DERBYSHIRE COUNTY COUNCIL SKIDDING RESISTANCE POLICY

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Issue 6

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3	04/03/2019	See review schedule 2	Second Review	J. Price
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5	07/11/2019	See review schedule 4	Fourth Review	J. Price
6	19/11/2020	See review schedule 5	Fifth Review	J. Price

CONTENTS

1. CHAPTER 1 - EXECUTIVE SUMMARY

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

Following a review of the Design Manual for Roads and Bridges (DMRB) in Autumn 2019 HD28/15 was withdrawn and replaced with CS228. The fundamentals of HD28/15 have been retained in CS228 and the update is primarily a 'cosmetic review' in line with all other documentation contained in DMRB.

The methodology detailed in CS228 forms a basis for the Council's Skidding Resistance Policy.

It is recognised that the Council's highway network has significant differences and expectations from the road user to the UK's motorway and trunk road network.

In accordance with the advice in GG101 The Introduction to the Design Manual for Roads & Bridges section 2.2 Note 3: "Other highway authorities or local authorities can develop their own application annexes to complement, supplement or replace the requirements and advice contained in the main DMRB document."

This document has been produced to detail all of the differences from the CS228 document with regard to the Council's Policy for maintaining adequate Skidding Resistance on the highway network.

This Local Application Annex sets out Derbyshire County Council's specific requirements and responsibilities, the annual skid resistance programme, applying seasonal correction to skid resistance measurements, setting the Investigatory Levels, the process for identifying sites that require a detailed investigation, methodology for identifying and prioritising proposed treatments and actions and for identifying sites where slippery road warning signs are required.

1.1 Principles

Derbyshire County Council is responsible for maintaining the local road network, containing strategic, main distributor and secondary distributor roads which are subject to skidding resistance survey.

Skid resistance surveys will be undertaken annually on defined parts of the highway network which are referred to as the Skid Network and is comprised of:

- Principal A Roads
- Classified B Roads
- Hierarchies 1 to 4

Skid resistance is an important property relating to the safety of highway users, particularly in wet or damp 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.

This document details the procedures undertaken by the Council to adhere to the Council's Skidding Resistance Policy and outlines a step by step approach to identifying skid deficient sites, the determination of appropriate treatments and prioritising remedial works in the context of budget and programme considerations.

The procedures in this Skidding Resistance Policy set out a long-term strategy to manage the skid resistance of the Council's network to a consistent and safe level. The procedure complements the Council's Highway Infrastructure Asset Management Strategy in managing the risks associated with using Derbyshire's highway network.

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

The objective of the Skidding Resistance Policy is to:

- Enable the public to travel safely
- Reduce the number of Killed or Seriously Injured on the Council's road network
- Ensure the Council adheres to their duty of care under the Highways Act 1980
- Enable the Council to robustly defend against claims
- Ensure that the Council has adequate defence in a Corporate Manslaughter case brought against the Council or its Chief Officer.

To achieve this the Council will:

- Formalise processes for monitoring skid resistance across the Council's road network on an ongoing basis
- Identify deficient sites using skid resistance survey methods for further investigation
- Use collision data on sites identified for further investigation to determine whether inadequate skidding resistance could be a factor
- Recommend appropriate actions to mitigate risks where possible
- Prioritise skid deficient sites for improvement works based on those that present the greatest risk
- Ensure improvements to grip deficient sites are incorporated into the annual highway works programme

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 and budget available.

- Skid resistance surveys will be undertaken annually on defined parts of the highway network which are referred to as the Skid Network and is comprised of:
    - Principal A Roads
    - Classified B Roads
    - Hierarchies 1 to 4

  Further explanation is given in Appendix 3.

- 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.
- Sites where skid resistance values are 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 collision 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 principles will be applied on an ongoing basis so that skid resistance across the Skid network is continually monitored and managed appropriately.

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

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.

2. CHAPTER 2 - RESPONSIBILITIES

2.1 Legal Responsibilities

The Council has a statutory duty under Section 41 of the Highways Act to maintain highways that are maintainable at public expense. Although the formal management of highway skid resistance is not a legal requirement it is considered good practice and it supports the aims and objectives set out in the Council's Highway Infrastructure Asset Management Strategy. It is also part of the national data set required by central government for statistical analysis.

Section 58 of the Highways Act 1980 provides the ability to form a statutory defence to counter legal actions for negligence. The Council must be able to prove in a court of law that it has taken 'such care as is in all the circumstances reasonably required to secure that part of the highway to which the action relates was not dangerous for traffic.' When considering a third party legal action against the Council the Court will consider such factors as:

- The character of the highway and the traffic which was reasonably expected to use it.
- The standard of maintenance appropriate for a highway of that character and used by such traffic.
- The state of repair in which a reasonable person would have expected to find the highway.
- Whether the Council knew or could reasonably have been expected to know that the condition of the highway to which the action relates to was likely to cause danger to users of the highway.
- Where the highway authority could not reasonably have been expected to repair that part of the highway before the cause of action arose, what warning notices of its condition had been displayed

Section 58 of The Highways Act 1980 does not stipulate the standard of maintenance applicable to the highway.

It is accepted by the Courts that different standards of maintenance are applicable to the road network; this is related to vehicle and pedestrian usage as well as speeds of the vehicles using the highway. The Court therefore takes into account that it would be unrealistic for the Council to monitor and maintain adequate levels of skid resistance on the whole network as this would not be deemed "reasonably practicable".

The development of this Skidding Resistance Policy is to ensure a suitably structured procedure and strategy is implemented for the highway under its care and adequate levels of skid resistance are maintained within reasonable expectations as outlined in the Highways Act 1980.

Importantly, this Policy document will provide documentary evidence that the Council has a proactive approach to skid resistance management and will provide documented evidence to support the Skidding Resistance Policy.

2.2 Roles, Responsibilities and Competencies

This section sets out the various roles and responsibilities for the management of the Council's Skidding Resistance Policy.

The annual Skid Resistance Survey Programme will be procured through a specialist accredited SCRIM or GripTester contractor.

The Councils Highway Asset Management Team will have the relevant competencies as set out in the Councils competency and training document. As a minimum they will have passed the RSTA Skid Resistance training course, which prepares them for:

- Management, development, implementation and regular review of the Skidding 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 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
- That appropriate records of site visits and associated documents are maintained
- Informing other Council 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 Council's Service Director for Highways will ensure that the most appropriate remedial action is taken at sites identified as requiring action. Some examples of the options available are:

- Monitor
- Erection and removal of warning signs
- Refresh the road markings on the carriageway
- Retexture the road surface with the appropriate treatments available
- Resurface the carriageway with a material that will ensure that the road achieves the correct skid resistance for that road section

3. CHAPTER 3 - GLOSSARY OF TERMS

AADF – Average Annual Daily Flow. The number of vehicles estimated to pass a given point on the road in a 24-hour period on an average day in the year

CSC - Characteristic Skid Coefficient - The SC value that has been corrected for seasonal variations following the method appropriate to the survey strategy adopted by the Council

IL – Investigatory Level – The level of skid resistance at or below which an investigation of the skid resistance is to be undertaken

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

LESC – Local Equilibrium SC

LMSC – Local Mean SC

PSV - Polished Stone Value

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

SAL – Skid Assessment Length

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

SCRIM - Sideways Force Coefficient Routine Investigation Machine

SC - A friction coefficient calculated from a sideway-force coefficient routine investigation machine reading, by application of a speed correction and index of SFC.

SD – SCRIM Deficiency or Skid-Resistance Difference. The value obtained by subtracting the Investigatory Level from the CSC.

SFC – Sideways 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

SR(s) - The sideways force coefficient, measured at test speed s, multiplied by 100

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

UKRLG - United Kingdom Roads Liaison Group

4. CHAPTER 4 - OPERATION

This section summarises the procedures for making and interpreting skid resistance measurements on the Skid Network and for the identification and prioritisation of sites for treatment, as indicated below in Figure 4.1

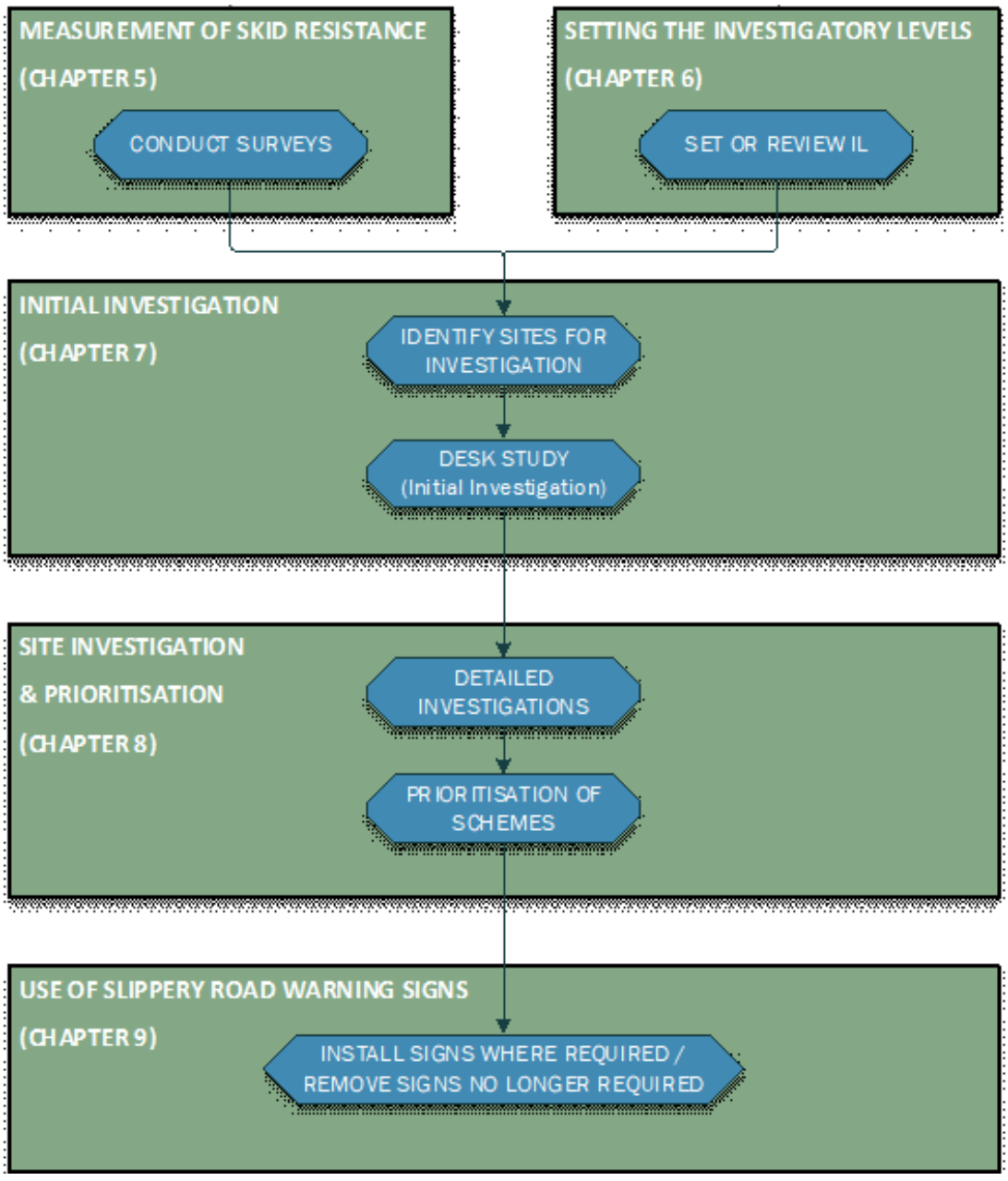

Figure 4.1 – Overview of the Operation of this Procedure

Routine measurement of skid resistance shall be measured by employing a SCRIM or GripTester survey as appropriate and processed to derive a Characteristic Skid 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 but 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.

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 professional engineering judgement taking into account local experience, the nature of the site, the condition of the road surfacing and the most recently available collision history for the past three years.

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 Skid Resistance annual programme is illustrated below in Table 4.1:

Date Range	Activity	Delivery Date	Comment
Not Specific	Annual Review of Existing Slippery Road Warning Signs	Should be within 12-18 months of last review	Annually
	Review Investigatory Levels	Within 3 years of last review	
Jan to April	Create and deliver to the survey contractor the network and sections to be surveyed	30 April Network shall be available for the contractor	The Council undertakes the Single Annual Skid 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 1 month 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 a 'Mid' survey is required		
Mid-August to end of September	SCRIM survey shall be undertaken if a 'Late' survey is required		
October (can be earlier if Mid or Early season survey)	Data shall be loaded into the Council's Pavement/Asset Management System 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
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	Within 4 months of the need for warning signs being identified	Average deficiency <=-0.2 and/or >70% polishing constitutes a need for a review of Warning Signs applicability
	Produce Treatment Priority List	Produce bespoke treatment/ action priority list within 6 months of completion of Detailed Site Investigations and incorporate in the 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 – Sample Skid Resistance Annual Programme

5. CHAPTER 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

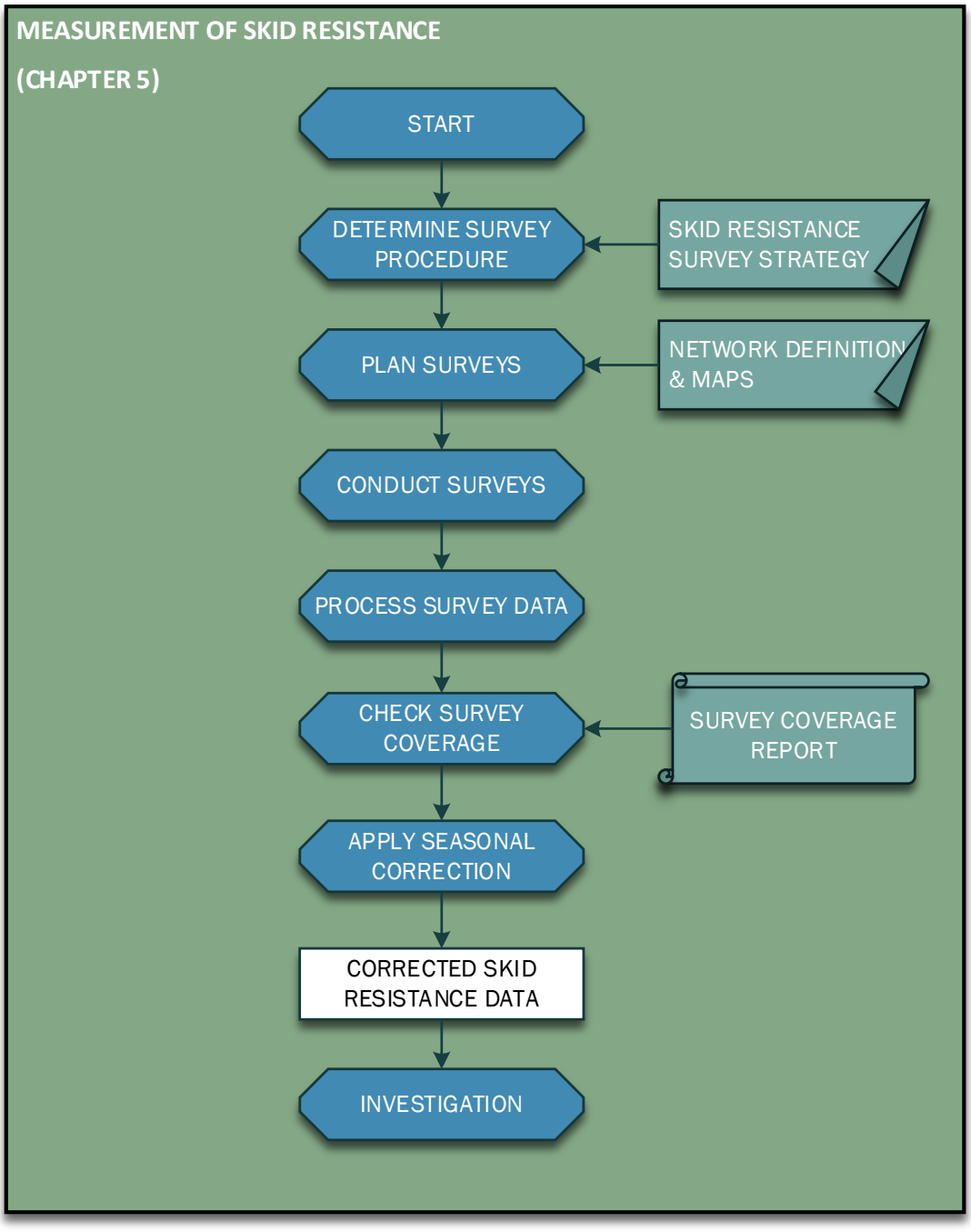

Figure 5.1 – Measurement of skid resistance

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 Skid Coefficient (CSC).

The Council has adopted the Single Annual Skid Survey. The method is detailed in Appendix 2 and in line with CS228. 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 Skid Network which will be subject to skid resistance testing is detailed in Appendix 3 and is subject to modification if there are changes in collision patterns or amendments to the network.

The Skid Network consists of:

- Principal A Roads
- Classified B Roads
- Hierarchies 1 to 4

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 each lane surveyed on dual carriageways as defined within the sections held on the Pavement Management System.

The Survey contractor will supply to the Council a list of road sections that are excluded from the survey with reasons for the exclusions, this could include traffic calming schemes, speed humps, plateaus and tables, width, height or weight restrictions 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

The Skid 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 set out in Table 5.1 below:

Early 1st May -20th June
Middle 21st June -10th August
Late 11th Aug – 30th September (Note late actually ends in October but due to time constraints for processing Derbyshire use 30th September)

Season/Year	2020	2021	2022	2023	2024	2025
Early						
Middle						
Late						

Table 5.1

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

5.3 Conduct Surveys

In each direction of travel the leftmost permanent lane will be surveyed

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 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.

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

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:

- 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.
- The Index of SFC (Sideways 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 and 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 E/1 of CS228).

6. CHAPTER 6 - SETTING THE INVESTIGATORY LEVEL

An Investigatory Level (IL) shall be defined for every part of the Skid 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 standards developed for Highways England. The site categories and associated Investigatory Levels defined in CS228 have been developed for Trunk Roads and Motorways. Therefore, in formulating this procedure, it has been recognised 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 CS228 can be found in Appendix 5.

The process is outlined below in Figure 6.1

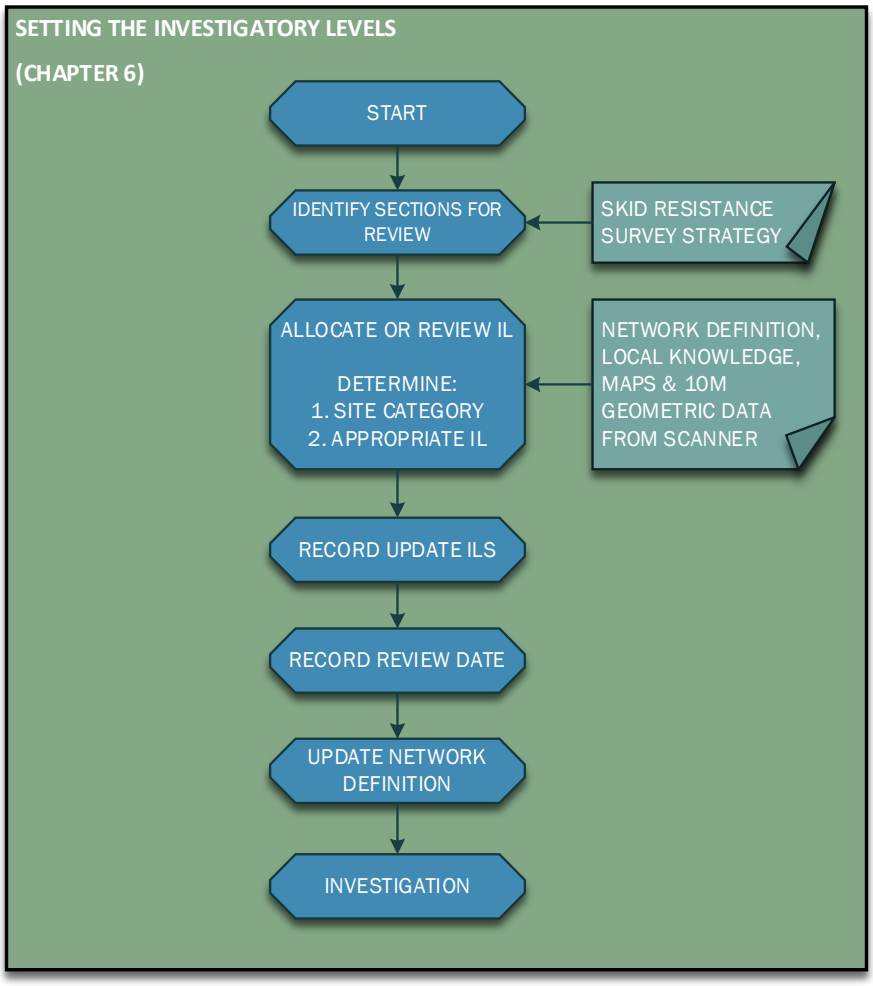

Figure 6.1 Setting the Investigatory Level

6.1 Identify Sections for Review

A review of the IL shall be carried out every three years.

6.2 Allocate or Review Investigatory Levels

Site Categories and their associated 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					
		0.30	0.35	0.40	0.45	0.50	0.55
A	Motorway						
BX	Non-event Dual carriageway						
BR							
BU							
CR	Non-event carriageway with two-way traffic						
CU							
QX	Approaches to and across minor and major junctions and approaches to roundabouts and mini-roundabouts (see Note 5 and 6)						
QR							
QU							
KS	The extents of school warning signs or road markings						
KR	Approaches to pedestrian crossings, traffic lights and other high-risk situations (see Note 5 and 6)						
KU							
RR	Roundabout						
RU							
G1R	Gradient 5-10% longer than 50m (see Note 7)						
G1U							
G2R	Gradient >10% longer than 50m (see Note 7)						
G2U							
S1i	High Risk Bends Dual Carriageway Rural radius <100m						
S1	Bends Dual Carriageway Rural radius <500m, Urban radius <100m						
S2i	High Risk Bends Single Carriageway Rural radius <100m						
S2	Bends Single Carriageway Rural radius <500m, Urban radius <100m						

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
   Suffix i applies to Rural roads where the bend radii is <100m and therefore higher risk
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. Similarly, QR and KR are based on an 80m approach.
7. Categories G1 and G2 should not be applied to uphill gradients.

Table 6.1

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 then the site should be included in either the preceding or following site, whichever has an investigatory level 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 Investigation Levels that may be reviewed.

7. CHAPTER 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 Chapter 8. The process is outlined below and can be split into the 4 steps detailed in Figure 7.1

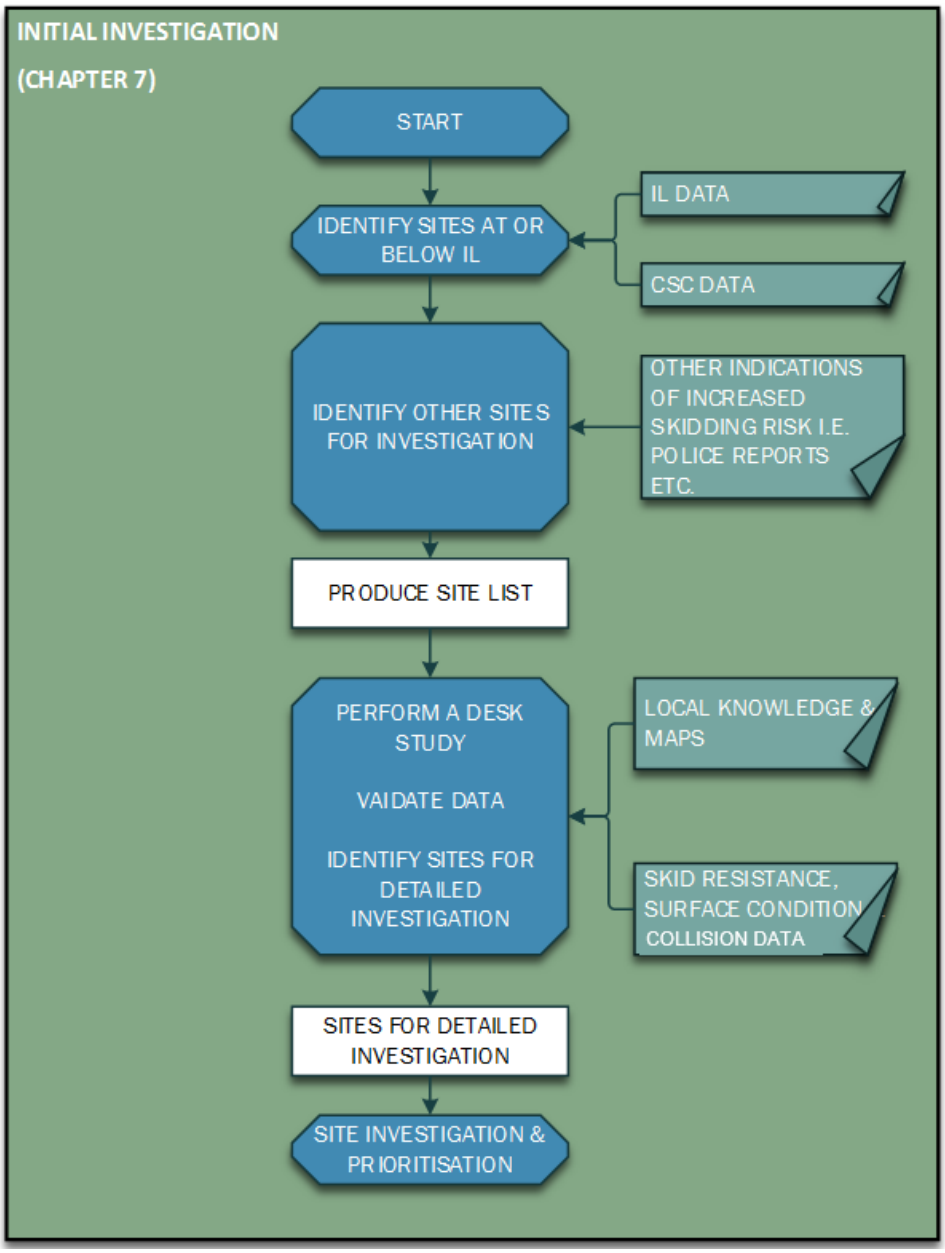

Figure 7.1 Initial Investigation

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 Standard, sites are identified where increased wet or damp skidding collision levels have been observed.

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 qualifying collision history.

A list of sites requiring detailed investigation shall be produced within 2 months 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 collision model, which has been developed specifically for the Highways England road network. It is not appropriate to use said collision model on a network outside of the Highways England's network).

8. CHAPTER 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. Full details of the procedure for identifying sites that require detailed investigation can be found in Appendix 6.

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

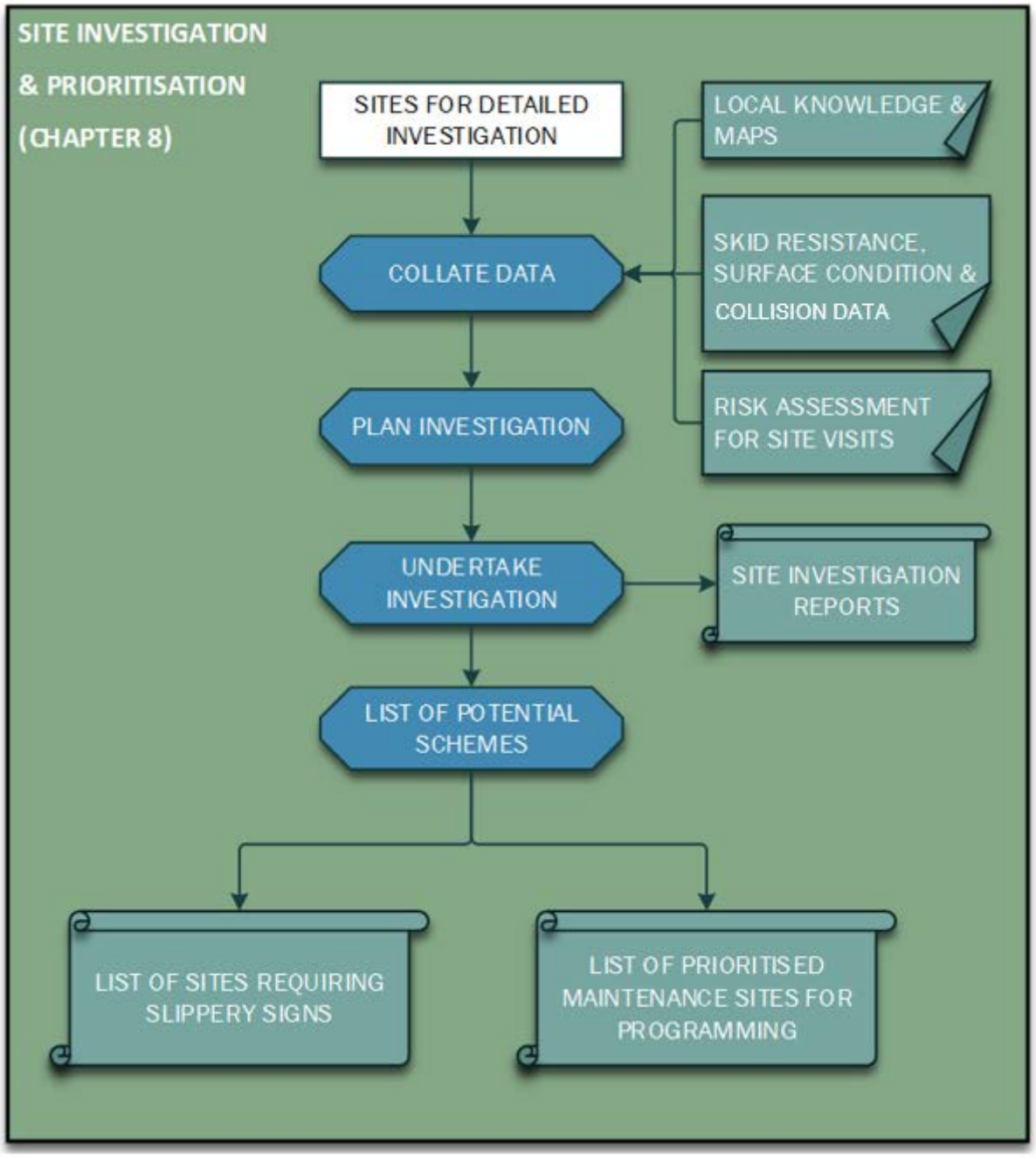

Figure 8.1 Detailed site investigation and prioritisation

8.1 Collate Data

As a minimum, the data collected shall include skid resistance and the most recent 3 years of collision data available.

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 collisions and features such as bends, junctions, etc. This data will be collated as GIS mapping.

The location of collisions occurring in wet or damp conditions irrespective of whether skidding was reported should be identified specifically.

8.2 Plan Investigations

Investigations should be planned primarily to maximise efficiency. Greater priority should be given to completing investigations for sites that are substantially below the IL or where the collision history indicates that there is a risk of wet or damp skidding collisions 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 7.

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 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 collision 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 collision history, it is likely to reduce the risk of collisions in wet or damp conditions. Based on knowledge of skid resistance and collision risk trends, this includes locations where the position of collisions in wet or damp conditions (whether or not skidding was reported) appears to be linked to surface condition, or where the overall collision 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 has been identified and should be reviewed by an engineer on site to confirm these areas.

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

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 take into account the findings of the site investigations which include:

- Average Deficiency
- Wet or Damp Skid Collisions
- On site questions as detailed in Appendix 7

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 section within the Council will be notified to identify the best course of action to be taken.

The Council have produced a 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 prioritisation is a risk based methodology incorporating consequence and likelihood attribute values and applying a risk matrix based on 'Well Managed Highway Infrastructure'.

The full methodology is detailed in Appendix 7.

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

9. CHAPTER 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 >= 50m in length may result in an increased risk of collision to road users and shall be signed as soon as practicable until the site has been rectified.

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

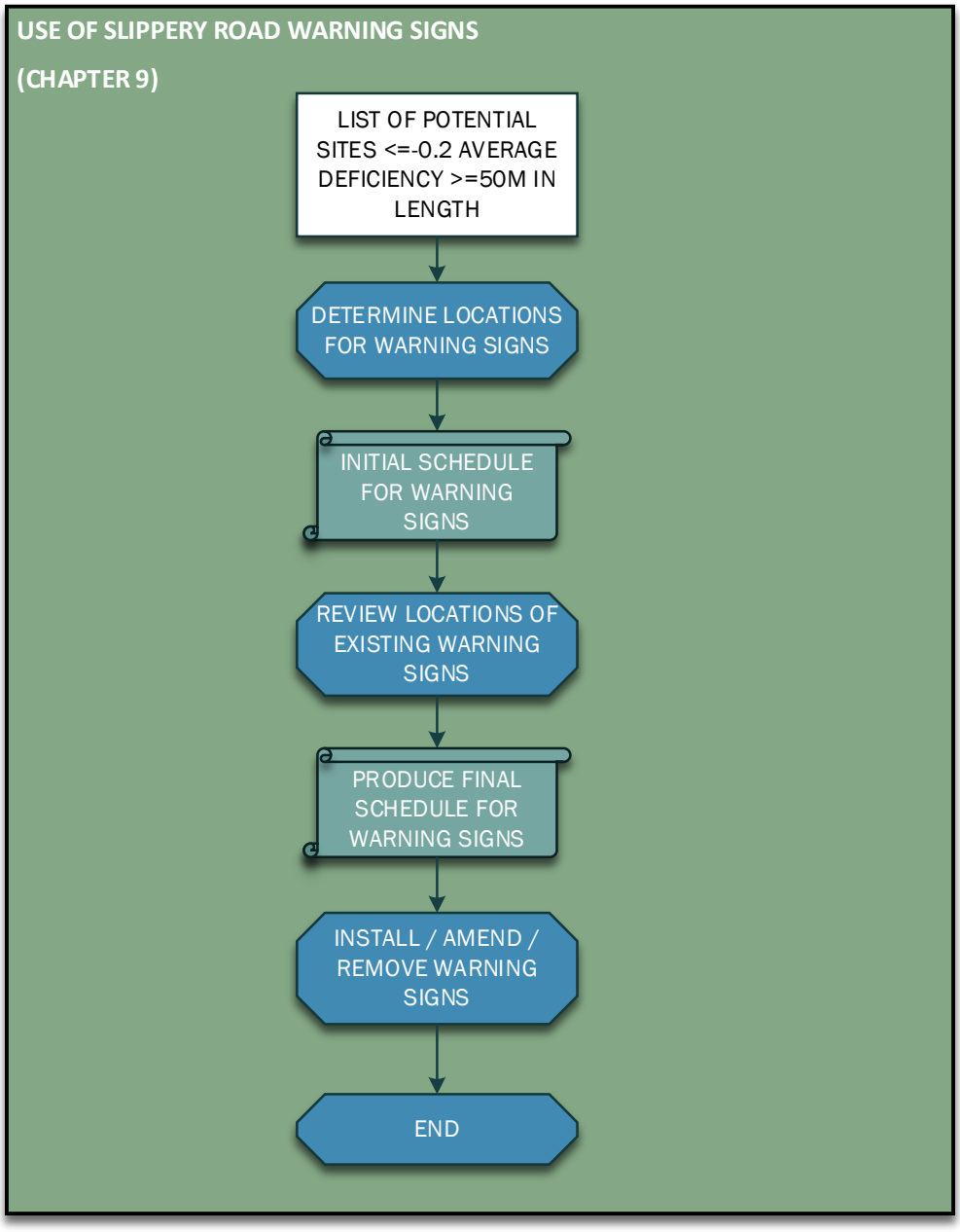

Figure 9.1 Use of slippery road warning signs

9.1 Determine Locations Requiring Road Warning Signs

Sites which have been identified as requiring treatment to improve the skid resistance shall have warning signs erected where it is deemed appropriate. Slippery road signs will not

automatically be used on every scheme; only to advise the road users where an engineer has deemed appropriate following a review of all the available information.

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 and >=50m in length. They shall then be removed as soon as practical after treatment has been applied.

The slippery road warning sign (Diagram 557) with no supplementary plate 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. CHAPTER 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 by maintaining the following records to demonstrate the ongoing operation of this procedure:

- Investigatory Levels for the surveyed road network, including justification for any deviation from the recommendations in Chapter 6 and dates of Investigatory Level review and the identity of the reviewer.
- Skid testing results and data analysis including survey date(s) and date(s) the survey data is received.
- Site investigation findings for every site assessed including survey date(s) and the identity of the inspector.
- A record of sites where and when slippery road warning signs have been erected showing subsequent removal dates where appropriate. This will also include dates when sites are identified as requiring signing.
- Priority lists of sites for remedial treatment to restore an adequate level of skid resistance. This will also include dates when the treatment/action priority list are produced and when the works programme is signed off.
- Details of completed works programmes, relating to remedial treatment for substandard skid resistance. This will also include dates when the works are complete

11. CHAPTER 11 - REFERENCES

Design Manual for Roads and Bridges

- CS 228 Skidding Resistance (August 2019)
- CD 236 Surface course Materials for Construction
- HD 37/99 (DMRB 7.5.2) Bituminous Surfacing Materials and Techniques

The Traffic Signs Regulations and General Directions 2002

Highways Act 1980

Well-maintained Highways. Code of Practice for Highway Maintenance Management

Well-managed Highway Infrastructure – A Code of Practice

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)

TRL Report TRL622 - Accidents and the Skidding Standards for Strategic Roads in England

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.

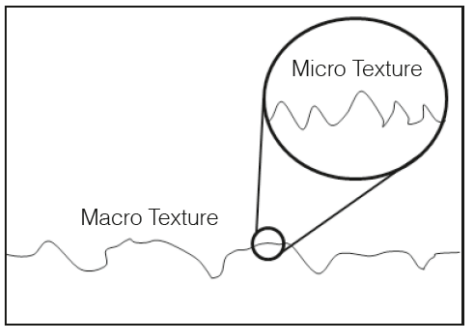

Figure A.1.1 Macro Texture and Micro Texture

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 collision risk

Within normal ranges, low skid resistance does not cause collisions 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 collisions in cases where drivers need to complete a more demanding manoeuvre in order to avoid a collision. 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.

Collision analyses have shown that there are relationships between measured skid resistance and collision risk. These relationships are not precise, in that differences in skid resistance may account for only a relatively small part of the difference in collision 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 collision 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 collision 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 collisions 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 collisions at these sites.

However, not all sites within a single category are equivalent in terms of their collision risk. Figure A.1.2 illustrates the range in collision 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 collision 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.

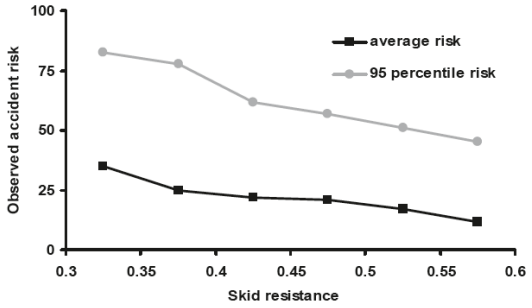

Figure A.1.2 Crash risk and skid resistance – variation within Site Category

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 surfacing 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.

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 sideways-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, this means that 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.

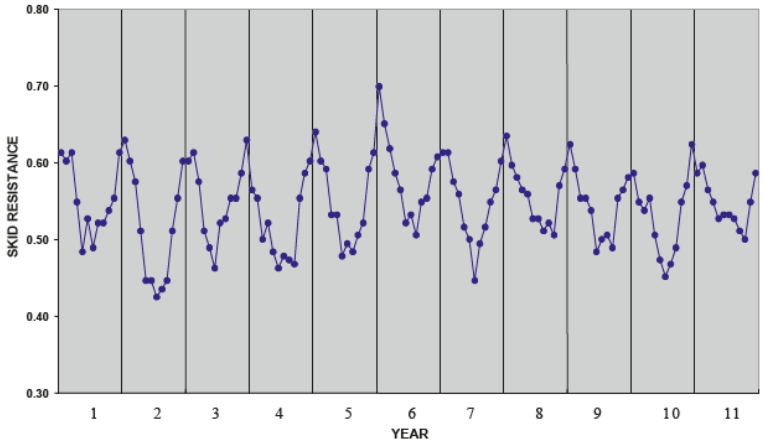

Figure A.1.3 Long term variation in skid resistance (from LR 738)

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 are detailed in Appendix 2.

Early life skid resistance of asphalt surfacing

Asphalt surfacing materials exhibit different skid resistance properties in the initial period after laying compared with the same surfacing's 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 collision 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 CS228 Annex E/1

Overview of SASS approach

The method shall use measurements from the preceding three years to characterise the long-term skid resistance of the network.

The long-term value of skid resistance shall be used, with the mean network skid resistance in the current year, to calculate a correction factor that is applied to the current year's data to make current values consistent with the long-term average.

Sections which have had resurfacings carried out in the last three years shall be identified and removed from the calculation procedure for the correction factors.

The SASS approach takes account of yearly variation and therefore the calculations are affected by maintenance carried out in the last three years.

Larger highway networks shall be split into smaller localities.

The correction factor shall be determined and applied separately within each locality.

The effect of seasonal variation will vary in different geographical areas (such as due to different amounts of rainfall), therefore necessitating the need for a local approach.

The whole network shall be surveyed once during the test 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.

As 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 should be tested in the early part of the season again, and so forth.

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 can be determined.

A locality shall be small enough so that similar weather conditions would 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 can influence all the roads in a local area in a similar way.

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

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.

The local equilibrium correction factor (LECF) is the correction factor that shall be used within each locality to bring the current year data to a level consistent with the long-term average.

The LECF is calculated in three stages.

The local equilibrium SC (LESC) shall be determined to represent the average skid resistance level for the locality over recent years.

The LESC is the average SC, calculated for all valid 10-m sub-section measurements in the defined locality over the three years that precede the current testing season.

The LESC shall contain surveys from each of the three parts of the test season with valid measurements being those that were made in the required part of the test season, on the required test line, and on road surfaces that were at least 12 months old at the time of testing.

As a consequence of Cl. E/1.12, if a length of road has been resurfaced within the last four years then that length should be excluded from the LECF calculation.

The Local Mean SC (LMSC) shall be determined for the current survey. The LMSC is the average of all valid 10-m sub-sections in the locality in the current year survey.

The LECF shall be determined by dividing the LESC by the LMSC, that is:

Equation E/1.15 Calculation of LECF

$$LECF = \frac{LESC}{LMSC}$$

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

APPENDIX 3 – THE SKID NETWORK

Sections of the following roads shall be surveyed on an annual basis and form the skid network.

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

The skid network currently consists of:

- Principal A Roads
- Classified B Roads
- Hierarchies 1 to 4

Inevitably there will be some sections in the above classifications where a SCRIM or GripTester 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 or road layouts where it is not possible or safe to maintain the survey speed and held on file within the ETE Department.

APPENDIX 4

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APPENDIX 5 – APPLICATION OF SITE CATEGORIES AND INVESTIGATORY LEVELS

Note: This Appendix is an amended version of Appendix A of CS228

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.

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 category **A** an IL is defined as **0.35**

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

For category **BU** an IL is defined as **0.35** where road section signed speed <50mph (Urban)

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

For category **CU** an IL is defined as **0.40** where road section signed speed is <50mph (Urban)

BU and **CU** are set at the lowest ranking IL in CS228 as it is considered that on the more lightly trafficked County road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

At junctions, use 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.

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

Use this Site Category for:

- Major/Minor priority junctions (defined as interconnecting classified roads)
- Other significant junctions (defined as Junctions with right-turn lanes including those giving access to Supermarkets, Business Parks, Industrial Estates and Retail Centres)
- Approaches to roundabouts and mini-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 category **B** or **C** instead).

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

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

For category **QU** an IL is defined as **0.45** where road section signed speed is <50mph (Urban). It is set at the lowest ranking IL in CS228 as it is considered that on the more lightly trafficked County road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads

Approaches to Junctions

Apply QR to the 80m approach (in the direction of travel) to the junction and across the extent of the junction (where applicable) where road section signed speed >=50mph (Rural).
Apply QU to the 50m approach (in the direction of travel) to the junction and across the extent of the junction (where applicable) where road section signed speed <50mph (Urban)

Approaches to roundabouts

Apply Site Category **QR** to the 80m approach to the stop/give way line where road section signed speed >=50mph (Rural)

Apply Site Category **QU** to the 50m approach to the stop/give way line where road section signed speed <50mph (Urban)

Do not use this Site Category for roundabouts with traffic signals – use category **K** instead.

Category K: Approaches to traffic signals, pedestrian crossings and railway crossings

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 collision. For the avoidance of doubt

High Risk situations are described in table A.5.1. This table will be reviewed periodically in the light of experience.

Apply Site Category **KR** on the 80m approach to the hazard where road section signed speed >=50mph (Rural)

Apply Site Category **KU** on the 50m approach to the hazard where road section signed speed <50mph (Urban)

High Risk Situation	Descriptor to be added to the specification
Schools	Category K shall be applied to the extent of any warning road signs or warning road markings associated with the school site. For the avoidance of doubt the positioning of the warning road signs or warning road markings will be deemed to incorporate appropriate approach distances to these high risk situations.
Market Places and Pedestrianised Streets	Category KU shall be applied to the extent of Market Places and Pedestrianised Streets where vehicular access is possible.

Table A.5.1

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

For category **KU** an IL is defined as **0.50** where road section signed speed <50mph (Urban). Set at the lowest ranking IL in CS228 as it is considered that on the more lightly trafficked County road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads.

Category R: Roundabout

Use for roundabout circulation areas, including approaches to traffic lights on roundabouts. If there are specific, high-risk situations then use category KR or KU depending on speed limit. Mini roundabouts should be excluded from this Site Category, in this instance category QR or QU depending on speed limit should be applied to the approach and across the mini roundabout.

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

For category **RU** an IL is defined as **0.45** where road section signed speed <50mph (Urban) . Set at the lowest ranking IL in CS228 as it is considered that on the more lightly trafficked County road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads.

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

Use for lengths of carriageway of at least 50m with an average downhill gradient of between 5 and 10%.

Category G1 should not be applied to uphill gradients.

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

For category **G1U** an IL is defined as **0.45** where road section signed speed <50mph (Urban). Set at the lowest ranking IL in CS228 as it is considered that on the more lightly trafficked County road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads.

Category G2: Gradient >10% longer than 50m

Use for lengths of carriageway of at least 50m with an average downhill gradient greater than 10%.

Category G2 should not be applied to uphill gradients.

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

For category **G2U** an IL is defined as **0.50** where road section signed speed <50mph (Urban). Set at the lowest ranking IL in CS228 as it is considered that on the more lightly trafficked County road network there is a diminished safety risk from lower Investigatory Levels than on the more heavily trafficked trunk roads.

Gradient assessments can be based on 10m gradient data from SCANNER surveys or from accurate topographical survey data when available.

Category S1i: Bend radius <100m Rural

For use on High Risk Bends dual carriageways (category S1i)

In high risk rural areas, carriageways subject to >=50mph, the **S1i** 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
- Roundabout exits

For category **S1i** an IL is defined as **0.50** where road section signed speed >=50mph (Rural).

Category S1: Bend radius <500m Rural, <100m Urban

For use on dual carriageways (category S1)

In rural areas, carriageways subject to >=50mph, the **S1** category should only be applied for bends with radii less than 500m

In urban areas, carriageways subject to <50mph, the **S1** 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
- Roundabout exits

The Site Category should be extended upstream and downstream to where the radius of the road has exceeded 500m (Rural roads) or 100m (Urban roads).

For category **S1** an IL is defined as **0.45** where road section signed speed >=50mph (Rural).

For Category **S1** an IL is defined as **0.45** where road section speed <50mph (Urban).

Category S2i: Bend radius <100m Rural

For use on High Risk Bends single carriageways (category S2i)

In high risk rural areas, carriageways subject to >=50mph, the **S2i** 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
- Roundabout exits

For category **S2i** an IL is defined as **0.55** where road section signed speed >=50mph (Rural).

Category S2: Bend radius <500m Rural, <100m Urban

For use on single carriageway roads (category S2)

In rural areas, those subject to >=50mph speed restrictions, the **S2** category should only be applied for bends with radii less than 500m

In urban areas, those subject to <50mph speed restrictions, the **S2** category should only be applied for bends with radii less than 100m

This category should not generally be used for:

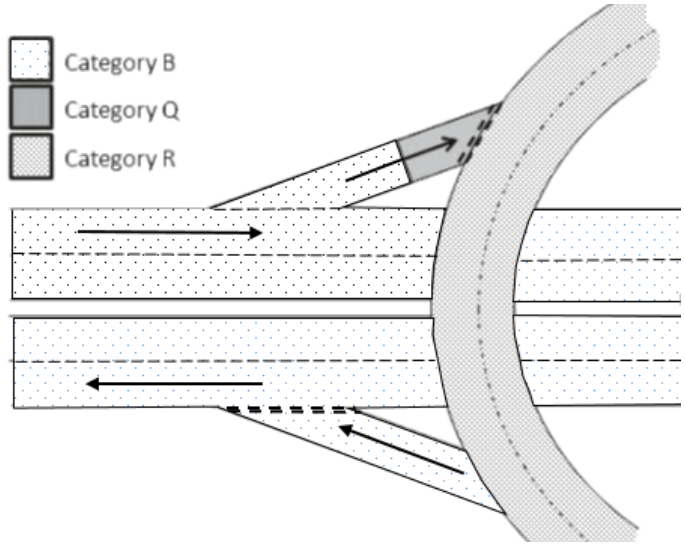
- Short lengths, for example less than 50m
- Roundabout exits

For category **S2** an IL is defined as **0.50** where road section signed speed >=50mph (Rural).

For Category **S2U** an IL is defined as **0.50** where road section speed <50mph (Urban).

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.



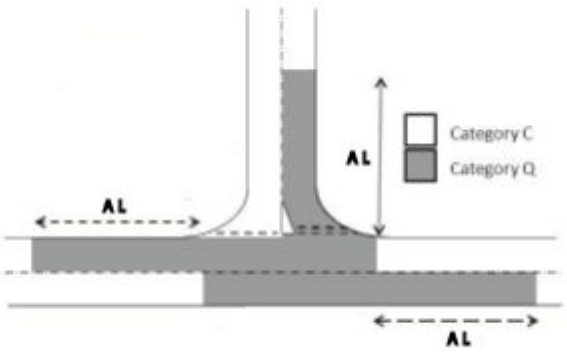
Note: Approach distances to hazards:
50m urban areas <50mph
80m rural areas =>50mph

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

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.

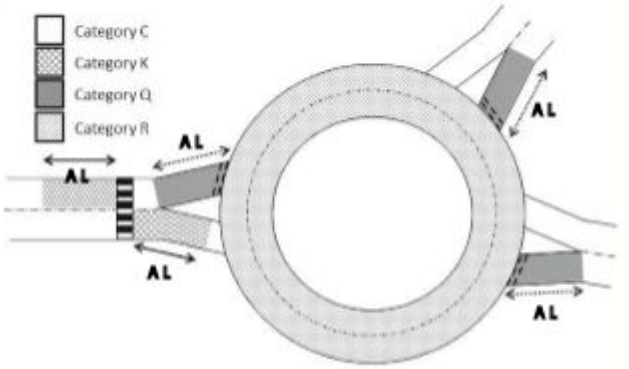


Note: Approach lengths (AL) are 50m for urban speeds <50 mph and 80m for rural speeds => 50 mph

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

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.5.3. In some cases other site categories may also be required due to other events occurring in the vicinity.



Note: Approach lengths (AL) are 50m for urban speeds <50 mph and 80m for rural speeds => 50 mph

Figure A.5.3 Site categories for a roundabout with a pedestrian crossing

APPENDIX 6 – METHODOLOGY FOR THE IDENTIFICATION OF SITES REQUIRING A DETAILED INVESTIGATION

The 'Crash Model', referred to in Annex E/2 of CS228, has been developed specifically for the Highways England road network and it is not appropriate to use it on the County road network.

The identification of sites requiring detailed investigation (the initial site score) will therefore be carried out as follows based on the 'Alternative Method' detailed in Annex 7 of HD28/15.

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. The 'Alternative Method' which is a simplified approximation of Highways England's 'Crash Model' is further adapted here to take into account collision severity and Wet/Damp road condition collisions.

It is nationally recognised that SCRIM and GripTester values are not an exact measure (it is a coefficient) 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 of 200 sites for detailed site inspections. The scoring includes a minimum criterion set using a threshold for "substantial average deficiency" set at <=-0.2.

Note: The score for the 200th site is taken as the minimum value to identify sites requiring detailed investigation. This value is subject to change to ensure a minimum 200 sites have a detailed inspection.

Any site with a score greater than or equal to the chosen score (N) will be subject to a detailed investigation.

Scores and criteria						
Number of wet collisions as defined in STATS19 (see also Note below)	0	1	2	3+		
Score	0	4	8	12		
Likely Impact of a Collision	Slight	Slight/Serious	Serious	Serious/Fatal		
Score	1	2	3	4		
Skid Resistance Difference (SRD)	> 0	> -0.05 and <= 0	> -0.10 and <= -0.05	> -0.15 and <= -0.10	> -0.20 and <=-0.15	<= -0.20
Score	0	1	3	6	12	99
Number of Fatal Collision	0		1+			
Score	0		1			

Table A.6.1

Note: The number of collisions will be based on the most recently available 3 years data

Given the limited accuracy of locating collision positions, it may be assumed for the purpose of this investigation that the position of a collision 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, collisions in excess of 75m/200m can be 'tagged' to the site and collisions 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 collisions 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 collision. The likely impact of a collision will vary from site to site, for example, collisions on roundabouts are likely to be low speed rear or sideways collisions (ie slight). Whereas a collision on a carriageway with 2-way traffic would possibly involve a head-on collision which is likely to be serious or fatal. Table A.6.2 has been created to reflect these variations and will be used to derive the likely impact of a collision at each site. Every applicable network section will have an attribute detailing its likely impact of a collision. The attribute will be reviewed with Investigatory Levels at least every 3 years.

The likely impact of a collision will be derived from the following table:

SCRIM CATEGORY	Impact of Crash
A	Serious
BX	Serious
BR	Serious
BU	Slight/Serious
CR	Serious/Fatal
CU	Serious
QX	Serious/Fatal
QR	Serious/Fatal
QU	Serious
KS	Serious/Fatal
KR	Serious/Fatal
KU	Serious
RR	Serious/Fatal
RU	Slight/Serious
G1R	Serious
G1U	Slight
G2R	Serious
G2U	Slight
S1i	Serious/Fatal
S1	Serious
S2i	Serious/Fatal
S2	Serious

Table A.6.2 Likely Collision Impact

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

APPENDIX 7 – METHODOLOGY FOR THE IDENTIFICATION AND PRIORITISATION OF PROPOSED TREATMENTS

The Council 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. This provides a certain level of intervention criteria, however, this level of intervention (ie treatment) is ultimately determined by budget, provided that a minimum service level can be attained.

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 sites identified in the procedure outlined in Appendix 6 will be subject to a detailed investigation, part completed on site and part as a desktop exercise. Although the investigation is prompted by this Skidding Resistance Policy the exercise will be used both to identify skid resistance remedial measures and to identify or promote measures for other work programmes.

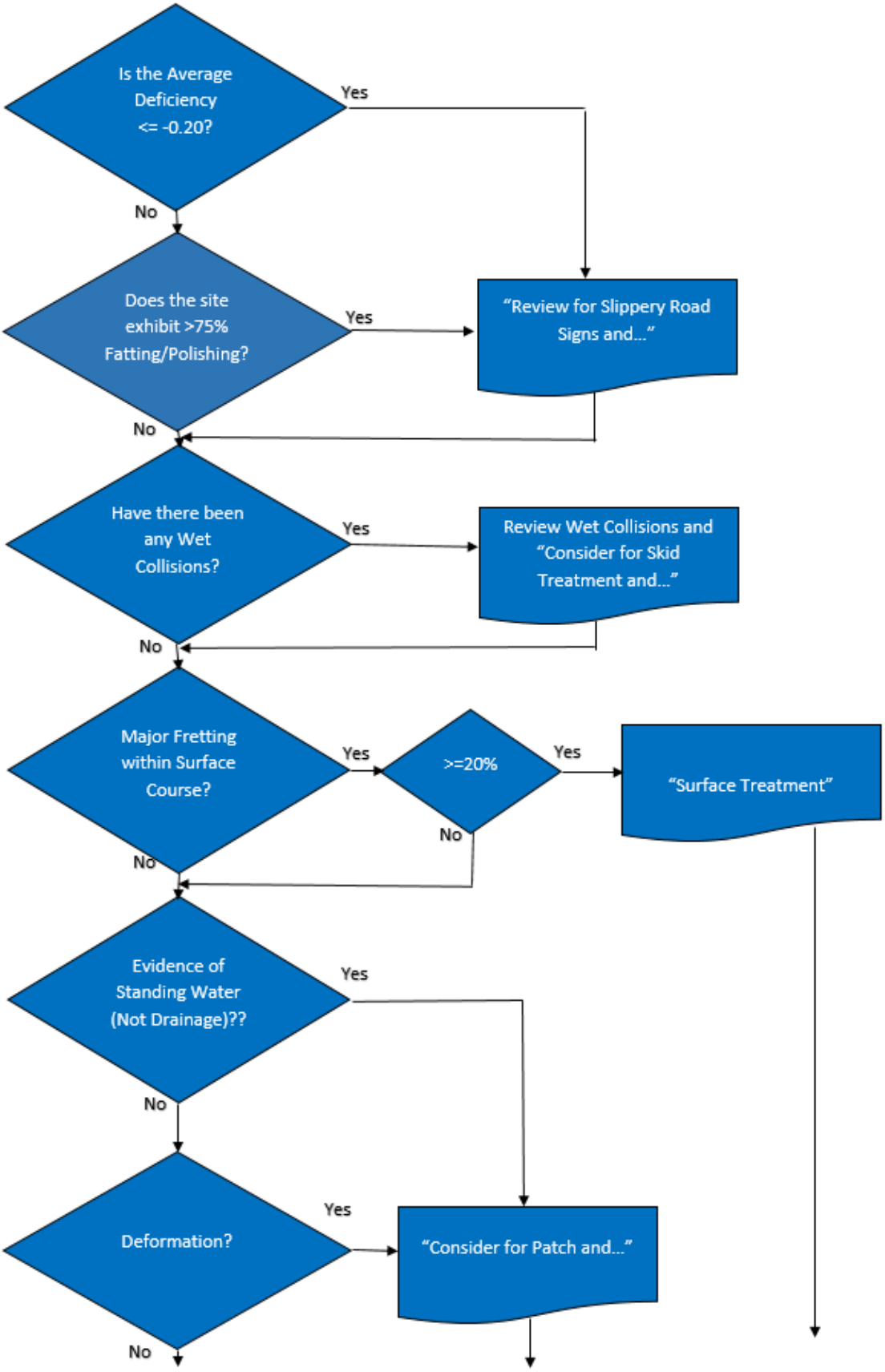
In particular the AEI (Annual Engineers Inspection) results for the site will be examined as part of the desktop element of the detailed investigation with the intention of creating synergies between surfacing treatment programmes.

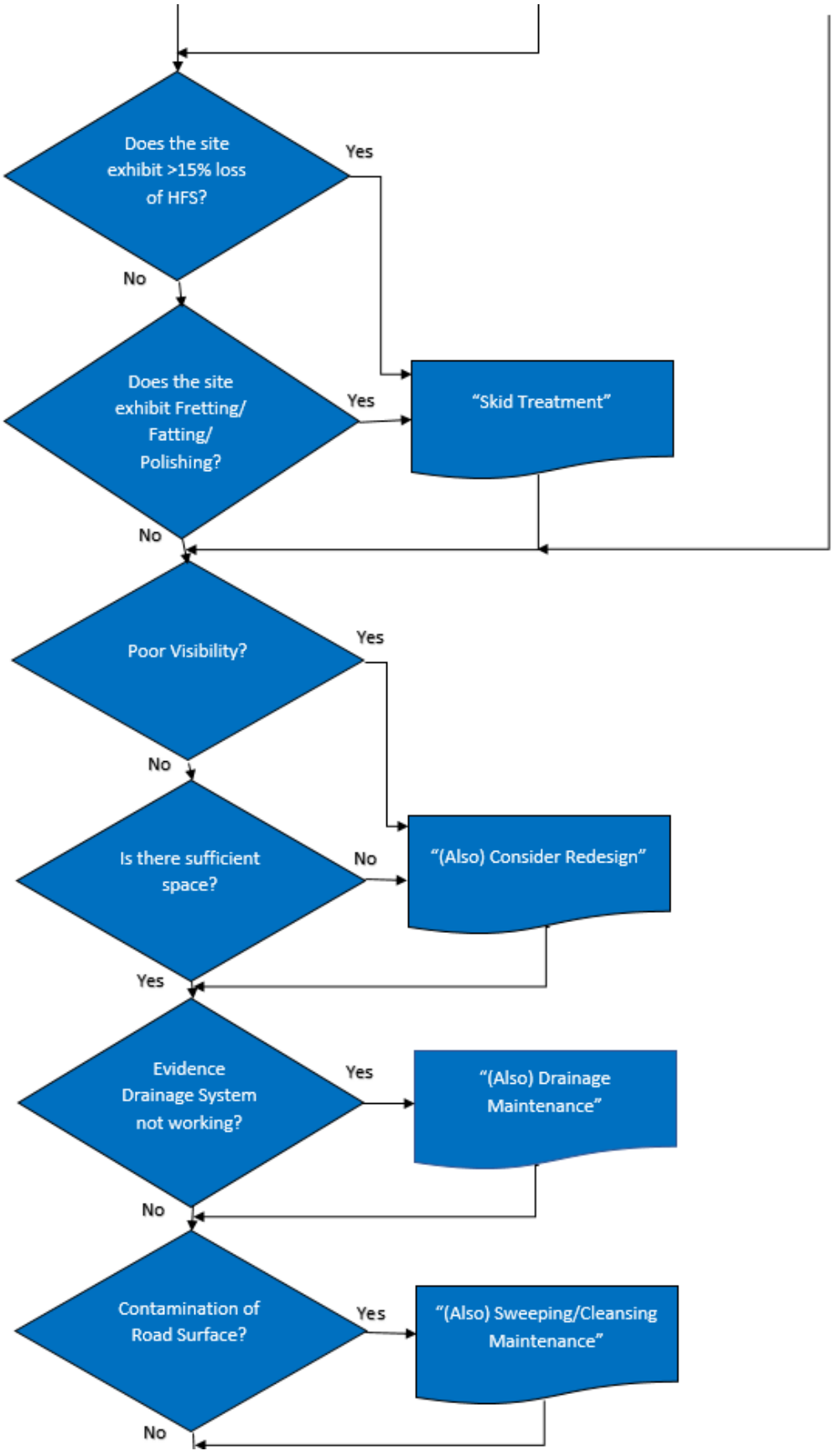
This detailed investigation will further prioritise sites and identify appropriate remedial treatments.

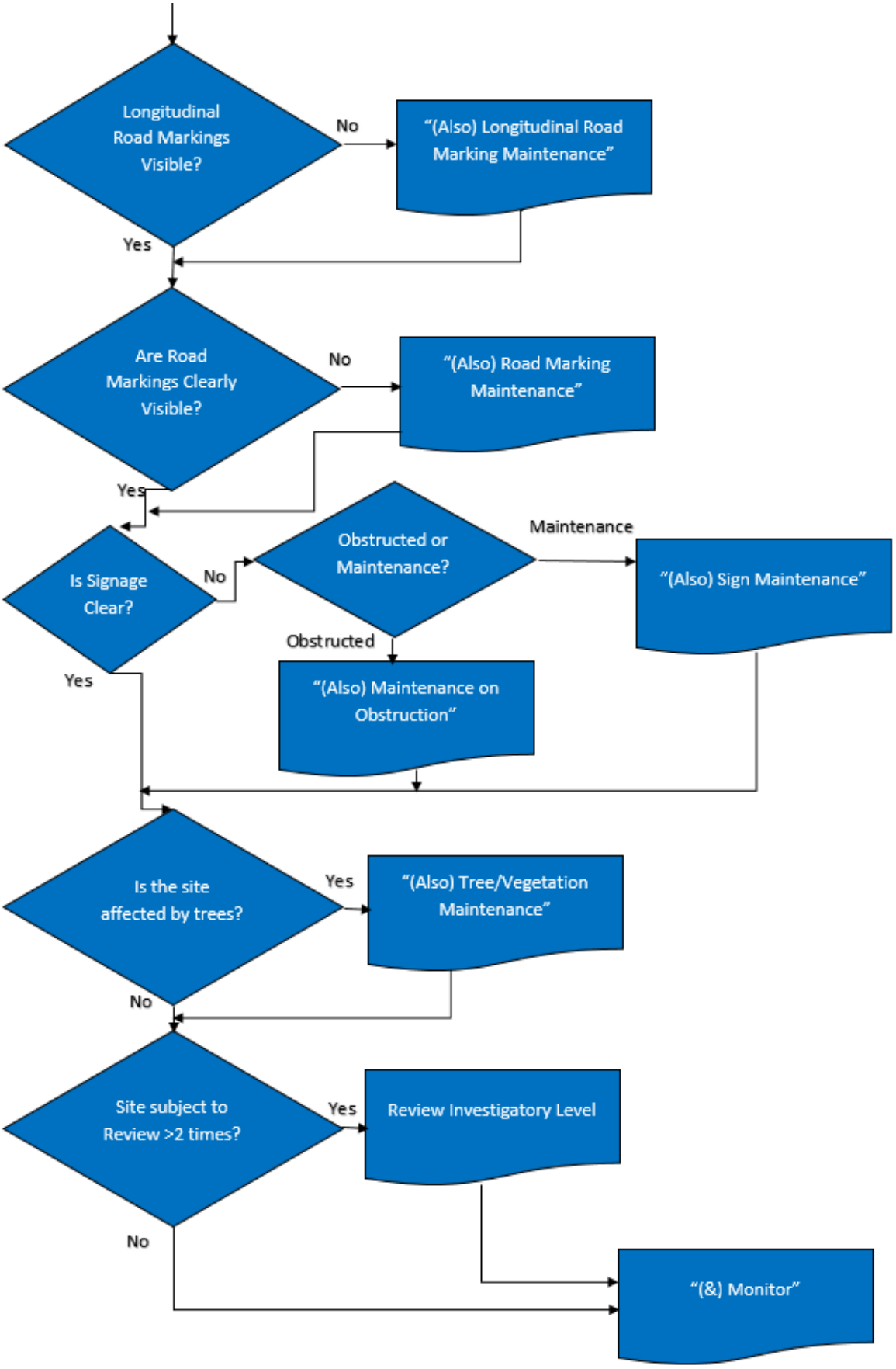
Treatment Identification

Figure A.7.1 illustrates the process followed. A series of questions are completed by the inspector and responses will identify site deficiencies and assign the site to a number of ‘broad brush’ treatment ‘Bins’ where appropriate. These are a tool for the engineer and will require final detail design/process to be determined. These responses also generate a score to be added to the initial site score derived from Table A.6.1

Fig. A.7.1 – On-site element of detailed site investigation process




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


Longitudinal Road Markings Visible?
No
"(Also) Longitudinal Road Marking Maintenance"
Yes
Are Road Markings Clearly Visible?
No
"(Also) Road Marking Maintenance"
Yes
Is Signage Clear?
No
Obstructed or Maintenance?
Maintenance
"(Also) Sign Maintenance"
Obstructed
"(Also) Maintenance on Obstruction"
Yes
Is the site affected by trees?
Yes
"(Also) Tree/Vegetation Maintenance"
No
Site subject to Review >2 times?
Yes
Review Investigatory Level
No
"(&) Monitor"

Desktop element of detailed investigation

The desktop element of the detailed investigation will:

- Analyse the Treatment Bin results as defined in Table A.7.1
- Look at the details of the collisions on each site
- Put together work programmes

The following will be taken into account in prioritising work programmes:

- The number, severity and nature of collisions (filtered at this stage to disregard extraneous incidents)
- The degree of skid resistance deficiency
- Cost effectiveness of treatments
- Opportunity to co-ordinate multiple treatments at a site
- Available resources

A further series of questions are completed as part of the desktop exercise with the results also contributing to the overall SAL score (see Table A.7.2).

The detailed investigation process has been designed to produce objective information to assist with the prioritisation of remedial works and to provide an audit trail.

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 Collisions	Review Wet Collision data	The existing prioritisation scoring methodology ensures that Collisions occurring in wet conditions are allocated a high priority. However, the location and relevance of the wet collision 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 collision 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.
		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
		Improve Sight Line	This option could be costly and possibly not feasible due to environmental factors /cost etc.
	Re-design	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

Group	Treatment 'Bin'	Treatment	Comments
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 collision data or local knowledge.

Table A.7.1 – Treatment 'Bins'

Detailed Investigation Questions

Source	Question Text	Response	Scoring
Condition	***Average Deficiency****	***1/-0.01/-0.05/-0.20***	**1/5/10/20**
Condition	Does the site exhibit >=25% loss of HFS within the wheel paths/braking zone?	No/Yes	0/1
	Does the site exhibit Fatting/Polishing/Minor Fretting within the wheel paths/ braking zone?	No (<15%)/Yes (15-75%)/Yes (>75%)	0/1/2
	Is there Deformation/Pushing of Material?	No/Yes	Info Only
	Does the site Exhibit Major Fretting within the Surface Course (entire area)?	No/Yes (<20%)/Yes (>=20%)	0/0.5/1
	Is there evidence of standing water NOT drainage related? (ie Rutting/Settlement)	No/Yes	0/1
	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
	Are Road Markings i.e. stop lines, clearly visible? (due to wear not leaves, etc.)	Yes/No	Info Only
	Are Road Signs clear, visible and easily understood?	Yes/No (Sign Requires Maintenance)/ No (Sign Obstructed)	Info Only
	Is the site affected by trees/ vegetation?	No/Yes	Info Only
	Majority Surface Type	HFS/HRA/SD/Micro /SMA/ Other/Bitmac	Info Only
	Is there Contamination (e.g. Detritus) on the road surface?	No/Detritus/Oil/ Soil/Sand/Other	Info Only
Site	*Wet collisions**	*0/1+*	0/1
	*Fatal collisions**	*0/1+*	0/1
	Is there evidence of past patching repairs/ pothole fillings?	No/Yes	0/1
	Is there evidence of collision damage or heavy braking (i.e. Skid marks)?	No/Yes	Info Only
	Does the site have shared use? (i.e. Bus or cycle lane)	No/Yes	Info Only
	Is there presence of existing slippery road signs?	No/Yes	Info Only
	Is there presence of Traffic Signal Induction Loops?	No/Yes	Info Only
Road Layout	Is Queuing/ Standing traffic likely at any time? (including Peak hours)	No/Yes	0/1
	Is there sufficient space? (i.e. lane width >2.7m No Damaged Kerbs present)	Yes/No	Info Only
	Is there presence of Lay-bys or other access (i.e. property/field access)?	No/Yes	0/1
	Is there poor advance visibility? (Cannot see event from 100m in either direction/ Complicated Turning/ Sudden stopping)	No/Yes	0/1

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

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