Length VRS in beyond (m)			Cost of Option (avg/year, £)	0.0
?	Containment Level	N2	?	Relaxation / Departure required?	None

Changing barrier from 0.6 m offset (default value when there is a hard strip or hard shoulder present) to say 1.2 m offset can be done if the verge width is adequate to allow VRS to be moved – see Figures 3-1 and 3-2 of TD 19 for details of constraints.

A return of 0.0 here indicates that the default costs are being used in the RRRAP. If better VRS cost information is available, the default average value can be changed. Back up on new costing must be provided in the table on the 'Barrier Option Costs' page.

Figure 9-17 Viewing a hazards details from the Collation & Results page

10 The Designer must Check and Ensure

(i) All the hazard definition and risk calculated values represent the final chosen option (this can be checked by either viewing individual hazards via the 'Collation & Reports' page or by viewing a full report, see section 11.3),

(ii) Detailed Results have been generated where necessary and the 'Comment' field for individual hazards has been populated with all the relevant data to back up the decisions made

11 VRS Summary

The VRS Summary can be viewed by clicking the VRS Summary button on the 'Collation & Reports' page. This page lists all the hazards that require some form of protection.

To add any further comments to a hazard to support the design choices, edit the hazard via either the 'Collation & Reports' or 'Hazards Overview' pages.

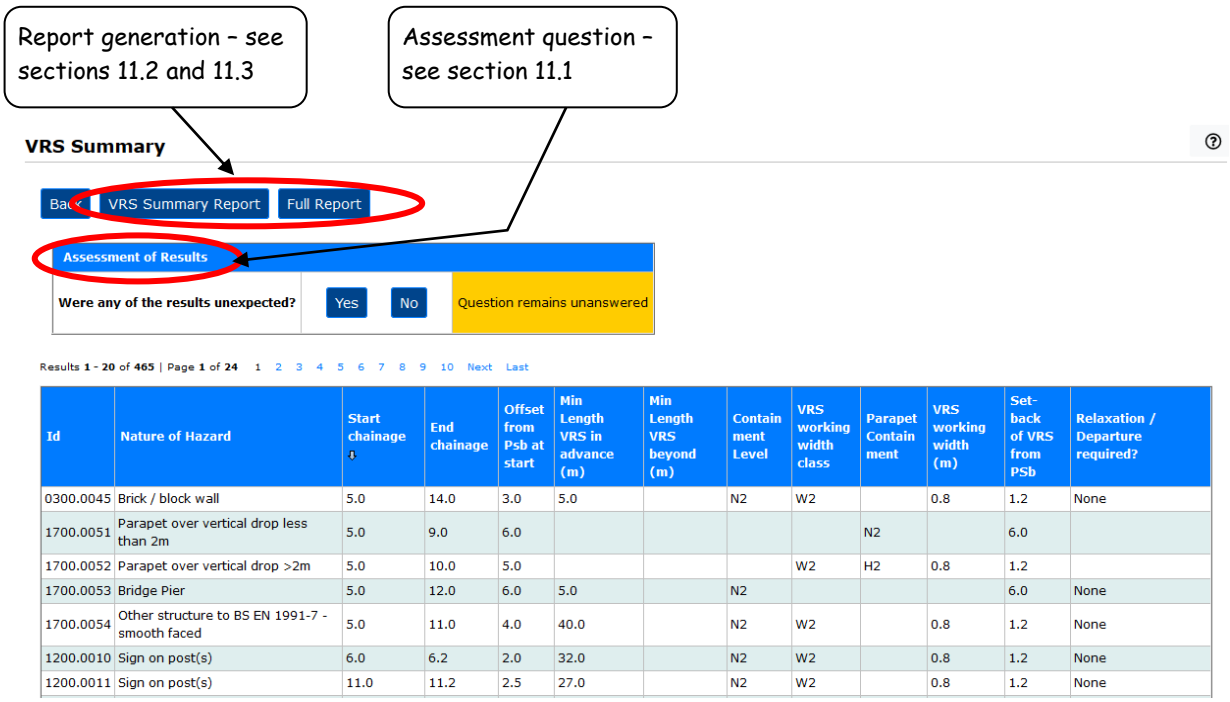
Notes

(i) This page will not list any hazards until risk has been calculated for the first time (except from exceptions identified in point iv).

(ii) This page will not list any hazards if, after running the risk calculation, no hazards in the record require protection (except from exceptions identified in point iv).

(iii) The hazards listed on this page will change if the user modifies hazard details and re-runs the risk calculation.

(iv) In addition to the hazards that require VRS protection, there are three additional hazard types that will always appear in the VRS Summary table. These are Parapets, Pedestrian Guardrail and Emergency Telephone hazards.



Id	Nature of Hazard	Start chainage	End chainage	Offset from Psb at start	Min Length VRS in advance (m)	Min Length VRS beyond (m)	Containment Level	VRS working width class	Parapet Containment	VRS working width (m)	Set-back of VRS from PSb	Relaxation / Departure required?
0300.0045	Brick / block wall	5.0	14.0	3.0	5.0		N2	W2		0.8	1.2	None
1700.0051	Parapet over vertical drop less than 2m	5.0	9.0	6.0					N2		6.0	
1700.0052	Parapet over vertical drop >2m	5.0	10.0	5.0				W2	H2	0.8	1.2	
1700.0053	Bridge Pier	5.0	12.0	6.0	5.0		N2				6.0	None
1700.0054	Other structure to BS EN 1991-7 - smooth faced	5.0	11.0	4.0	40.0		N2	W2		0.8	1.2	None
1200.0010	Sign on post(s)	6.0	6.2	2.0	32.0		N2	W2		0.8	1.2	None
1200.0011	Sign on post(s)	11.0	11.2	2.5	27.0		N2	W2		0.8	1.2	None

Figure 11-1 VRS Summary page

11.1 Assessment of Results

At the top of the VRS Summary page is a small section titled 'Assessment of Results'.

The Designer should only answer the question 'Were any of the results unexpected?' once risk assessments for all hazards has been completed and no further changes are to be made. The response to this question will be included within any generated VRS Summary and Full Report.

11.2 VRS Summary Report

Clicking the VRS Summary Report link will generate a VRS Summary PDF report. Once the report has been generated, a browser specific dialog will be displayed. This will allow you to either open or save the generated PDF report.

The report will contain summary details of the section being assessed (section details, location details) as well as listing details for the hazards that require protection.

11.3 Full Report

Clicking the Full Report link will generate a PDF report of the full details of the RRRAP record. Once the report has been generated, a browser specific dialog will be displayed. This will allow you to either open or save the generated PDF report.

The Full Report contains all of the following details:

- Record Information (record name, project name, description, the RRRAP version number and issue date, etc)
- Answer to 'Assessment of results' question on VRS Summary page
- Record declarations (i.e. any completed sign off details from the Record Status tab)
- All common details
- Option Costs (if any provided)
- All data relating to each individual hazard (both entered by the user and generated via risk calculation) categorised by hazard type
- Any available Detailed Results generated for specific hazards
- VRS Summary details
- Temporary works

Note: The Full Report does not contain any Restraint Summary details entered via the Restraint Summary page. A report containing these details can be created via a separate report link which is available in the Restraint Summary page (see section 12.1).

The Full Report can be generated at any time, and does not rely on running the risk calculation or there being hazards listed in the VRS Summary page.

It is **recommended** that you generate a Full Report and use the export facility (see section 4.4) to backup your hazard data at key stages in the design process.

12 Restraint Summary (Specification Appendix 4/1)

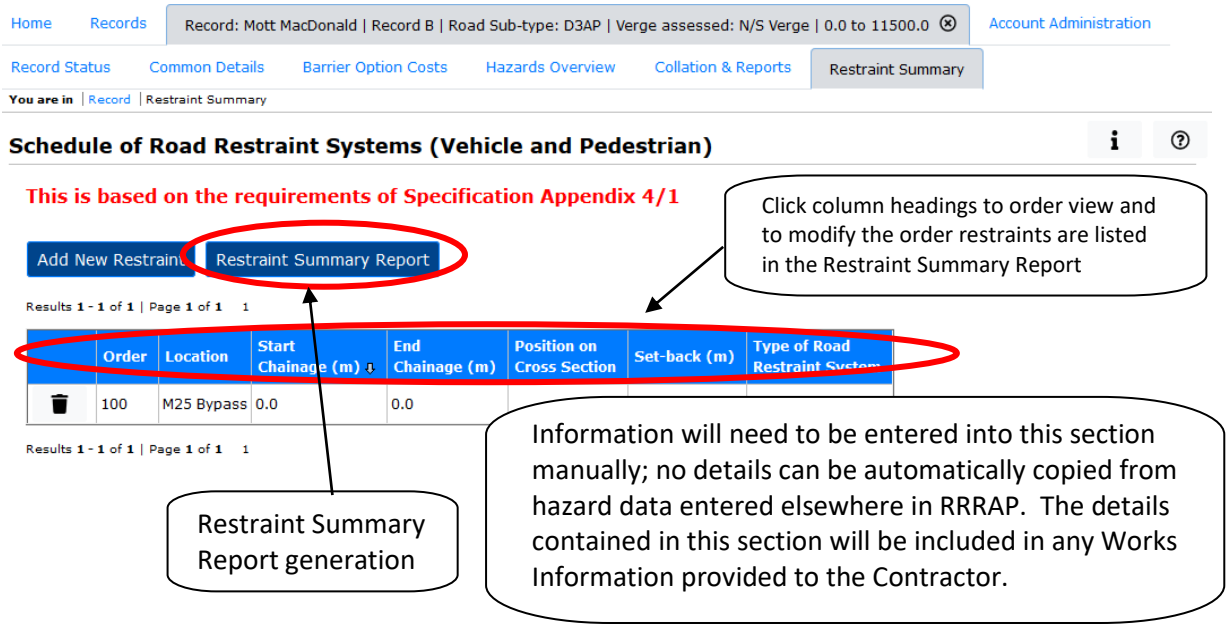


Figure 12-1 Appendix 4-1 Restraint Summary

Notes:

- Complete the schedule and include in Appendix 4/1. Incorporate in the schedule all the Road Restraint Systems (i.e. safety barriers, terminals, transitions, vehicle parapets, crash cushions, pedestrian parapets and pedestrian guardrails) and any associated anti-glare screens required.
- Cross-reference should be made to the Drawings where appropriate.
- The respective Start and End Chainages of the proposed Road Restraint Systems should be listed.
- All the Performance Class requirements appropriate for the Road Restraint System and other details such as parapet height should be included.
- The difference between the End and Start Chainages should be at least the Length of Need of the Road Restraint System as defined in TD 19.

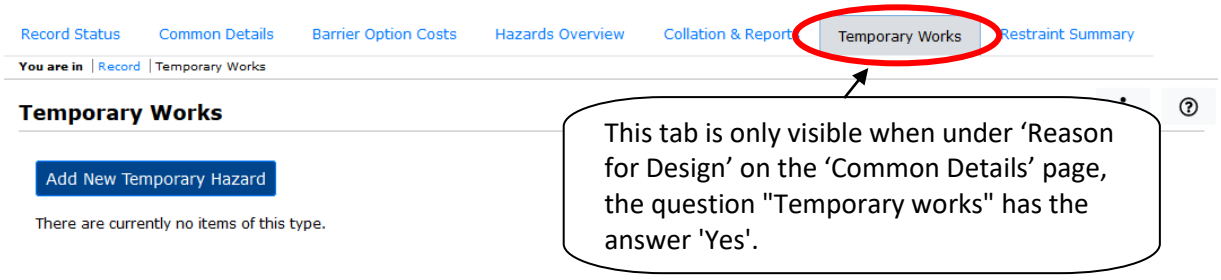
12.1 Generating the Restraint Summary Report

Clicking the Restraint Summary Report link will generate a PDF report. Once the report has been generated, a browser specific dialog will be displayed. This will allow you to either open or save the generated PDF report.

By default, ordering of restraints in the report is by start chainage. If you wish to alter the ordering of the restraints in the report click the column headings in the table that lists the entered Restraints (see Figure 12-1). Clicking a different heading will sort the restraints by that field. Continue to click the same heading multiple times will switch the ordering of the restraints to be in either ascending or descending order for the chosen field. Once you have chosen your desired ordering, generate the report.

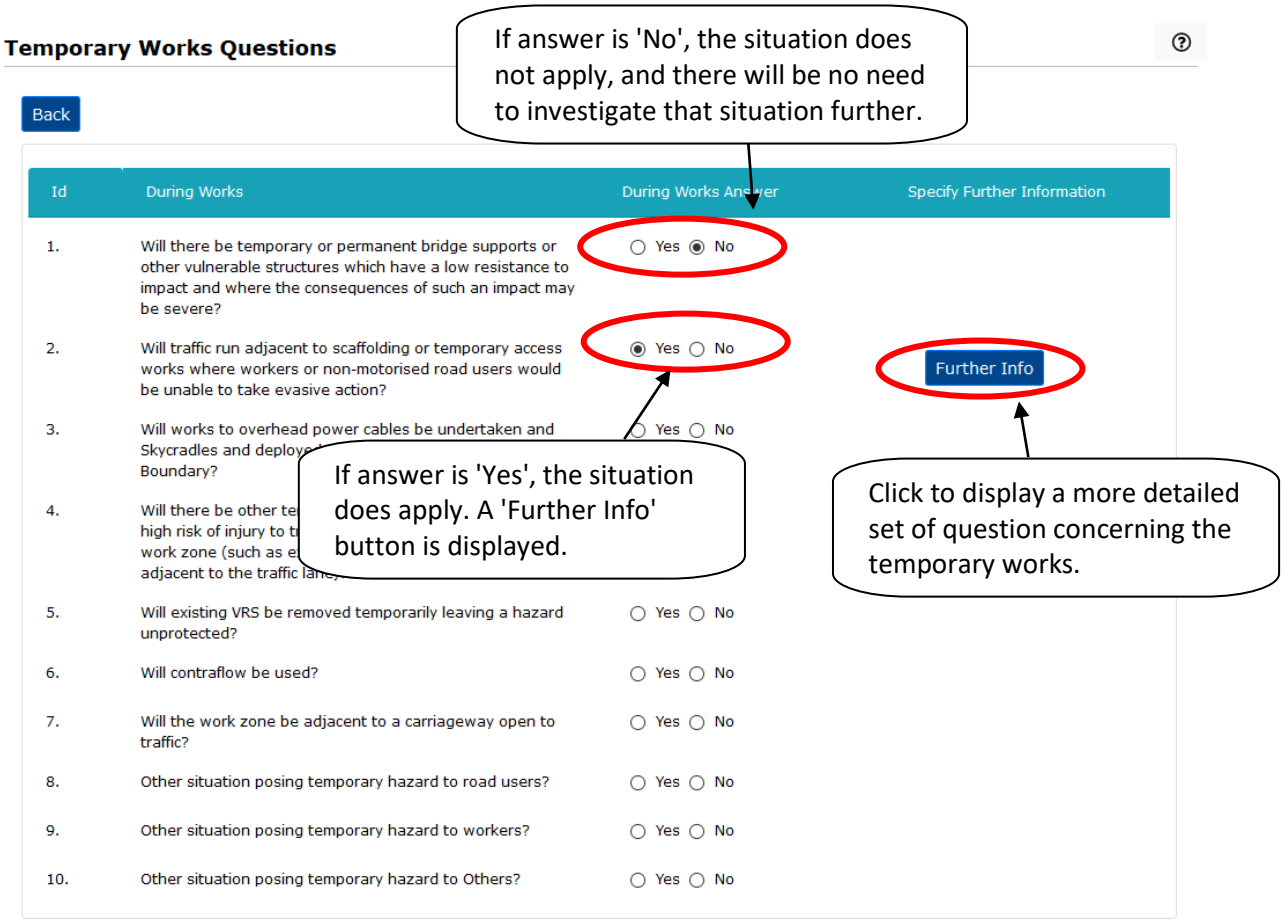
13 Temporary Hazards (not yet incorporated use RRRAP v1.3a spreadsheet)

~~To be able to enter temporary hazard information, you must answer 'Yes' to the option 'Temporary works' listed under 'Reason for Design' for the records 'Common Details' (see section 5.2).~~



~~**Figure 13-1 Temporary Works**~~

~~In the Temporary Works page (see Figure 13-1), click the 'Add New Temporary Hazard' button. This will create a new set of questions to answer for temporary hazards (see Figure 13-2). Up to four copies of the question set can be created.~~



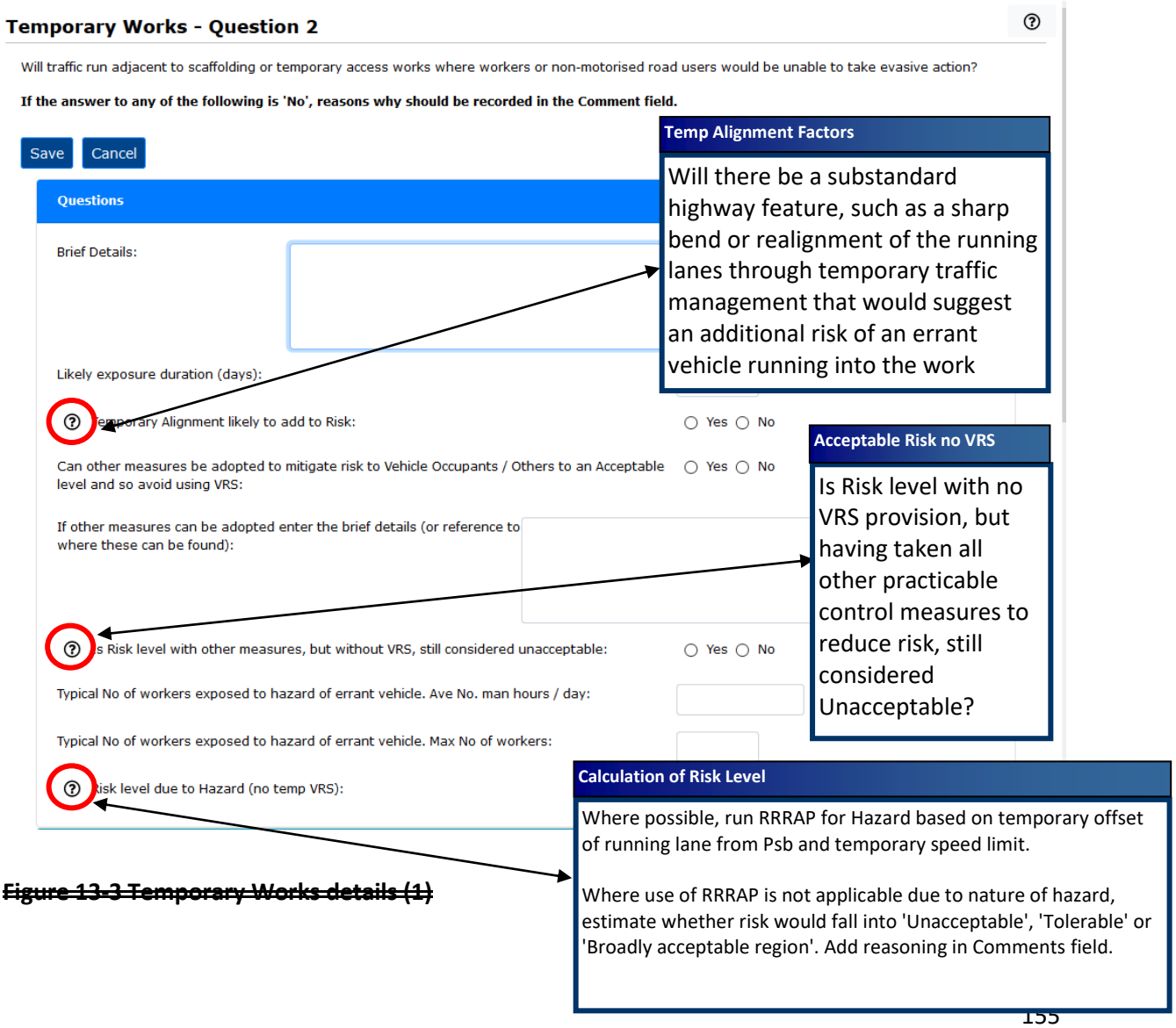
~~**Figure 13-2 Temporary Works Questions**~~

~~The set of questions describe typical situations that might be encountered during temporary works. For each question indicate either (via Yes or No) whether or not each of the circumstances applies in the situation being assessed.~~

~~If the answer is 'No', the situation does not apply, and there will be no need to investigate that situation further.~~

~~If the answer is 'Yes', the situation does apply; a 'Further Info' button is displayed. Clicking this button will display a more detailed set of question concerning the temporary works. Completing these questions will assist in determining whether provision of a temporary vehicle restraint system(s) is appropriate in each of the circumstances and act as a record for the factors considered.~~

~~Figure 13-3, Figure 13-4, and Figure 13-5 show the detailed set of questions and help menus available for temporary works. Completion of these details will assist the Designer in determining whether provision of a temporary vehicle restraint system(s) is appropriate in each of the circumstances and act as a record for the factors considered. It should be noted that whilst it may not be considered cost effective to provide temporary VRS for a single situation, it may be cost effective when the combination of circumstances is considered. Where the response is 'No' to the questions, brief details as to why should be recorded in the Comment field.~~



~~**Figure 13-3 Temporary Works details (1)**~~

If a temporary VRS were to be deployed could it be installed, operated and removed to meet / achieve the following without Departures From Standard

Without disproportionate time and cost relative to rest of works: ○ Yes ○ No

Safely within available space: ○ Yes ○ No

Acceptable disruption to motorists: ○ Yes ○ No

TD 19 Set-back: ○ Yes ○ No

If no, specify Set-back(m) achievable:

TD 27 Lane width: ○ Yes ○ No

If no, specify Lane widths achievable:

Ch 8 TSM Safety Zone requirements:

If no, specify Safety Zone achievable:

Works access / egress:

Emergency Access requirements:

TD 19 Working Width:

If yes specify the Max Working Width Class:

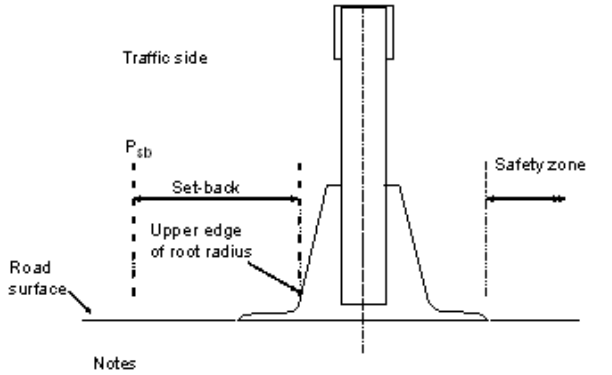
Available Space?

Space necessary for VRS will include any temporary lane closures and space for workers, plant and equipment to load / install / remove, etc the VRS safely.

Acceptable Disruption

Consider disruption during installation, operation and removal.

Measurement of Set-back with Temp VRS



Notes

1. Psb = point from which Set-back is measured (ref TD 27).
2. Refer to TD 19 Chapter 8, Table 8-1 for Set-back dimensions.

Measurement of Set-back to Temporary Deformable VRS with protruding base plate

~~**Figure 13-4 Temporary Works details (2)**~~

VRS Details (if required)

Recommend use VRS: ○ Yes ○ No

Details of VRS required:

Details of Departures from Standard required:

Comment:

Details of VRS required

Include Working Width, Containment Level, Length of Need, start chainage / location, end chainage, Terminal performance criteria, any constraints on type of VR System to be used.

~~**Figure 13-5 Temporary Works details (3)**~~

14 Saving and retaining a copy of the RRRAP

It is essential once the RRRAP process has been completed and the Design Organisation has completed all its internal checks and is satisfied with the RRRAP's content and outcome, that a copy is retained, stored and backed up as appropriate. This may be on CD possibly with a secure master copy and a working copy or copies as required, with secure long term electronic back up. The files archived should include:

- An exported copy of the RRRAP record (see section 4.4)
- A full PDF record report (see section 11.3)
- A PDF restraint summary report (see section 12.1)
- Any other relevant files to be used as evidence (individual detailed result reports, etc)

An important element of the RRRAP process is that it forms part of the Health and Safety file for the Scheme, Maintenance Area and Highway Authority as appropriate, and that it is available to the Client and all those who have a legitimate need to make use of it in the future.

Design organisations should discuss and agree with their Client at an early stage how this requirement is to be fulfilled and implemented.