# **Highways Asset** Management Plan

Skid Resistance Code of Practice January 2021



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# 1 Introduction

Lancashire County Council (the Council) is responsible for approximately 7,200km of highway and is committed to managing skid resistance levels of road surfaces across this network to achieve acceptable road user safety in a cost-effective manner.

The maintenance of adequate levels of skidding resistance on carriageways, footways and cycle routes is a critical aspect of highway maintenance, and one that contributes significantly to network safety.

This Skid Resistance Code of Practice sets out the Council's approach to managing skid resistance levels of road surfaces across the Council's highway network and provides detailed guidance for the processes by which the strategy will be applied.

#### Aims

The Council's aims in managing skid resistance on their highways network are:

- To allow the public to travel safely using the highway network
- To contribute to a reduction in the number of people killed or seriously injured on the highway network
- To ensure the Council fulfils its duty of care under the Highways Act 1980

#### What is Skid Resistance?

Skid resistance is a measure of the frictional properties between the tyre of a moving vehicle and the road surface which directly affect the ability of a driver to slow/stop the vehicle. As such, it is a key component of road safety. In this document, skid resistance is considered in wet conditions, since the skid resistance of a wet or damp road surface can be substantially lower than the same surface when dry.

The skid resistance of a surface decreases over time due to the effects of traffic and weathering. Routine monitoring of skid resistance is carried out annually across the network using a Sideways-force Coefficient Routine Investigation Machine (SCRIM) to provide an average deficiency measurement known as the Characteristic Skid Coefficient (CSC), and combined with other data to determine areas for further investigation and potential treatment.

See Appendix 1 for further information on skid resistance.

#### What does this Strategy document cover?

This Skid Resistance Strategy provides the framework, processes and guidance for the management of skid resistance, with the aim of ensuring that the frictional properties of road surfaces are appropriate for their expected use and safety risk.

The operational guidance describes the detailed processes to:

- Define the network for which skid resistance will be managed
- Define the framework for assessing skid resistance risk
- Measure skid resistance on the SCRIM network
- Analyse skid resistance data to identify sites at which skid resistance may require further investigation
- Investigate selected sites to determine/confirm skid resistance risk
- Determine appropriate remedial actions where required

## Benefits of Effective Skid Resistance Management

The safety benefits of effective skid resistance management are:

- Prevention: reduced likelihood of wet skidding accidents
- Mitigation: improved safety outcomes in cases where wet skidding accidents do occur

Non-safety-related benefits of effective skid resistance management include:

- Improving road surface condition (and extending road useful life) through implementation of skid resistance improvement works
- Reducing the risk of claims against the Council due to wet-skidding incidents
- Providing a cost-effective opportunity to address other identified highway condition deterioration in synergy with network maintenance programmes

#### **Technical Basis**

This document is based on guidance in the UK Design Manual for Roads and Bridges (DMRB), CS 228 Skidding Resistance. CS 228 is designed for application to the UK Strategic Road Network rather than a local authority network such as Lancashire's. As such, some aspects of this Code of Practice deviate from CS 228 guidance to ensure that desired outcomes are maintained and that the strategy is practical for the Council's purposes. Deviations from CS 228 are noted and justified throughout this document, and are made only where there is a clear benefit and safety risk is considered to remain acceptable

This Strategy is also written in accordance with the relevant principles defined in the 2017 UKRLG Code of Practice (Well-Managed Highway Infrastructure), in particular section B.5.6.

#### Legal Basis

Ensuring safe levels of skid resistance is not a specific legal requirement on local authorities. However, maintaining highways to an acceptable level of safety supports the fulfilment of the duties of Highways Authorities under the Highways Act 1980. In addition, it is general good practice and clearly desirable to maintain acceptable skid resistance.

#### A Risk-Based Approach

In line with the general principles of the UKRLG Code of Practice (Well-Managed Highway Infrastructure) and CS 228 Skidding Resistance, this Strategy applies a risk-based approach to the management of skid resistance, including:

- Defining the parts of the highways network for which skid resistance will be managed
- Setting the framework for determining levels of skid resistance which may require investigation
- Assessing site skid risk in order to prioritise risk management activities
- Making deviations from CS 228 to take better account of local road characteristics

#### **Consideration for Other Road Users**

This Skid Resistance Code of Practice applies to carriageways only and does not apply to off-carriageway skid resistance (e.g.: cycle paths, slip resistance for pedestrians).

The following sources of guidance may be referenced where relevant for particular road users:

- For motorcycles: Institute of Highways Engineers Guidelines for Motorcycling
- For horses: British Horse Society & ADEPT (then CSS) Horses and Highway Surfacing

Note that the skid resistance of cycleways located on carriageways will be managed in the same way as for the adjoining carriageway (and therefore will be maintained to the same standard of skid resistance).

# 2 Strategy Overview

The flowchart in Figure 1 below provides an overview of the process behind the Council's Skid Resistance Strategy. Each of these steps is detailed further in the relevant sections of this Code of Practice.

Figure A: Overview of Skid Resistance Strategy processes

Define roads/sections to be surveyed for skid resistance (see page 8)
This SCRIM Network will be defined based on a pre-assessment of likely skidding
risk The SCRIM Network will be divided into Site Categories (SCs) based on risk
factors
Establish skid resistance assessment framework (see page 10)
Assess the relative skid risk of each site on the SCRIM Network
<ul> <li>Set Investigatory Level (ILs) for each site based on the Site Category and relative risk</li> </ul>
Measure Skid Resistance and determine deficient sites (see page 12)
Measure skid resistance using a Sideways-force Coefficient Routine Investigation
Machine (SCRIM)
Analyse SCRIM survey data to check skidding resistance against relevant ILs
Assess site skid risk and plan further actions (see page 16)
Risk assess sites with skid resistance below the IL or otherwise flagged for
assessment Determine whether further action is needed based on appeared risk
Investigate high-risk sites (see page 17)
<ul> <li>Investigate sites according to their site risk rating – high risk sites will have a</li> </ul>
mandatory inspection
Frovide recommendations for remedial actions to reduce skid fisk, if necessary
Determine remedial actions to reduce skid risk (see page 20)
<ul> <li>Identify appropriate remedial actions (if required) to reduce skid risk based on the site investigation</li> </ul>
Implement chosen remedial actions, planned and prioritised according to site risk

This process flow has built-in review loops – these are detailed throughout this document in the relevant sections. The overall review requirements are specified on page 2.

This Code of Practice employs a risk-based approach throughout. Some key risk-based steps are summarised in Table 1 below, using site risk scores as described in 5.1, pg 16.

#### Table 1: Risk-based approach to investigations

	Low Risk	Mid Risk	High Risk
Risk Score	≤3	3-12	≥12
(as per 5.1, pg 16)			
Site Investigations (see 5.2, pg 17)	No further investigation required	Investigate on a risk- prioritised basis, as resources allow, as soon as is reasonably practical following initial risk assessment	High-priority site investigation, to be carried out as soon as possible following initial risk assessment
Warning Signs <sup>1</sup> (see 6.3, pg 21)	None required	To be installed at identified locations as soon as is reasonably practical following site investigation	To be installed at identified locations as a matter of urgency following site investigation
Remedial Actions <sup>1</sup> (see 6.1, pg 20)	Implement only of/when resources allow, and only if cost-effective as part of a wider programme	Implement as soon as is reasonably practical, and as far as resources will allow	Works to be added to the current/next network maintenance works programme as high- priority schemes

<sup>1</sup> Based on <u>post-investigation</u> risk rating (this may differ from the initial risk rating)

# **3 Defining the SCRIM Survey Network**

## 3.1 The SCRIM Survey Network

The SCRIM survey network is that part of the highway network on which skidding resistance will be managed according to this strategy.

The Council have defined their SCRIM survey network as all classified roads (i.e.: DfT class A, B and C) within their adopted highway network – this is shown in Figure 2 below. By including all classified roads within the SCRIM survey network, the Council is taking a conservative approach to managing skidding risk.



Figure B: Map of Lancashire's SCRIM Survey Network

Skid resistance surveys will not be routinely undertaken on parts of the network other than the SCRIM survey network. Skid resistance measurement of sites not on the SCRIM survey network may be undertaken when requested by a suitably qualified and experienced person, where justifiable reasons are provided, for example as a result of reported incidents. Where possible, such sites will be appended to the routine annual SCRIM survey programme.

These sites will be reviewed to determine whether they should be added directly to the SCRIM survey network in future years.

Details of the SCRIM survey network (including Site Categories and corresponding Investigatory Levels – see below) shall be maintained in appropriate formats and stored using appropriate methods, including within the Council's highways asset management systems. These details shall be provided to SCRIM surveying contractors prior to every annual survey.

# 3.2 Setting Site Categories

The SCRIM Network is divided into sections, called Site Categories, based on the broad characteristics of the section in relation to skidding incident risk, considering both the likelihood and potential consequences of a skidding incident. The Council's criteria for setting Site Categories are identical for the most part to those in CS 228, with a few differences to account for the specificities of Lancashire's SCRIM survey network.

Changes from the Site Category criteria given in HD 28/15 are:

- Category S2 is split into two separate categories: S2a for bend radii < 250m, and 2b for bend radii < 100m. This is to account for the generally lower bend radii (= tighter bends) on Lancashire's network compared to the SRN.
- Applicable minimum speed for S2 categories reduced from 50mph to: 40mph for S2a, and 30mph for S2b. This is to account for the higher incidence of sections with a 30/40mph speed limit on Lancashire's network compared to the SRN, and to account for the reduced maximum applicable bend radius for category S2b.
- The requirement to apply categories S1 or S2 to all bends with <100m bend radius regardless of speed limit is removed, since this case is covered by new category S2b except for sections with speed limit <30 mph, where skidding risk is low.

The resulting full list of Site Categories applied to the Council's SCRIM survey network is as follows:

- B non-event carriageway with one-way traffic
- C non-event carriageway with two-way traffic
- Q approaches to and across junctions; approaches to roundabouts and traffic signals
- K approaches to pedestrian crossings and other high-risk situations
- R roundabout<sup>1</sup>
- G1 gradient of 5-10% longer than 50m<sup>2</sup>
- G2 gradient >10% longer than 50m<sup>2</sup>
- S1 bend radius  $<500m \ge 50$  mph carriageway with one-way traffic
- S2a bend radius  $<250m \ge 40$  mph carriageway with two-way traffic
- S2b bend radius <100m ≥30 mph carriageway with two-way traffic

<sup>1</sup> Mini-roundabouts should be excluded from this Site Category. Category Q should be applied for the approach to and across mini roundabouts.

<sup>2</sup> Categories G1 and G2 are <u>not</u> applicable to uphill gradients on carriageways with one-way traffic.

Site Categories will be applied to the entire SCRIM survey network according to the criteria set out above, and the following general principles:

- Site Categories shall not overlap at sites where more than one Site Category applies, the Site Category with the highest potential Investigatory Level (see Table 2, pg 12) will be applied. If highest potential Investigatory Levels in this case are identical, then the Site Category highest up the Table shall be applied (B is highest on the table, S2b the lowest).
- Site categories will be applied to all lanes of a carriageway with traffic running in the same direction therefore, all lanes of a carriageway should be considered when identifying what Site Category will be applied.
- Small sections up to 50m classified as "Non-Event" (Site Categories B or C) may be merged with adjacent sections – the small section will then be classified with the Site Category of the section it is merging into. This is a conservative approach since the "Non-Event" categories are the lowest risk. The purpose of this is to avoid small lowrisk sections, which will complicate the application of this Strategy with little to no benefit to skid resistance risk.<sup>1</sup>

<sup>1</sup>Note that this merging rule is not present in CS 228 (the SRN is unlikely to have many small "Non-Event" sections) and is introduced here to improve applicability to a local highway authority network.

Site Categories shall be set based on the guidance in this strategy in conjunction with the detailed guidance in Annex 5 of HD 28/15 (NB: the differences between the Site Categories specified in this strategy and those specified in HD28/15 should be taken into account).

## 3.3 Setting Investigatory Levels

Investigatory Levels (ILs) represent a pre-defined limit below which investigation may be required: above this limit, skid resistance is considered to be satisfactory; at or below this limit skid resistance may require further investigation.

Investigatory Levels shall be set for each part of the SCRIM survey network –one value shall be set for each individual site, based on its Site Category. These shall be set by suitably qualified and experienced persons only, based on the guidance in this document and in CS 228 (Appendix A in particular).

A range of possible ILs is given for each Site Category to account for the fact that skidding risk may vary between sites of the same Site Category. These ranges are set according to the relative skidding risk judged to be inherent to each Site Category. The predefined ranges for setting ILs according to Site Category are shown below in Table 2 (where L/S/H = Low/Standard/High risk).

These ranges are identical for the most part to those in CS 2285, however, additional "Low" IL values (noted as L\* in Table 2) are available for categories R and G1 to account for the specificities of Lancashire's SCRIM survey network (including accounting for the additional Site Category S2b as described in 3.2, pg 10) (CS 228 notes that: "*The range of ILs for each site category has been developed as a result of UK research studies on motorway and all-purpose trunk roads and reflects the variation in crash risk within a site category.*"):

- The L\* IL for category R is to account for the general variation between roundabouts on Lancashire's network compared to the SRN, in particular with reference to approach speeds, and size/complexity of roundabout layouts.
- The L\* IL for category G1 is to account for the much higher incidence of sections with a ≤30mph speed limit on Lancashire's network compared to the SRN. These speeds in conjunction with an uphill gradient generally present low skid risk.

The default IL applicable to each site is the Standard (S) value given in Table 2 for the relevant Site Category. This may be varied within the applicable range given in Table 2 if the site is considered to be higher/lower risk than usual – see the notes below Table 2 for some such cases. The detailed guidance on setting ILs given in Appendix A of CS 228 will be the main reference point in this process (NB: the differences between the Site Categories/ILs specified in this strategy and those specified in CS 228 should be taken into account).

Investigatory Levels will be applied to each individual site on the SCRIM survey network according to the criteria set out here, in CS 228, and in 3.4 below. Each site shall have only one IL applied to it. If it appears that more than one IL could apply, the highest value shall be chosen.

			Investigatory Level (L/S/H risk)				
Site 0	Category Code & Description	0.30	0.35	0.40	0.45	0.50	0.55
В	Non-event carriageway with one-way traffic	L	S	Н			
С	Non-event carriageway with two-way traffic		L	S	Н		
Q	Approaches to and across minor and major				L	S	н
	junctions. Approaches to roundabouts and traffic signals						
K	Approaches to pedestrian crossings and					S	Н
	other high-risk situations.						
R	Roundabouts <sup>1</sup>			L*	S	H	
G1	Gradient of 5-10% longer than 50m			L*	S	Н	
G2	Gradient of >10% longer than 50m <sup>2</sup>				L	S	Н
S1	Bend radius <500m - ≥50mph carriageway				S	Н	
	with one-way traffic						
S2a	Bend radius <250m - ≥40mph carriageway				L	S	Н
	with two-way traffic						
S2b	Bend radius <100m - ≥30mph carriageway				L	S	Н
	with two-way traffic⁴						

#### Table 2: Investigatory Levels by Site Category and relative risk

<sup>1</sup>Mini-roundabouts should be excluded from this Site Category. Category Q should be applied for the approach to <u>and across</u> mini roundabouts. The added L\* IL may be applied in cases where roundabout approach speeds are ≤30 mph, or roundabout layout presents a low skid risk, unless other risk factors apply.

<sup>2</sup>Categories G1 and G2 are not applicable to uphill gradients on carriageways with one-way traffic. The added L\* IL may be applied to uphill gradients on carriageways with two-way traffic and where speed limit is  $\leq$ 30 mph, unless other risk factors apply.

<sup>4</sup>Where category S2b applies and speed limit is  $\leq$ 30 mph, the site may be classified as "Low" risk when setting the IL, unless other risk factors apply.

## 3.4 Defining Individual Sites

Individual sites on the SCRIM survey network shall be defined in order to allow meaningful comparison with an average CSC (see 4.2, pg 15) across the site. Individual sites shall be defined as follows:

- A site will have only one Site Category and IL applicable for its whole length, i.e.: a site shall be truncated on any change of Site Category or IL
- Site length shall not exceed 100m, except where a residual length is less than 50% of a site –in this case the residual length may be appended to the site if both lengths have the same IL

NB: these same criteria will apply to sites with the Roundabout (R) Site Category, although CS 228 specifies 10m site lengths on roundabouts. Given the size and layouts of the majority of roundabouts on a Local Authority network, the general site length criteria given above will be suitable. Using 10m sections on roundabouts provides little/no benefit on a Local Authority network, while greatly multiplying the number of sites to manage.

# 4 Measuring Skid Resistance

# 4.1 Performing Routine Skid Resistance Surveys

Skid resistance for routine surveys will be measured using a SCRIM (Sideways-Coefficient Routine Investigation Machine). Exceptionally, alternative measurement systems may be used for the sole purpose of detailed investigation of local sites (see 5.2, pg 17) if the Council is satisfied that the system is suitable for purpose and operators are suitably qualified and experienced.

## Survey Regime

Skid resistance will be measured annually over the entire SCRIM survey network (as defined in 3.1, pg 9, and which may include specific sites appended to the standard survey network where justifiable). Surveys will be planned in accordance with the Single Annual Skid Survey (SASS) approach as defined in HD 28/15 Annex 2. This specifies that, over a 3-year cycle, each road length on the SCRIM survey network shall be tested once in each part of the survey season: Early, Middle and Late.

The survey season for Lancashire County Council is defined as 1<sup>st</sup> May to 30<sup>th</sup> September of each year, and is divided into three parts as follows:

- Early season: 1<sup>st</sup> May to mid-June
- Middle season: mid-June to mid-August
- Late season: mid-August to 30<sup>th</sup> September

The SASS approach has been selected by the Council as it is deemed to be the most costeffective and allows for full coverage of the SCRIM survey network each year.

## **Survey Specification**

SCRIM surveys shall be carried out by a suitably qualified and experienced contractor, with equipment conforming to the general characteristics of British Standard BS7941-1.

SCRIM surveys shall be undertaken in accordance with clauses 3.9 to 3.19 of CS 228 – refer to these clauses for detailed information. Any deviations from these clauses must be clearly agreed between the Council and the surveying contractor and documented.

Processing of raw SCRIM survey data to produce Skid Coefficient (SC) values shall be undertaken in accordance with clauses 3.20 to 3.23 of CS 228 – refer to these clauses for detailed information. This processing will generally be undertaken by the surveying contractor – if so, this should be specified in their contract.

The surveying contractor shall deliver survey data of content and format to be agreed during the procurement process. Delivery shall include a survey coverage report detailing the network that was to be surveyed, lengths with missing or invalid data, and an explanation for any missing data.

Raw and processed data from SCRIM surveys shall be stored in accordance with the Council's Data Management policies, no later than the end of the 3<sup>rd</sup> quartile of the survey year. Relevant processed data shall be uploaded to Yotta's Horizons strategic asset management system for use in site investigation prioritisation, skid resistance-related works programming, and for general viewing of the data.

## 4.2 Calculation of the Characteristic Skid Coefficient

The Skid Coefficient (SC) is the measurement of skid resistance which is produced by the SCRIM survey. The SC must be corrected to account for seasonal variations in skid resistance – the corrected SC is known as the Characteristic Skid Coefficient (CSC).

Once raw survey data has been loaded, checked and processed (as per 4, pg 14), seasonally-corrected CSC values shall be calculated from the SC values following the SASS approach defined in the England National Application Annex to CS 228.

Processing of SCRIM survey data shall be undertaken using an accredited UKPMS.

The mean CSC of each site shall be calculated according to the relevant averaging length (see 3.4, pg 12).

The mean CSC of each site shall be checked against the corresponding site IL. All sites with a mean CSC equal to or less than the IL shall undergo the initial site risk assessment process as per section 5. These sites shall also be mapped in a software with appropriate mapping capabilities.

#### 4.3 Collection of Other Relevant Data

In addition to the skid resistance data to be captured by SCRIM surveys, the full application of this strategy requires data on surface texture depth, gradients and bend radii for roads on the SCRIM survey network, and the collection of the most recent three years of crash data across the whole network.

Texture depth will be measured and collected as part of annual Surface Condition Assessment National Network of Roads (SCANNER) surveys. The Council currently runs SCANNER surveys on the classified network only – as this aligns with the SCRIM survey network this coverage will be adequate.

Although gradients and bend radii can be obtained via desktop methods if necessary, both of these parameters are collected in the normal course of routine SCANNER surveys – it is therefore likely to be efficient to use gradient and bend radius data from SCANNER surveys wherever possible.

Crash data will be taken from government-published road safety data available from data.gov.uk at:

https://data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data

# 5 Site Risk Assessment & Investigations

## 5.1 Initial Site Risk Assessment

All sites where the measured CSC is at or below the corresponding IL shall undergo the initial site risk assessment process as described below. Identification of sites at which there is a SCRIM deficiency will be undertaken as soon as is reasonably practical, and within no more than six weeks from receipt of all relevant processed data.

Other sites may be put forward for initial risk assessment where justifiable, for example where increased skidding crash levels have been observed. However, such sites should usually have been included in the process prior to this point if the processes outlined in this document are correctly followed.

The objective is to provide a risk assessment of selected sites with regards to the risk of a skidding incident. This risk assessment will enable prioritisation of sites for detailed on site investigations.

Risk assessment will be carried out using the risk-based site scoring system in Table 3 below, this is taken directly from the superseded standard HD 28/15 (Table A.7.1, Annex 7) with no deviations. The method for identification of sites requiring detailed investigation within CS 228 is specific to each national annex, where the England National Annex uses a Highways England Crash Model, developed for all-purpose trunk roads and motorways managed by Highways England and is therefore not applicable to the County's network. No other methodology is available within the current standard CS 228. Table 3 must be used in conjunction with the accompanying guidance notes. Table 4 provides an initial guideline for determining the likely impact of a crash based on the applicable Site Category, for use in the risk assessment.

Other factors which relate to risk such as speed limit, road classification and traffic levels are considered when defining Site Categories and IL's, as detailed in the corresponding sections above.

Number of crashes <sup>1</sup>	0	1	2	3+	
Score	0	4	8	12	
Likely impact of a crash <sup>2</sup>	Slight	Slight/ serious	Serious	Serious/ fatal	
Score	1	2	3	4	
Skid resistance Difference (SD) <sup>3</sup>	>0	≤0 and >-0.05	≤-0.05 and >-0.10	≤-0.10 and >-0.15	≤-0.15
Score	0	1	3	6	12
Site has SD≤0 <u>and</u> poor texture at some point⁴	No	Yes			
Score	0	1			

Table 3: Risk-based site scoring system

<sup>1</sup> This refers to the total number of personal injury crashes. Wet and wet skid crash counts are not considered separately here and should be investigated during the detailed investigation of the site. To account for possible inaccuracies in the recording of collision locations, analysis will extend over a length of road extending 100m in each direction from recorded collision locations. All road traffic collision incident data will be validated before being used in analysis to ensure there is no duplication.

<sup>2</sup>The likely impact of a crash shall be assessed on an individual site basis where required. Guidance is provided in Table 4 below.

 $^{3}SD = CSC - IL$ . Where the site has multiple SD values the lowest value should be used

<sup>4</sup>Poor texture is defined as  $\leq 0.6 \text{ mm}$  (NB: CS 228 indicates an upper threshold level of 0.8mm, for the England National Application Annex, however 0.6mm is considered to be more applicable to local networks due to differences in traffic speeds and types. This is also the upper threshold value used for the 'amber' band of the SCANNER Road Condition Index [RCI] performance indicator which is nationally applicable to classified roads). For sites with texture depth  $\leq 0.6$ mm, a review of available works history records should be undertaken to identify sections where materials have low or negative texture by design – if this is the case, a score of zero shall be applied for this criterion.

Site	Likely impact	
		of a crash
В	Non-event carriageway with one-way traffic	Slight
С	Non-event carriageway with two-way traffic	Serious/fatal
Q	Approaches to and across minor and major junctions. Approaches to	Serious/fatal
	roundabouts and traffic signals	
K	Approaches to pedestrian crossings and other high-risk situations.	Serious/fatal
R	Roundabouts	Slight
G1	Gradient of 5-10% longer than 50m	Slight/serious
G2	Gradient of >10% longer than 50m	Serious
S1	Bend radius <500m - ≥50mph carriageway with one-way traffic	Serious/fatal
S2a	Bend radius <250m - ≥40mph carriageway with two-way traffic	Serious/fatal
S2b	Bend radius <100m - ≥30mph carriageway with two-way traffic	Serious/fatal

Table 4: Indicative likely impact of a crash by Site Category

Note: the likely crash impacts given in this table are indicative only. Where the characteristics of an individual site warrant it, a specific assessment of likely crash impact should be undertaken.

#### 5.2 Detailed Site Investigations

All sites selected for detailed investigations following the initial risk assessment process as described above in 5.1 will be passed on to the person(s) responsible for coordinating these investigations. A schedule of investigations will be planned out in such a way as to undertake the work in as timely and efficient a manner possible – investigations should be carried out according to initial risk assessment:

- High risk (≥12): high-priority site investigation, to be carried out as soon as possible following initial risk assessment
- Medium risk (3 12): investigate on a risk-prioritised basis, as resources allow, as soon as is reasonably practical following initial risk assessment
- Low risk ( $\leq$ 3): no further investigation required

Site investigations must be undertaken by a competent person in highway maintenance, using the Site Investigation Form in Appendix 2 (designed with reference to CS 228 Appendix B), and making reference to the detailed guidance notes.

Prior to going on site, the investigator should gather all relevant information as far as is practical, and pre-fill the Site Investigation form where possible. The following list provides a guide for information to be gathered prior to going on site:

- *Location/referencing*: road number and/or name, section reference, site ID, chainages, coordinates, etc.
- **Site attributes**: layout, design, particular features, speed limit, gradient, etc. If possible a map and/or a design drawing of the site should be obtained. Current Site Category and IL should be recorded.
- **Condition data**: skid resistance data (CSC and differential vs. IL) and texture depth data (from latest SCANNER survey) are necessary as a minimum. Additional pavement condition data may also be useful, in particular longitudinal profile variance and rutting measurements from machine surveys, and defects noted from visual inspections.
- **Crash data**: limit the investigation to the past 3 years of available data. Number of crashes, with subtotals for wet and/or wet-skid crashes, and detailed crash causes if available. Benchmark crash data for the site against crash data for the route the site forms a part of, and relevant national data, where available.
- **Traffic data**: where available, traffic flow volume data will be useful (even more so if there is any indication as to the types of vehicle using the site).

Site investigations may be carried out on foot or from a vehicle – the decision shall be made based on factors such as assessed site skid risk, resources and/or time available, health and safety risks to inspectors, and prior knowledge of the site. In general, it is preferable for the investigator to walk the site in order to get the most detailed results, especially if skid risk is high.

In rare circumstances, detailed site investigations may be carried out without physically going on site, however this must be robustly justified – for example, due to health and safety risks. In these cases, the investigator should use (recent) photos/videos of the site wherever possible.

The Health and Safety of personnel conducting site investigations, maintenance operatives and other road users is paramount. As such, site investigations shall be undertaken in a manner that minimises risk to these groups. Health and safety risks should be managed in accordance with the Council's usual procedures.

During on-site investigations, the investigator(s) should take photos to illustrate/record key information where relevant and include these in the investigation report. A camera with georeferencing should be used when possible.

As a result of the investigation, remedial actions to address skid resistance risk at the site may be recommended by the investigator(s). These will be clearly noted on the Site Investigation form, and addressed according to the approach set out in the following section (6).

Post-investigation, an investigation report for each site shall be produced including:

- Site investigation form (see Appendix 2), completed by the investigator and signed off by the appropriate person
- Digital copies of relevant photos taken at the scene
- Any other documentation/information deemed relevant

Records of all site investigations and ensuing reports (including additional data/documentation) will be retained in line with Council policies.

## 5.3 Outcomes of Site Investigations

Site investigations may result in the need for various actions. These may include actions to reduce skid resistance risk (e.g.: pavement works, improving signage, etc.) – these are covered in section 6, pg 20.

The investigator may also recommend changes to the site IL and/or risk rating (as per 5.1, pg 16) based on risk factors observed at the site. In these cases, a review will be undertaken, taking into account the site investigation report and inspector recommendations, to determine whether the site IL and/or risk rating should be changed, and to what value(s).

Site investigations may also result in an outcome of "no action required". These sites should be picked up by the process in the following year since they will have  $SD \le 0$  – in this way their skid risk will be continually monitored.

All such reviews will be documented and records maintained. Where the site risk rating is changed following any review, this post-investigation risk rating will be applied for the purposes of determining the priority of remedial actions, as described in section 6, pg 20. Note that a change to the IL may affect site risk rating whether/not the risk rating is changed directly.

All site investigation outcomes will be reviewed and approved by a suitably qualified and experienced person – this person will sign off the investigation form.

# 6 Remedial Actions to Reduce Skid Risk

## 6.1 Road Surface Condition Improvement

If, following detailed site investigation, the condition of the road surface is considered to be a contributory factor to unacceptable skid resistance at the site, it may be necessary to plan works to remedy this. These works will generally fall into one of two categories:

- Surface improvement: involving the addition of a thin surface layer on top of the existing pavement surface
- Resurfacing: involving the removal of surface/binder course material to a given depth and laying new material

The type of treatment (and extent, depth, etc.) will be decided by suitably qualified and experienced personnel, taking into consideration any recommendations from the site investigator(s). Scheme design is not covered in this document. Scheme design will follow all the usually applicable Council processes and conform to all applicable standards and guidance.

The programming and prioritisation of remedial works will be risk-based (using postinvestigation site risk scores) as follows:

- High risk (≥12): High priority implementation. Any necessary remedial works to be added to the current/next network maintenance works programme as high-priority schemes
- Medium risk (3-12): Implement as soon as reasonably practical, as far as resources will allow
- Low risk (≤3): Implement only if/when resources allow, and only if cost-effective as part of a wider programme

Subject to the conditions above, works will be prioritised where necessary in order of descending skid risk in accordance with their post-investigation risk score.

Works will be programmed in as part of the usual works programming processes – this will allow potential efficiencies to be identified where synergies are available between works to improve skid resistance and general maintenance works to improve road condition.

## 6.2 Non-invasive Remedial Actions

In addition to/as an alternative to pavement condition improvement, several non-invasive options for reducing skid risk may be recommended following site investigation. These include:

- Signage: removing /confusing signs, cleaning/replacing signs, etc.
- Road markings: removing redundant/confusing markings, renewing markings, etc.
- Driver visibility: cutting back/removing vegetation, removing street clutter, etc.
- Pedestrian safety features: installing pedestrian barriers, crossing islands, etc.
- Traffic speeds: reduce speed limits, install traffic-calming measures, etc.
- Road cleansing: removal of debris, sweeping, etc.

Where such actions are recommended in a Site Investigation report, they should be implemented according to the post-investigation risk rating:

• High risk (≥12): Implement with high priority

- Medium risk (3 12): Implement as soon as reasonably practical, as far as resources will allow
- Low risk (≤3): Implement only if/when resources allow, and preferably as part of a wider programme

Actions can be prioritized within categories by descending risk rating where necessary.

## 6.3 Use of Warning Signs

"Slippery road" warning signs shall be installed at all sites for which the site investigation identified a need for treatment to improve skid resistance. The urgency of installing warning signs will depend on the site's post-investigation risk rating:

- High risk (≥12): to be installed at identified locations as a matter of urgency following site investigation
- Medium risk (3 12): to be installed at identified locations as soon as is reasonably practical following site investigation
- Low risk (≤3): none required

If necessary to prioritise sign installation, this should be done on the basis of decreasing site risk, assessed according to 5.1, pg16.

Once the location of sites requiring warning signs has been identified, a schedule for installation shall be produced. While drawing up the schedule, the skid resistance at the location of all currently installed slippery road warning signs shall be reviewed to determine whether signs are still needed. This review should occur at least annually. Once completed the schedule for warning signs shall be updated to also include currently installed signs which require removal.

The Slippery Roads warning sign (Diagram 557, see example at right) in conjunction with an appropriate supplementary plate (Diagram 570) will be used in accordance with the Traffic Signs Regulations and General Directions, and Chapter 4 of the Traffic Signs Manual.



Note that slippery road warning signs shall not be used in connection with newly-laid asphalt road surfacing materials.

Warning signs shall be removed as soon as reasonably practical after treatment has been applied <u>and</u> maintenance engineers are satisfied that skid resistance levels are acceptable. Note that warning signs may still be required for a period of time post-completion of remedial works where skid resistance levels may take some time to reach required levels.

A visual inspection of sites shall be made after signs are installed/removed to confirm that they have been correctly installed/removed, and a record of these inspections shall be made and retained.

An inventory of all slippery road signs installed/removed as part of this process shall be recorded and retained. This inventory will include details of sign locations, date of installation/removal, and details of related works orders.

# Appendices

# Appendix 1 Explaining Skid Resistance

Skid resistance is a measure of the frictional properties between the tyre of a moving vehicle and the road surface which directly affect the ability of a driver to slow / stop the vehicle. As such, it is a key component of road safety.

The skid resistance of a surface decreases over time due to the effects of traffic and weathering.

Routine monitoring of skid resistance is carried out annually across the network using a Sideways-force Coefficient Routine Investigation Machine (SCRIM) to provide an average deficiency measurement known as the Characteristic Skid Coefficient (CSC), and combined with other data to determine areas for further investigation and potential treatment.

Dry, clean road surfaces achieve a high and generally consistent skid resistant level whereas the same surface when wet or damp can produce a significantly lower skid resistance level. For this reason, measurements of skid resistance are made on wetted road surfaces.

Wearing of road surface materials caused by weathering and commercial vehicle damage can significantly reduce skid resistance performance when the road is wet or even damp. By managing the risk of skidding accidents in wet conditions we equalise the risk across the road network. This is achieved by providing a level of skid resistance to a section of road based on a risk analysis using accident records, road layout and engineering experience.

Research by TRL demonstrates that the risk of a wet-road skidding accident increases as skid resistance decreases. However, the secondary nature of skid resistance as an accident factor means that the relationship between skid resistance and accident risk is not a precise one.

#### **Road Surface Parameters**

The level of skid resistance is dependent on two road surface parameters: the micro-texture, which is the surface roughness of the aggregate in the road; and the macro-texture, which is the surface texture as shown in Figure A.1 below.



Figure A.1: Macro- and micro-texture of a road surface (reproduced from HD28)

Micro-texture is the main contributor to skid resistance at low speeds of less than 50 km/h (30mph) whilst macro-texture generates friction by deforming the tyre and providing a drainage route between tyre and road surface helping to prevent aquaplaning. Macro-texture is a more important factor for wet skidding resistance at speeds of greater than 65 km/h (40 mph).

#### **Seasonal Variation of Sid Resistance**

Skid resistance fluctuates through seasonal weathering and polishing cycles. During the winter period – defined here as October to March – the roads are often wet, and gritty road detritus roughens the micro-texture, causing the skid resistance to rise. In the summer period – defined here as April to September – the roads are generally dry and road detritus is mainly dusty, so the road surface becomes polished and the skid resistance falls. In practice, the minimum skid resistance will vary from year to year and within year depending on weather conditions.

The Single Annual Skid Survey (SASS) approach to skid resistance measurement, as detailed in the England National Application Annex to CS 228, has been developed to allow for this seasonal variation in skid resistance.

#### **Relationship to Accident Risk**

Within normal ranges, low skid resistance may be a significant contributory factor to collisions. 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 can allow manoeuvres that demand higher friction to be completed, e.g. to shorten stopping distance or to turn sharp corners. Higher skid resistance can therefore reduce accidents in cases where drivers need to complete a more demanding manoeuvre in order to avoid an accident.

Accident analysis reveals that there are relationships between measured skid resistance and accident risk. These relationships are not precise – the influence of skid resistance on accident risk is significantly different for roads with different characteristics. For this reason, site categories have been defined to group roads with similar characteristics.

For some site categories, the relationship between accident and skid resistance is tenuous. For other site categories progressively more accidents are observed as the skid resistance falls. For these categories there are clear benefits in maintaining a higher level of skid resistance. The ranges of Investigatory Levels (i.e.: acceptable minimum skid resistance) applied to each site category reflect this variation in skid resistance risk.

Additionally, not all sites within a single category are equivalent in terms of their accident risk. Judgement of the relative accident risk and appropriate level of skid resistance for different sites within the same category forms a key part of the effective operation of this strategy. Guidance in determining SCs and allocating ILs is provided on pages 9-15 of this document.

# Appendix 2 Site Investigation Form

Based on the template from CS 228, Appendix B.

This form is designed to be completed electronically - replace the guidance notes in blue with the relevant information

Relevant photos should be taken during the site investigation to accompany the information to be provided in this form – make reference to photos where relevant.

Lancashire County Council – Skid Site Investigation Report Survey Year:										
Unit										
Name of Mana	iging Orga	nisation	ar	nd Overs	eeing Org	anisation	's Area	a/Region Des	sign	ation
Road name a	nd/or nun	nber			Sit	te ID			Ŭ	
					Wi	th re. to t	he SC	RIM survey r	netv	vork
Section ref.					Ch	ainage (	if rele	vant)		
Site Location	and Use									
Location and	nature of	site:								
State the limits of and nature of the site including speed limit and environment. Provide positional										
information (O	SGR, lat./	long., etc	c.)	where p	ossible.					
List hazards e.	g. junctior	ns, lay-b	ys,	other ad	ccesses, ci	rossings,	bends	s or steep gra	Idie	ents.
Note likelihood	l of vulner	able use	ers,	such as	cyclists, p	edestria	ns, mo	torcyclists, cl	nild	ren, etc., and
related feature	s such as	crossing	js,	footway	bridges, c	ycle path	ns, etc.			
Current Site C	Category	and Inve	est	tigatory	Level:	<b></b>				
Also confirm w	hether or	not thes	e a	are consi	stent with	Skid Res	sistanc	e Strategy gu	lida	nce – if not,
provide justific	ations for	deviation	าร	if availat	ole.					
Pavement Co	ndition D	ata								
Skid resistan	ce and tex	xture de	pt	h:						
Attach data for	skid resis	stance, te	ext	ure dept	h, and oth	er data if	releva	int. Note whe	the	r low skid
resistance or to	exture dep		rs۱	where ro	ad users h	ieed to si	top or l	manoeuvre. I	NOL	e variability of
skid/texture da	ta across	site.		141						
Other aspects	s of paver	nent col	na	Ition	aitu alima I m	nefile ver	ioneed	hat any la off	+	vehiele
Note any extre	me values	s of rul a	ep	the corri	giludinai p	rome var	iance i	nat could an	ect	venicie
Attach data if r	anage or v	valer no	III	the carri	ageway.					
Crash Data	elevalit.									
Period			Nıı	mher of	crashos			Analysis l	200	uth
Tenou			Tu					Analysis R	Jing	Traffic
From:	To:		Tot	tal:	Wet:	Wet	skid:	Length (km)		
										(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
				_	Control	Data				
			Sit	e Data	Similar s	ites	Rout	e data	N	ational data
Crashes/vear							1.0041	o dulu		
Crashes/year	/100km									
Crashes/10 <sup>8</sup> v	eh-km									
Are crashes lin	ked to su	face		Y/N	lf so <sup>.</sup> do l	locations	of wet	/wet-skid cra	she	es coincide
condition?		lace			with sect	ions of lo	w skid	resistance?		
Has crash data	a for the si	te		Y/N	If so, pro	vide pote	ential c	auses for var	iati	on, with
changed signif	icantly ov	er the las	st		evidence					
3 years	3 years									
Site Investiga	tion									
Date Inspector Method										
								On foot/from	n v	ehicle
Visual Assess	sment									
Type and conc	lition of su	irfacing:		Note va	riations acr	ross CW	width.			
	Especially consider: fretting/stripping, polished aggregate,									
	visible depressions/rutting.									

	Note (patcł	presence of utility trenches and/or reactines, etc.)	ve maintenance			
Inconsistencies with survey data:						
Presence of debris or other surface contamination:						
Local defects:	Indica misali	ate position, extent, and severity of defection of defection of the section of th	xts (e.g.: potholes,			
Is drainage adequate:	lf no,	note observations.				
Road User						
Volume and type of traffic:	Incluc	le all observed and/or likely road users.				
Traffic speeds in relation to site characteristics:	Consi Obse	ider different times of day (peak, day, nig rve traffic speeds vs. speed limit	ght)			
Types of manoeuvres and potential consequences of driver error:	Note skid n	evidence of crash damage and/or near r narks, tyre tracks in verge…	nisses, e.g.: tyre			
Road Lavout						
Does layout appear to meet current design specifications?	Also r	note unusual/confusing layouts.				
Is layout appropriate for	Consi	idering types of vulnerable road users re	asonably to be			
vulnerable road users?	expec	expected (refer to Road Users, above)				
Are junctions appropriate for expected manoeuvres?	Note whether junction sizes are appropriate for all vehicle movements and right turning vehicles are adequately catered for. Note whether traffic signals are operating correctly and are clearly visible.					
Markings, Signs and Visibility						
Are markings and signs clear and effective in all conditions? Note old pavement markings which have not been fully removed. Check sign reflectivity where possible. Consider appropriateness and clarity of signage and road markings.						
Are roadside objects protected from vehicle impact?						
Clear sight lines/visibility of queues/vegetation	sight lines/visibility of Consider sight lines through junction/accesses. Is there enough visibility of likely traffic queues? Does/will vegetation growth affect visibility or obscure signage?					
Additional Information and Othe	er Obs	ervations				
Recommendations (please refer	r to Se	ctions 6 and 6.3 of this Strategy)				
Is treatment required to improve skid resistance?	Y / N If so: why, and what type of treatment is recommended.					
Should the site risk rating be changed?	Y/N	If so: why, and what is the recommen	ded change.			
Should the site category and/or IL be changed	Y/N	If so: why, and what is the recommen	ded change.			
Any other action(s) required?	Y / N	If so: explain.				
Reviewed and Approved by:						
Name	3	Signature	Date			

# Glossary of Acronyms

Abbreviation	Definition
ADEPT	Association of Directors of Environment, Economy, Planning &
	Transport
BS	British Standard
CSC	Characteristic Skid Coefficient: an estimate of the skid resistance
	accounting for the effects of seasonal variation.
CS 228	DMRB: Skidding Resistance
DMRB	The Design Manual for Roads and Bridges
HD28	DMRB 7.3.1: Skidding Resistance. This superseded version is dated
	2015
IL	Investigatory Level: pre-defined limit of minimum acceptable skid
	resistance, applied to specific sites.
SASS	Single Annual Skid Survey: a method of programming SCRIM
	surveys and processing their results to account for seasonal
	variations of skid resistance.
SC	Site Category: categorisation of a site on the SCRIM network based
	on the characteristics of that site in relation to wet-skidding incident
	risk.
SCANNER	Surface Condition Assessment National Network of Roads – machine
	survey which collects data on a range of items contributing to a road
	condition index for classified roads.
SCRIM	Sideways-force Coefficient Routine Investigation Machine, used to
	perform
	skid resistance surveys
TRL	Transport Research Laboratory
UKPMS	United Kingdom Pavement Management System (the UK national
	standard for pavement management systems)

# References

Document	Publisher and Retrievable Location
The Design	Department for Transport
Manual for	https://www.standardsforhighways.co.uk/ha/standards/
Roads and	
Bridges	
HD28 on	Department for Transport
Skidding	http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol7/section3.htm
Resistance	
Well-Managed	Roads Liaison Group
Highway	http://www.ukroadsliaisongroup.org/en/codes/index.cfm
Infrastructure	
Horses and	British Horse Society/ADEPT (formerly County Surveyors Society)
Highway	http://www.bhs.org.uk/safety-and-accidents/common-incidents/riding-on-the-
Surfaces	road/slippery-roads
Guidelines for	Institute of Highway Engineers
Motorcycling	http://www.motorcycleguidelines.org.uk/the-guidelines/3-0-road-design-traffic-
	engineering/3-4-road-design/
Traffic Signs	Department for Transport
Regulations	https://www.gov.uk/government/collections/traffic-signs-signals-and-road-
and General	markings
Directions	