LEEDS CITY COUNCIL
SKID RESISTANCE STRATEGY

OCTOBER 2019

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Document Information

Title (Sub Title)	**Skid Resistance Strategy**
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Author	**Richard Hobson**
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01	**Draft**	**R Hobson**	**December 2018**	**First release for internal review**
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1. Introduction

The Leeds City Council Skid Resistance Strategy comprises of 2 parts, the WYCA+ Common Skid Resistance Policy and a Skid Resistance Procedure

Part A – WYCA+ Common Skid Resistance Policy

The constituent local authorities of the West Yorkshire Combined Authority (WYCA) – including Leeds City Council, Kirklees Council, Bradford Metropolitan District Council, Calderdale Council and Wakefield Council with the inclusion of City of York Council, henceforth referred to as the WYCA+ for simplicity, have developed a common skid resistance policy. A common policy ensures consistency on cross boundary networks, such as the West Yorkshire Key Route Network, whilst the format allows each local authority the autonomy to manage their network appropriate to the local conditions in accordance with their skid resistance procedure.

The policy takes an asset management approach to managing skid resistance and puts a greater emphasis on engineering assessment. It will provide documented evidence of the local authority proactive approach to skid resistance management.

Part B – LCC Skid Resistance Procedure

This document is a supplementary document to the WYCA+ Common Skid Resistance Policy. It has been produced to provide a step by step approach to identifying skid deficient sites and sets out a process for deciding on their subsequent treatment, and how this will be prioritized taking into account budget and programme considerations in Leeds. The procedures in this Skid Resistance Procedure set out a long-term strategy to manage the skid resistance of Leeds City Council's strategic network to a consistent and safe level. The procedure complements the Council's Highway Infrastructure Asset Management Strategy, which looks to manage assets in a strategic way.

WEST YORKSHIRE COMBINED AUTHORITY

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WEST YORKSHIRE COMBINED AUTHORITY
COMMON SKID RESISTANCE POLICY

OCTOBER 2019

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Document Information

Title (Sub Title)	**WYCA+ Common Skid Resistance Policy**
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03			**October 2017**	**Minor amendments and updates**
04	**Final**	**R Hobson**	**October 2019**	**Section 4 – comments re replacement of HD28/15 with CS228**

1. Introduction

The constituent local authorities of the West Yorkshire Combined Authority (WYCA) – including Leeds City Council, Kirklees Council, Bradford Metropolitan District Council, Calderdale Council and Wakefield Council with the inclusion of City of York Council, henceforth referred to as the WYCA+ for simplicity, have developed a common skid resistance policy. A common policy ensures consistency on cross boundary networks, such as the West Yorkshire Key Route Network, whilst the format allows each local authority the autonomy to manage their network appropriate to the local conditions in accordance with their skid resistance procedure.

The local authorities are Highway Authorities responsible for the maintenance of the road lengths shown in the following table.

Local Authority	Classified A Roads	Classified B and C Roads	Unclassified Roads	Total
Bradford	184	196	1,462	1,842
Calderdale	149	119	874	1,142
Kirklees	210	239	1,462	1,911
Leeds	389	239	2,234	2,862
Wakefield	189	220	1,044	1,453
York	79	103	1,673	1,855
TOTAL	**1,200**	**1,116**	**8,578**	**10,894**

Road lengths maintained (km)

The policy takes an asset management approach to managing skid resistance and puts a greater emphasis on engineering assessment. It will provide documented evidence of the local authority proactive approach to skid resistance management.

2. Skid Resistance

The term “skid resistance” used in this document refers to the frictional properties of a road surface in wet conditions, measured using a specified device, under standardised conditions. Skid resistance testing is carried out on wet or damp surfaces as the skid resistance of a surface will be substantially lower than when the same surface is dry.

Skid resistance is an important property relating to the safe passage of highway users, particularly in damp or wet conditions. Over the course of a road’s life the surface can lose some of its characteristics associated with grip. Effective maintenance of the highway network includes the requirement to systematically monitor the skid resistance of the road surface and to take a proactive approach so that the skid resistance across the network is maintained to an appropriate standard.

Skid resistance measurements are used as an empirical assessment of a road surface’s level of grip and as an indication of the potential need for further investigation based on known acceptable limits. However, it should be noted it does not represent the definitive grip available to a road user making a particular manoeuvre at a particular time and at a particular speed.

3. The WYCA+ Common Skid Resistance Policy

The objective of the WYCA+ Common Skid Resistance Policy is to:

- Maintain a consistent approach to the provision of skid resistance across the strategic road network, so that road users find consistent friction characteristics when accelerating, braking and cornering.
- Provide a level of skid resistance appropriate to the nature of the road environment at each location. The appropriate level is determined from a combination of: network-wide analysis of crash history, consideration of friction demands by road users and local judgement of site specific factors by suitably experienced engineers.

To achieve this each constituent authority will:

- Formalise processes for monitoring skid resistance across its Classified A Road network on an ongoing basis.
- Identify deficient sites using skid resistance survey methods for further investigation.
- Use accident data on sites identified for further investigation to determine whether inadequate skidding resistance could be a factor.
- Recommend appropriate actions to negate risks.
- Prioritise skid deficient sites for improvement works based on where the greatest risks lie.
- Ensure improvements to skid deficient sites are incorporated into the annual highway maintenance works programme.

4. Skid Resistance Procedure

Each constituent authority will have a Skid Resistance Procedure that details how the common skid resistance policy will be implemented

In 2015 Highways England published an updated comprehensive methodology for managing carriageway skid resistance on motorways and trunk roads and this is set out in their design standard, HD 28/15.

The methodology detailed in HD 28/15 forms a basis for the individual authority's skid resistance procedure. However, this is adapted to reflect local needs and resource constraints.

In August 2019 the document HD28/15 was replaced by CS 228.

Whilst the vast majority of the CS 228 document is word for word identical to HD28/15 there is an important omission from the HD28/15 document that is referenced in the councils' skid policy. Namely, the removal of Annex 7 – An alternative method procedure for identifying sites requiring detailed investigation.

XAIS and Enodamus (the company of Dr Helen Viner, an independent consultant and formerly chief scientist of TRL; individually the main researcher for Highways England's Crash Model) have proposed a research project to DfT to research, calibrate and produce a crash model for Local Roads. It is envisaged that this model will not be available for the foreseeable future (12-24 months).

Therefore, in the interim, the User Community have agreed to continue to follow the process detailed in the Council's Skid Resistance Policy and Procedure documentation.

In summary the methodology is as follows:

- Skid resistance surveys will be undertaken annually on defined parts of the highway network which are referred to as the SCRIM Network.
- The current SCRIM Network is the Classified A Road network
  NB: This network definition is subject to review once maintenance hierarchies have been defined during the implementation of the new Code of Practice for Well Managed Highway Infrastructure.
- The defined network will be assigned Investigatory Levels depending on a range of factors such as the speed limit and geometry of the road.
- Skid resistance data for a particular section of road (a site) will be scrutinised and compared against its Investigatory Level within ExpertAssets© Corporate Risk Management Tool (CRMT).

- Sites where skid resistance falls at or below the investigatory level will be identified for further investigation.
- The further investigation will take into account other factors such as whether there is road traffic crash history at the site to establish whether remedial treatment is necessary.
- Where remedial treatment is deemed to be of benefit, sites will be prioritised using a risk assessment approach and inserted into a work programme for action within the resources available.

The above methodology will be applied on an ongoing basis so that skid resistance across the highway network is monitored and managed appropriately.

5. Responsibilities

5.1. Legal responsibilities

The Highways Act 1980 sets out the main duties of Highways Authorities in England and Wales. In particular, Section 41 imposes a duty to maintain highways maintainable at public expense, and almost all claims against authorities relating to highway functions arise from the alleged breach of this section.

Section 58 provides for a defence against action relating to alleged failure to maintain on grounds that the authority has taken such care as in all the circumstances was reasonably required to secure that the part of the highway in question was not dangerous for traffic.

5.2. Roles and Responsibilities

This section sets out the various roles and responsibilities for the implementation of the Skid Resistance Policy.

The individual authority's Highway Asset Management Team is responsible for the:

- Management, development, implementation and regular review of the Skid Resistance Policy.
- The procurement and subsequent management of skid resistance surveys with contractors.
- Assignment of site categories and investigatory levels on the road network subject to skid resistance surveys.
- Processing, analysis and review of skid resistance data received from the survey contractor.
- Review of the site categories and investigatory levels for the road network subject to skid resistance surveys. This review will be undertaken every three years.
- Maintaining the appropriate records of site visits and associated documents.
- Informing other local authority departments of any issues affecting the site which may be contributory to skid resistance issues.
- Providing a prioritised list of sites that would benefit from improvement works and making informed decisions about how these are integrated into the annual highways forward works programme.

The individual authority's Highway Asset Management Team will ensure that the most appropriate remedial action is taken at sites identified as requiring action. Some examples of the options available are:

- Erection of warning signs
- Refresh of road markings
- Retexturing of the road surface
- Resurfacing of the carriageway with appropriate material

Leeds CITY COUNCIL

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SKID RESISTANCE PROCEDURE

DECEMBER 2018

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03	**Draft**		**November 2017**	**Minor amendments and updates**
04	**Draft**	**R Hobson**	**September 2018**	**Review & Lessons learnt update, mainly appendices 6, 7, & 8**

1. Introduction

This document is a supplementary document to the WYCA+ Common Skid Resistance Policy. It has been produced to provide a step by step approach to identifying skid deficient sites and sets out a process for deciding on their subsequent treatment, and how this will be prioritized taking into account budget and programme considerations. The procedures in this Skid Resistance Procedure set out a long-term strategy to manage the skid resistance of Leeds City Council's strategic network to a consistent and safe level. The procedure complements the Council's Highway Infrastructure Asset Management Strategy, which looks to manage assets in a strategic way.

This document takes an Asset Management approach to managing skidding resistance and puts a greater emphasis on engineering assessment.

2. Principles

Each constituent authority will have a Skid Resistance Procedure that details how the common skid resistance policy will be implemented

In 2015 Highways England published an updated comprehensive methodology for managing carriageway skid resistance on motorways and trunk roads and this is set out in their design bulletin, HD 28/15.

The methodology detailed in HD 28/15 forms a basis for the individual authority's skid resistance procedure. However, this is adapted to reflect local needs and resource constraints.

In summary the methodology is as follows:

- Skid resistance surveys will be undertaken annually on defined parts of the highway network which are referred to as the SCRIM Network.
- The current SCRIM Network is the Classified Road network (as detailed in Appendix 3)

  NB: This network definition is subject to review once maintenance hierarchies have been defined during the implementation of the new Code of Practice for Well Managed Highway Infrastructure.

- The defined network will be assigned Investigatory Levels depending on a range of factors such as the speed limit and geometry of the road. This is detailed in Chapter 6.
- Skid resistance data for a particular section of road (a site) will be scrutinised and compared against its Investigatory Level within ExpertAssets© Corporate Risk Management Tool (CRMT).
- Sites where skid resistance falls at or below the investigatory level will be identified for further investigation.
- The further investigation will take into account other factors such as whether there is road traffic crash history at the site to establish whether remedial treatment is necessary.
- Where remedial treatment is deemed to be of benefit, sites will be prioritised using a risk assessment approach and inserted into a work programme for action within the resources available.

The above methodology will be applied on an ongoing basis so that skid resistance across the highway network is monitored and managed appropriately.

3. Glossary of Terms

AADF – Average Annual Daily Flow is the average over a full year of the number of vehicles passing a point in the road network each day

CRMT – Corporate Risk Management Tool – the module of ExpertAssets that the Council use to process the SCRIM data through every process of the road skid resistance procedure

CSC - Characteristic SCRIM Coefficient

ExpertAssets © – ExpertAssets is the name of the Asset Management Software developed by XAIS Asset Management Limited that the Council use to process the SCRIM data through every process of the road skid resistance procedure.

IL - Investigatory Level

LECF - Local Equilibrium Correction Factor - the correction factor used to calculate the CSC

PSV – Polished Stone Value

Rural Attribute – denotes network sections subject to 50mph or above speed restrictions (Not related to whether the environment is not built up)

SASS – Single Annual Skid Survey – A method used for calculating the CSC

SC – SCRIM coefficient

SD – SCRIM Deficiency or Skid Resistance Difference

SCRIM - Sideway Force Coefficient Routine Investigation Machine

SFC – Sideway Force Coefficient

Site – A Site is an Assessment Length with consistent Site Categorisation and Investigatory Level whose length is defined in table 6.1 (typically site lengths range from 50-149m and 10m for roundabouts). Detailed investigations are undertaken for whole sites (previously referred to as SAL)

SR – SCRIM reading

Urban Attribute – denotes network sections subject to 40mph or less speed restrictions (Not related to whether the environment is built up)

WYCA – West Yorkshire Combined Authority

WYCA+ – The West Yorkshire Combined Authority including City of York Council

ExpertAssets © – ExpertAssets is the name of the Asset Management Software developed by XAIS Asset Management Limited that the Council use to process the SCRIM data through every process of the road skid resistance procedure.

4. Skid Resistance Procedure

This section summarises the procedures for making and interpreting skid resistance measurements on the SCRIM road network and for the identification and prioritisation of sites for treatment, as indicated below in figure 4.1.

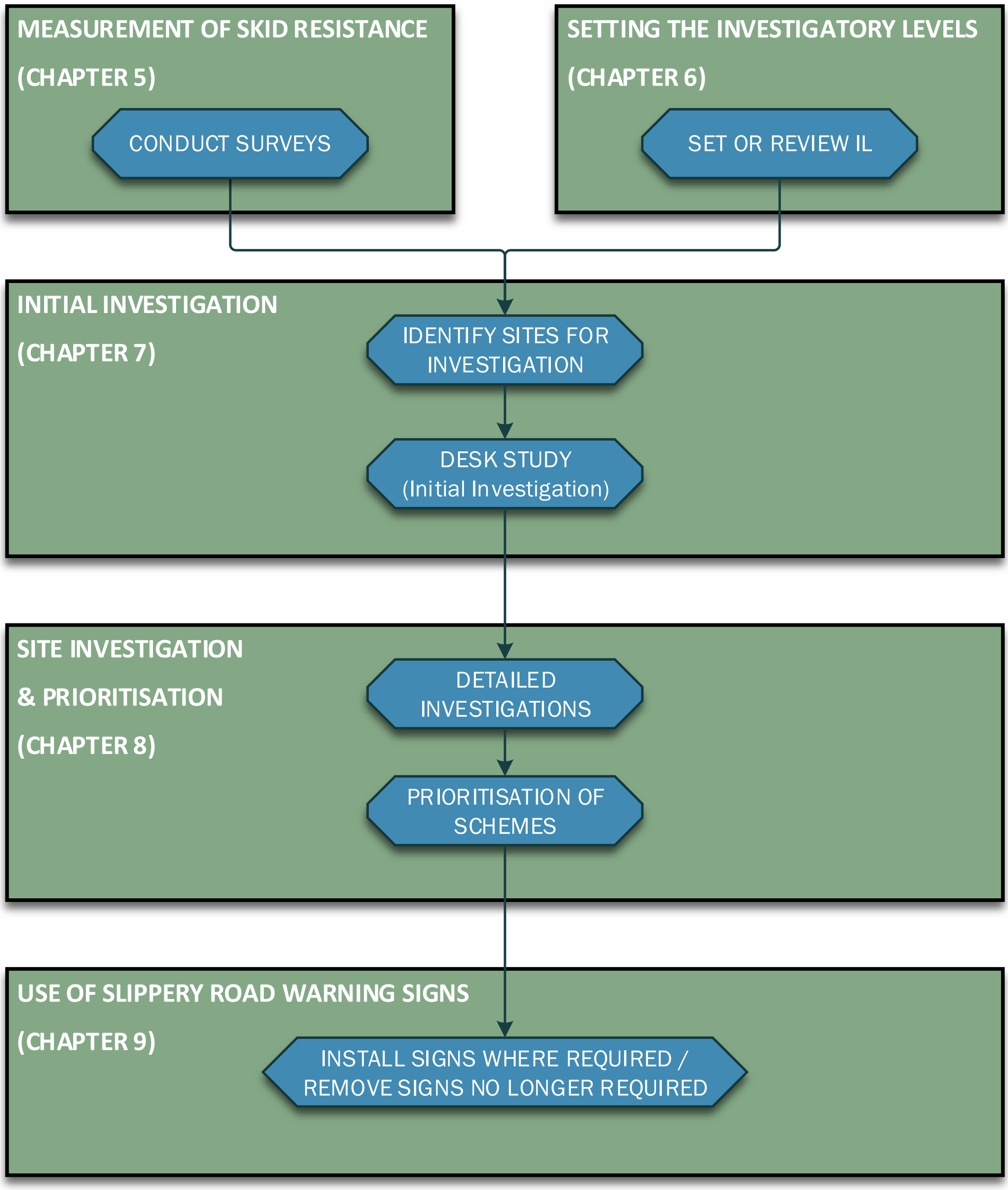


Figure 4.1 – Overview of the Operation of this Procedure

Routine measurement of skid resistance shall be measured by employing a SCRIM survey as appropriate and processed to derive a Characteristic SCRIM Coefficient (CSC) in accordance with chapter 5.

The CSC is an estimate of the underlying skid resistance once the effect of seasonal variation has been taken into account. This value is taken to represent the state of polish of the road surface. These terms are explained in Chapter 5 and Appendix 1.

On receipt of processed survey data, the CSC values shall be compared with the predetermined Investigatory Levels (ILs), to identify lengths of road where the skid resistance is at or below the Investigatory Level.

Investigatory Levels represent a limit, above which the skid resistance is considered to be satisfactory at or below which the road is judged to require an investigation of the skid resistance requirements. Site Categories are assigned based on broad features of the road type and geometry plus specific features of the individual site. Investigatory Levels are assigned according to the perceived level of risk within each Site Category. Investigatory Levels will be reviewed on a rolling programme, to ensure that changes in the network are identified. local experience is applied and consistency is achieved. The process for setting Investigatory Levels and the normal range of Investigatory Levels for each Site Category are described in Chapter 6 and Appendix 5

Wherever the CSC is at or below the assigned Investigatory Level an investigation shall be carried out to determine whether treatment to improve the skid resistance is required or whether some other action is required to be reviewed.

The investigation process is described in Chapters 7 and 8. The decision of whether treatment is necessary is unlikely to be clear-cut, but requires competent engineering judgement taking into account local experience, the nature of the site, the condition of the road surfacing and the latest available Department for Transport Road Safety Data.

The processes of setting Investigatory Levels and undertaking investigations are complementary, since local knowledge and experience gained through conducting detailed investigations can be used to refine the criteria for setting Investigatory Levels for similar types of sites within the authority.

The investigation process will result in a number of lengths being recommended for treatment to improve the skid resistance. The priority for treatment will be established through the defined process for prioritising maintenance if budget allows for these recommendations.

The following Table 4.1 shall form part of the Skid Resistance annual programme:

Date range	Activity	Delivery Date	Comment
Not Specific	Annual Review of Existing Slippery Road Warning Signs	Should be within 1 year of last review	
	Review Investigatory Levels	Should be within 3 years of last review	May choose to review one third of the network each year
Jan to April	Create and deliver to the survey contractor the network and sections to be surveyed	30th April Network shall be available for the contractor	The Council undertakes the Single Annual Survey.
May to Mid-June	SCRIM survey shall be undertaken if an “Early” survey is required	Survey contractor shall deliver the corrected CSC to the council within 30 days of the final survey date	The council may request the uncorrected data as soon as the survey is complete. However, the CSC data will also be supplied in accordance with the delivery date
Mid-June to Mid-August	SCRIM survey shall be undertaken if an “Mid” survey is required		
Mid-August to End of September	SCRIM survey shall be undertaken if an “Late” survey is required		
October (can be earlier if mid or early season survey)	Data shall be loaded into ExpertAssets for processing	Within 1 month of receipt of corrected CSC data all road sections requiring investigation shall be identified	The Council’s representative shall process the data through the configured rule set within ExpertAssets
November to June (can be earlier if mid or early season survey)	Road sections requiring detailed investigation shall have an on-site assessment carried out	Detailed site investigations shall be undertaken within 6 months of having been identified	ALL sites requiring signing OR treatment shall be identified for the forward works programme
	Erect Slippery Road Signs where applicable	As soon as Practicable after the treatment AND need for warning signs has been identified	Average deficiency <=-0.2 and/or > 75% polishing constitutes a need for a review of Warning Signs applicability
	Produce Treatment Priority List	Incorporate within production of works programme	Based on budget and priorities
	Undertake Remedial Treatment/ Action	Incorporate within works programme	Maintain and update record of maintenance works

Table 4.1- Annual Programme of Activities

5. Measurement of Skid Resistance

This section details the procedure for planning and conducting skid resistance surveys and processing the data. The process is outlined below and can be split into the 6 steps detailed in Figure 5.1.

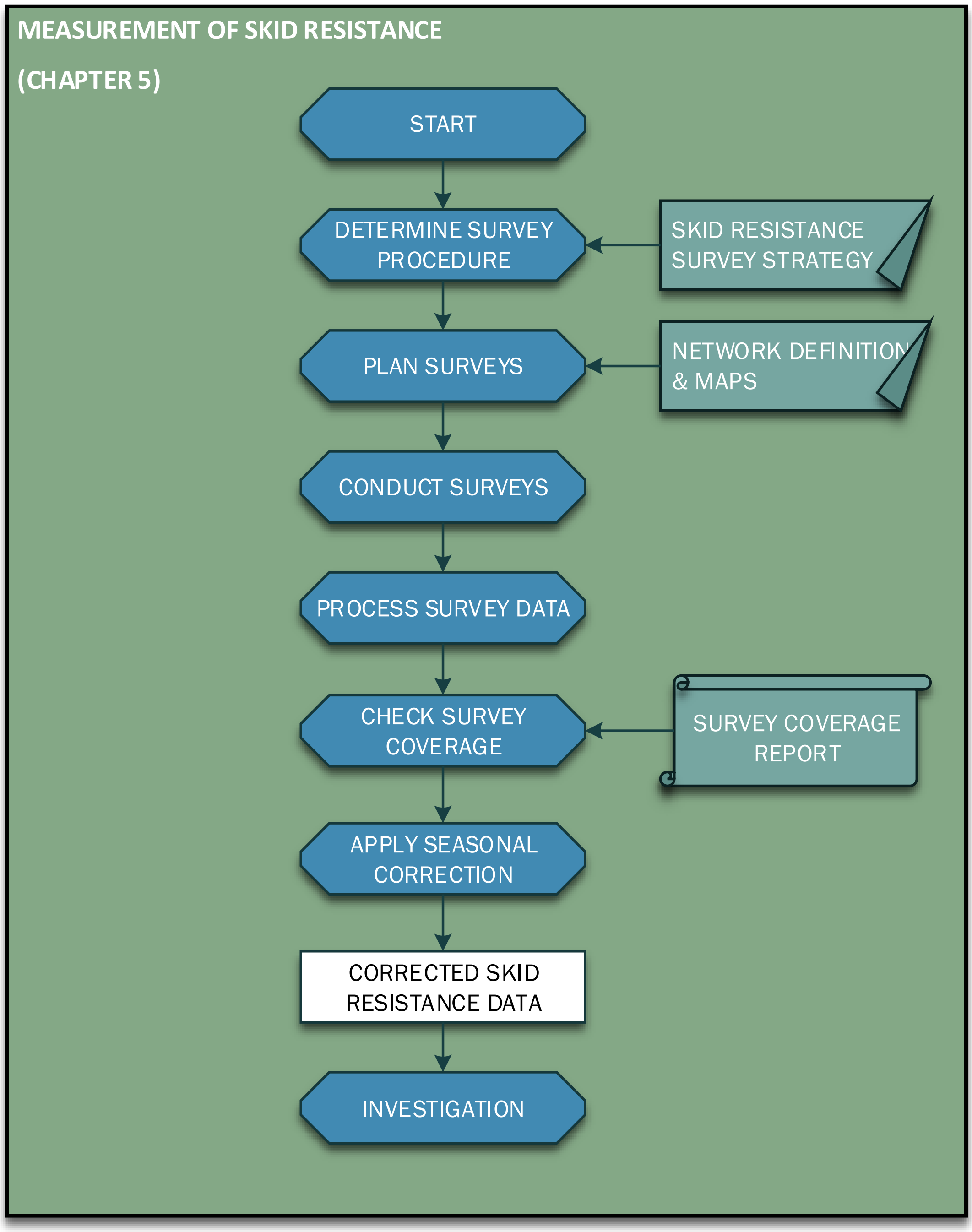


Figure 5.1 – Measurement of Skid Resistance

5.1. Determine the Survey Procedure

The skid resistance of road surfaces can fluctuate within a year and between successive years, while maintaining a similar general level over a long period of time. By smoothing these fluctuations due to seasonal effects, sites exhibiting lower skid resistance can be identified more accurately.

The basis of this Standard is that the overall (summer) level of skid resistance will be assessed rather than using a single measurement. This overall level of skid resistance is known as the Characteristic SCRIM Coefficient (CSC).

The Council has adopted the Single Annual Skid Survey. The method is detailed in Appendix 2 and in line with HD28/15 Annex 2. This will produce a CSC for each 10m sub-section of the surveyed roads.

Skid resistance is not a constant and is influenced by various factors such as test speed, temperature, weather conditions and also longer-term effects such as seasonal weather variations or change of traffic flows. With this in mind the measurements of road skid resistance shall be carried out annually between the dates of 1st May - 30th September.

5.2. Plan Surveys

The SCRIM network which will be subject to skid resistance testing is detailed in Appendix 3 and is subject to modification if there are changes in crash patterns or amendments to the network.

Following the release of the new Code of Practice for Well-Managed Highway Infrastructure whereby Authorities are encouraged to adopt a new ‘maintenance hierarchy’ the Council will review the existing hierarchy and the SCRIM survey shall be carried out on ‘maintenance hierarchies’ in the future. ‘Maintenance hierarchies’ will be subject to review and are likely to change and be updated. This will also reflect the ILs which relate to the changes.

An up to date network section list will be provided for the survey contractor to use. Both directions of each carriageway shall be surveyed, with lane 1 and lane 2 surveyed on dual carriageways or other multiple lanes defined within the sections held on the Pavement Management System.

The survey contractor will supply a list of road sections that are excluded from the survey with a reason for this exclusion, which will be reported back to the Council. Reasons for exclusions could include traffic calming schemes, speed humps and tables, width, height or weight restrictions, 20mph zones or road layouts where it is not possible or safe to maintain the survey speed; this is detailed in Appendix 3.

Surveys shall be planned so that they will occur during the required survey period (early, middle or late) to allow for the determination of CSC values. These survey periods will be defined so that the low point in the summer should occur during the middle period, as shown in Figure 5.2.

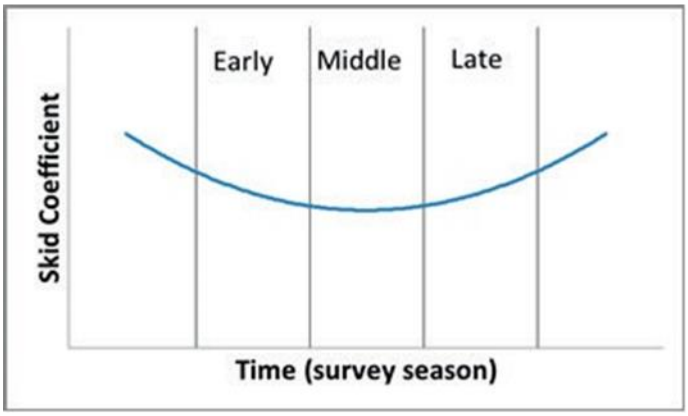


Figure 5.2 Seasonal Variation

The SCRIM network will be surveyed once during the testing season in each year. For continuity, the surveys are planned such that in successive years the network is tested in the early, middle, and late parts of the season as defined in HD28/15 and illustrated in Table 5.1 below:

Early	1st May -20th June
Middle	21st June -10th August
Late	11th Aug – 30th September

Season\ Year	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Early						
Middle						
Late						

Table 5.1 – Annual Survey Regime

This method will produce over 3 years the average CSC value for roads across the District and will take into consideration the effects of seasonal variation.

5.3. Conduct Surveys

Measurements shall be carried out with the test wheel in the nearside (left) wheel path of the lane to be tested.

If it is necessary for the machine to deviate from the test line (e.g. to avoid a physical obstruction or surface contamination) the data shall be marked as invalid and eliminated from the standard analysis procedure.

Roundabouts can present practical problems regarding potential traffic conflicts and testing speed. They range from small, mini-roundabouts to large grade-separated interchanges. Larger roundabouts may have free-flowing traffic or traffic light controls at certain times of day.

After entering a roundabout, a minimum of one complete circuit shall be tested. Where safe to do so, the preferred test line is the outermost lane. However, on multiple lane roundabouts with lane markings for different routes, it may be necessary to test an alternative lane to avoid conflict with other traffic.

A roundabout which cannot be surveyed is one where the survey speed of 50km/h cannot be safely maintained. These include mini roundabouts and small island roundabouts that are physically too small to test as above. These shall be tested as part of the main carriageway and do not need to be tested separately.

Measurements shall not be undertaken where the air temperature is below 5°C.

Testing shall be avoided in heavy rainfall or where there is standing water on the road surface. Excess water on the surface can affect the drag forces at the tyre/road interface and influence the measurements.

The target survey speed shall be 50km/h where this speed is permissible given the mandatory speed limit in force. The machine driver shall maintain a vehicle speed as close to the target test speed as possible. However, all speed limits, either temporary or permanent, must be obeyed regardless of the target survey speed. In addition, if it is not safe to maintain the target speed then a different speed may be used at the discretion of the driver. The safety of the machine and other road users shall take priority at all times.

Contamination of the road surface by mud, oil, grit, or other contaminants shall be noted and the results eliminated from the standard analysis procedure.

The survey operator shall maintain a record of weather conditions that could influence the survey results, such as heavy rainfall and strong wind.

5.4. Pre-Process Survey Data

Readings for each 10m sub-section collected within the speed range 25 to 85km/h shall be corrected to a speed of 50km/h using the following equation:

SR(50) = SR(s)*(-0.0152*s2 +4.77 *s +799)/1000

where:

SR(50) is the value of SR(s) corrected to 50km/h

SR(s) is the Sideway Force Coefficient, measured at test speeds, multiplied by 100. This term is defined further in British Standard BS7941-1.

Temperature correction shall not be applied for surveys carried out under the conditions set in this standard.

SC values shall be calculated for each 10m sub-section for which a valid SR(s) value is available using the following equation:

SC = (SR(50) /100) * Index of SFC

where:

The Index of SFC (Sideway Force Coefficient) is currently 0.78 and shall be applied to all survey machines in current use.

5.5. Check Survey Coverage

The survey contractor shall produce a survey coverage report detailing the network that was to be surveyed, lengths with missing or invalid data. An explanation for the missing or invalid data will be submitted with the survey data.

5.6. Apply Seasonal Correction

Once the data has been loaded and checked the seasonally corrected CSC values shall be determined from the SC values following the method described in Appendix 2 (Annex 2 of HD28/15).

6. Setting the Investigatory Level

An Investigatory Level (IL) shall be defined for every part of the SCRIM network, by determining which Site Category is most appropriate to each location and then selecting an appropriate IL from within the range for that Site Category. The objective of setting an IL is to assign a level of skid resistance appropriate for the risk on the site, at or below which further investigation is required to evaluate the site-specific risks in more detail.

In developing this procedure reference has been made to skidding resistance standard HD28/15 developed for Highways England. The site categories and associated Investigatory Levels defined in HD28/15 have been developed for the UK strategic road network (Trunk Roads and Motorways). Therefore, in formulating this procedure, it has been recognized that these standards may not be applicable to the more diverse nature of local authority roads. A table of approved Investigatory Levels is contained in Table 6.1. A schedule detailing the rationale for the Investigatory Levels and variations from HD 28/15 can be found in Appendix 5.

The process is outlined below and can be split into the 3 steps detailed in Figure 6.1.

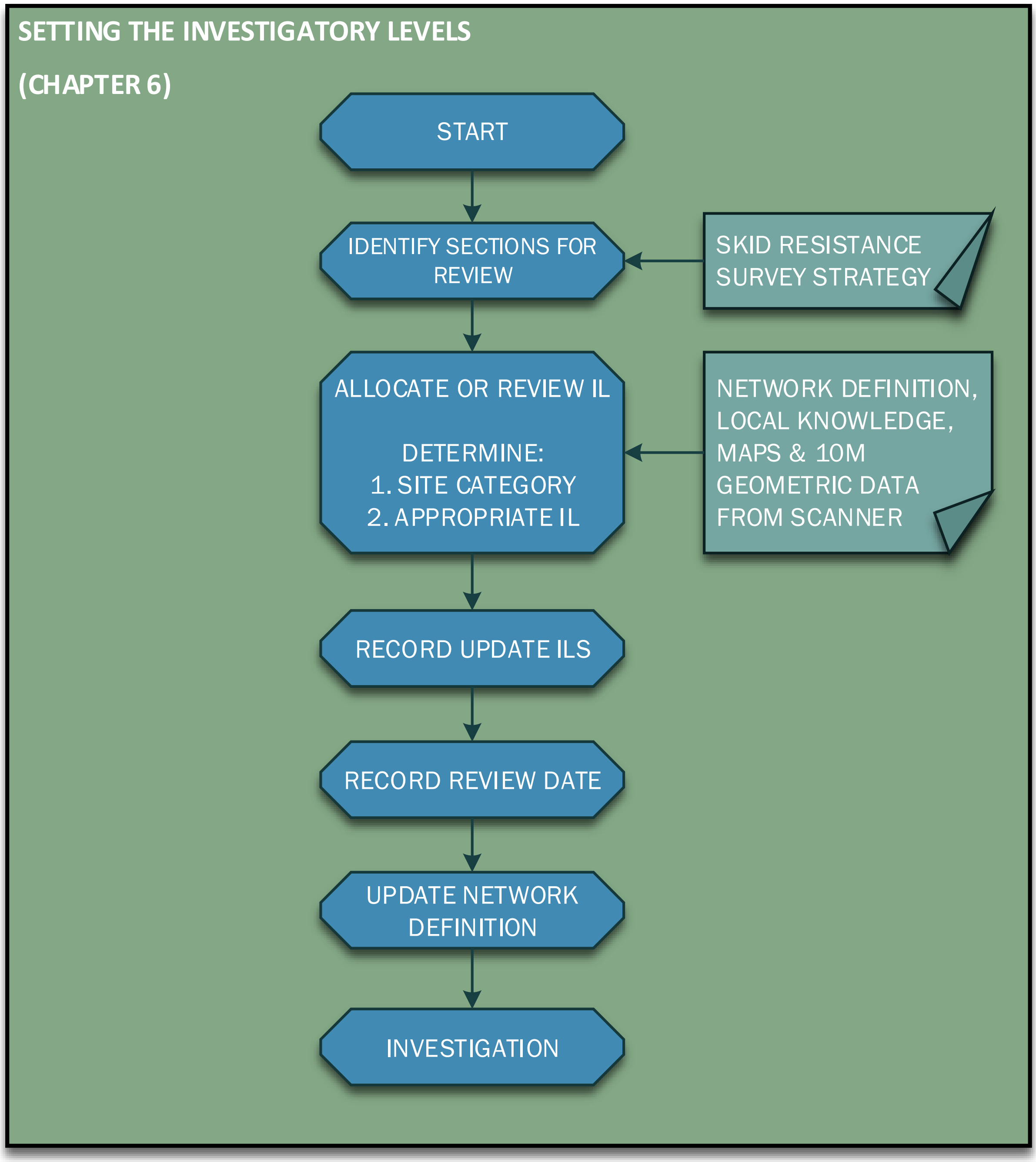


Figure 6.1 Setting the Investigatory Level

6.1. Identify Sections for Review

A review of the IL shall be carried out every three years or when a significant change to the network is made, for example, changes to the road layout, such as new traffic lights and pedestrian crossings and changes to speed restrictions.

6.2. Allocate or Review Investigatory Levels

Site categories and an associated range of ILs are defined in Table 6.1. The Site Category most appropriate to the layout of the site will be selected from the list in Table 6.1.

Site Category	Definition	Investigatory Level at 50km/h					
		0.30	0.35	0.40	0.45	0.50	0.55
A	Motorway (see Appendix 5)						
BR	Non-event Dual carriageway (see Appendix 5)						
BU							
CR	Non-event carriageway with two-way traffic (see Appendix 5)						
CU							
QX	Approaches to and across minor and major junctions and approaches roundabouts (see Appendix 5 and note 6)						
QR							
QU							
KR	Approaches to pedestrian crossings, traffic lights and other high-risk situations (see Appendix 5 and note 6)						
KU							
RR	Roundabout (see Appendix 5)						
RU							
G1R	Gradient 5-10% longer than 50m (see Appendix 5 and note 7)						
G1U							
G2R	Gradient >10% longer than 50m (see Appendix 5 and note 7)						
G2U							
S1R	Bend radius <500m – Dual carriageway (see Appendix 5)						
S1U	Bend radius <100m – Dual carriageway (see Appendix 5)						
S2R	Bend radius <500m – carriageway with two-way traffic (see Appendix 5)						
S2U	Bend radius <100m – carriageway with two-way traffic (see Appendix 5)						

Notes applicable to all:

1. The IL should be compared with the mean CSC, calculated for the appropriate averaging length
2. The averaging length is normally 100m or the length of a feature if it is shorter, except for roundabouts, where the averaging length is 10m
3. Residual lengths less than 50% of a complete averaging length may be attached to the penultimate full averaging length, providing that the Site Category is the same
4. As part of site investigation, individual values within each averaging length should be examined and the significance of any values that are substantially lower than the mean value assessed
5. Suffix R applies to Rural roads, subject to 50mph or above speed restrictions
   Suffix U applies to Urban roads, subject to 40mph or less speed restrictions
   Suffix X applies to roads subject to 70mph speed restriction
   Notes applicable to specific site categories
6. ILs for site categories QU and KU are based on the 50m approach to the feature and, in the case of approach to junctions, through to the extent of the junction. The approach length shall be extended when justified by local site characteristics. Similarly, QR and KR are based on an 80m approach
7. Categories G1 and G2 should not be applied to uphill gradients on Dual carriageways

Table 6.1 Site Categories and Investigatory Levels

After selecting a Site Category, the appropriate IL is assigned.

If more than one Site Category is appropriate, then the Site Category with the highest recommended IL will be selected. If the highest recommended IL for the site categories are the same, then the category highest up the Table shall be selected (A being the highest on the table and S2 the lowest). When defining site categories, no site shall be defined as being less than 50% of its averaging length. Where this occurs, the site should be included in either the preceding or following site, whichever has an IL nearest to and at or above the investigatory level of the site being defined.

6.3. Record Updated Investigatory Levels and Review Date

The sections reviewed shall be recorded, together with the review date and any changes to the site categories and ILs that may be reviewed.

7. Initial Investigation

All sites where the measured CSC is at or below the IL shall be investigated. The objective is to determine whether a surface treatment is justified to reduce the risk of vehicles skidding, whether some other form of action is required, or whether no action is currently required.

The investigation may be undertaken in two stages: an initial automated investigation, described in this chapter to check the data and assess the need for a detailed investigation and secondly, a detailed investigation to assess the justification and priority for treatment, which is described in the next Chapter. The process is outlined below and can be split into the 4 steps detailed in Figure 7.1.

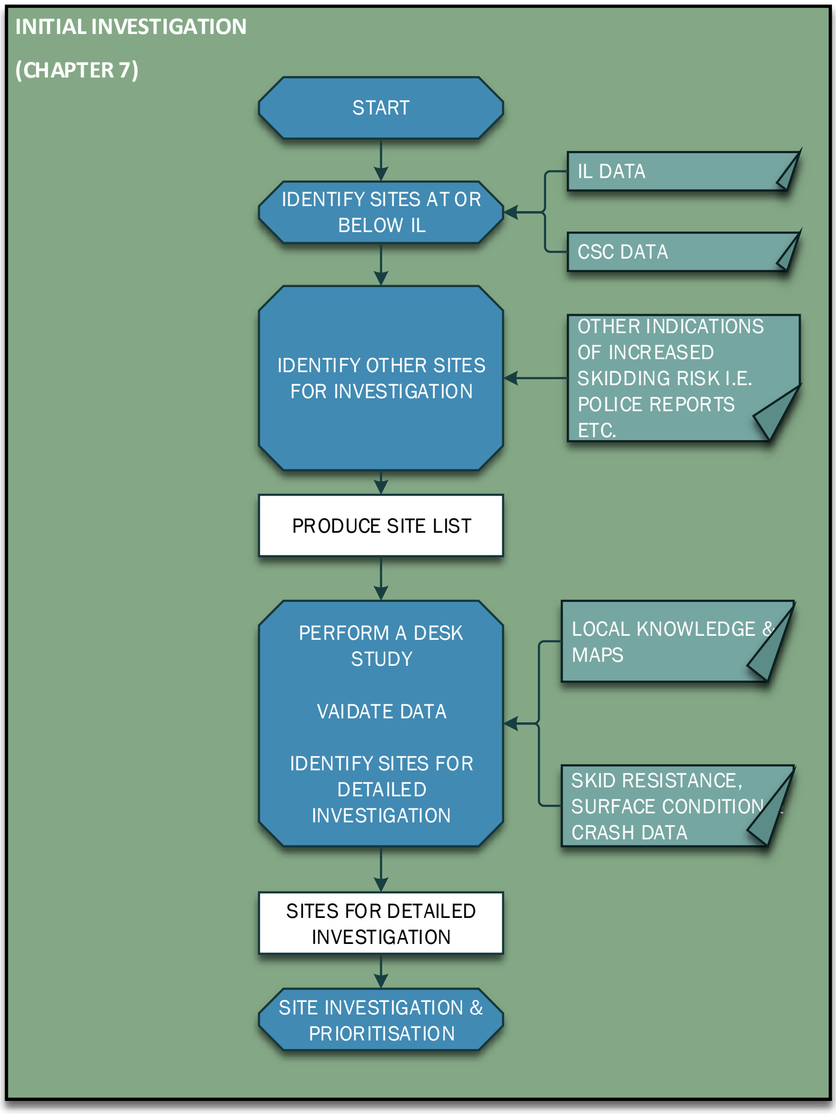


Figure 7.1 Initial Investigation

7.1. Identify Sites at or below the Investigatory Level

The mean CSC for 100m averaging lengths should be calculated for comparison with the IL, except that 10m averaging lengths should be analysed for roundabouts (Site Category R). The averaging length shall be truncated on any change of Site Category or IL; consequently, the averaging length will be shorter where the Site Category is less than 100m long or at the end of a Site Category longer than 100m. Residual lengths less than 50% of a complete averaging length will be appended to the penultimate length, if both the lengths have the same IL. Therefore, site lengths will range from 50-149m in length (except for roundabouts).

7.2. Identify Other Sites Requiring Investigation

An investigation shall also be carried out if, as a result of processes separate from this procedure, sites are identified where increased wet or skidding crash levels have been observed. Examples include Annual Safety Reports, Police complaints, local observations and damage to roadside furniture. These sites shall be subject to a detailed investigation.

7.3. Data Validation

Basic data validation checks shall be conducted for sites that have been identified as at or below the IL. This shall include confirming that the IL has been assigned correctly in accordance with current guidance and that the skid resistance recorded is within the normal range expected.

If the IL is incorrect then it shall be updated and recorded together with the date of the change. If the skid resistance is above the revised IL, then further investigation is unnecessary and the change of IL should be recorded as the outcome of the investigation.

7.4. Identify Sites for Detailed Investigation

Sites at or below IL requiring detailed investigation should be identified based on the Site Category, IL, current skid resistance and observed crash history.

A list of sites requiring detailed investigation shall be produced using ExpertAssets© within 1 month of receipt of the CSC data.

The identification of sites requiring detailed investigation (the initial site score) can be carried out as detailed in Appendix 6, which is based on the alternative method detailed in Annex 7 of HD28/15. (The alternative method is an alternative to the crash model, which has been developed specifically for the Highways England road network. It is not appropriate to use this crash model on a network outside of the Highways England network).

8. Detailed Site Investigation and Prioritisation

A detailed investigation is undertaken to collate and assess the information available for each site in order to reach a decision about the best course of action. These detailed investigations are carried out on the sites identified from the initial investigation.

The process is outlined below and can be split into the 4 steps detailed in Figure 8.1.

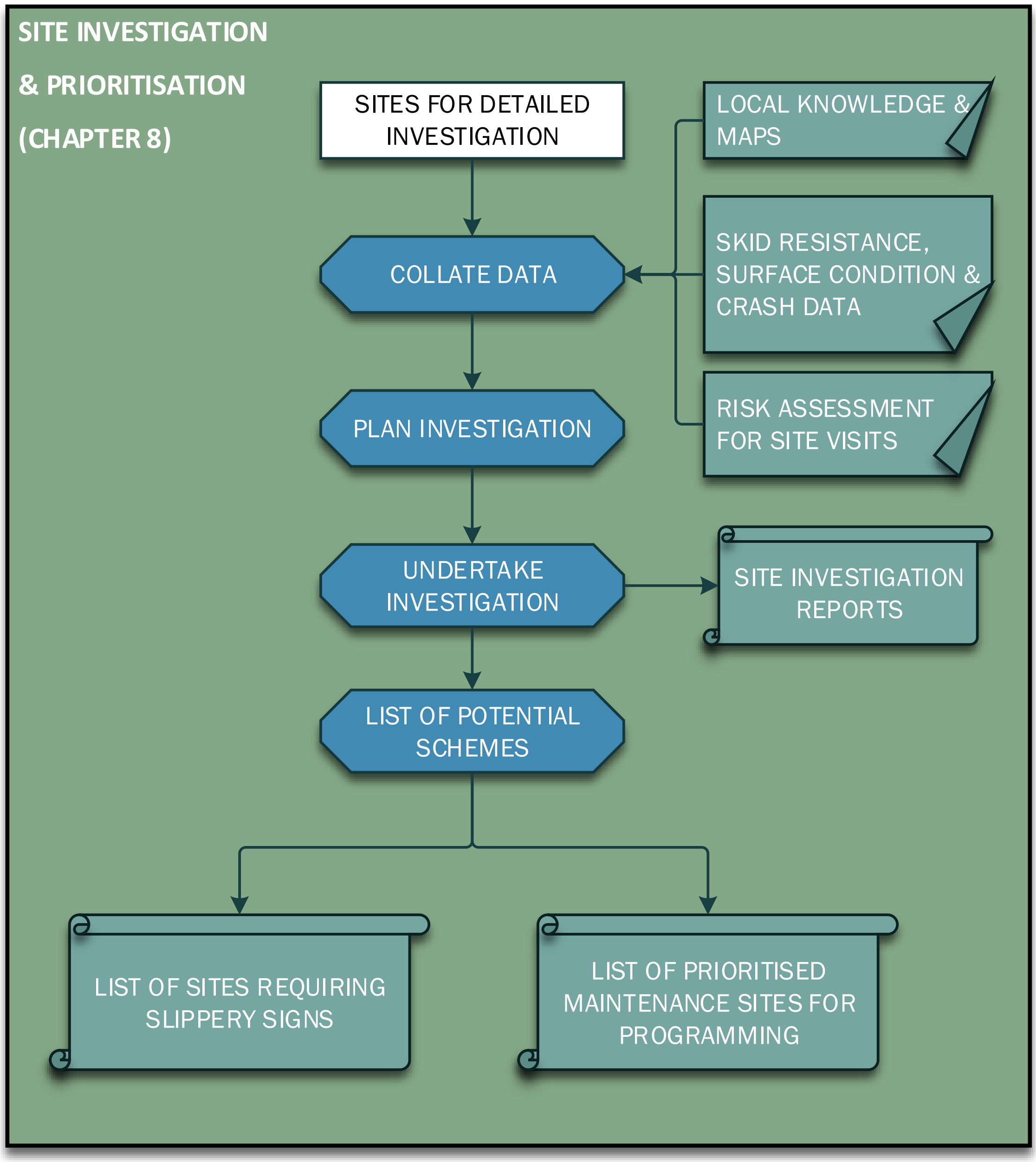


Figure 8.1 Detailed Site Investigation and Prioritisation

8.1. Collate Data

As a minimum, the data collected shall include skid resistance, texture depth and the latest available Department for Transport Road Safety Data.

Skid resistance data at 10m intervals for bends and roundabouts shall be obtained, because short lengths with low skid resistance could be hazardous for vehicles cornering. These shall not be disguised by being averaged over a longer length.

Skid resistance data at 10m intervals shall also be obtained if the condition of the surfacing material is known to be variable over local areas.

The SCANNER defects of rut depth, longitudinal profile, gradient, cross-fall and curvature data should be reviewed to establish if they are relevant. i.e. if the site has poor transverse or longitudinal evenness, or bends or gradients. In some instances, these data assist in checking whether the Site Category and/or Investigatory Level are correct or need amending. Information on the date of last surface treatment if available may also be relevant to the investigation and the interpretation of collision data.

For each site, the relevant data should be collated to show the location of lengths with poor surface condition relative to the location of previous crashes and features such as bends, junctions, etc. This data will be collated as strip diagrams and GIS mapping.

The location of crashes occurring in wet conditions, irrespective of whether skidding was reported, should be identified specifically where possible.

The latest available crash data is supplied nationally and is updated on an annual basis. (2015 crash data became available in July 2016). The data set can be downloaded from the following web address: https://data.gov.uk/dataset/road-accidents-safety-data

Given the limited accuracy of locating crash positions, it may be assumed for the purpose of this investigation that the position of a crash coincides with a Site if it occurred within 75m for urban roads (40 mph or less) and 200m for rural roads (50mph or greater). However, crashes in excess of 75m/200m can be 'tagged' to the site and crashes within the 75m/200m boundary can be 'untagged' if their location is deemed to not be relevant to the specific site. For example, there are some crashes that are within 75m of a site that occur on roads parallel to the site but cannot be accessed from the site.

Note: HD28/15 states a 200m buffer, but after reviewing the accuracy of the location of crashes, particularly in urban areas, it was deemed more appropriate to set a buffer of 75m for urban roads (40mph or less); the rationale for 75m is that the stopping distance for 40 mph in the wet *is 72m (75m accommodates a further 3m for location accuracy). Far too many crashes automatically tagged were clearly not relevant to the site as there were on parallel roads, etc.*

The overall crash risk shall be calculated for the site for comparison with control data.

8.2. Plan Investigations

Investigations should be planned primarily to maximize efficiency. Greater priority should be given to completing investigations for sites that are substantially below the IL or where the crash history indicates that there is a risk of wet skidding crashes occurring.

All site visits will be undertaken by appropriately qualified personnel and wherever possible undertaken on foot.

The following methods/information/media can be used to supplement the information collated by the site visit:

- A driven site visit, often undertaken immediately before and/or after the on-foot site inspection (this allows the pattern of traffic movement and speed to be observed during the visit, but has associated safety risks that shall be controlled).
- Recent local knowledge of the site (this may provide a more general knowledge of the road usage under a wider range of traffic, weather and lighting conditions).
- Video records and maps. Note: maps should not be used in isolation as they do not show obstructions to visibility, drainage issues, field accesses, hidden dips etc.

8.3. Undertake Investigations

Detailed site investigations shall be undertaken within 6 months of having been identified.

Site investigations shall consider the factors detailed below and shall be carried out by personnel with suitable experience and/or qualifications. An example template of a site investigation form is given in Appendix 8.

The level of detail appropriate for this investigation will depend on the nature of the site and the time since a detailed investigation was last carried out. Many of the points listed are only relevant to more complex sites. If the site has been investigated recently, then it will only be necessary to identify the changes that have occurred since the last investigation was carried out.

The full carriageway width should be included in the investigation. e.g. all lanes of a dual carriageway and both directions of a single carriageway. In addition, all junction approaches should also be investigated to determine whether the advance signing/alignment etc. is adequate or could be improved.

When carrying out site investigations it should be borne in mind that skid resistance and texture depth are generally measured in the nearside wheel track. If, during a site investigation, the rest of the pavement is not visually consistent then it is possible that the skid resistance of the rest of the lane or other lanes could be lower than the line tested. In these cases, it may be necessary to carry out additional surveys to investigate this or duplicate this survey to confirm the findings.

If a site contains a sharp bend to the left in combination with traffic braking or accelerating, then the offside wheel path can become more polished and the CSC can be up to 0.05 units lower than in the nearside wheel path. If present, this should be taken into account during the detailed investigation.

Determine if the skid resistance is likely to be representative for the site; in particular, very low values should be viewed with caution. Localised reduction in the skid resistance can be caused by contamination or by fatting up of the binder. Alternatively, it is possible that there has been an error in the survey. In this case, the data should be compared to data measured in previous years and also with adjacent lengths with the same surfacing material, to determine if the skid resistance is representative of the condition of the surfacing material. If it is considered that the reduction in skid resistance is temporary and not representative for the site, then this should be recorded with reasons. Further investigation is not needed at that time, but if subsequent surveys continue to appear unrepresentative then the causes should be investigated.

As a result of the investigation, a clear recommendation shall be recorded of the actions to be taken (including if no immediate action is required).

If the site investigation identified any characteristic of the site or road user behaviour that suggests other road safety engineering measures could be appropriate, then persons with relevant local experience, such as the person locally responsible for crash investigation and prevention, should be consulted.

If the site investigation identifies requirements for additional routine highway maintenance, such as sweeping, renewal of markings etc. then appropriate action shall be taken.

Treatment to improve the skid resistance should be recommended if, taking into account the nature of the site and the observed crash history, it is likely to reduce the risk of crashes in wet conditions. Based on knowledge of skid resistance and crash risk trends, this includes locations where the position of crashes in wet conditions (whether or not skidding was reported) appears to be linked to surface condition, or where the overall crash risk is higher than average when compared with suitable control data.

If treatment is only required on part of the site, then particular care should be taken to identify the lengths where treatment is required, this should be reviewed by an engineer on site to confirm these areas / limits.

Treatment should also be recommended if the skid resistance, combined with the nature of the individual site, suggest that the observed crash count underestimates the actual level of risk. In this case, preventive treatment is justified to pre-empt a potential increase in crashes.

If there is no justification for treatment, then no further action shall be required.

The results of the investigation shall be documented and retained together with the identity of the assessor and other parties consulted.

8.4. Prioritise and Programme Maintenance

Budgeting and programming issues will influence when the treatments are carried out and this process should be managed through the Council's process for prioritising maintenance.

Ranking of skid resistance maintenance schemes takes into account the findings of the site investigations which include:

- Average Deficiency
- Wet Skid Crashes
- On site questions as detailed in Appendix 7 (Table A.7.2)

The most appropriate form of treatment will be identified for each site which is found to require remedial works and to restore an adequate level of skid resistance. Often this will include a surface treatment. However, if site investigations should identify different defects or an issue with the behaviour of road users which an engineering measure may be able to resolve, then the relevant department within the council will be notified to identify the best course of action to be taken.

WYCA+ has produced a risk based methodology for the identification and prioritisation of proposed treatments and actions as detailed in Appendix 7. This provides an auditable objective process to the identification and prioritisation based on the results from the detailed on-site investigations and other available information.

The final programme of works will be based on the available budget and Council priorities. The final list of schemes shall be reported in accordance with the procedures detailed in the Highways Infrastructure Asset Management Policy.

9. Use of Slippery Road Warning Signs

Slippery road warning signs are erected to warn road users of sites where the skid resistance is substantially low. Those sites with a deficiency <=-0.2 and longer than 50m may result in an increased risk of collision to road users and shall be signed prior to treatment.

The process is outlined below and can be split into the 3 steps detailed in Figure 9.1

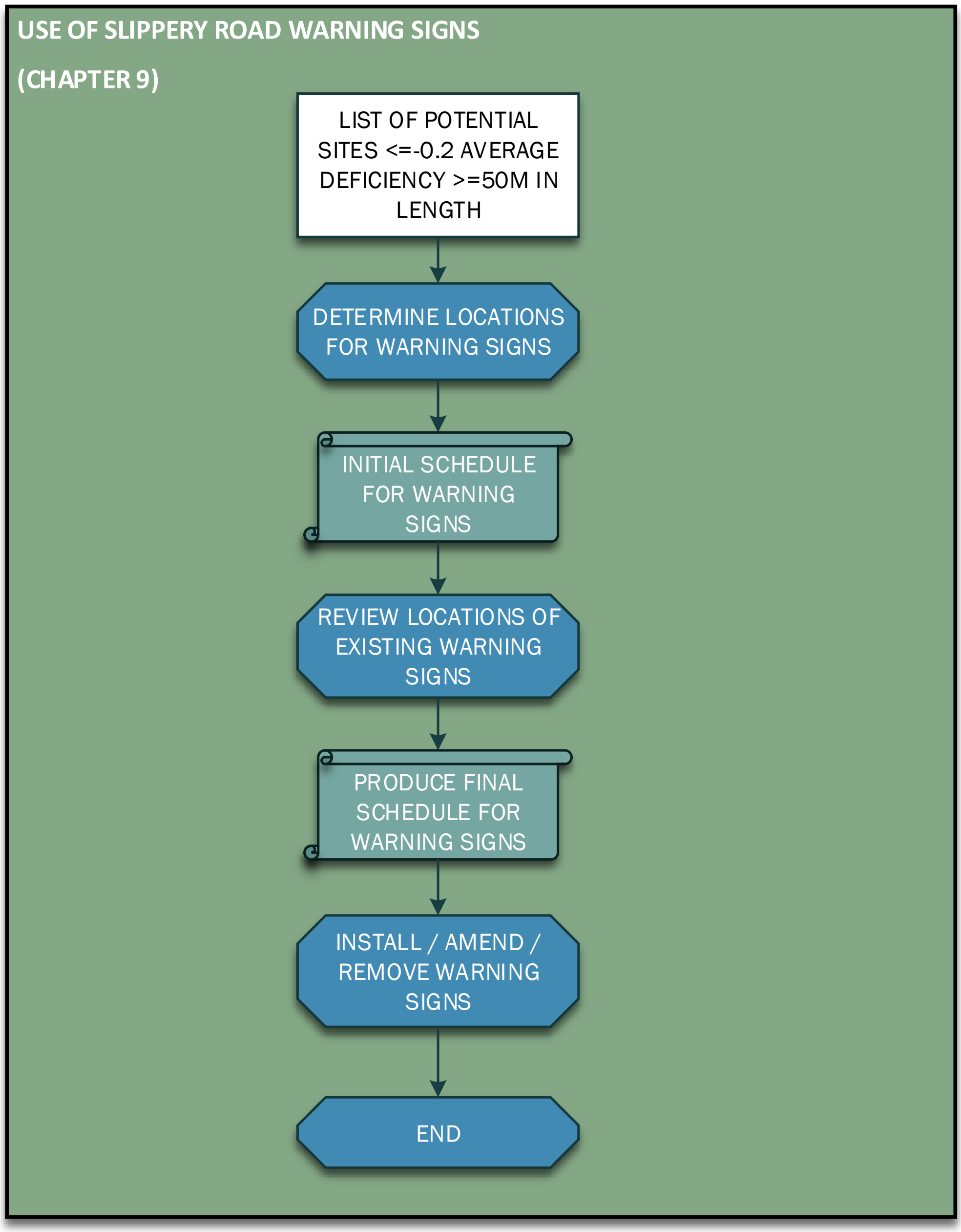


Figure 9.1 Use of Slippery Road Warning Signs

9.1. Determine Locations Requiring Warning Signs

Sites which have been identified as requiring treatment to improve the skid resistance shall have 'slippery road' warning signs erected where it is deemed appropriate. Such signs will not automatically be used on every scheme only to advise the road users where an engineer has reviewed all the information available to them.

'Slippery road' warning signs shall not be used in connection with newly-laid asphalt road surfacing materials see Appendix 1 "Early life skid resistance of asphalt surfacing" (HD28/15 Annex 1. A.1.24 to A.1.26).

Once the location of sites requiring warning signs has been identified, a schedule for warning signs shall be produced.

9.2. Review Locations of Existing Signs

The skid resistance at the location of all existing slippery road warning signs shall be reviewed to determine whether the sign is still needed. This review should occur annually and once completed the schedule for warning signs shall be updated to include the signs which require removal.

9.3. Install/ Amend/ Remove Warning Signs

Warning signs shall be installed as soon as practicable after the need for treatment has been identified, on sites which have an average deficiency <=-0.2. They shall then be removed as soon as practical after treatment has been applied.

The 'slippery road' warning sign (Diagram 557) in conjunction with an appropriate supplementary plate (Diagram 570) must be used in accordance with the Traffic Signs Regulations and General Directions and Chapter 4 of the Traffic Signs Manual.

Short individual lengths requiring warning signs should be merged if they are separated by less than 1km.

For the purpose of legal proceedings, it is essential that records of the erection and removal of slippery road warning signs shall be kept, including works orders issued and inventories.

A visual inspection of the site shall be made after the signs are erected to confirm that they have been erected and correctly placed and a record of this observation shall be made and retained.

10. Records

In order to maintain accurate and up to date information it will be necessary to formally record skid resistance data and this will be done as follows:

All verbal and written enquiries regarding skidding matters on the surveyed network will be registered onto a customer enquiry system.

The following records shall be maintained to demonstrate the ongoing operation of this procedure:

- Investigatory Levels for the surveyed road network, including justification for any deviation from the recommendations of HD28/15
- Skid testing results and data analysis
- Site investigation findings for sites assessed
- A record of sites where and when slippery road warning signs have been erected showing subsequent removal dates where appropriate
- Priority lists of sites for remedial treatment to restore an adequate level of skid resistance
- Details of completed works programs, relating to remedial treatment for substandard skid resistance

11. References

- County Surveyors Society – Code of Practice for Highways Management – Section 9.7 Skidding Resistance Measurement Requirements (Revision F).
- County Surveyors Society – CSS Guidance Note – The Use of High Friction Surfaces (January 2010).
- Design Manual for Roads and Bridges.
  HD28 (DMRB 7.3.1) Skid Resistance.
  HD29 (DRMB 7.3.2) Data for Pavement Assessments.
  HD36 (DMRB 7.5.1) Surfacing Materials for New and Maintenance Construction.
  HD37 (DMRB 7.5.2) Bituminous Surfacing Materials and techniques.
- Highways Act 1980.
- LR738; Hosking, J. R. and Woodford, G. C. Measurement of Skidding Resistance Part ii: Factors Affecting the Slipperiness of a Road Surface, TRRL, 1976
- The Traffic Signs Regulations and General Directions 2016.
- TRL Report TRL622 - Accidents and the Skidding Standards for Strategic Roads in England.
- Well-managed Highway Infrastructure: A Code of Practice.

Appendix 1 – Background Information on the Measurement and Interpretation of Skid Resistance for Highways England

Note: This Appendix is a copy of Annex 1 of HD28/15

What is Skid Resistance?

The contribution of the road surface to the overall friction available between the tyre and the road surface is known as skid resistance. The skid resistance of a wet or damp road surface can be substantially lower than the same surface when dry, and is more dependent on the condition of the surfacing. For this reason, measurements of skid resistance for the purpose of routine condition monitoring are made on wetted road surfaces.

How is it generated?

The level of (wet road) skid resistance is dependent on two key properties of the surface, the microtexture and the texture depth. The fine scale microtexture, provided by the surface of aggregate particles or by the fines in the mixture, is the main contributor to skid resistance at low speeds and the main property measured in wet skid resistance tests. Greater texture depth generates friction by physically deforming the tyre surface and also provides rapid drainage routes between the tyre and road surface.

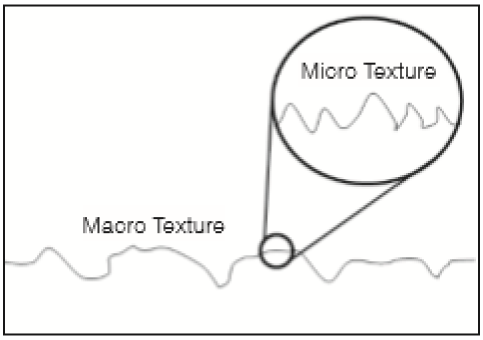


Figure A.1.1 Macro Texture and Micro Texture

The effects of microtexture and texture depth combine to influence the skid resistance at higher speeds.

Under the action of traffic, the microtexture becomes 'polished', leading to a reduction in skid resistance. HD36 (DMRB 7.5.1) requires the components of the surfacing mixture to satisfy certain criteria in relation to their resistance to polishing, so that surfacing materials generally provide adequate skid resistance during their service lifetimes.

Relationship with crash risk

Within normal ranges, low skid resistance does not cause crashes although depending on the particular circumstances, it may be a significant contributory factor. The level of skid resistance, even on a polished surface, will generally be adequate to achieve normal acceleration, deceleration and cornering manoeuvres on sound surfaces that are wet but free from other contamination. However, higher skid resistance is required to allow manoeuvres that demand higher friction to be completed safely, e.g. to stop quickly or corner sharply. Higher skid resistance can therefore reduce crashes in cases where drivers need to complete a more demanding manoeuvre in order to avoid a crash. A key part of this Standard is the judgement of locations where this is more likely to occur, so that the provision of higher levels of skid resistance can be targeted at these locations.

Crash analyses have shown that there are relationships between measured skid resistance and crash risk. These relationships are not precise, in that differences in skid resistance may account for only a relatively small part of the difference in crash risk between individual sites because of all the other factors involved. Nevertheless, they have allowed general conclusions to be drawn that make it possible to provide guidance for managing the provision of skid resistance on the network.

The influence of skid resistance on crash risk is markedly different for roads with different characteristics. For this reason, Site Categories have been defined to group roads with similar characteristics.

For some Site Categories, no statistically significant relationship, or only a weak relationship is observed between skid resistance and crash risk. A good example of this is motorways, where the road design has effectively reduced the potential for conflict between road users. Although the skid resistance is still important because of the need to provide uniform road characteristics, the level of skid resistance can be lower than other categories.

For other Site Categories, progressively more crashes are observed on average, as the skid resistance falls. For these categories, there are benefits in maintaining a higher level of skid resistance to contribute to reducing the number of crashes at these sites.

However, not all sites within a single category are equivalent in terms of their crash risk. Figure A.1.2 illustrates the range in crash risk present for individual sites within a single Site Category. This range is not surprising when the range of characteristics present within a single nominal Site Category is considered. e.g. in road design and traffic flow. It should also be noted that there is no boundary at which the skid resistance passes from being ‘safe’ to being ‘dangerous’.

Judgement of the relative crash risk and appropriate level of skid resistance for different sites within the same category therefore forms a key part of the effective operation of this Standard.

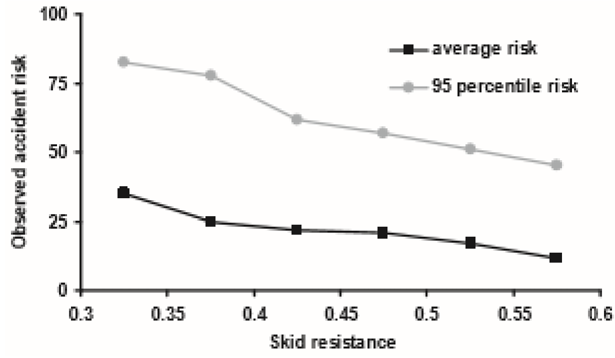


Figure A.1.2 Crash risk and skid resistance – variation within Site Category

Measuring skid resistance

Road surface skid resistance is monitored to identify areas where the micro texture has been lost due to the surface being polished by traffic. In these cases, treatment might be needed to improve the skid resistance. This is necessary because the performance in service cannot be predicted precisely from the properties of the surfacing components and traffic levels, and the effects of weather, traffic and other influences may be different to what was anticipated at the time the surfacing was designed.

Similarly, the texture depth of road surfaces can reduce with time under the combined influences of traffic flow, temperature and the nature of the surface. Therefore, texture depth is also regularly monitored in accordance with HD29 (DMRB 7.3.2).

Various types of equipment are available for measuring skid resistance. They use different measurement principles although, in different ways, all measure the force developed on a rubber tyre or slider passing over a wetted road surface and derive a value that is related to the state of polish of the road surface. In spite of many attempts to determine a correlation between devices, there is currently no reliable method for converting between measurements of different types.

Skid resistance is influenced by the measurement principle employed, the slip ratio (described below), the vehicle speed, test tyre and water depth; it also varies during the year as a result of seasonal effects. For this standard the effect of these factors are removed by either standardisation (e.g. specified slip ratio and test tyre) or are corrected to a standard condition (e.g. seasonal correction and speed correction). Skid resistance is also influenced by temperature, although this effect is relatively small for the normal temperature range in the UK and is ignored under this Standard.

The slip ratio is the ratio of the speed at which the test tyre slides over the surface (the slip speed) to the speed of the survey vehicle (the survey speed), normally expressed as a percentage. Devices which are suitable for routine measurements of a network have a slip ratio of less than 40%. For example, when a Sideway-force Coefficient Routine Investigation Machine (slip ratio 34%) carries out a test at 50km/h, the test wheel is sliding at a slip speed less than 20km/h.

Measurement devices using different principles, including in Police braking tests are used for research and investigation purposes. The results are not directly comparable with those from Sideway-force Coefficient Routine Investigation Machines and they do not form part of this Standard.

Since friction reduces with increasing speed, the level of skid resistance reported from routine measurements (the road surface contribution to friction) will be higher than that experienced by road users during a skid.

The reduction of friction with speed depends on surface type and texture depth. As such, sites with low skid resistance and low texture depth should be prioritised. The typical reduction of friction experienced by traffic with speed and the influence of texture depth is illustrated in Table A.1.1. The effect of texture depth becomes apparent at speeds as low as 50 km/h, but is increasingly significant at higher speeds.

Table A.1.1 Typical reduction in skid resistance experienced by traffic compared with sideways -force coefficient routine investigation machines measurement

Speed	Texture depth (mm SMTD)		
	Below 0.5	0.5 – 0.8	Above 0.8
50 km/h	40%	30%	25%
120 km/h	70%	60%	50%

Seasonal variation of skid resistance

After the initial period of wearing in, road surfaces reach an equilibrium state of polishing. For roads where the traffic level is constant, the skid resistance will then fluctuate through seasonal variations, weathering and polishing cycles but will usually remain at about a constant level for many years. If the traffic level subsequently increases or decreases the position of the equilibrium may shift so that a lower or higher overall level of skid resistance is observed, but with the same seasonal fluctuation superimposed.

An example of long term variation in skid resistance is shown in Figure A.1.3. A suggested explanation for the annual variation is that in the winter (October to March) when the roads are wet for much of the time, the detritus is mainly gritty so that the road surface becomes harsh and the skid resistance rises. The lowest skid resistance is generally observed in the summer period, when the roads are wet for a relatively short time, the detritus on them is mainly dusty so that the road surface becomes polished and the skid resistance falls. Also, other contaminants such as oil and tyre rubber (which act as lubricants and hence reduce the available skid resistance) can build up on the surface, particularly between the wheel paths. In practice, the minimum skid resistance varies from year to year and occurs during different periods depending on the prevailing weather conditions.

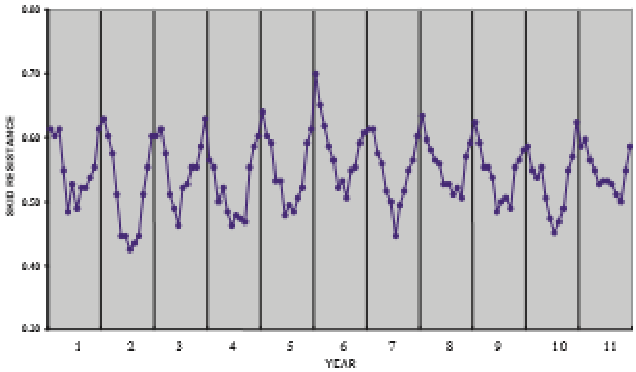


Figure A.1.3 Long term variation in skid resistance (from LR 738)

Because the skid resistance varies continuously various strategies have been developed to provide a measurement that characterises the state of polish of the micro texture. Survey strategy and processing procedures are designed to reduce the effect of the variation within a year and/or between successive years, so that sites with low skid resistance can be identified more accurately. Typically, measurements are made during the summer period, when the lowest measured values are observed.

The strategy for providing a measurement that characterises the state of polish of the micro texture is detailed in Appendix 2.

Early life skid resistance of asphalt surfaces

New asphalt surfaces exhibit different skid resistance properties in the initial period after laying compared with the same materials that have been exposed to traffic for a period of time. This phenomenon is not within the scope of this document, which is concerned with in-service condition rather than the properties in the initial period.

A substantive review of the tyre/road friction characteristics and accident risk associated with newly-laid asphalt materials showed that the risks were smaller and different to those initially envisaged and that the options for mitigation are limited and would not be cost-effective.

Sections of road that exhibit these different skid resistance properties shall be identified so that they can be excluded from certain types of analyses, as described in Chapter 5 and Appendix 2 of this Standard. The duration of this initial phase will depend on local conditions but, for the purpose of interpreting skid resistance measurements, it is assumed that the surface has reached an equilibrium state one year after opening to traffic on the strategic road network in the UK.

Appendix 2 – Single Annual Skid Survey (SASS) Approach to Calculation of CSC

Note: This Appendix is a copy of Annex 2 of HD28/15

Overview of SASS approach

This approach is based upon a single annual survey of the network. The method uses measurements from the preceding 3 years to characterise the long-term skid resistance of the network. This value is used with the mean network skid resistance in the current year to calculate a correction factor which is applied to the current year's data to make current values consistent with the long-term average.

Benefits of SASS approach

The SASS approach only requires one survey for each section in each year. It is therefore economically viable to survey the whole network each year and produce yearly CSC values.

Variation of skid resistance both within and between years can be taken into account by using the SASS approach.

It is possible to determine the correction factors (and therefore supply CSC values) after the end of each survey period rather than at the end of the survey season.

Shortfalls of SASS approach

The processing of the survey data in order to determine the correction factors can be labour intensive.

The SASS approach takes account of yearly variation and therefore the calculations are affected by maintenance carried out in the last three years. As such, sections which have had resurfacings carried out in the last three years have to be identified and removed from the calculation procedure for the correction factors.

If a survey is undertaken outside of the designated survey period then additional processing of data is required to calculate a correction factor. The resulting correction factor is less suitable resulting in less accuracy in the CSC value. Surveys undertaken outside of the target survey period for the current year can also reduce the accuracy of correction factors calculated in the next three years.

SASS approach calculation procedure

The effect of seasonal variation will vary in different geographical areas (e.g. due to different amounts of rainfall), therefore larger networks will be split into smaller localities and the correction factor will be determined and applied separately within each locality.

The whole network shall be surveyed once during the Testing Season in each year. Surveys shall be planned such that in successive years each road length is tested in the early, middle and late parts of the season.

For example, a route tested in the early part of the season in year 1 could be tested in the late part of the season in year 2 and in the middle part of the season in year 3. In year four it will be tested in the early part of the season again, etc.

Each site on the network shall be allocated to a locality by the Overseeing Organisation.

A **locality** is a collection of road sections or routes for which a correction factor will be determined. A locality should be small enough so that similar weather conditions will normally be experienced within it and large enough so that a stable value can be calculated to represent the long-term skid resistance. This approach is based on the assumption that the climatic effects leading to seasonal variation influence all the roads in a local area in a similar way.

The **Local Equilibrium Correction Factor** (LECF) is the correction factor determined within each locality to bring the current year data to a level consistent with the long-term average.

By surveying all road sections within a locality at the same time, this method can remove a component of the within-year seasonal variation as well as the variation between years.

All the road sections within each locality shall be surveyed within the same part of the test season.

The LECF is calculated in three stages:

i. The **Local Equilibrium SC** (LESC) is determined to represent the average skid resistance level for the locality over recent years. The LESC is the average SC, calculated for all valid 10m sub-section measurements in the defined locality over the 3 years that precede the current testing season. This shall contain surveys from each of the three parts of the test season. Valid measurements are those that were made in the required part of the test season, on the required test line on road surfaces that were at least 12 months old at the time of testing. This means that if a length of road has been resurfaced within the last 4 years then that length should be excluded from the LECF calculation.

ii. The Local Mean SC (LMSC) is determined for the current survey. The LMSC is the average of all valid 10m sub-sections in the locality in the current year survey.
iii. The LECF is determined by dividing the LESC by the LMSC i.e.:
LECF = LESC/LMSC

The CSC for each 10m sub-section shall be determined by multiplying the corrected SC by the LECF.

Appendix 3 – The SCRIM Network - A List of sections to be surveyed annually

Sections of the following road hierarchy shall be surveyed on an annual basis and form the SCRIM network

The SCRIM network which will be subject to skid resistance testing is subject to modification if there are changes in crash patterns or amendments to the network.

The SCRIM network currently consists of:

- The Classified Road Network

Following the release of the new Code of Practice for Well Managed Highway Infrastructure whereby Authorities are encouraged to adopt a new 'maintenance hierarchy' the existing hierarchy will be reviewed. After this review the SCRIM network is likely to change and be updated. This will also reflect the ILs which relate to the changes.

However, inevitably there will be some sections in the above classifications where a SCRIM survey is inappropriate and will be excluded from the annual survey. Reasons for exclusions could include traffic calming schemes, speed humps and tables, width, height or weight restrictions, 20mph zones or road layouts where it is not possible or safe to maintain the survey speed.

A list of sections not surveyed is produced by the surveyor contractor on an annual basis

Certain un-classified roads are tested on an annual basis where there is a need to ascertain the skid resistance of the existing road surface. This can be due to a number of factors including:-

- requests from other sections where work such as a new crossing/junction is planned,
- where we become aware of a unusual pattern of accidents,
- where the traffic flows are similar to that on the classified road network

This list of unclassified roads will be reviewed along with the investigatory levels at least every 3 years

Bayton Lane, Horsforth
Newhall Road, Middleton
Bullerthorpe Lane, Colton

Appendix 4 – List of 'Other' High Risk Situations

The following sites have been identified as 'Other' high risk situations and primarily include uncontrolled crossings for vulnerable users

Note: This should be reviewed along with the Investigatory Levels at least every 3 years

<xx insert plan and/or list of sections and chainage xx>

Appendix 5 – Application of Site Categories and Investigatory Levels

Note: This Appendix is an ammended version of Annex 5 of HD28/15

Overview

This Appendix provides detailed guidance on the selection of appropriate site categories and ILs from the range in Table 6.1. These are then followed by some examples.

The guidance given in this section is not exhaustive and therefore judgement of the risks specific to each location shall be exercised.

Additional information such as safety reports and congestion reports may be useful when setting site categories and the IL. They can be used to help identify higher risk situations and where queuing is likely.

Site Category A, B & C: Non-event carriageway

Use for all non-event carriageway sections, Motorway (A), Dual Carriageway (B) and single two way traffic (C)

For Site Category **A** an IL is defined as **0.35**

For Site Category **BR** an IL is defined as **0.40** where road section signed speed >=50mph (Rural)

For Site Category **BU** an IL is defined as **0.35** where road section signed speed <=40mph (Urban)

For Site Category **CR** an IL is defined as **0.45** where road section signed speed >=50mph (Rural)

For Site Category **CU** an IL is defined as **0.40** where road section signed speed is <=40mph (Urban)

BU and **CU** are set at the lowest ranking IL in HD28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

At junctions, use site category **C** for areas where traffic merges or diverges if:

- The junction layout allows traffic leaving or joining the mainline to match the speed of the mainline traffic, and/or
- There is adequate taper length for merging to occur without the mainline being forced into avoiding action.

Site Category Q: Approaches to and across minor and major junctions and approaches to roundabouts

Use this Site Category for:

- Major / minor priority junctions
    - Major junctions are defined as all interconnecting classified roads
    - Minor roads are defined in rural areas, those subject to 50 mph or above speed restrictions as junctions that include all interconnecting unclassified roads
    - Minor roads are defined in urban areas, those subject to 40mph or less speed restrictions as junctions that will only include unclassified roads that are bus routes.
- Other significant accesses
  These include accesses with right turning lanes, "Ghost" islands, access to supermarkets, business parks and retail centres
- Approaches to roundabouts

If the junction design and traffic volume allows the traffic to merge with/diverge from the mainline traffic without changing speed, this Site Category is not needed (use site category **B** or **C** instead).

For Site Category **QX** an IL is defined as **0.55** where road section signed speed =70mph

For Site Category **QR** an IL is defined as **0.50** where road section signed speed =50 or 60mph (Rural)

For Site Category **QU** an IL is defined as **0.45** where road section signed speed is <=40mph (Urban). It is set at the lowest ranking IL in HD28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

Approaches to Junctions:

For the purposes of this standard, roads involved in a junction are split into two types:

- Roads where traffic has permanent priority
- Roads where traffic is required to give way

Drivers on the road with permanent priority and are not expecting to give way, but may have to brake sharply if a vehicle emerges unexpectedly from the intersecting road or turns right across their path. Factors to consider are:

- Right turning vehicles from an intersecting road are at risk of a side impact with traffic on the permanenet priority road, and the outcome of this type of crash is likely to be severe.
- The risks increase where the speed of traffic joining or leaving the main carriageway differs greatly from those continuing straight on. This is heavily influenced by the taper length, provision of dedicated lanes for right-turning traffic, etc.

On the permanent priority road apply Site Category Q to the 50m approach (in the direction of travel) to the junction and across the extent of the junction. For roads with a speed limit of 50mph or above, consider extending the approach distance, depending on the risk of traffic having to brake unexpectedly.

For permanent priority roads with two-way traffic, consider the two directions separately to determine the overall extent of the Site Category. The two directions should be assigned the Site Category and IL independently so that Site Category Q is not applied on the length following a junction.

On the road where traffic is required to give way, the risk of having to brake unexpectedly is lower since the need to give way is indicated clearly in advance of the junction. Apply Site Category Q to the 50m approach to the stop/give way line. Extend the distance, if necessary, to take into account likely queues.

Where the volume of traffic using the access warrants it, treat other significant accesses (petrol stations, superstores etc.) as for the junction, above. If the volume of traffic is low use the appropriate non-event categories instead.

Approaches to roundabouts:

Apply Site Category **Q** to the 50m approach to the stop/give way line. Extend the distance, as necessary to take into account likely regular queuing.

Do not use this Site Category for roundabouts with traffic signals or for other high risk situations – use site category **K** instead.

Site Category K: Approaches to traffic signals, pedestrian crossings and other high-risk situations

Use this category at the following locations:

- Traffic Lights
- Signal controlled pedestrian crossings i.e. Pelican / Toucan
- Zebra pedestrian crossings

- Railway crossings

  Other High Risk situations; where there is both a likelihood of vulnerable users in the road and a high risk of injury in the event of a crash. For the avoidance of doubt High Risk situations are described in table A.5.1. This table will be reviewed periodically

High Risk Situation	Descriptor to be added to the specification
Schools / Nurseries	Areas around schools often include School Patrol/parking signage, crossing points and appropriate "School" lining. For the avoidance of doubt, within the confines of a school boundary and/or school warning signs, all pedestrian dropped crossings (tactile or non-tactile) shall be recorded under this item.
Isolated bus stops	These are bus stops where the pedestrian is required to cross the carriageway to get to an "Isolated" bus stop, where the signed speed of the road section is >=50mph. An isolated bus stop is a bus stop which does not have a footpath running up to, or away from, the bus stop. For the avoidance of doubt this item should be recorded at the bus stop sign.
Footways requiring pedestrians to cross the carriageway	Where a footway stops on one side of the road and continues on the other side shall be recorded as "High Risk" where the signed speed of the road section is >=50mph. Signed Public footpaths/bridleways shall also be recorded under this item

Table A.5.1

In rural areas, those subject to 50mph or above speed restrictions, site category **KR** is to be applied for the 80m approach to the event.

In urban areas, those subject to 40mph or less speed restrictions, site kategory **KU** is to be applied for the 50m approach to the event.

For site category **KR** an IL is defined as **0.55** where road section signed speed >=50mph (Rural).

For site category **KU** an IL is defined as **0.50** where road section signed speed <=40mph (Urban). Set at the lowest ranking IL in HD28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads.

Site Category R: Roundabout

Use for roundabout circulation areas, including approaches to traffic lights on roundabouts. If there are specific, high-risk situations then use Site Category **K**. Mini roundabouts should be excluded from this Site Category; in this instance Site Category **Q** should be applied to the approach and across the mini roundabout.

For Site Category **RR** an IL is defined as **0.50** where road section signed speed >=50mph (Rural)

For Site Category **RU** an IL is defined as **0.45** where road section signed speed <=40mph (Urban). Set at the lowest ranking IL in HD28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

Site Category G1: Gradient 5-10% longer than 50m

On carriageways with two-way traffic, use for lengths of at least 50m with an average uphill or downhill gradient of between 5 and 10%.

On Dual carriageways, use for lengths of at least 50m with an average downhill gradient of between 5 and 10%.

This assessment can be based on 10m gradient data from Scanner surveys or from accurate topographical survey data when available.

For site category **G1R** an IL is defined as **0.50** where road section signed speed >=50mph (Rural)

For site category **G1U** an IL is defined as **0.45** where road section signed speed <=40mph (Urban). Set at the lowest ranking IL in HD28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

Site Category G2: Gradient >10% longer than 50m

On carriageways with two-way traffic, use for lengths of at least 50m with an average uphill or downhill gradient greater than 10%.

On Dual carriageways, use for lengths of at least 50m with an average downhill gradient of 10% of higher.

This assessment can be based on 10m gradient data from Scanner surveys or from accurate topographical survey data when available.

For Site Category **G2R** an IL is defined as **0.55** where road section signed speed >=50mph (Rural)

For Site Category **G2U** an IL is defined as **0.50** where road section signed speed <=40mph (Urban). Set at the lowest ranking IL in HD28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

Site Category S1: Bend radius < 500m (100m Urban)

Use for bends on carriageways with dual carriageway traffic (site category **S1**)

In rural areas, those subject to 50mph or above speed restrictions, the **S1R** site category should only be applied for bends with radii less than 500m

In urban areas, those subject to 40mph or less speed restrictions, the **S1U** site category should only be applied for bends with radii less than 100m

This site category should not generally be used for:

- Short lengths, for example less than 50m, with a radius of curvature between 250m and 500m.
- Roundabout exits.

The Site Category should be extended upstream and downstream to where the radius of the road has exceeded 500m or 100m for bend radii where S1 is used at speeds lower than 50mph.

For Site Category **S1R** an IL is defined as **0.50** where road section signed speed >=50mph (Rural)

For Site Category **S1U** an IL is defined as **0.45** where road section speed <50mph (Urban). Set as the lowest ranking Investigatory Level in HD 28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

This assessment shall be based on 10m curvature data from Scanner surveys, drawings or from accurate topographical survey data when available.

Site Category S2: Bend radius < 500m

Use for bends on carriageways with dual carriageway traffic (category **S2**)

In rural areas, those subject to 50mph or above speed restrictions, the **S2R** site category should only be applied for bends with radii less than 500m

In urban areas, those subject to 40mph or less speed restrictions, the **S2U** site category should only be applied for bends with radii less than 100m

This category should not generally be used for:

- Short lengths, for example less than 50m, with a radius of curvature between 250m and 500m.
- Roundabout exits.

The Site Category should be extended upstream and downstream to where the radius of the road has exceeded 500m or 100m for bend radii where S1 is used at speeds lower than 50mph.

For Site Category **S2R** an IL is defined as **0.55** where road section signed speed >=50mph (Rural)

For Site Category **S2U** an IL is defined as **0.50** where road section speed <50mph (Urban). Set as the lowest ranking Investigatory Level in HD 28/15 as it is considered that on the more lightly trafficked council road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

This assessment shall be based on 10m curvature data from Scanner surveys, drawings or from accurate topographical survey data when available.

Example: Dual carriageway grade separated Junction

For a dual carriageway grade separated junction there are two different site categories in effect, as described below and shown in Figure A.5.1. In some cases other site categories may also be required due to other events occurring in the vicinity

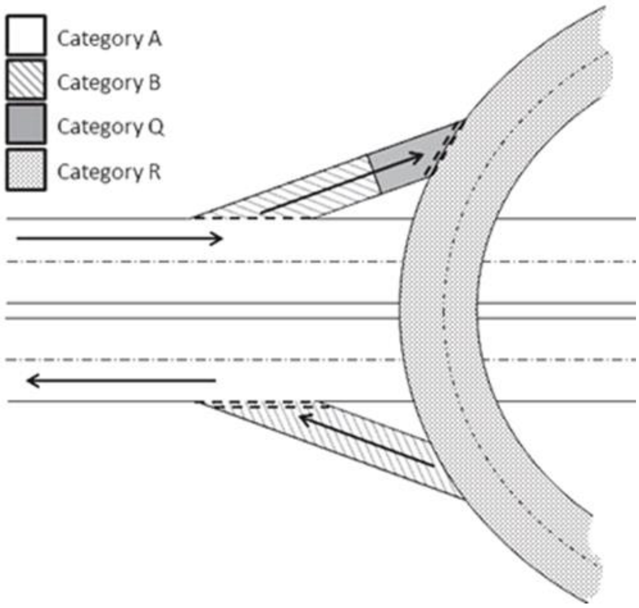


Figure A.5.1 Site Categories for a typical motorway grade separated junction

The main carriageway will have category **B** applied to its whole length (if appropriate to its geometry/layout).

The off slip will have category **B** applied for the majority of its length with category **Q** applied to the last 50m (length of **Q** to be extended if queues likely)

The on slip will have category **B** applied to its whole length unless other events for the site take precedence (e.g. high gradient or tight bend)

The roundabout will have category **R** applied to its whole length.

Example: T-junction on a Single carriageway

For a T-junction on a single carriageway there are two different site categories in effect, as described below and shown in Figure A.5.2. In some cases other site categories may also be required due to other events occurring in the vicinity

In the figure for this example the major road (where traffic has permanent priority) is the horizontal road and the minor road (where traffic is required to give way) is the vertical road.

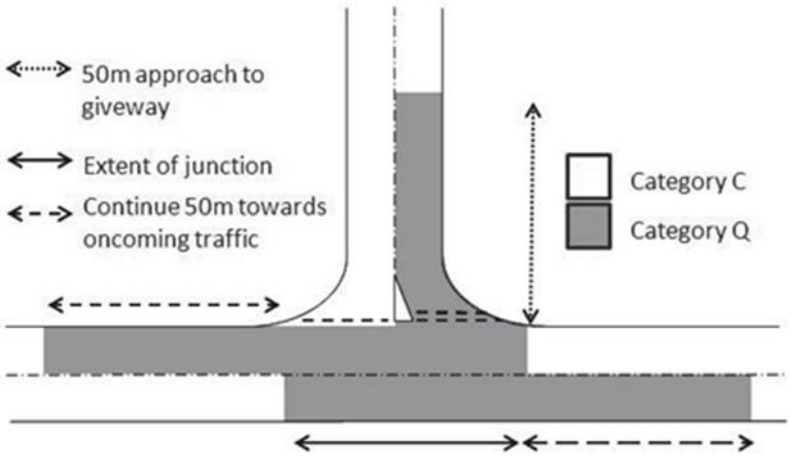


Figure A.5.2 Site Categories for junction approaches on a single carriageway

On the minor road a category of **Q** is applied to the 50m approach to the junction. This length may be extended if queuing is likely. The remaining length (including the lane with traffic moving away from the junction) is given a category of **C**.

On the major road a category of **Q** is applied to the extent of the junction and the 50m leading to the junction (in the direction of traffic on the major road) for both lanes. This length may be extended if the risk of traffic having to brake unexpectedly is higher than usual. The remaining length of the major road is given a category of **C** (if appropriate to the site geometry/layout).

Example: Priority junction

For a priority junction between two single carriageways there are two different site categories in effect, as described below and shown in Figure A.5.3. In some cases other site categories may also be required due to other events occurring in the vicinity.

In the figure for this example the “major road” (where traffic has permanent priority) is the top part of the horizontal road (traffic moving from left to right) and the bottom part of the horizontal road (traffic moving from right to left). The "minor roads" are the vertical road and the turn lane of the horizontal road. This example is assuming that right turns from the vertical road are prohibited.

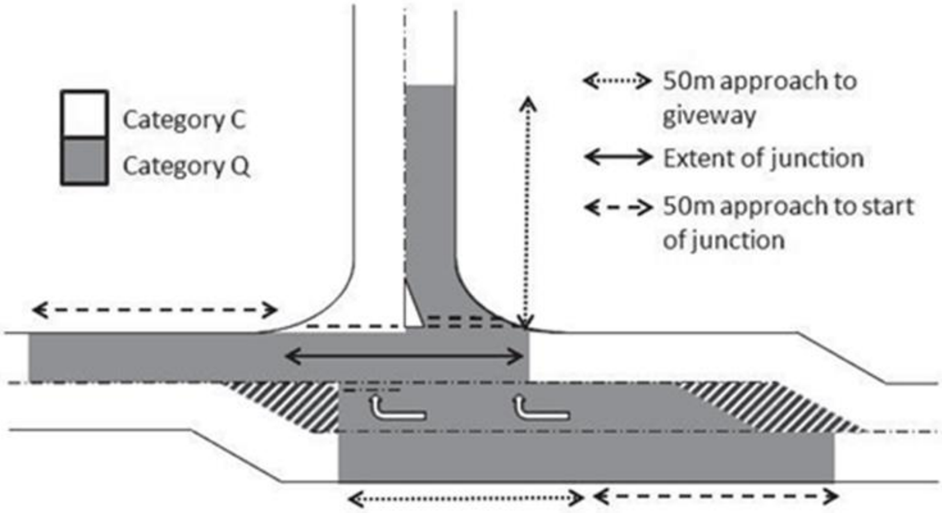


Figure A.5.3 Site Categories for a priority junction

The top part of the horizontal road ("major road") will have a category of **Q** applied to the extent of the junction and the 50m leading to the junction (in the direction of traffic on the major road). This length may be extended if the risk of traffic having to brake unexpectedly is higher than usual. The remainder of the top part of the horizontal road will have the appropriate non-event category applied (in this case **C**)

The turn lane ("minor road") will have a category of **Q** applied to the 50m approach to the give way. The bottom part of the horizontal road ("major road") will have a category of **Q** applied to the 50m approach to the start of the junction and for the extent of the junction. As the two lanes described above are running lanes from the same carriageway with traffic in the same direction, they will have the same Site Category and IL applied along their coinciding length

The vertical road (one of the "minor roads") will have a category of **Q** applied to the 50m approach to the junction. This length may be extended if queuing is likely. The remaining length (including the lane with traffic moving away from the junction) will have the appropriate non-event category applied (in this case **C**)

Example: Roundabout with a pedestrian crossing

For a roundabout with a pedestrian crossing on an approach or exit, there are four different site categories in effect (if all of the roads are single carriageway), as described below and shown in Figure A.5.4. In some cases other site categories may also be required due to other events occurring in the vicinity.

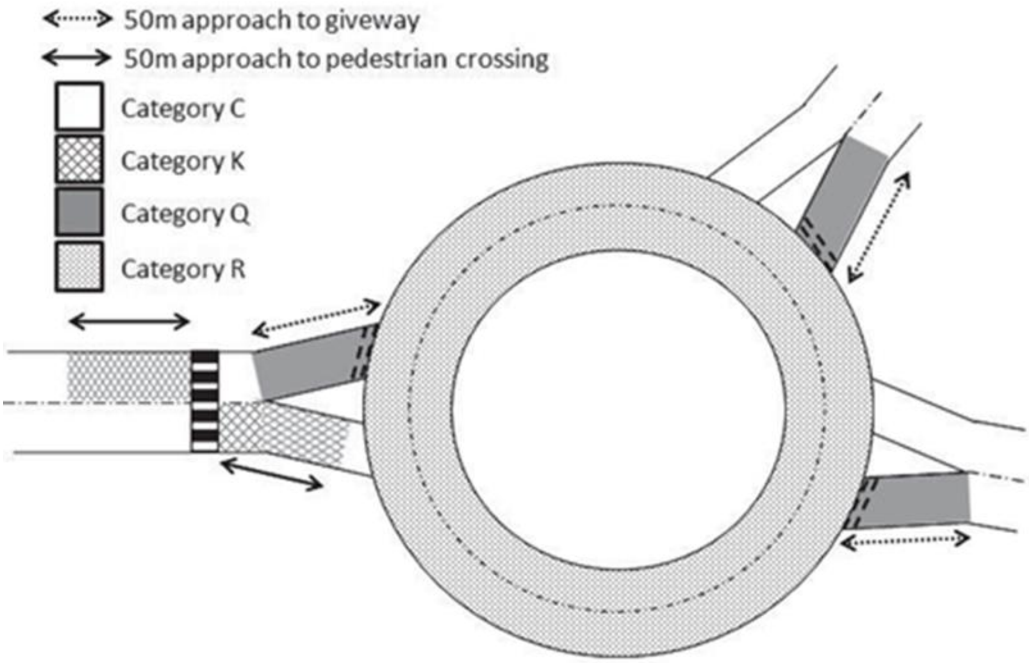


Figure A.5.4 Site categories for a roundabout with a pedestrian crossing

A Site Category of **K** will be applied to the 50m approach to the pedestrian crossing. This length may be extended depending on the likelihood of traffic having to brake unexpectedly

The roundabout will be assigned a category of **R** for its whole length. Note, if this was a signalised roundabout, the roundabout would still be assigned a category of **R** for its whole length

The approaches to the roundabout will all have category **Q** applied for the 50m approach. This length may be extended if queuing is likely. Also if the remaining distance between this category and the crossing is small then this category may be extended back to the crossing

The remaining lengths will have category **C** applied (if appropriate to its geometry/layout), as they are all non-event carriageways with 2-way traffic.

Example: Signal controlled crossroads involving a dual carriageway road and a single carriageway road

For this type of crossroads there are four different site categories in effect, as described below and shown in Figure A.5.5. In some cases other site categories may also be required due to other events occurring in the vicinity.

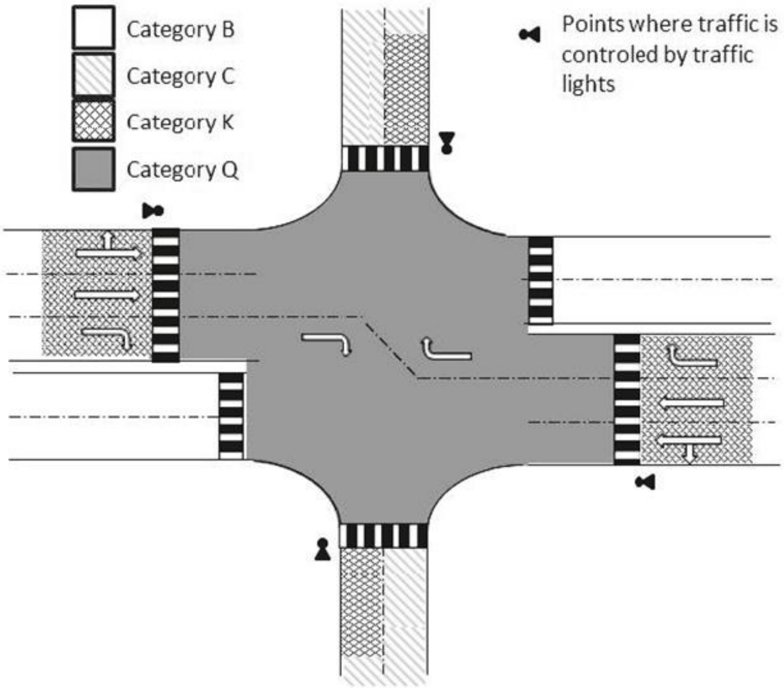


Figure A.5.5 Site categories for a signal controlled crossroads between a dual carriageway road and a single carriageway road

A Site Category of **K** will be applied to the 50m approach to the pedestrian crossings. This length may be extended depending on the likelihood of traffic having to brake unexpectedly

The extent of the junction (i.e. in this case, the area enclosed by the pedestrian crossings) will have a site category of **Q** applied to it. The remaining lengths will have the appropriate non-event site categories applied (**B** for the dual carriageway and **C** for the single carriageway)

Appendix 6 – Methodology for the Identification of Sites requiring a Detailed Investigation

The identification of sites requiring detailed investigation (the initial site score) can be carried out as follows based on the alternative method detailed in Annex 7 of HD28/15. (The alternative method is an alternative to the crash model, which has been developed specifically for the Highways England road network. It is not appropriate to use this crash model on a network outside of the Highways England's network)

The initial site score will identify sites requiring detailed investigation and is achieved by summing up the scores from the criteria in Table A.6.1 for each site. This method is a simplified approximation of the Highways England's Crash Model and refined further to include additional points for Fatal and Wet Skid crashes.

It is nationally recognized that SCRIM is not an exact measure (it is a co-efficient) and WILL have a seasonal variation. This seasonal variation not only varies throughout the summer months, but can and will vary year on year. With this in mind setting a threshold has resulted in significant fluctuations in the number of sites identified. Therefore, the council use the following methodology to identify a minimum number of 200 sites.

Note: The score for the 200th site is taken as the minimum value to identify sites requiring detailed investigation. This is subject to change to ensure a minimum 200 sites have a detailed inspection. For example, in 2017 the 200th site had a value of 22 which produced 233 sites for detailed investigation.

Scores and criteria					
Number of crashes	0	1	2	3+	
Score	0	4	8	12	
Likely Impact of a crash	Slight	Slight/serious	Serious	Serious/fatal	
Score	1	2	3	4	
Skid resistance Difference (SD)	>0	> -0.05 and <= 0	> -0.10 and <= -0.05	> -0.15 and <= -0.10	<= -0.15
Score	0	1	3	6	12
Site has Low texture	No	Yes			
Score	0	1			
Number of Fatal Crashes	0	1+			
Score	0	1			
Number of Wet-skid crashes	0	1+			
Score	0	1			

Table A.6.1

Number of crashes within the last 3 years of available data. This refers to the total number of personal injury crashes. Fatal and wet skid crash counts are also considered separately here resulting in a possible extra 2 points to the final score.

The latest available crash data is supplied nationally and is updated on an annual basis. (2015 crash data became available in July 2016). The data set can be downloaded from the following web address: https://data.gov.uk/dataset/road-accidents-safety-data

Given the limited accuracy of locating crash positions, it may be assumed for the purpose of this investigation that the position of a crash coincides with a Site if it occurred within 75m for urban roads (40 mph or less) and 200m for rural roads (50mph or greater). However, crashes in excess of 75m/200m can be 'tagged' to the site and crashes within the 75m/200m boundary can be 'untagged' if their location is deemed to not be relevant to the specific site. For example, there are some crashes that are within 75m of a site that occur on roads parallel to the site but cannot be accessed from the site.

Note: HD28/15 states a 200m buffer, but after reviewing the accuracy of the location of crashes, particularly in urban areas, it was deemed more appropriate to set a buffer of 75m for urban roads (40mph or less); the rationale for 75m is the stopping distance for 40 mph in the wet is 72m (75m accommodates a further 3m for location accuracy). Far too many crashes automatically tagged were clearly not relevant to the site as there were on parallel roads, etc.

Likely impact of a crash will vary from site to site, for example, crashes on roundabouts are likely to be low speed rear or sideways collisions (i.e. slight). Whereas a crash on a carriageway with 2-way traffic would possibly involve a head-on collision which is likely to be serious or fatal. Every applicable network section will have an attribute detailing its likely impact of crash. The attribute will be reviewed with Investigatory Levels at least every 3 years (in the first instance a default of 'Serious' is applied to 2-way traffic on speed limits greater than 40mph and 'Slight/serious' applied to all other carriageway sections)

The likely impact of crash is generated from the following table A.6.2:

SITE CATEGORY	ENVIRONMENT	
	Urban (<=40MPH)	Rural (>=50MPH)
A	Slight/Serious	Serious
B	Slight/Serious	Serious
C	Serious	Serious/Fatal
Q	Serious	Serious/Fatal
K	Serious	Serious/Fatal
R	Slight/Serious	Serious/Fatal
G1	Slight	Serious
G2	Slight	Serious
S1	Slight/Serious	Serious/Fatal
S2	Slight/Serious	Serious/Fatal

Table A.6.2 Likely Crash Impact

Skid Resistance Difference (SD) is equal to the CSC value minus the Investigatory Level. Therefore, sites which should be investigated (i.e. with a CSC value at or below the Investigatory Level) will have a Skid Resistance Difference of zero or below (i.e. negative). The lowest SD value for the segment will be used.

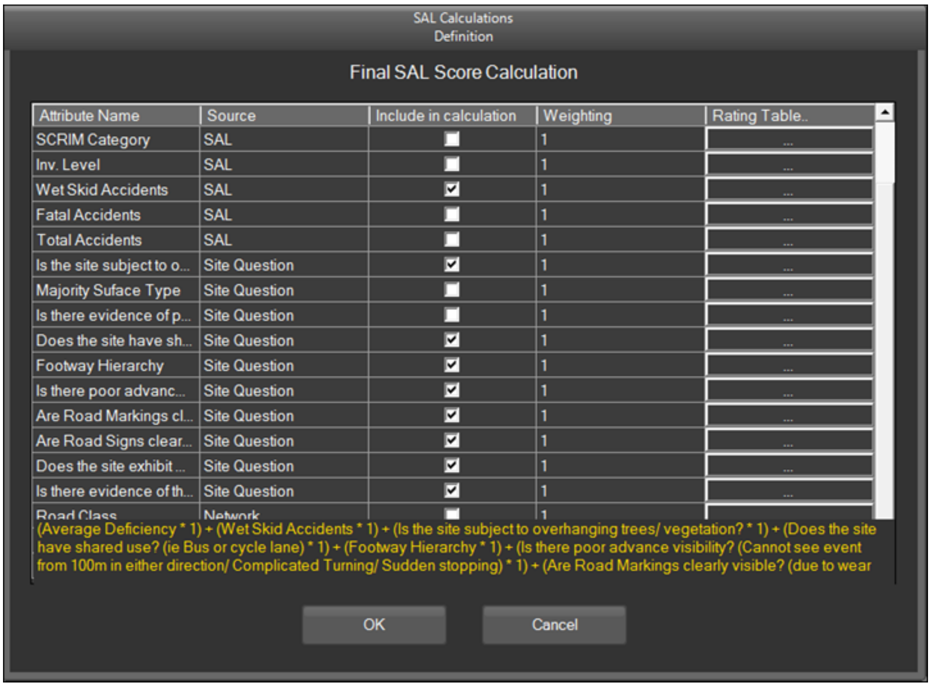
When a site has SD≤0 and poor texture at the same point. The combination of low texture depth and low skid resistance has been shown to be associated with an increased crash risk. Texture depths less than or equal to 0.6mm are considered to be low. Note, low texture depth combined with skid resistance above the Investigatory Level does not pose an increased crash risk for the purposes of this standard.

Appendix 7 – Methodology for the Identification and Prioritisation of Proposed Treatments

WYCA+ have produced a risk-based methodology for the identification and prioritisation of proposed treatments and actions this provides an auditable objective process to the identification and prioritisation based on the results from the detailed on-site investigations and other available information.

The on-site questions (detailed in Table A.7.2) and the process detailed below are specifically designed to reduce the level of subjectivity with regards to treatment selection.

The on-site questions, number and severity of crashes and the SCRIM Deficiency contribute to the final site score and can be configured as shown in figure A.7.1 below:


SAL Calculations
Definition

Final SAL Score Calculation

Attribute Name	Source	Include in calculation	Weighting	Rating Table..
SCRIM Category	SAL	☐	1	...
Inv. Level	SAL	☐	1	...
Wet Skid Accidents	SAL	☑	1	...
Fatal Accidents	SAL	☐	1	...
Total Accidents	SAL	☐	1	...
Is the site subject to o...	Site Question	☑	1	...
Majority Suface Type	Site Question	☐	1	...
Is there evidence of p...	Site Question	☐	1	...
Does the site have sh...	Site Question	☑	1	...
Footway Hierarchy	Site Question	☑	1	...
Is there poor advanc...	Site Question	☑	1	...
Are Road Markings cl...	Site Question	☑	1	...
Are Road Signs clear...	Site Question	☑	1	...
Does the site exhibit ...	Site Question	☑	1	...
Is there evidence of th...	Site Question	☑	1	...
Road Class	Network	☐	1	

(Average Deficiency * 1) + (Wet Skid Accidents * 1) + (Is the site subject to overhanging trees/ vegetation? * 1) + (Does the site have shared use? (ie Bus or cycle lane) * 1) + (Footway Hierarchy * 1) + (Is there poor advance visibility? (Cannot see event from 100m in either direction/ Complicated Turning/ Sudden stopping) * 1) + (Are Road Markings clearly visible? (due to wear

OK Cancel

Figure A.7.1 - Illustration of on-site Questions contributing to the Final Prioritisation Score

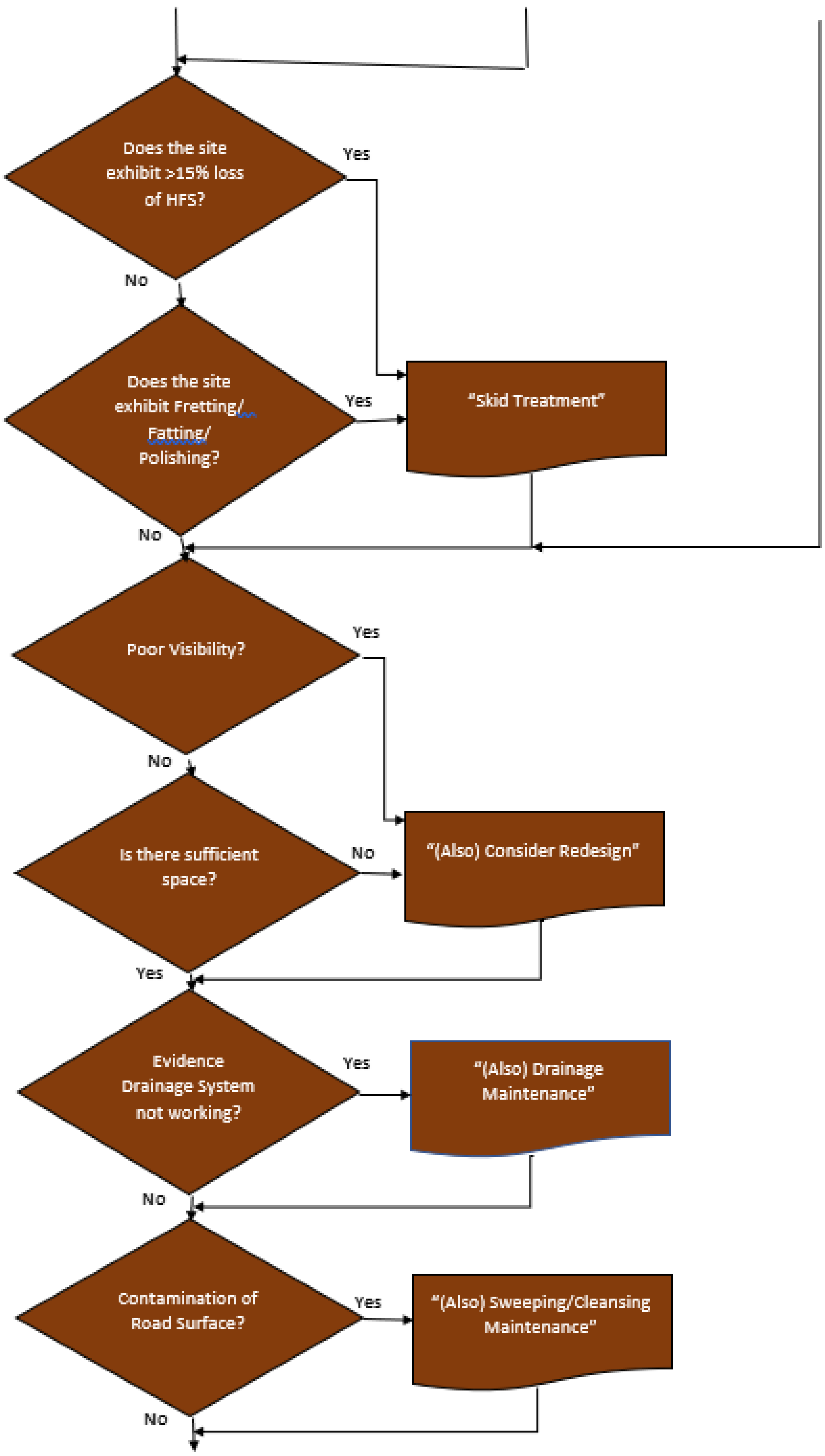
Treatment identification

The treatments identified by the following process are treatments suggested based on the information collated.

These suggested treatments are categorised into 'broad brush' treatment 'Bins' which allows for costing. Having this process also allows for changes to the process to be introduced and data being analysed. This is a 'Tool' for the Engineer and will require final detail design/process to be determined.

This methodology provides an audit trail and also provides the facility to iteratively review, update if necessary and re-process the results; this is particularly useful during the initial process of producing the draft Treatment Selection rule set

The Treatment 'Bin' Identification Rules are illustrated in the flow chart in Figure A.7.2


Does the site exhibit >15% loss of HFS?
Yes
No
Does the site exhibit Fretting/ Fatting/ Polishing?
Yes
"Skid Treatment"
No
Poor Visibility?
Yes
No
Is there sufficient space?
No
"(Also) Consider Redesign"
Yes
Evidence Drainage System not working?
Yes
"(Also) Drainage Maintenance"
No
Contamination of Road Surface?
Yes
"(Also) Sweeping/Cleansing Maintenance"
No

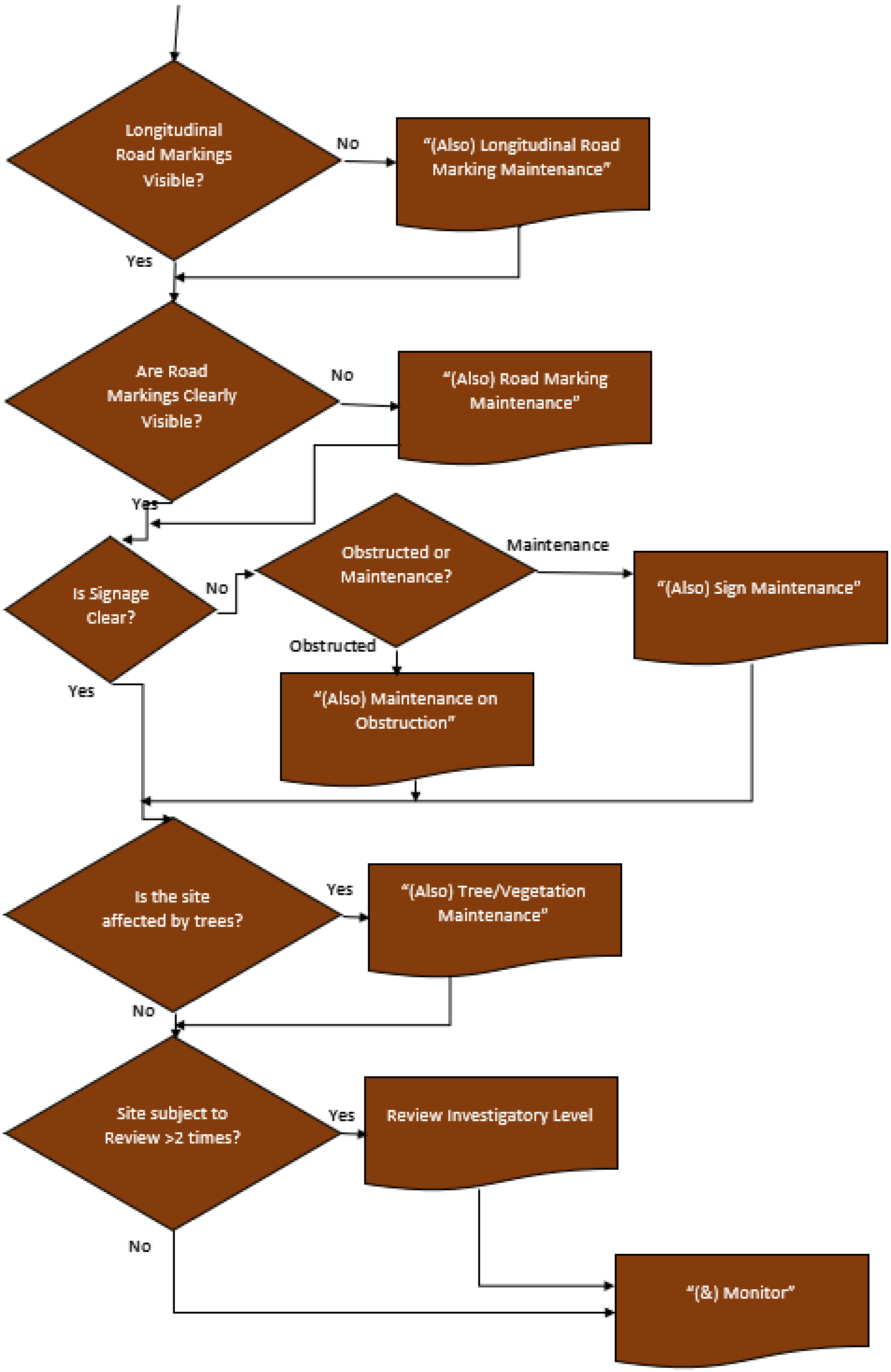


Figure A.7.2 – Treatment Selection Flow Chart

Treatment 'Bins'

The treatments identified by the above process are treatments suggested based on the information collated

The treatments identified by the Engineer shall be allocated into the treatment 'Bin(s)' detailed in Table A.7.1

The objective is to reduce the risk of vehicle skidding and to determine the appropriate treatment or whether some other form of action is required or whether no action is required.

Group	Treatment 'Bin'	Treatment	Comments
1	Review for Slippery Roads Signs	Review for Slippery Roads Signs	If the skid value is at or below the assigned level an investigation shall be carried out to determine whether treatment to improve skid resistance is required or whether some other action is required. Once a site requiring treatment to improve the skid resistance has been identified, signs warning road users that the road could be slippery shall be erected, as described in section 9 of the skid policy/strategy. Remove signs when no longer required.
	Review Wet Accidents	Review Wet Crash data	The existing prioritisation scoring methodology ensures that crashes occurring in wet conditions are allocated a high priority. However, the location and relevance of the wet crash should be further reviewed before determining the appropriate treatment
		Technical Survey	Consider other options to support the skid investigatory location if deemed necessary i.e. Skid Pendulum or Sand Patch Testing
	Resurface	Plane and Resurface	Requires professional engineering judgement taking into account local experience, the nature of the site, the condition of the site and crash history for the past 3 years. Considering any of these treatment options suggests that skid treatments listed below are not an option based on defects present including any evidence of structural failure.
		Overlay	
		Partial Recon <200mm	
		Full Recon >200mm	
	'Patch and..'	Structural Patch Repair	Based on defects present it is likely that a resurface treatment is not yet required, but a surface treatment alone will not be sufficient
	Patch	Patch Repair	Consider basic maintenance patching to minor/localised areas of failure.

	Skid Treatment	High Friction Surfacing	Hot or cold applied. Hot applied and screeded out or cold applied by machine or manually.
		Surface Dressing	Consider all options available - 10mm, 10/6 racked 14/6 racked Sandwich Dressing etc.
		Micro Asphalt	Thin surfacing treatment <20mm
		Diamond Grooving	Retexturing - Ideal for concrete surfaces but also used on flexible pavements.
		Shot Blasting	Retexturing - Restores skid resistance and re- exposes the Macro texture of the carriageway surface aggregate.
		Bush Hammering	Retexturing - can be used on all surfaces
		High Velocity Water Blasting	Retexturing - Water cutting. Restores both micro and macro texture. Short term solution only
	Re-design	Improve Sight Line	This option could be costly and possibly not feasible due to environmental factors /cost etc.
		Improve Existing Lining Layout	Inadequate lining. Refer any comments to the traffic department re: feasibility study?
		Improve Existing Signing/ fencing	Investigation required re: existing signing at the skid location. Need for additional signing or safety fencing or pedestrian guardrail. Advanced signing or review speed limit is traffic calming required etc
		Improve Street Lighting	Is the existing street lighting inadequate or additional street lighting is required? Refer any concerns to the street lighting department
2	Routine Maintenance	Drainage Maintenance	Blocked gullies, standing water, detritus in channel or localised flooding etc. Drainage cleansing or design investigation required
		Sweeping/ Cleansing Maintenance	Contamination of the road surface has been identified and should be cleansed appropriately
		(Longitudinal) Road Marking Maintenance	Renew/ Repair Longitudinal lines or road markings etc
		Sign Maintenance	Renew/ Repair or Clean sign
		Obstruction to Sign	Remove Obstruction and/or Illegal signing etc deemed a hazard etc
		Tree/ Vegetation Maintenance	Refer to Environmental/PROW Department (Enforcement Action)

3	Review Investigatory Level	Review Investigatory Level	If a site has been subject to a review 3 times and there is no evidence to support maintenance then the Investigatory Level should be reviewed
	Monitor	Monitor	No evidence to support skid value. Monitor via future Scrim/Road accident data or local knowledge.

Table A.7.1 – Treatment 'Bins'

Prioritisation of Suggested Treatments

The treatment can then be prioritised within each individual 'Group' or 'Bin' based upon the final calculation below. The highest scoring site will be the highest priority within the 'Group' or 'Bin'.

The prioritisation is based on the scoring detailed in Table A.7.2; the greater the score the higher the priority.

Source	Question Text	Response	Scoring
Condition	*Average Deficiency**	*1/-0.01/-0.05/-0.10*	1/5/10/20
Condition	Does the site exhibit >=25% loss of HFS within the wheel paths/braking zone?	No/Yes	0/1
Condition	Does the site exhibit Fatting/Polishing/Minor Fretting within the wheel paths/ braking zone?	No (<15%)/Yes (15-75%)/Yes (>75%)	0/1/2
Condition	Is there Deformation/Pushing of Material?	No/Yes	Info Only
Condition	Does the site Exhibit Major Fretting within the Surface Course (entire area)?	No/Yes (<20%)/Yes (>=20%)	0/0.5/1
Condition	Is there evidence of standing water NOT drainage related? (i.e. Rutting/Settlement)	No/Yes	0/1
Condition	Is there evidence of the drainage system not working? (i.e. Blocked drains)	No/Yes	Info Only
Visual	Is >50% of the Centre Line Longitudinal Road Markings clearly visible? (Due to wear not leaves, etc.)	Yes/No	Info Only
Visual	Are Road Markings i.e. stop lines, clearly visible? (due to wear not leaves, etc.)	Yes/No	Info Only
Visual	Are Road Signs clear, visible and easily understood?	Yes/No (Sign Requires Maintenance) /No (Sign Obstructed)	Info Only
Visual	Is the site affected by trees/ vegetation?	No/Yes	Info Only
Visual	Majority Surface Type	HFS/HRA/SD/Micro /SMA/ Other/Bitmac	Info Only

Visual	Is there Contamination (e.g. Detritus) on the road surface?	No/Detritus/Oil/ Soil/Sand/Other	Info Only
Site	*Wet Accidents**	*0/1+*	0/5
Site	*Fatal Accidents**	*0/1+*	0/1
Site	Is there evidence of past patching repairs/ pothole fillings?	No/Yes	0/1
Site	Is there evidence of crash damage or heavy braking (i.e. Skid marks)?	No/Yes	Info Only
Site	Does the site have shared use? (i.e. Bus or cycle lane)	No/Yes	Info Only
Site	Is there presence of existing slippery road signs?	No/Yes	Info Only
Site	Is there presence of Traffic Signal Induction Loops?	No/Yes	Info Only
Rd Layout	Is Queuing/ Standing traffic likely at any time? (including Peak hours)	No/Yes	0/1
Rd Layout	Is there sufficient space? (i.e. lane width>2.7m No Damaged Kerbs present)	Yes/No	Info Only
Rd Layout	Is there presence of Lay-bys or other access (i.e. property/field access)?	No/Yes	0/1
Rd Layout	Is there poor advance visibility? (Cannot see event from 100m in either direction/ Complicated Turning/ Sudden stopping)	No/Yes	0/1

**Average Deficiency & accident information are automatically collated for each site and are not specific on-site detailed Inspection question and responses*

Table A.7.2 – On-site Questions and their effect on the Final Prioritisation Score

Appendix 8 – Detailed Site Investigation

The following detailed information is collected and available for information for the detailed site investigations

There are four main tabs: Site, Site Assessment, Site Condition & Accidents

Site

The 'Site' tab provides information about the site location including the site category and Investigatory Level and is illustrated in figure A.8.1.

The inspector can select the required action and proposed treatment (if applicable) from the drop- down menu options.

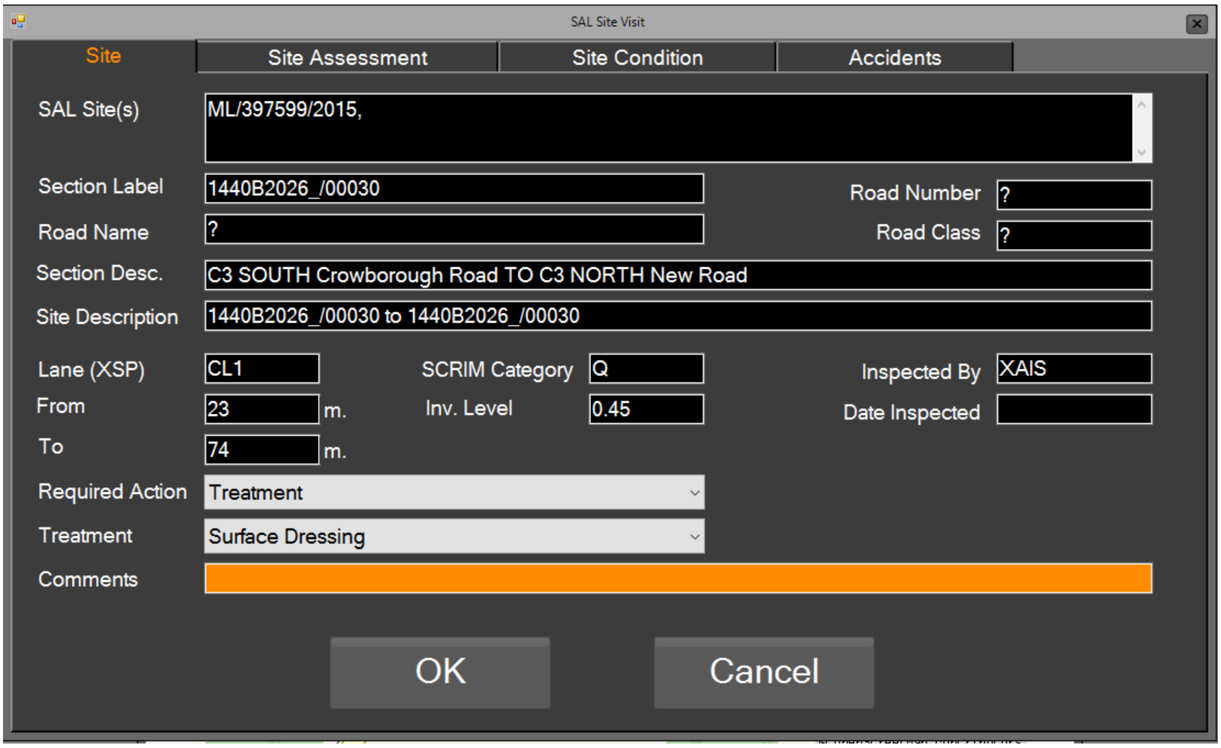


Figure A.8.1– Site Details (as viewed using the on-site Detailed Inspection software)

Site Assessment

The 'Site Assessment' tab provides the facility for the inspector to input the pre-configured site assessment questions and is illustrated in figure A.8.2.

The Questions and responses are configured to match table A.7.2

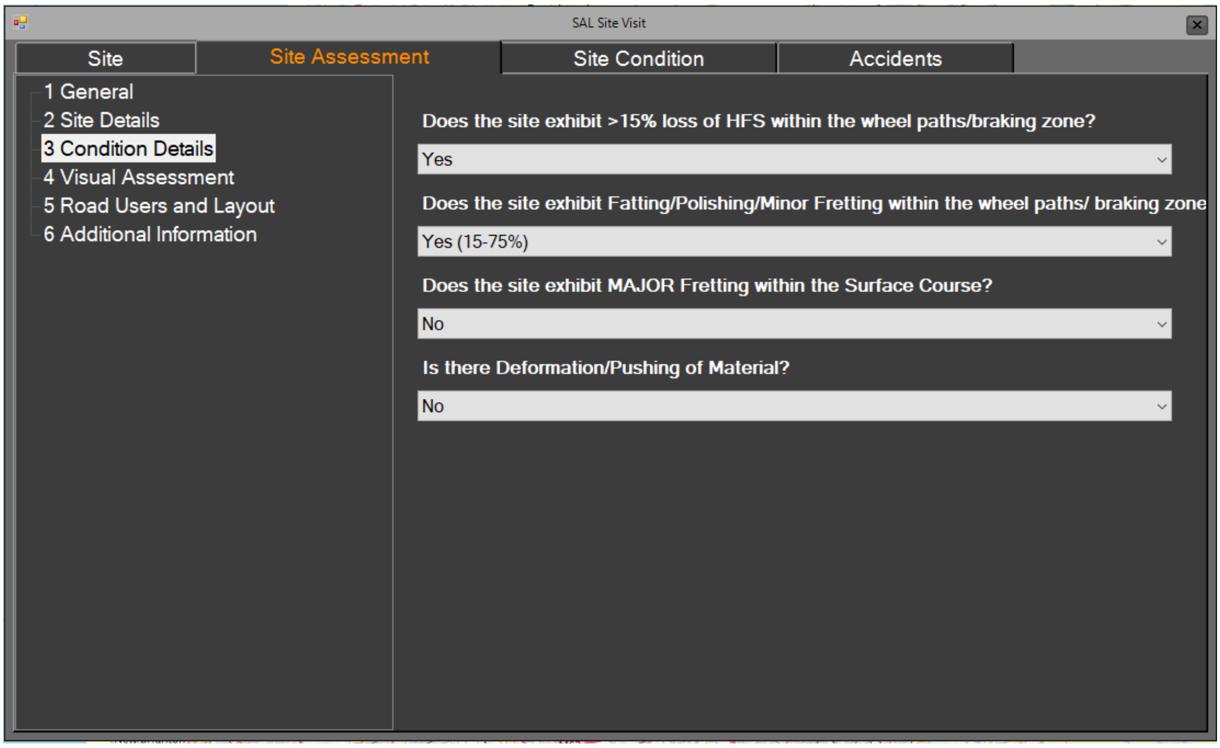


Figure A.8.2 – Site Assessment (as viewed using the on-site Detailed Inspection software)

Site Condition

The ‘Site Condition’ tab provides information about the site’s condition based on existing condition surveys and is illustrated in figure A.8.3.

Site Condition Data such as SCRIM Deficiency and Raw values and the Texture depth measured by the Scanner machine are available for review whilst on site. The defect can be selected from the drop-down menu.

Figure A.8.3 – Survey Condition (as viewed using the on-site Detailed Inspection software)

Accidents

The ‘Accidents’ tab provides the crash data location from the most recently available 3 years for the inspector to review whilst on site and is illustrated in figure A.8.4.

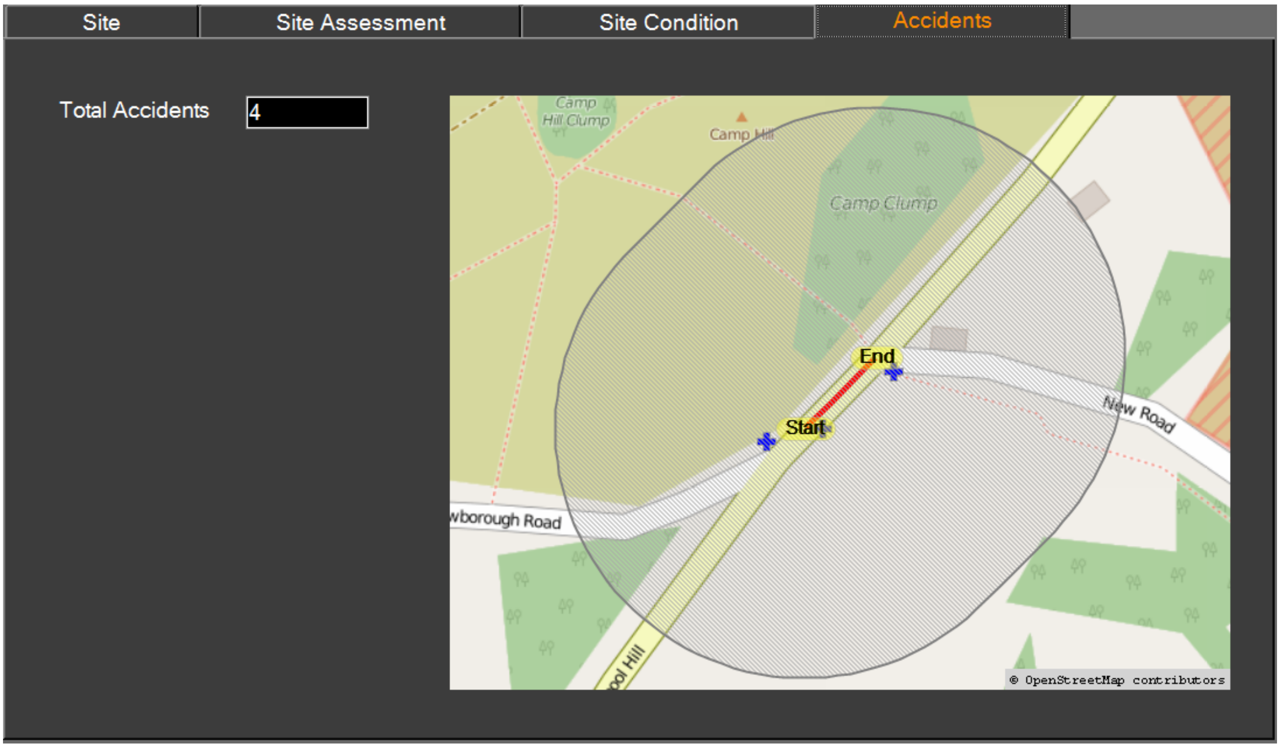


Figure A.8.4 – Crashes (as viewed using the on-site Detailed Inspection software)

Sample Detailed Site Investigation Report

A report can be produced for every Detailed Site Investigation. A sample of this report is illustrated in figure A.8.5 below.

SAL SITE ASSESSMENT REPORT

SITE SUMMARY

SAL ID	426340
Section Label	A6033 /010
Section Desc	
XSP	CL1
Start	.00
End	190.00
Length	190.00
SCRIM Category	S2
Inv Level	.50

Date Inspected	30/01/2018
SAL Score	20.000
Treatment	Review Wet Accidents and Consider for Patch and Skid Treatment Also Routine Maintenance

Comments	Review Wet Accidents and Consider for Skid Treatment and Consider for Patch Also Drainage Maintenance

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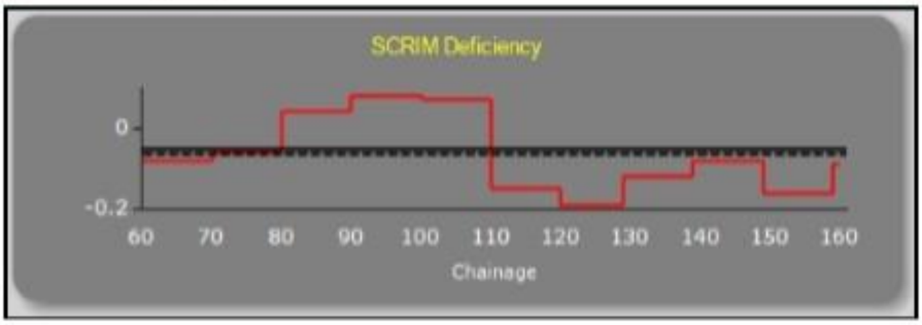
SURVEY DATA

SCRIM Deficiency (SDIF)



Sideways Force Coefficient (SFC)

Texture (LLTX)

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SITE INVESTIGATION

1 General	
Is the site subject to overhaning trees/ vegetation?	No
Is there evidence of crash damage or heavy braking (ie Skid marks)?	No
Is there evidence of past patching repairs/ pothole fillings?	No
Majority Suface Type	SD/Micro

2 Site Details	
Are Road Markings ie stop lines, >50% clearly visible? (due to wear not leaves, etc)	Yes
Are Road Signs clear, visible and easily understood?	Yes
Is >=80% of the Longitudinal Road Markings clearly visible? (Due to wear not leaves, etc)	Yes
Is there poor advance visibility? (Cannot see event from 100m in either direction/ Complicated Turning/ Sudden stopping)	No
Signed Traffic Speed	30

3 Condition Details	
Does the site exhibit Fatting/Polishing within the wheel paths/ braking zone?	No
Does the site exhibit loss of HFS within the wheel paths/braking zone?	No
Is there Cracking within the Surface Course?	No
Is there Major Fretting within the Surface Course?	No

4 Visual Assessment	
Is there Contamination (eg Detritus) on the road surface?	No
Is there evidence of standing water? (ie Rutting/Settlement)	Yes
Is there evidence of the drainage system not working? (ie Blocked drains)	Yes

5 Road Users and Layout	
Does the site have shared use? (ie Bus or cycle lane)	No
Is Queuing/ Standing traffic likely at any time? (including Peak hours)	No
Is there sufficient space? (ie lane width >2.7m /Damaged Kerbs present)	Yes

6 Additional Information	
Is there presence of existing slippery road signs?	No
Is there presence of Lay-bys or other access (ie property/field access)?	Yes
Is there presence of Traffic Signal Induction Loops?	No

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Figure A.8.5 – Sample Detailed Site Investigation Report