Skid Resistance Strategy and Operational Guidance

South Tyneside Council

Document History

Version	Date	Author(s)	Reviewer(s)	Notes
1.0	Oct 2018	Ben Tyrrell	n/a	Incorporation of changes from v0.9 review
0.9	Aug 2018	John Proust	Ben Tyrrell	Minor changes

Review Requirements

Since this strategy will be applied for the first time in financial year 2018/19, it will be reviewed as a whole in financial year 2019/20 (i.e. after one year of implementation) in order to fully assess the first year of implementation.

Following this first review this document will be assessed as a whole on a three-yearly basis, or when HD28 is amended by the Department for Transport.

Review and/or update requirements for specific aspects of the strategy are detailed in the appropriate place throughout the document, and may result in a different frequency to the whole document review mentioned above. To facilitate the review process, these specific review requirements are outlined with a green box, e.g.:

> Format for review requirements

Data Management Requirements

All inputs to, and outputs from, the operation of this Skid Resistance Strategy shall be managed in accordance with South Tyneside Council's data management requirements. It is important to retain key information for the proper implementation of this strategy, to enable effective review and improvement, and to demonstrate all actions taken to manage skid resistance.

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1. Introduction

South Tyneside Council (the Council) is responsible for approximately 600km's 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 most important aspect of highway maintenance, and one that contributes significantly to network safety. Skid resistance can be improved at relatively low cost and provides substantial benefits to communities, making this aspect of highways maintenance a cost-effective use of Council resources.

This Skid Resistance Strategy and Operational Guidance 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.

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), Vol. 7 Section 3 Part 1 – HD 28/15: Skidding Resistance. HD 28/15 is designed for application to the UK Strategic Road Network rather than a local authority network such as South Tyneside's. As such, some aspects of this strategy deviate from HD 28/15 guidance to ensure that desired outcomes are maintained and that the strategy is practical for the Council's purposes. Deviations from HD 28/15 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.

> Significant changes to any of the standards/guidance referred to above will result in a review of the relevant parts of this Strategy.

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 and HD28, 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 HD28/15 to take better account of local road circumstances

Considerations for Other Road Users

This Skid Resistance Strategy applies to carriageways only. Off-carriageway skid resistance (e.g.: cycle paths, slip resistance for pedestrians) is managed separately by other processes.

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

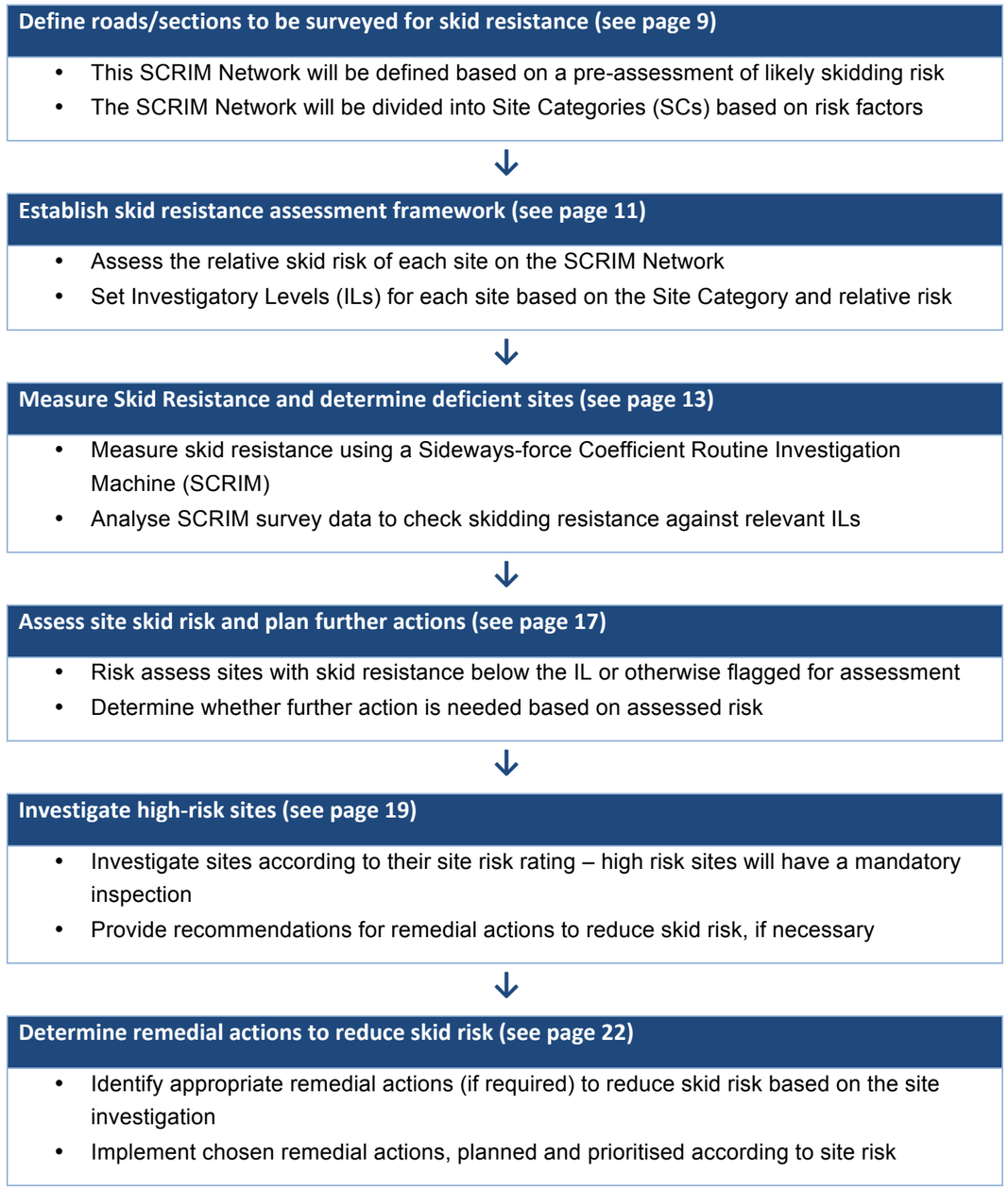
- For motorcycles: Institute of Highways Engineers – Guidelines for Motorcycling
- For horses: British Horse Society & ADEPT (then CSS) – Horses and Highway Surfacing

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 the Strategy.

Figure 1: Overview of Skid Resistance Strategy processes



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 Strategy 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 17

Table 1: Risk-based approach to investigations

	Low Risk	Mid Risk	High Risk
Risk Score *(as per 5.1, pg 17)*	≤ 5	6 – 18	≥19
Site Investigations *(see 5.2, pg 19)*	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[1] *(see 6.3, pg 23)*	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[1] **(if recommended)** *(see 6.1, pg 22)*	Implement only if/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

[1] *Based on post-investigation 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. Analysis of accidents on the Council's network shows that 73% of all accidents 2015-17 occurred on the classified network, further supporting this approach (the proportion is identical when considering only the last three years).

Figure 2: Map of South Tyneside'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 the maintenance engineer as a result of reported incidents.

The SCRIM Survey Network will be regularly reviewed as part of the whole strategy review, and/or in the following specific cases:

- After significant changes to the highway network (including to network hierarchies)
- When there are a significant number and/or a significant variation of recorded accidents or other relevant recorded incidents, complaints, etc.

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 HD 28/15, with a few differences to account for the specifics of South Tyneside's SCRIM survey network (HD 28/15 notes that the Site Categories it specifies are: "developed for the strategic road network and may not be applicable to local authority roads, which are more diverse in nature").

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

- Category S1 is for bend radii < 250m which only applies to higher speed roads of ≥40 mph carriageway, and S1 for bend radii < 100m. This is to account for the generally lower bend radii (= tighter bends) on South Tyneside's network compared to the SRN.

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[1]
- G1 – gradient of 5-10% longer than 50m[2]
- G2 – gradient >10% longer than 50m[2]
- S1 – bend radius <250m – ≥40 mph carriageway with two-way traffic
- S2 – bend radius <100m – ≥30 mph carriageway with two-way traffic

[1] *Mini-roundabouts should be excluded from this Site Category. Category Q should be applied for the approach to and across mini roundabouts.*

[2] *Categories G1 and G2 are not 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 13) 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 low-risk sections, which will complicate the application of this Strategy with little to no benefit to skid resistance risk.[1]

[1] *Note that this merging rule is not present in HD 28/15 (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).

Site Categories will be regularly reviewed as part of the whole strategy review, and/or in the following specific cases:

- After significant changes to the highway network
- [for individual sites] When recommended following site investigations

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 HD 28/15 (Annex 5 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 HD 28/15, however, additional "Low" IL values (noted as L* in Table 2) are available for categories R and G1 to account for the specifics of South Tyneside's SCRIM survey network (including accounting for the additional Site Category S2b as described in 3.2, pg 10):

- The L* IL for category R is to account for the general variation between roundabouts on South Tyneside'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 South Tyneside'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 Annex 5 of HD 28/15 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 HD28/15 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 HD 28/15, 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.

Investigation Levels will be regularly reviewed as part of the whole strategy review, and/or in the following specific cases:

- After significant changes to the highway network and/or Site Categories
- [for individual sites] When recommended following site investigations

Table 2: Investigatory Levels by Site Category and relative risk

Site Category Code & Description		Investigatory Level (L/S/H risk)					
		0.30	0.35	0.40	0.45	0.50	0.55
B	Non-event carriageway with one-way traffic	L	S	H			
C	Non-event carriageway with two-way traffic		L	S	H		
Q	Approaches to and across minor and major junctions. Approaches to roundabouts and traffic signals.				L	S	H
K	Approaches to pedestrian crossings and other high-risk situations.					S	H
R	Roundabouts[1]			L*	S	H	
G1	Gradient of 5-10% longer than 50m[2]			L*	S	H	
G2	Gradient of >10% longer than 50m[2]				L	S	H
S1	Bend radius <250m – ≥40 mph carriageway with two-way traffic				L	S	H
S2	Bend radius <100m – ≥30 mph carriageway with two-way traffic[4]				L	S	H

[1] Mini-roundabouts should be excluded from this Site Category. Category Q should be applied for the approach to and across 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.*

[2] 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 ≤30 mph, unless other risk factors apply.*

[4] Where category S2 applies and speed limit is ≤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 16) 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 HD 28/15 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 19) if the Council is satisfied that the system is suitable for purpose and operators are suitably qualified and experienced.

Skid resistance will be measured annually over the entire SCRIM survey network (as defined in 3.1, pg 9). 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 South Tyneside Council is defined as 1st May to 30th September of each year, and is divided into three parts as follows:

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

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

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 3.14 to 3.27 of HD 28/15 – 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 3.28 to 3.31 of HD 28/15 – 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. 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 15), seasonally-corrected CSC values shall be calculated from the SC values following the SASS approach defined in HD 28/15 Annex 2.

Where the Council undertake their own processing of SCRIM survey data, an accredited UKPMS shall be used.

The mean CSC of each site shall be calculated according to the relevant averaging length (see 3.4, pg 13).

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:

- For national data: https://data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data
- For Greater Manchester data: https://data.gov.uk/dataset/25170a92-0736-4090-baea-bf6add82d118/gm-road-casualty-accidents-full-stats19-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 increased skidding crash levels have been observed.

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

Risk assessment will be carried out using the risk-based site scoring system in Table 3 below – this is taken directly from HD 28/15 (Table A.7.1, Annex 7) with no deviations. 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.

Table 3: Risk-based site scoring system

Number of crashes[1]	0	1	2	3+	
Score	0	4	8	12	
Likely impact of a crash[2]	Slight	Slight/serious	Serious	Serious/fatal	
Score	1	2	3	4	
Skid resistance Difference (SD)[3]	>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 and poor texture at same point[4]	No	Yes			
Score	0	1			

[1] *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.*

[2] *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*

[4] *Poor texture is defined as ≤0.6 mm (NB: HD 28/15 uses a threshold value of 0.8mm instead. 0.6mm is considered to be more applicable to local networks due to differences in traffic speeds and types, and is 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 ≤0.6mm, 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.*

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

Site Category Code & Description		**Likely impact of a crash**
B	Non-event carriageway with one-way traffic	Slight
C	Non-event carriageway with two-way traffic	Serious/fatal
Q	Approaches to and across minor and major junctions. Approaches to roundabouts and traffic signals.	Serious/fatal
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 <250m – ≥40 mph carriageway with two-way traffic	Serious/fatal
S2	Bend radius <100m – ≥30 mph carriageway with two-way traffic	Serious/fatal

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.

Following this initial risk assessment, sites will be ranked in order of descending risk. Detailed site investigations will be carried out at all sites with a risk score of 19 or greater, as determined by the system set out in 5.1, pg 17. This threshold is higher than that set out in HD28/15 for mandatory detailed site investigations (HD 28/15 threshold = 6). The increased threshold is to account for the more limited resources of a local authority (as compared to Highways England) while still balancing safety risks, and was determined by assessing various scenarios using potential combinations of the criteria in Table 3. For example, a site with a "serious/fatal" likely crash impact and a skid resistance difference of between -0.10 and -0.15 would be assigned a risk rating of 10.

Sites with a risk score of 3 and below may be excluded from the list of sites for potential investigation, except where there are other clear reasons for concern not captured by the risk assessment system set out in Table 3 (if so, these reasons should be recorded, and the risk

assessment process updated if relevant). This lower threshold was also arrived at using scenario analysis. For example, a site with no historical crashes, a “slight/serious” likely crash impact, a skid resistance difference between 0 and -0.05, and acceptable texture, would be assigned a risk rating of 3, i.e.: within the lower threshold.

All other sites flagged for potential investigation (i.e. with risk scores between 6 and 18) should undergo detailed site investigations on a risk-prioritised basis, as far as resources will allow, in descending order of risk-ranking, i.e. higher risk sites have a higher priority for investigation.

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 (≥ 19): high-priority site investigation, to be carried out as soon as possible following initial risk assessment
- Medium risk (6 – 18): investigate on a risk-prioritised basis, as resources allow, as soon as is reasonably practical following initial risk assessment
- Low risk (≤ 5): 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 HD28/15 Annex 4), 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 geo-referencing 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 for five years.

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 22.

The inspector may also recommend changes to the site IL and/or risk rating (as per 5.1, pg 17) 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 ≤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 22. 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 post-investigation site risk scores) as follows:

- High risk (≥ 19): High priority implementation. Any necessary remedial works to be added to the current/next network maintenance works programme as high-priority schemes
- Medium risk (6-18): Implement as soon as reasonably practical, as far as resources will allow
- Low risk (≤ 5): 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 redundant/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 (≥ 19): Implement with high priority
- Medium risk (6-18): Implement as soon as reasonably practical, as far as resources will allow
- Low risk (≤ 5): 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 (≥ 19): to be installed at identified locations as a matter of urgency following site investigation
- Medium risk (6 - 12): to be installed at identified locations as soon as is reasonably practical following site investigation
- Low risk (≤ 5): none required

If necessary to prioritise sign installation, this should be done on the basis of decreasing site risk, assessed according to 5.1, pg17.

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 (see HD 28/15 Annex 1, A.1.24 to A.1.26).

Warning signs shall be removed as soon as reasonably practical after treatment has been applied and maintenance engineers are satisfied that skid resistance levels are acceptable. 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.

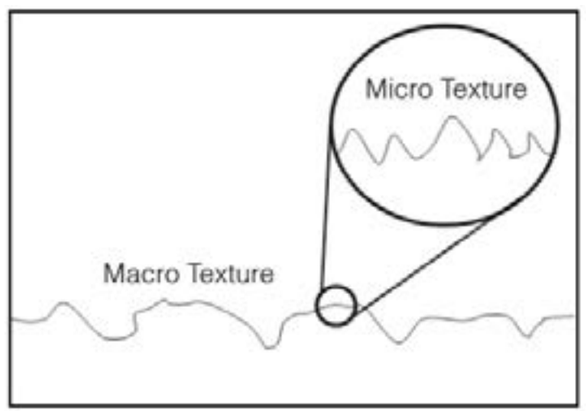
Wearing of road surface materials caused by weathering and commercial vehicle damage can significantly reduce skid resistance performance when the road is wet or even damp. By managing the risk of skidding accidents in wet conditions we equalise the risk across the road network. This is achieved by providing 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 Skid 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 HD 28/15 Annex 2, 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 9-13 of this document.

Appendix 2 Site Investigation Form

Based on the template from HD 28/15, Annex 6.

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.

South Tyneside Council – Skid Site Investigation Report	**Survey Year:**
Unit	
Name of Managing Organisation and Overseeing Organisation's Area/Region designation	
Road name and/or number	***Site ID***
	With ref. to the SCRIM survey network.
Section ref.	***Chainages (if relevant)***

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 (OSGR, lat./long., etc.) where possible. List hazards e.g. junctions, lay-bys, other accesses, crossings, bends or steep gradients. Note likelihood of vulnerable users, such as cyclists, pedestrians, motorcyclists, children, etc., and related features such as crossings, footway bridges, cycle paths, etc..
Current Site Category and Investigatory Level:
Also confirm whether or not these are consistent with Skid Resistance Strategy guidance – if not, provide justifications for deviations if available.

Pavement Condition Data

Skid resistance and texture depth:
Attach data for skid resistance, texture depth, and other data if relevant. Note whether low skid resistance or texture depth occurs where road users need to stop or manoeuvre. Note variability of skid/texture data across site.
Other aspects of pavement condition
Note any extreme values of rut depth or longitudinal profile variance that could affect vehicle handling or drainage of water from the carriageway. Attach data if relevant.

Crash Data

Period		***Number of crashes***			***Analysis length***	
From:	*To:*	*Total:*	*Wet:*	*Wet skid:*	*Length (km):*	*Traffic (AADT):*

	Site Data	***Control Data***
Crashes/year		
Crashes/year/100km		
Crashes/10^8 veh-km		

		Similar sites	*Route data*	*National data*
Crashes/year				
Crashes/year/100km				
Crashes/10^8 veh-km				

Are crashes linked to surface condition?	Y/N	If so: do locations of wet/wet-skid crashes coincide with sections of low skid resistance?
Has crash data for the site changed significantly over the last 3 years?	Y/N	If so, provide potential causes for variation, with evidence.

Site Investigation

Date	***Inspector***	***Method***
		On foot/from vehicle

Visual Assessment

Type and condition of surfacing:	Note variations across CW width. Especially consider: fretting/stripping, polished aggregate, visible depressions/rutting. Note presence of utility trenches and/or reactive maintenance (patches, etc.)
Inconsistencies with survey data:	
Presence of debris or other surface contamination:	
Local defects:	Indicate position, extent, and severity of defects (e.g.: potholes, misaligned ironwork, local subsidence, etc.)
Is drainage adequate?	If no, note observations.

Road Users

Volume and type of traffic:	Include all observed and/or likely road users.
Traffic speeds in relation to site characteristics:	Consider different times of day (peak, day, night…) Observe traffic speeds vs. speed limit
Types of manoeuvres and potential consequences of driver error:	Note evidence of crash damage and/or near misses, e.g.: tyre skid marks, tyre tracks in verge…

Road Layout

Does layout appear to meet current design specifications?	Also note unusual/confusing layouts.
Is layout appropriate for vulnerable road users?	Considering types of vulnerable road users reasonably to be 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	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 Other Observations		
Recommendations (please refer to Sections 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 recommended change.
Should the site category and/or IL be changed?	Y/N	If so: why, and what is the recommended change.
Any other action(s) required?	Y/N	If so: explain.

Reviewed and Approved by:		
Name	***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.
DMRB	The Design Manual for Roads and Bridges
HD28	DMRB 7.3.1: Skidding Resistance. The current version dates from 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 Manual for Roads and Bridges	Department For Transport www.gov.uk/guidance/standards-for-highways-online-resources#the-design-manual-for-roads-and-bridges
HD28 on Skidding Resistance	Department for Transport http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol7/section3.htm
Well-Managed Highway Infrastructure	Roads Liaison Group http://www.ukroadsliaisongroup.org/en/codes/index.cfm
Horses and Highway Surfaces	British Horse Society/ADEPT (formerly County Surveyors Society) http://www.bhs.org.uk/safety-and-accidents/common-incidents/riding-on-the-road/slippery-roads
Guidelines for Motorcycling	Institute of Highway Engineers http://www.motorcycleguidelines.org.uk/the-guidelines/3-0-road-design-traffic-engineering/3-4-road-design/
Traffic Signs Regulations and General Directions	Department for Transport https://www.gov.uk/government/collections/traffic-signs-signals-and-road-markings

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