

**Transport Scotland
Executive Agency of the Scottish Government
Roads (Standards and Asset Management)**

**Transport Scotland Interim Amendment 51/22
Skidding Resistance**

Summary

The purpose of this document is to accompany CS 228 from the Design Manual for Roads and Bridges and to provide additional detail to those implementing a skid resistance strategy on the Scottish Trunk Road Network.

1. Background

This TSIA provides additional detail to the Design Manual for Roads and Bridges for those implementing a skid resistance strategy on the Scottish Trunk Road Network.

2. Action

This document is to be used in conjunction with CS 228 (Jan 2021) or any updated document. It replaces TSIA 51/20 which is withdrawn.

3. Implementation

This TSIA should be implemented immediately except where the procurement of works, at any stage from conception through design and completion of construction, has reached a stage at which, in the opinion of the TS Project Manager, use of this document would result in significant additional expense or delay progress.

4. Further action

Any questions or feedback regarding the use or content of this TSIA should be directed to Transport Scotland.

5. Withdrawal conditions

This TSIA shall be applied until it is either withdrawn or updated.

Appendix A

Transport Scotland Interim Amendment 51/22

Skidding Resistance

Revision: 1.2

Date: April 2022

Feedback and enquiries

Users of this document are encouraged to raise any queries and /or provide feedback on the content and usage of this document to Transport Scotland using the e-mail address:

TStandardsBranch@transport.gov.scot



Transport Scotland Interim Amendment 51/22

Skidding Resistance

Version 1.2 - Apr 2022

Document History

Version	Date	Comments
1.0	6/9/2019	V1.0 (Draft) Issued
1.1	12/10/20	Updated references to new CS 228
1.2	20/4/22	Amended section 2.1 Amended Section 3 number of scrim correction localities. New Figure 3 IL table and associated notes.

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1.0 INTRODUCTION

The purpose of this document is to accompany CS 228 Skidding resistance and to provide additional detail to those implementing a skid resistance strategy on the Scottish Trunk Road Network.

It describes how the Operating Companies shall implement the Transport Scotland skid policy and it shall be used as a source of information to assist DBFO, and other Contracts in fulfilling their contractual obligations. This document is not intended for the management of skid resistance on Scottish local road networks, however similar principles may be applicable. It does not repeat guidance from CS 228 except to add clarification or emphasis. Transport Scotland will review the content of this document from time to time and issue updates when required.

The objectives of CS 228 and this Guidance are to:

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

Operating Companies are encouraged to develop working procedures to support the delivery of CS 228 and this document.

This document is structured following the same convention as CS 228; i.e. section 2 is Operation in both documents.

2.0 OPERATION

The Transport Scotland process introduces Prioritisation of sites for investigation as a stage of the Initial Investigation.

2.1 Roles in Implementing the Transport Scotland Skid Policy

Transport Scotland implement the policy through the Operating Companies. Transport Scotland will produce a prioritised site listing to allow the Operating Companies to undertake investigations as per this TSIA. Transport Scotland will arrange reviews of the Operating Companies procedures as required, and arrange meetings of the Skid Policy User Group. Transport Scotland will also undertake research relating to skid resistance. In particular Site Category Accident rate/Characteristic Scrim Coefficient (CSC) analysis should be commissioned by TS every 4 years.

The term maintenance contracts require the Operating Companies to appoint a nominated Skid Manager who has overall responsibility for the management of all activities relating to the Transport Scotland Skid Policy. These responsibilities include but are not limited to the following:

- Day to day implementation of the Skid Policy in line with the requirements of the contract;
- Develop working procedures within their quality system for the management of the Skid Policy;
- Maintain such records as required to support the decisions made in implementing the skid policy;
- Plan the programme of Initial and Detailed Investigations;
- Plan and implement the 3-year review of SCRIM Site Category and Investigatory Level;
- Review and approve the outcomes and recommendations from Detailed Investigations as well as any changes to Site Category or Investigatory Level;
- Ensure that Pavement Management System(PMS) is updated with records of investigations;
- Report on the implementation of the Skid Policy on a monthly basis;
- Report on the implementation of the Skid Policy on an annual basis (Annex 1);
- Advise Transport Scotland on the need to erect Slippery Road Signs;
- Advise Transport Scotland on the need to survey additional lanes;
- Take part in reviews or audits with Transport Scotland or their advisors;
- Share any developments or improvements to the processes used to manage the skid policy;
- Assist TS to determine the best way to assess the impact of the Skid Policy;
- Assist with skid resistance related initiatives; and
- Assess changes to the policy or processes used to manage the skid policy by providing feedback to Transport Scotland.

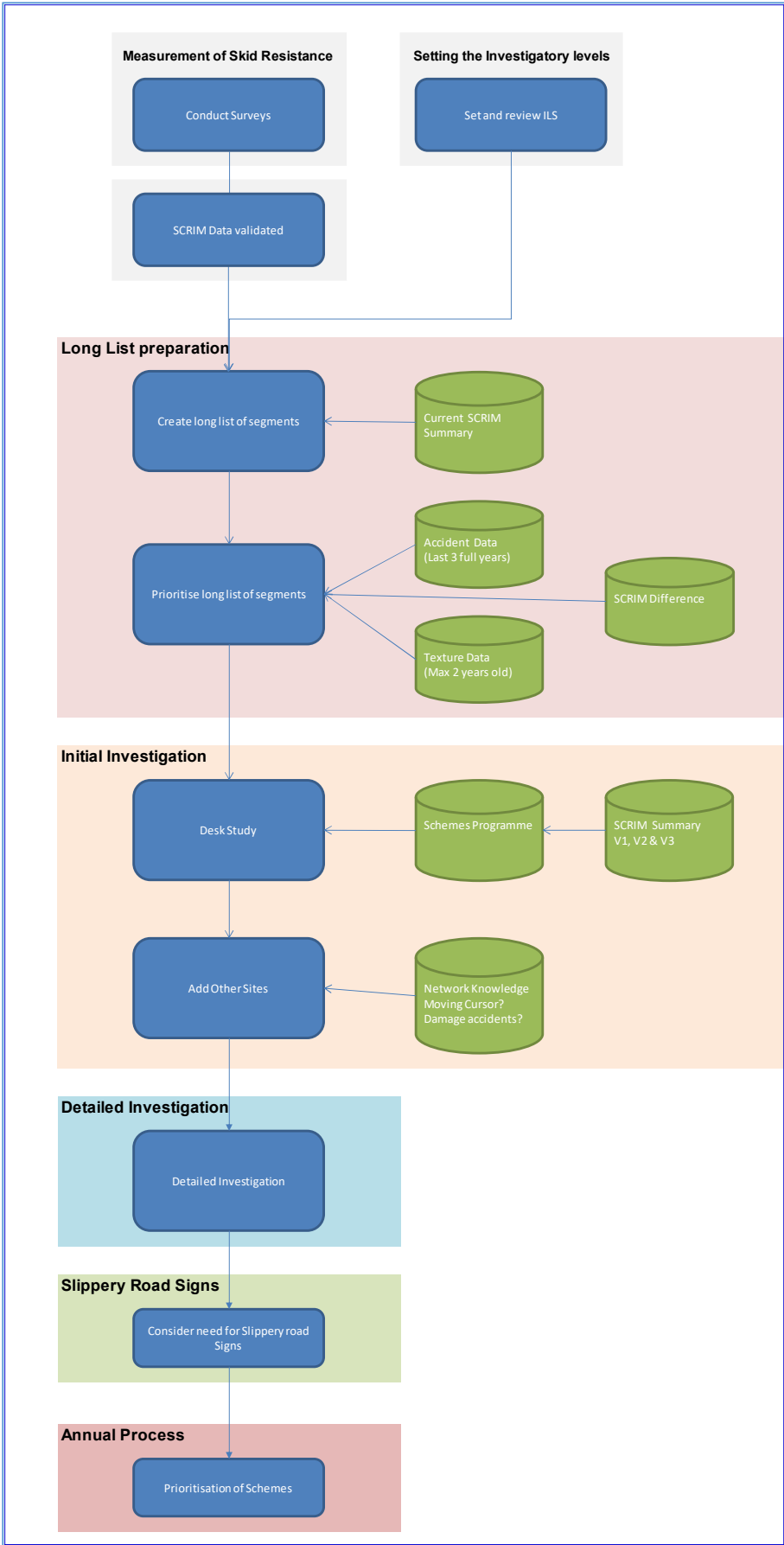


Figure 1 - Overview of implementation of the Skid Resistance Procedure for Transport Scotland.

3.0 MEASUREMENT OF SKID RESISTANCE

Transport Scotland will determine the survey network annually. It will include CL1 and CR1 for all single carriageways, and CL1 on all dual carriageways and motorways (including slip roads and roundabouts.)

The Skid Manager is required, as part of the 3 year network review to identify and inform Transport Scotland of locations where additional lanes may warrant testing. These may be lanes 2, 3 or 4 on dual carriageways and motorways, where they carry high levels of commercial traffic. The Skid Manager shall identify locations from review of traffic survey data and their own network knowledge.

Surveys will be carried out on an early/ middle/ late sequence where the survey periods are defined as follows:

Early 1 May – 20 June

Middle 21 June – 10 August

Late 11 August – 30 September

These periods will be kept under review.

The survey cycle is as follows:

Early	2016	2019	2022
Middle	2017	2020	2023
Late	2018	2021	2024

Figure 2

The survey will be undertaken using a Sideways - Force Routine Investigation Machine conforming to BS7941-1. Machines will either be accredited as set out in the *UK Roads Liaison Group* document *Accreditation and Quality Assurance of Sideways Force Skid Resistance Survey Devices*, or by an alternative methodology proposed by the survey contractor and agreed by Transport Scotland.

The 'Raw' survey data is corrected using the 'Single Annual Skid Survey (SASS) Approach to Calculation of CSC' as described in the Scotland National Application Annex to CS 228. 11 Localities have been set up in the pavement management system to allow for differences in rainfall and climate across Scotland.

4.0 SETTING THE INVESTIGATORY LEVEL

The Transport Scotland Site Category and Investigatory Levels are provided in Figure 3 below which replaces CS 228 table 4.2.

Site Category and definition		IL for CSC data (Skid data speed corrected to 50km/h and seasonally corrected)							
		0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
A	Motorway	LR	ST						
B	Non-event Dual carriageway	LR	ST	ST					
C	Non-event Single carriageway		LR	ST	ST				
Q	Approaches to and across minor and major junctions, approaches to roundabouts and traffic signals				ST	ST	ST		
K	Approaches to pedestrian crossings and other high risk situations					ST	ST		
R	Roundabout				ST	ST			
G1	Gradient 5-10% longer than 50m				ST	ST			
G2	Gradient >10% longer than 50m				LR	ST	ST		
S1	Bend radius <=250m – carriageway with one-way traffic				ST	ST			
S2	Bend radius <=250m – carriageway with two-way traffic				LR	ST	ST		

Figure 3 - Allowable Site Category and Investigatory Levels TS2010 Class 1 shown by green TS2010 Class 2 shown by yellow TS2010 Class 3 shown by red

NOTE 1 Sites with the same site category can have different levels of risk of skidding crashes. There is therefore the flexibility to set different ILs for different sites within the same category.

NOTE 2 This allows sites where the risk of skidding crashes is potentially higher to have a higher IL and possibly be treated to maintain a higher level of skid resistance.

NOTE 3 The objective of setting an IL is to assign a level of skid resistance appropriate for the risk on the site, at or below which further investigation is required to evaluate the site specific risks in more detail.

NOTE 4 Advice for selecting an appropriate IL is provided in Appendix A. The range of ILs for each site category has been developed as a result of UK and TS research studies on motorway and all-purpose trunk roads and reflects the variation in crash risk within a site category.

1. 'ST' in cells within Figure 3 indicates the range of ILs that should generally be used for roads carrying significant levels of traffic. The default value where no other information is available will be the lowest ST value.
2. 'LR' in cells indicates a lower IL that may be appropriate in lower risk situations, such as low traffic levels providing this has been confirmed by the crash history.
3. Exceptionally, an IL higher or lower than those indicated in Figure 3 may be assigned if justified by the observed crash record and local risk assessment.

4. If more than one site category is appropriate then the site category with the highest recommended IL shall be selected.
5. ILs for site categories Q and K shall be based on the 50m approach to the feature and, in the case of approach to junctions, through to the extent of the junction.
 - The approach length may be extended when justified by local site characteristics.
6. Categories G1 and G2 shall not be applied to uphill gradients on carriageways with one-way traffic.
7. Category S1, the higher value shall be applied to all bends on carriageways with one-way traffic where the radius of curvature is <100m.
8. Category S2 shall be applied to all bends on carriageways with two-way traffic where the radius of curvature is <100m.
9. Category S1 shall be applied to bends on carriageways with one-way traffic with a radius of curvature \geq 100m but <250m where the speed limit is \geq 50mph.
10. Category S2 shall be applied to bends on carriageways with two-way traffic with a radius of curvature \geq 100m but <250m where the speed limit is \geq 50mph.
11. The site category and IL applied to a length shall be applied to all lanes of the carriageway that have traffic running in the same direction.
 - All lanes of the carriageway (with the same direction of traffic) should be included when identifying what site category and IL will be applied. This includes the hard shoulder where hard shoulder running is implemented.
12. The site category and IL information shall be recorded together with the date of assessment.

All Site Categories and Investigatory levels shall be reviewed at intervals not exceeding 3 years. Approximately 1/3 of the network should be reviewed each year as a minimum. Site Category and Investigatory levels shall also be reviewed when there is a significant change to the network e.g. when new junctions or road layouts are constructed.

When Site Categories and Investigatory levels are reviewed, the whole link/section shall be reviewed for accident rate. Where a Site Category has had 0 collisions within the preceding 3 years and the collision rate for the section is less than 75% of the national average for that road type, the IL should be dropped to a lower band within the range given in the table above, including the Low Risk 'LR' labelled boxes.

All reviews shall be approved by the Skid Manager and be submitted to Transport Scotland within 4 weeks of approval. Skid Managers shall enter the Site Categories and Investigatory level information into the pavement management system.

The table above provides a range of ILs for each Site Category and it is expected that the full range of allowable ILs shall be used based on the assessed risk for each site.

Where local factors suggest the assessed risk is higher, the higher IL (referred to as H) shall be used.

Appendix A to CS 228 is supplemented by more detailed Guidance for use on Transport Scotland's roads which is included in Annex A of this document.

5.0 INITIAL INVESTIGATION

The process for the Initial Investigation is split into the following steps:

1. Prioritise sites using the prioritisation methodology.
2. Identify sites for Initial Investigation
3. Identify other sites for investigation.
4. Undertake Initial Investigations desk study.
5. Reporting of Initial Investigations.

In identifying sites for Initial Investigation the survey date should be considered. There is a small quantity of data within the pavement management system that is significantly more than 2 years old. In general, this data should be treated with caution, and there may be grounds to remove the site from the Initial Investigation programme.

5.1 Prioritise sites using the prioritisation methodology

The mean CSC for 100m averaging lengths (or site category length if shorter, and at the end of sections) will be used for comparison against the IL, including roundabouts.

On completion of the annual survey Transport Scotland will produce a prioritised 'long list' of sites as described in Figure 2. This uses:

- SCRIM Difference (the arithmetical difference between CSC and IL)
- Wet collisions (where surface field is flagged as wet/ damp) occurring in the past 3 years.
- Texture (Derived from the average of Texture RAW over the site length)

Number of wet collisions at Site SCRIM Diff ≥ 0	Score
0	0
1	4
2	8
3+	12

SCRIM Diff. (SD)	Score
SD Less than or equal to 0 and greater than -0.05 $0 \geq SD > -0.05$	1
SD less than or equal to -0.05 and greater than -0.10 $-0.05 \Rightarrow SD > -0.10$	3
SD less than or equal to -0.10 and greater than -0.15 $-0.10 \Rightarrow SD > -0.15$	6
SD less than or equal to -0.15 $-0.15 \Rightarrow SD$	12

Texture	Score
SCRIM Diff ≤ 0 and Texture ≤ 0.7	1
else	0

To assign a ranking score to each SCRIM summary length, derived using the seasonally corrected SCRIM summary data, Texture (Derived from the average of Texture RAW over the site length) and 3 full calendar years of collision data as well as any collision data from the current year at time of analysis. The SCRIM data is not trended to a specific date.

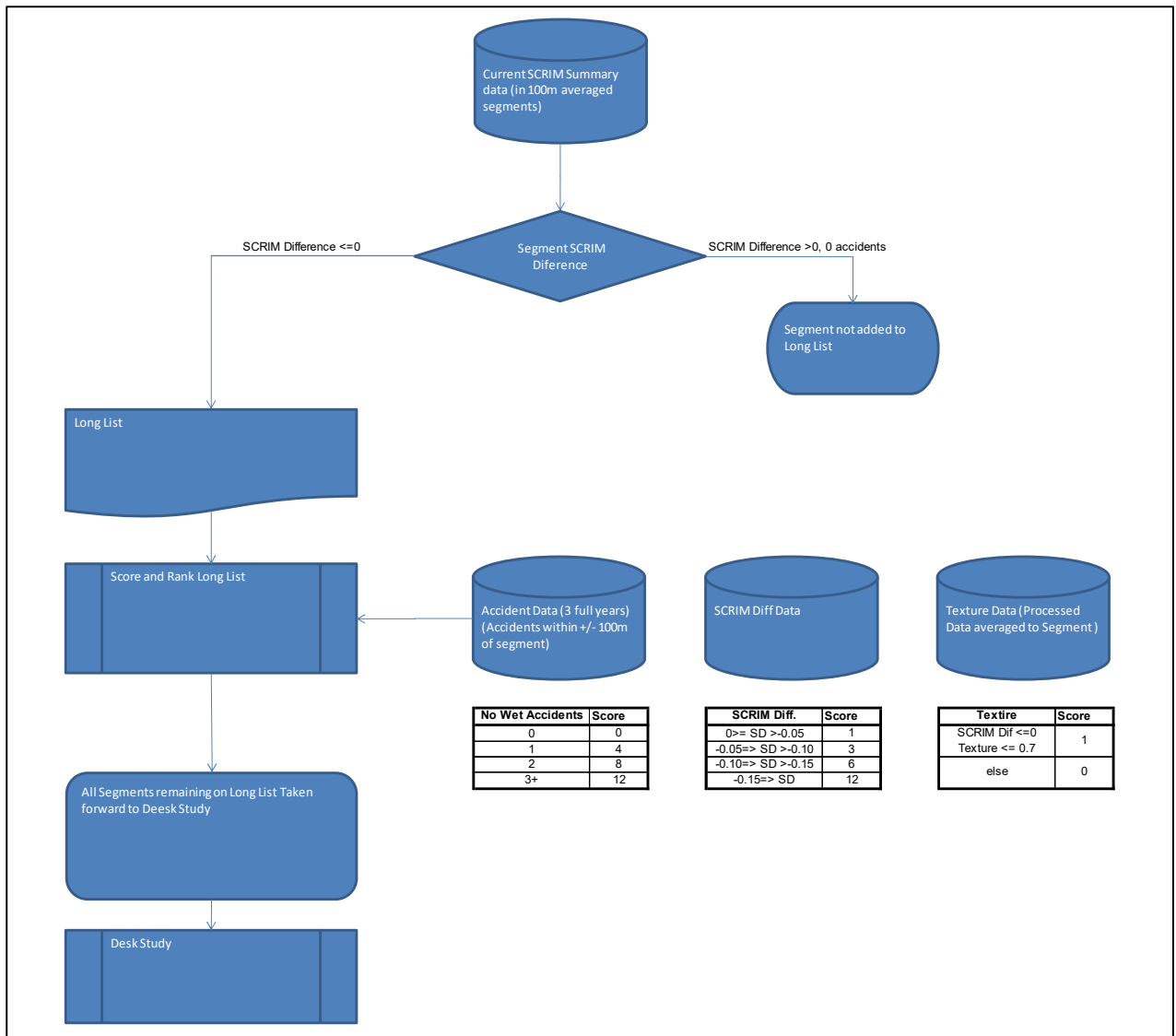


Figure 2 - Long list preparation

5.2 Identify sites for Initial Investigation

The Operating Company Contracts set a timescale for the completion of the Initial Investigations. Unless otherwise agreed with Transport Scotland, the Initial Investigations shall be completed and the reports updated in pavement management system by the 1st March each year.

5.3 Identify other sites for Investigation

It is anticipated that most sites will be identified through the prioritisation process described above. Additional sites may however be identified by Operating Companies. For example, where there is 'Damage to Crown Property' that may be indicative of a problem; where reports are received from other stakeholders or road users; or from other safety initiatives; these can be added to the list for Investigation.

Other sites may be identified at any time. These would typically be where there has been a noticeable and sudden increase in collisions, where the surface condition may be a contributory factor. These can be flagged up using the unique site reference in the prioritised long listing, and the same investigation protocol followed.

5.4 Undertake Initial Investigation Desk Study

The Desk study shall be carried out in accordance with the flow chart shown in

Figure 3. The Desk study allows locations to be identified which have recently been treated or are about to be treated. Where recent or planned treatment will significantly change the skid resistance measurements, those sites can be excluded from further investigation.

5.5 Reporting of Initial Investigations

The outcomes from all Initial Investigations shall be recorded in the pavement management system. Additional records produced by those undertaking the investigation may be held within the Operating Company's management system.

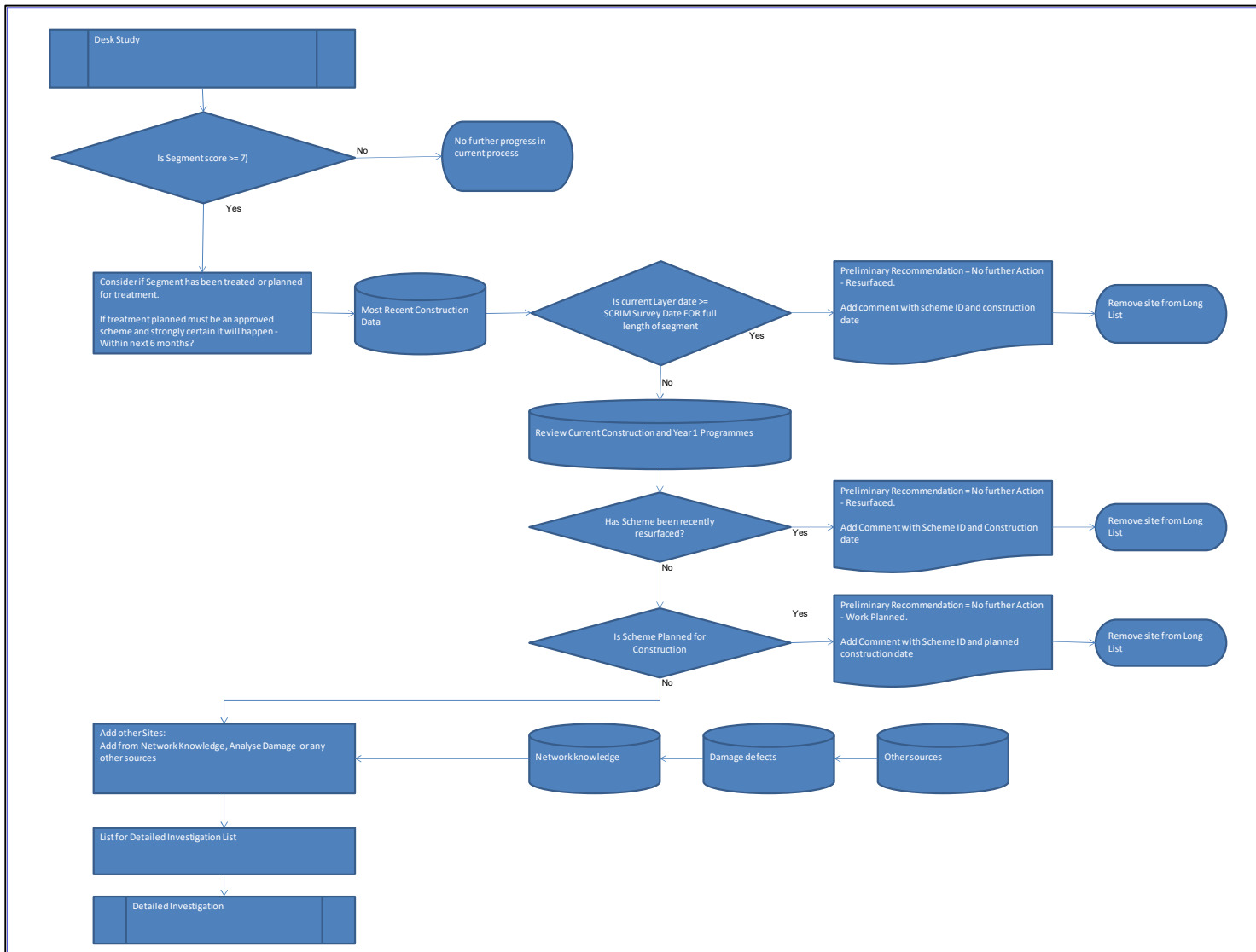


Figure 3 - Initial Investigation Desk Study
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6.0 DETAILED INVESTIGATION

The Detailed Investigation shall be carried out by the Operating Companies under the direction of the Skid Manager.

The Operating Company Contracts set a timescale for the completion of the Detailed Investigations. Unless otherwise agreed with Transport Scotland the Detailed Investigations shall be completed and the reports updated in the pavement management system by the date prescribed in the Contract.

The Skid Manager shall ensure that the Investigation has been undertaken by staff with suitable experience and/ or qualifications, and that all recommendations are appropriately evidenced within the records entered in the pavement management system.

The working procedures adopted by the Operating Company in undertaking Detailed Investigations shall be developed to consider the various elements laid out in the Detailed Investigation flowcharts, see **Error! Reference source not found.**1-3.

Detailed Investigations

6.1 Collate data

All data listed in **Error! Reference source not found.**1-3 shall be collated using reports and functions available in AMPS.

6.2 Planning investigations

The list of sites recommended for Detailed Investigation shall be reviewed to maximise the efficiency of the Detailed Investigation process and to decide on the most appropriate method for carrying out the Detailed Investigation. Detailed investigation shall comprise of a Desktop Review followed if necessary by a Site Visit.

6.3 Carry out Investigations

The outcomes from these Detailed Investigations shall be recorded in AMPS. Additional records by those undertaking the investigation may be held within the Operating Company's management system.

6.3.1 Investigating Bends and Roundabouts

For bends and roundabouts 10m data from the SCRIM processed table should be collated for the site. This will identify within the survey data whether there are any data omissions due to test speed on roundabouts, and whether any localised variations in skid resistance exist that may result in short lengths with low skid resistance that could be hazardous for vehicles performing cornering manoeuvres.

6.4 Recommendations

The Skid Manager shall review and approve the outcomes from all the Detailed Investigations and authorise them within the pavement management system. Detailed investigations may conclude that as many of the following recommendations as are appropriate should be considered.

6.4.1 No Further Action

If the Detailed Investigation concludes that there is not enough evidence to warrant any of the other outcomes then 'No Further Action' should be recorded. The site will be considered in the prioritisation process in the following cycle, with updated collision and SCRIM data.

6.4.2 Change Site Category and/or Investigatory Level

This recommendation might arise from the Initial Investigation; however, there may be cases where evidence gathered during the Detailed Investigation supports a change to either the Site Category or Investigatory Level. In recommending this outcome, the ranking of the site following amendment should be reviewed. If the site is still below IL, then an additional recommendation will be required, which could include 'No Further Action'.

6.4.3 Treatment to improve the Skid Resistance

If the evidence from the Detailed Investigation indicates that a surface treatment is warranted, this should be identified. At the time of the Detailed Investigation it is not necessary that a specific treatment is proposed as this will be determined during scheme development.

6.4.4 Routine Maintenance Required

During the site inspection phase of Detailed Investigations, any and all observed defects (e.g. centrelines/ road studs need renewing/ missing sign needs replacing/ drainage works to prevent standing water on the site etc.), should be noted and recorded within the Routine Maintenance section of the pavement management system.

Where those defects are considered to contribute to the skid related safety of the site, the Detailed Investigation report shall record a recommendation of Routine Maintenance Required and any Category 1 defects shall be recorded in the pavement management system.

When Routine Maintenance is required to maintain road condition/ address other defects (e.g. repair failed joint, footway works, sign cleaning etc.), these should be recorded as either category 1 or category 2 defects in the pavement management system as appropriate.

Routine or reactive maintenance shall be arranged in accordance with the requirements of the OC Contract.

6.4.5 Safety Treatment other than Skid Resistance

If during the investigation there is evidence that some other form of safety treatment should be considered, this can be identified as an outcome from the investigation. This could include the provision of new or altered road signs, improvements to geometry, improved road edge definition etc.. These recommendations may need further input from other supporting teams e.g. road safety teams.

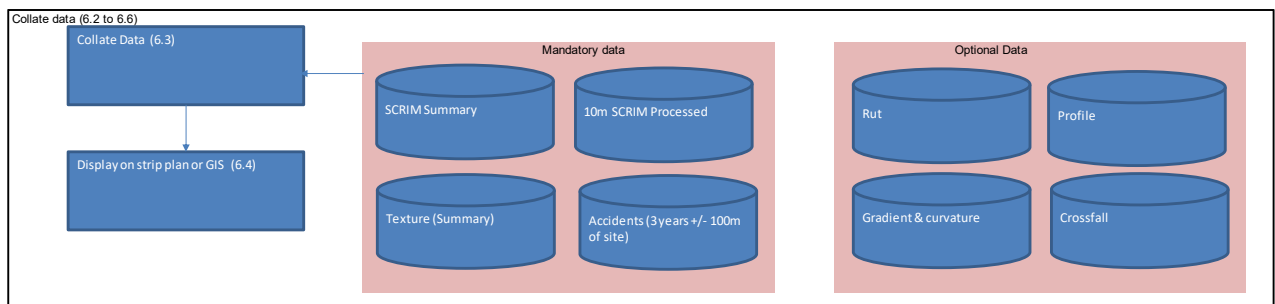


Figure 4.1 - Detailed Investigation, Collate Data

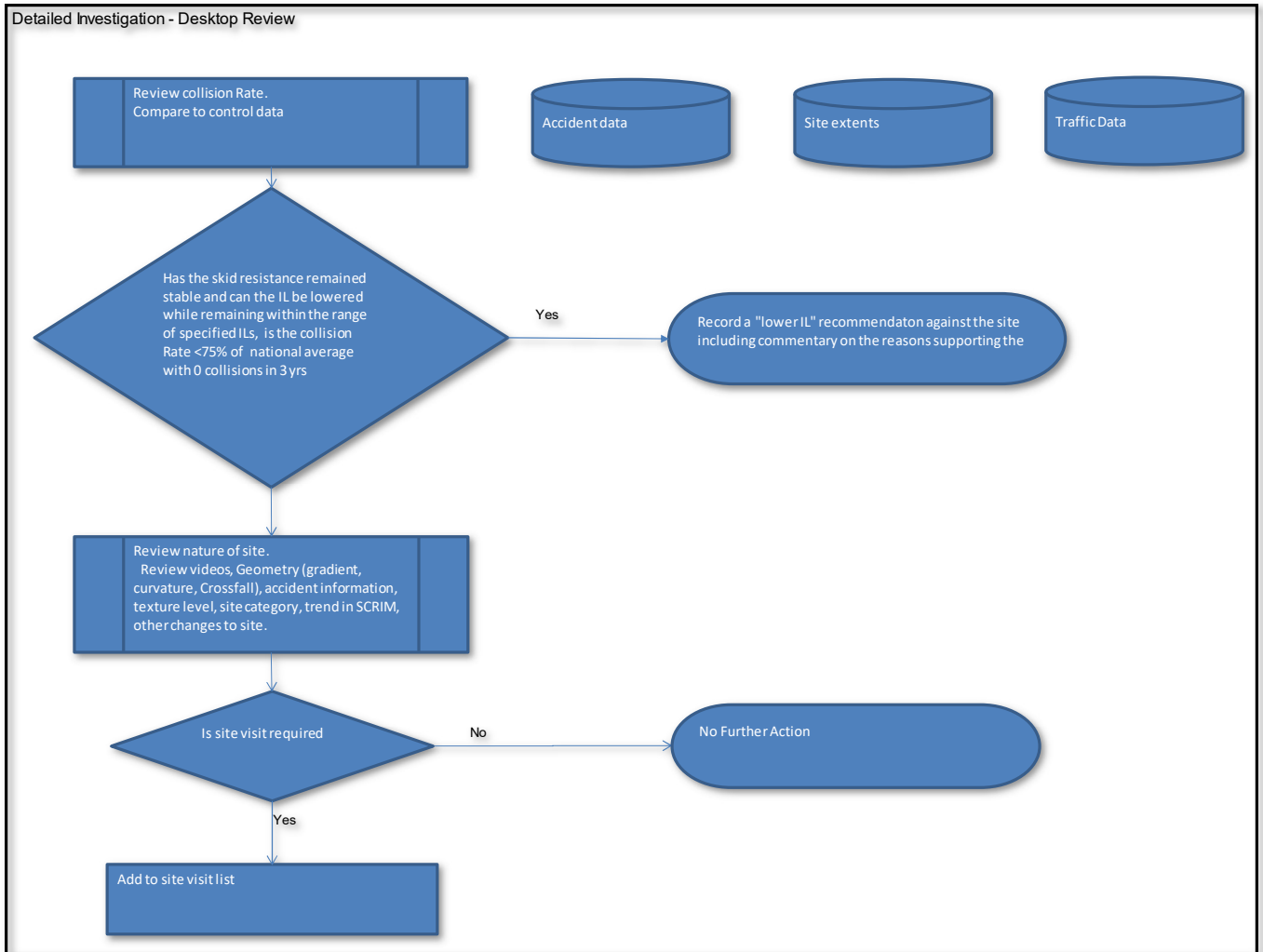


Figure 5.2 - Detailed Investigation Process, Desktop Review

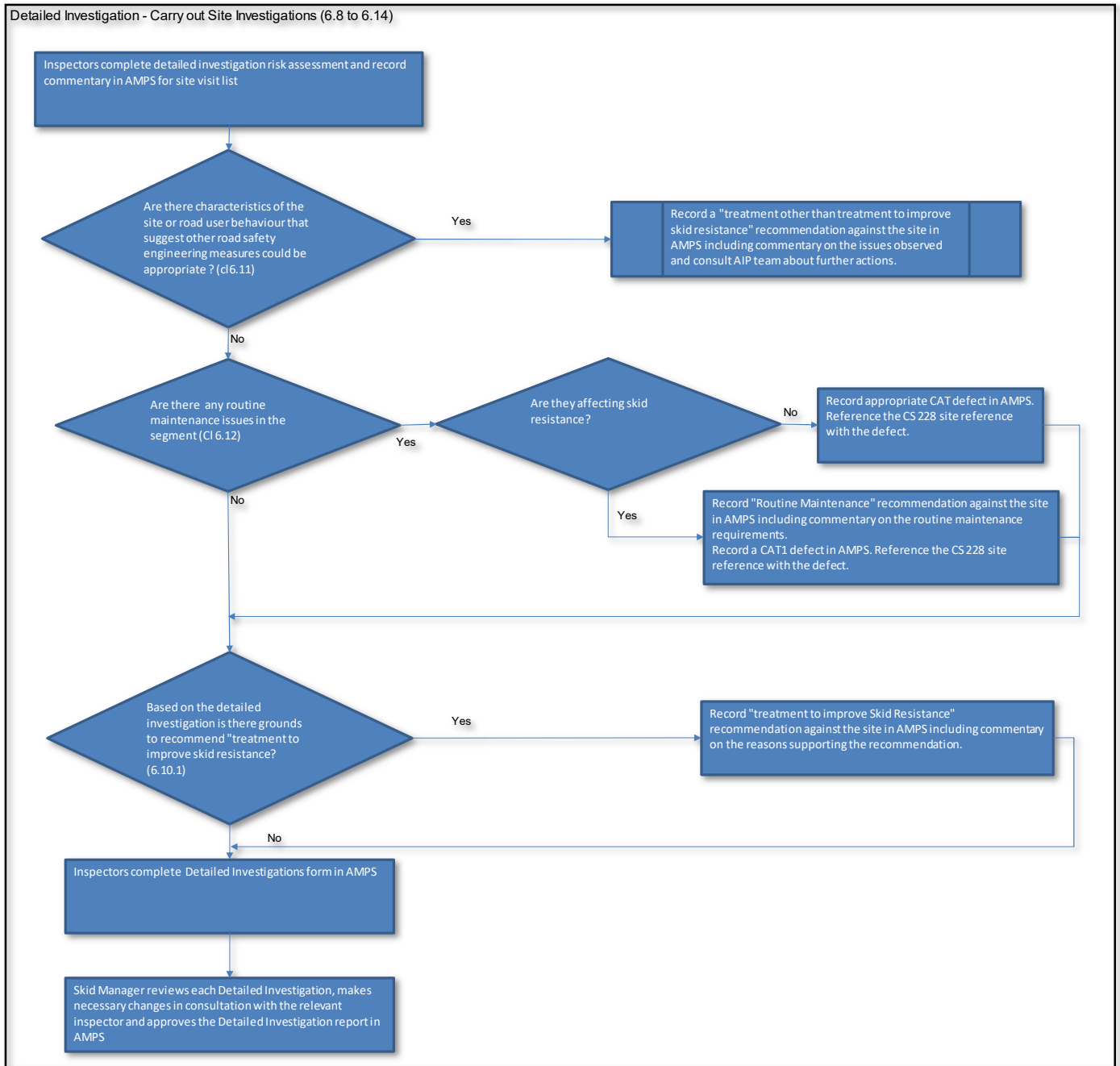


Figure 6.3 - Detailed Investigation Process, Site Investigation

6.4.6 Maintenance Prioritisation and Programming

Schemes shall be developed and prioritised in accordance with the Annual Process for maintenance in the Operating Company Contract.

7.0 USE OF SLIPPERY ROAD WARNING SIGNS

The flowchart shown in Figure 7 shall be followed.

Temporary slippery road warning signs can provide useful additional information to drivers but a number of aspects should be considered before installation. 'A-frame' type signs can be erected relatively quickly, however, these signs can require very frequent maintenance and previous assessments have noted that the obviously temporary nature of the signs means that their impact can be short-lived. It is therefore suggested that these signs should be used for only very transient hazards, for example a spillage. The erection of 'permanent' signs on a temporary basis has previously been judged to be more effective and these are recommended for locations where additional warning signs are required for a longer period. The over-use, however, of such warning signs risks undermining their wider effectiveness and hence proliferation is to be avoided and their use should therefore be restricted to those sites which are judged to carry an uncharacteristically higher risk. The potential benefits to be gained from warning signs should also be balanced against the cost, resource and duration required to design, install and later remove the signs. Where treatment works are programmed for completion within nine months, it is less likely that permanently installed temporary signs will provide appropriate value for money. Where treatment works on higher risk sites are not expected within nine months then it is more likely that road users would benefit from additional signage at these sites.

No later than 31 August each cycle, the Skid Manager shall review all sites where treatment to improve skid resistance has been recommended and identify locations where slippery road signs are judged to be beneficial where the risk is judged to be uncharacteristically high and where the delivery of maintenance schemes is likely to be programmed for construction in the following Financial Year. These shall be assessed based on the site characteristics, the nature of the hazard identified, the level of risk assessed during investigation and the likely time period until delivery of maintenance treatments. Proposals for the installation of signs shall be submitted to the Transport Scotland Asset Management team for approval using the following email address.

TRNMD_Skid_Policy_Investigation_Mailbox@gov.scot

Once approved by Transport Scotland, the slippery roads warning sign (Diagram 557) in conjunction with an appropriate supplementary plate (Diagram 570) shall be used in accordance with the Traffic Signs Regulations and General Directions and Chapter 4 of the Traffic Signs Manual.

Slippery road sign locations shall be recorded in pavement management system and shall be removed once the site has been treated.

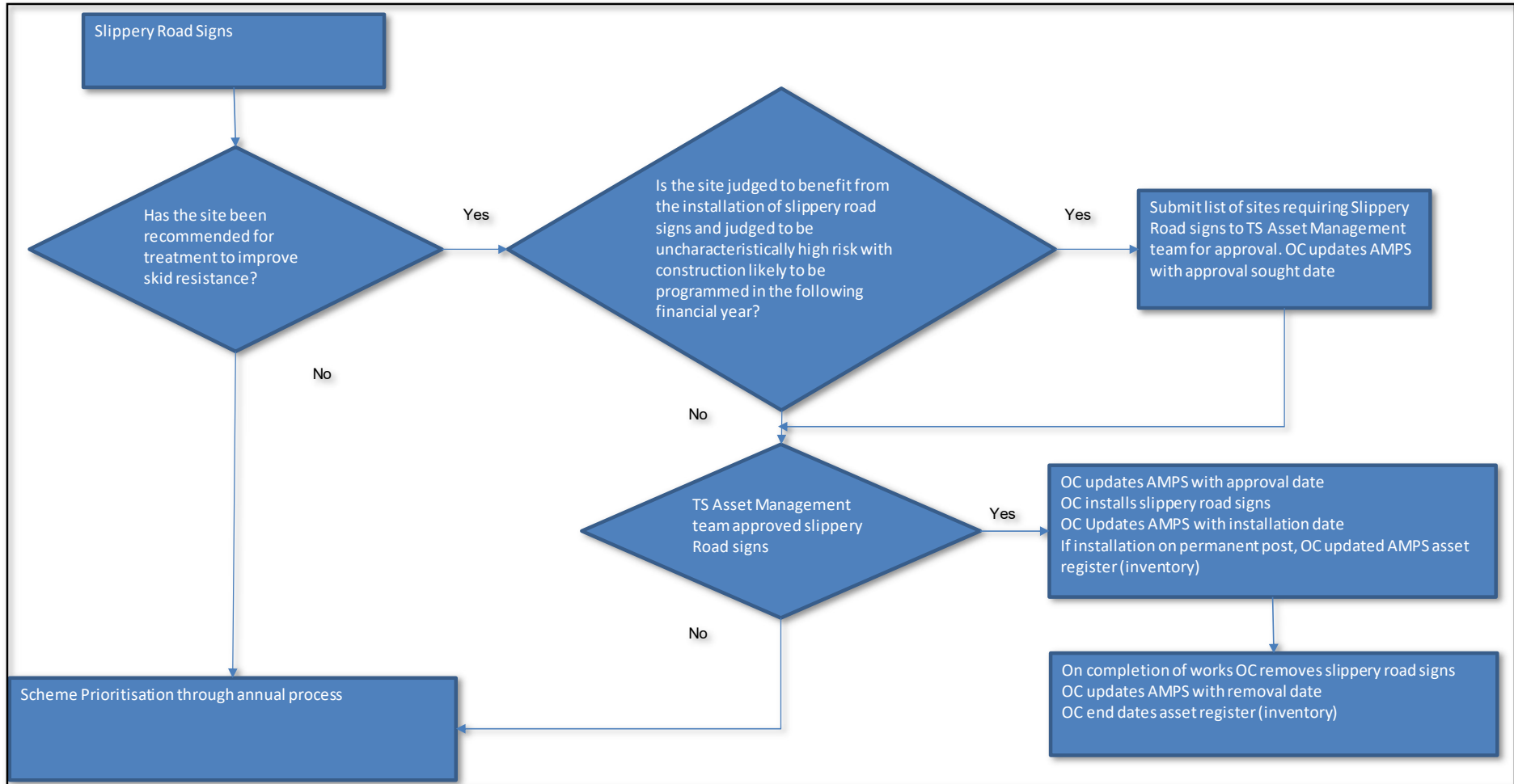


Figure 7 - Slippy Road signs

8.0 MONITORING AND REPORTING

The Transport Scotland skid policy runs on an annual cycle following completion of the SCRIM survey. The milestones for the cycle are set out in the Operating Company contracts.

The recommendations from Investigations are added to programmes of work and may not be completed within the annual cycle. The Skid Manager shall monitor all recommendations made from the investigation process through to completion, or where circumstances change at a site that mean the recommendation is no longer valid, document the reasons for change within the pavement management system.

The annual report provides an opportunity to report on the outcomes from all previous recommendations.

9.0 REFERENCES AND DEFINITIONS

1. Design Manual for Roads and Bridges: CS 228 Skidding Resistance.
2. Accreditation and Quality Assurance of Sideways Force Skid Resistance Survey devices. Version 4; Feb 2020.
3. BS7941 -1; Methods for measuring the skid resistance of pavement surfaces. Part 1: Sideway-force coefficient routine investigation machine. BSI, 2006.

Defenitions


Collision	Data held in the pavement management system describing injury occurring on the Transport Scotland network. Crash and collisions may also be used.
Damage to Crown property	An incident resulting in damage to road infrastructure recorded within the pavement management system.
Investigatory Level. (IL)	The level of skid resistance at or below which an investigation of the skid resistance is to be undertaken.
AMPS	Asset Management Performance System Database which holds Transport Scotland asset data and information.
Locality	Geographic area with similar climatic conditions used to derive seasonal correction
Operating Company	The Company awarded the maintenance contract for trunks roads within a designated area
Preliminary Investigation	Initial Investigation. Prior to this version of the Guidance this terminology was used. The terms can be used interchangeably.
SCRIM	Sideways Force Coefficient Routine Investigation Machine. The testing device to undertake routine skid resistance surveys for Transport Scotland.
SCRIM difference	The difference between the CSC and the Investigatory Level
SCRIM Processed	SCRIM data held in AMPS which includes corrected data at 10m sub section level
SCRIM RAW	SCRIM data held in AMPS which includes uncorrected SCRIM coefficient
SCRIM Summary	SCRIM data held in AMPS reporting the average for each SCRIM summery length (100m of length od site category)
Characteristic SCRIM coefficient (CSC)	The Sideways force Coefficient value that has been corrected for seasonal variations following the method appropriate to the survey strategy adopted by the Overseeing Organisation.
Seasonal correction	Process of applying CSC methodology to the raw data in processing within AMPS
Secondary Investigation	Detailed Investigation. Prior to this version of the Guidance this terminology was used. These terms can be used interchangeably.
Site Category	One of the levels within a broad classification of the road network according to the risk of skidding.
Skid Manager	Named person in a OC responsible for implementing the Transport Scotland Skid Resistance Strategy
Speed corrections	Process of correcting readings to 50kph speed limit (applying correction in 3.21 of CS 228)
Survey period	The period within the survey year when the survey is carried out in.

Annex A: Transport Scotland Guidance on Site Category and Investigatory Levels

Note- Capital letter “H” is used to denote the higher available value in the range given in Figure 3.

Category A: Motorway

(CS 228 A2)



Situation	Additional Guidance	Example Images
Police observation platform	<p>Clarification: Unless local knowledge suggests there is extensive use or high risk the IL should not be raised to AH.</p> <p>Extents: The Site Category shall extend across the feature.</p>	







Category B: Non-event carriageway with one-way traffic

(CS 228 A3)

Skid Managers **could** consider raising the IL to 0.40 (BH) where there is evidence of a higher risk. In assessing the risk the following issues should be considered as a minimum:

- traffic volumes,
- traffic speed,
- visibility,
- Usage.

Situation	Additional Guidance	Example Images
Junction	<p>Definition: Junctions will typically be indicated by either: The presence of give way lines and/or: Advance flag or warning sign. This can include junctions with both other roads, and private accesses etc. For junctions meeting the above criteria Category Q should be appropriate. For accesses etc. that do not meet these criteria then Category B should be more appropriate.</p>	
Signing for pedestrians or other crossings	<p>Locations: May include cycle path or footway crossings or areas adjacent to viewpoints etc. where users may park.</p> <p>Extents: The Site Category shall extend across the feature and 50m approach.</p>	
Access requiring warning signage	<p>Extents: The Site Category shall extend across the feature and 50m approach.</p>	




Situation	Additional Guidance	Example Images
Layby without separation from carriageway	<p>Extents: The Site Category shall extend across the length of the layby and 50m approach (dotted line + 50m)</p>	
Layby with physical separation from carriageway	<p>Extents: The Site Category shall extend across the length of egress from the main carriageway and 50m approach.</p>	
	<p>Extents: The Site Category shall extend across the length of access to the main carriageway and 50m approach.</p>	
Other accesses, e.g. private roads/drives.	<p>Extents: The Site Category shall extend across the feature and 50m approach.</p>	
Field Access	<p>Additional Guidance: The Field accesses should not require raising.</p>	
Police observation platform	<p>Clarification: Unless local knowledge suggests there is extensive use or high risk the IL should not be raised.</p> <p>Extents: The Site Category shall extend across the feature.</p>	






Category C: Non-event carriageway with two-way traffic

(CS 228 A4)

Skid Managers **could** consider raising the IL to 0.45 (CH) where there is evidence of a higher risk. In assessing the risk the following issues should be considered as a minimum:

- traffic volumes,
- traffic speed,
- visibility,
- Usage.

Situation	Additional Guidance	Example Images
Junction	<p>Definition: Junctions will typically be indicated by either: The presence of give way lines and/or: Advance flag or warning sign. This can include junctions with both other roads, and private accesses etc. For junctions meeting the above criteria Category Q should be appropriate. For accesses etc. that do not meet these criteria then Category B or C should be more appropriate.</p>	
Signing for pedestrians or other crossings	<p>Locations: May include cycle path or footway crossings or areas adjacent to viewpoints etc. where users may park. Extents: The Site Category shall extend across the feature and 50m approach (both lanes).</p>	
Layby without separation from carriageway	<p>Extents: The Site Category shall extend across the length of the layby and 50m approach (lane adjacent to layby only).</p>	
Layby with physical separation from carriageway	<p>Extents: The Site Category shall extend across the length of egress from the main carriageway (entrance to layby) and 50m approach (lane adjacent to layby only). Extents: The Site Category shall extend across the length of access to the main carriageway (exit from layby) and 50m approach (lane adjacent to layby only).</p>	

Situation	Additional Guidance	Example Images
Informal pull in	<p>Definition Generally, these will not have any signage</p> <p>Clarification: Unless local knowledge suggests there is extensive use or high risk the IL should not be raised.</p> <p>Extents: The Site Category shall extend across the feature and 50m approach (lane adjacent to layby only).</p>	
Other accesses, - Access to filling	<p>Extents: The Site Category shall extend across the feature and 50m approach (both lanes).</p>	
Other accesses, - Private/farm access	<p>Extents: The Site Category shall extend across the feature and 50m approach (both lanes).</p>	
Other accesses, - Property access	<p>Extents: The Site Category shall extend across the feature and 50m approach (both lanes).</p>	
Formal parking area off carriageway	<p>Extents: The Site Category shall extend across the feature and 50m approach (both lanes).</p>	
Bends on roads with a radius >100m	<p>Definition Where the speed limit is below 50mph S1 or S2 Site Categories are not appropriate. Where the bend radius is >100m and the speed limit is below 50mph and the site is considered to present a particular hazard in spite of the lower speed, 0.45 (CH) could be applied.</p>	

Situation	Additional Guidance	Example Images
Uphill sections	<p>Definition</p> <p>Where the gradient is less than 5% G1 or G2 Site Categories are not appropriate.</p> <p>Where the uphill section is less than 5% and the speed differential between vehicles could result in increased, 0.45 (CH) could be applied.</p>	


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

(CS 228 A5)

Situation	Additional Guidance	Example Images
Junction	<p>Definition:</p> <p>Junctions will typically be indicated by either: The presence of give way lines and/or: Advance flag or warning sign. This can include junctions with other roads and with private accesses etc. For junctions meeting the above criteria Category Q should be appropriate. For accesses etc. that do not meet these criteria then Category B/C should be more appropriate.</p>	


Category K: Approaches to pedestrian crossings and other high risk situations

(CS 228 A6)

Situation	Additional Guidance	Example Images
Other situations	<p>Definition:</p> <p>Other situations could include swing bridges over canals.</p>	

Category R: Roundabout

(CS 228 A7)

Situation	Additional Guidance	Example Images
Roundabout exit	<p>Clarification: Typically, roundabouts are designed with a short length of tight radius on the exit from roundabouts. These should not be identified as bend features; however, there are a number of roundabouts where there is a longer bend feature on the exit from a roundabout. Based on an assessment of the site these should be identified as discrete bends</p>	
	<p>Example A9 Keir Roundabout, M8 exit. Although strictly speaking a roundabout exit curve, local knowledge suggests that this curve is a higher risk and therefore a S1 bend Site Category applied</p>	

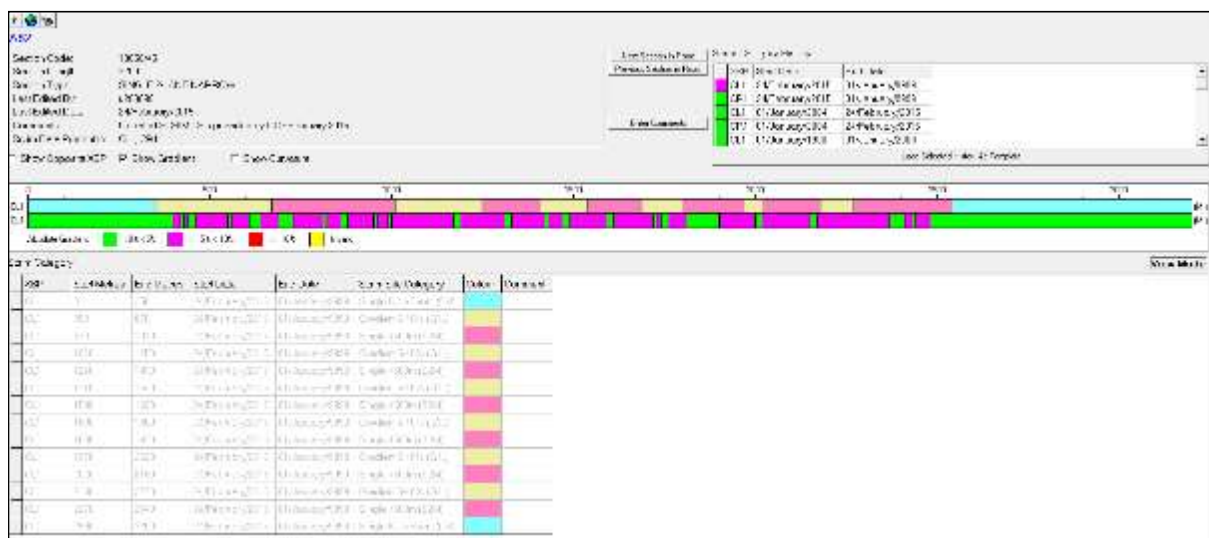
Category G1: Gradient 5-10% longer than 50m Category G2: Gradient >10% longer than 50m

(CS 228 A8 and CS 228 A9)

Gradient shall be assessed from the alignment data held in the pavement management system, or from topographical data. It should be noted this is collected by SCANNER during the regular network surveys, so is unlikely to be more than 2 years old. Gradient is assessed using an inertial platform sampling at every 0.01 seconds. Data is reported in AMPS as the average for every 10m sub section.

The SCANNER Specification requires gradient to be reported to +/- 1.5% or +/- 10% of the 'true gradient' (whichever is larger)

SCRIM site category viewer can be used to view gradient data



Site category viewer showing gradient.

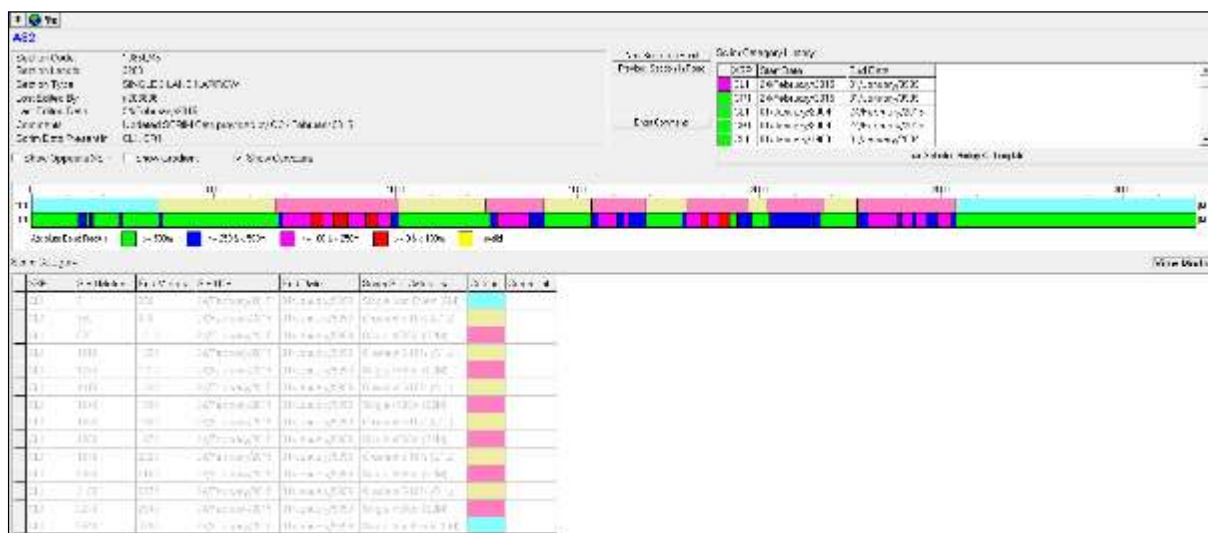
Category S1/S2: Bend radius < 250m

(CS 228 A10)

Situation	Additional Guidance	Example Images
Bends <100m radius	Clarification: S1/S2 Site categories shall apply to roads with any speed limit	
Bends radius 100m to 250m	Clarification: S1/S2 Site Categories shall only apply where the speed limit is 50mph or greater. Where the speed limit is less than 50mph A/B/C site categories should apply.	
Minimum length	Clarification: For bends with radii < 250m the S1 and S2 categories should only apply where the length of the bend is ≥30m.	
	Clarification: If the measured radius varies the curve can be assigned for the overall length of the feature, as long as there are no gaps greater than 20m where the radius criteria is not met.	
	Clarification: If the bend continues without a break > 20m in length, and more than 50% of the overall length of the potential bend has the required curvature for the distances above this will be the length of the feature.	

Curvature shall be assessed from the alignment data held in AMPS, or from topographical data. It should be noted this is collected by SCANNER during the regular network surveys, so is unlikely to be more than 2 years old. Curvature is assessed using an inertial platform sampling at every 0.01 seconds. Data is reported in AMPS as the average for every 10m sub section.

The SCANNER measures curvature on the drive line of the vehicle. Any curvature identified will need to be verified using video and other alignment data.



Site category viewer showing curvature.

Multiple Site Categories

If more than one Site Category is appropriate, then the Site Category with the highest recommended IL for the site/environment will be selected. If the highest recommended IL for the site categories are the same then the category highest up the Table shall be selected (A being the highest on the table and S2 the lowest). Where the residual length of any feature is shorter than the lengths set out in this Guidance the residual length will still be defined to the feature; for example:

Situation	Additional Guidance	Example Images
Chainage 320 – 450m has gradient of 5 -10%. There is a junction at 410m. Speed limit > 50mph.	Clarification: 320 – 360m – G1L (note length is less than 50m in Figure 3) 360 - 420m – QM 420 – 450m – G1L (note length is less than 50m in Figure 3)	

Lowering the Investigatory level

A higher or lower IL may be assigned if justified by the observed crash record and local risk assessment.

Lowering the IL will change the prioritisation ranking for any site and the overall length of the network that is reported as below IL by Transport Scotland.

The investigatory levels should not be adjusted in response to a scheme design to widen the choice of material options, unless Transport Scotland have approved any relaxation through the ‘Statement of Intent’ approval.

Investigatory levels can be lowered after a detailed review, within the approved band after consideration of the road safety performance of the specific road and section. Sections of road that have an collision rate of less than 0.75 of the national average for a road of its type should be considered for lowering the IL. Any recommendations to lower the IL should be documented with supporting collision data.

Considerations when reviewing the IL include:

Site Category	IL and sub Site Category	CS 228 Options	Amending IL from default
A: Motorway	0.30 (AL)	available in ‘low risk situations’	Used only in areas of low risk or where the collision rate is less than 0.75 times the national average for a road of its type
	0.35 (AH)	Default Category	
B: Dual Carriageway non event	0.30 (BL)	available in ‘low risk situations’	Used only in areas of low risk or where the collision rate is less than 0.75 times the national average for a road of its type
	0.35 (BM)	Default Category	See CS 228 and examples in this Guidance
	0.40 (BH)		
C: Single carriageway non event	0.35 (CL)	available in ‘low risk situations’	Used only in areas of low risk or where the collision rate is less than 0.75 times the national average for a road of its type
	0.4 (CM)	Default Category	
	0.45 (CH)		See CS 228 and examples in this Guidance
Q: Approaches to junctions /roundabouts	0.45 (QL)	Default Category	Areas with speed limit < 50mph or speed limit >=50mph and low risk See CS 228.
	0.50 (QM)		Areas with speed limit >=50mph and moderate risk, risk See CS 228

Site Category	IL and sub Site Category	CS 228 Options	Amending IL from default
	0.55 (QH)		In exceptional circumstances where the risk is high
K: Approaches to crossings and other high risk situations	0.50 (KL)	Default Category	
	0.55 (KH)		Consider number of pedestrians, pattern of use (e.g. schools), Multi lane approaches
R: Roundabout	0.45 (RL)	Default Category	
	0.50 (RH)		Consider speed, weaving traffic, deflection angle for approaches
G1: Gradient 5 - 10%	0.45 (G1L)	Default Category	
	0.5 (G1H)		Consider actual gradient/ length. Alignment (bends)
G2 Gradient > 10%	0.45 (G2L)		Used only in areas of low risk or where the collision rate is less than 0.75 times the national average for a road of its type
	0.50 (G2M)	Default Category	
	0.55 (G2H)		Consider actual gradient/ length. Alignment (bends)
S1: Bend radius < 250m Dual	0.45 (S2L)	DefaultmCategory 100-250M	
	0.50 (S2H)	Default category <100m	High traffic flows Bend not 'readable' Bend out of context with preceding alignment Difficult or unforgiving roadside (e.g. rock cutting)
S2: Bend radius < 250m Single	0.45 (S2L)		Used only in areas of low risk or where the collision rate is less than 0.75 times the national average for a road of its type
	0.50 (S2M)	Default Category	
	0.55 (S2H)		High traffic flows Bend not 'readable' Bend out of context with preceding alignment Difficult or unforgiving roadside (e.g. rock cutting)

Annex B – Investigation form

Detailed Investigation form key headings

Location Details		Road	Section	Start Metres	End Metres
SCRIM Site Category & IL		Site category		Investigatory level	
SCRIM Site Details		Site ID (from Long List)		Site priority score	
Initial Investigation					
Site Treatment		Yes	No	Associated scheme IDs and comments	
Has the site been treated or is treatment planned (if so provide details of Scheme IDs)					
Initial Investigation Date/Time					
Initial Investigator's name					
Detailed Investigation					
Site Location		Risk rating			Comments
		L	M	H	
1	Assess the risk from the prevailing traffic speed & volume relative to the usage of the site.				
2	Assess the risk from the number of events or features (junctions, bend, and gradients) noted on site.				
Road layout		Risk rating			Comments
		L	M	H	
3	Assess the risk associated with the geometry of the site from a visual assessment and use of data. Note risks e.g. Adverse camber, flat spots in crossfall.				
4	Assess the risk of a potentially unusual/alternative layout causing confusion to drivers.				
Collisions		Risk rating			Comments
		L	M	H	
5	Assess the risk from a review of the collisions data, their circumstances and comment on their relevance to the site and any trend.				
6	Assess the risk indicated by any additional evidence e.g. damage to crown property, non-injury collisions or presence of debris.				
Pavement and surface condition		Risk rating			Comments
		L	M	H	
7	Assess the CSC history (SCRIM Difference and any trends)				
8	Assess the relationship between location of collisions and low CSC				

9	Assess the relationship between location of low texture and low CSC				
10	Assess the risk from rutting or longitudinal profile (e.g. consider water ponding, or vehicle handling)				
11	Assess the risk from any other features (e.g. pavement or drainage features or defects)				
12	Assess the risk from any noted or potential surface contamination				
Road user		Risk rating			Comments
		L	M	H	
13	Assess the risk due to the higher incidence of pedestrians, cyclists or other vulnerable road users				
14	Assess the risk due to a higher incidence of heavy good vehicles manoeuvres				
Visibility		Risk rating			Comments
		L	M	H	
15	Assess the risk associated with the appropriateness and visibility of the traffic signals, signs and markings to all road users				
Additional comments/observations					
16	Any additional comments or observations? (e.g. complaints about the section of road)				
Desktop Investigator's details					
Desktop Investigation completed Date/time					
Desktop Investigator's Name					
Is a Site visit required to complete the Detailed Investigation?		Site Investigation required to complete Detailed Investigation			
		Detailed Investigation Complete			
Site Investigator's details					
Site Investigation completed Date/time					
Site Investigator's Name					
		Detailed Investigation Complete?			
Recommendations					
Safety Treatment other than improving skid resistance					
Are there characteristics of the site or road user behaviour that suggests other road safety engineering measures could be appropriate? (cl 6.11)		Yes	No	Description of recommendation	
Closure Date					
Closure comment					
Routine Maintenance					
Are there any Routine Maintenance recommendations affecting skid resistance in the site? (cl 6.12)		Yes	No	Description of recommendation	

CAT1 Defect IDs		Record any CAT1/CAT2 defects in AMPS and note defect IDs for monitoring	
CAT2 Defect IDs			
Closure Date			
Closure comment			
Routine Maintenance – Other defects and observations			
Optionally are there any routine maintenance defect or observations NOT affecting skid resistance in the site? (These should be recorded in AMPS as CAT1/2 defects to be taken forward via the CAT1/2 programme).	Yes	No	Description of other defects and observations
Treatment to Improve Skid Resistance			
Based on the Detailed Investigation are there grounds to recommend "Treatment to improve Skid Resistance" (cl 6.10.1)	Yes	No	Description of recommendation
Closure Date			
Closure comment			
Change Site Category or IL			
Should the Site Category or IL be changed including can the IL be lowered by 0.05? (cl 6.13.1)	Yes	No	Description of recommendation
Closure Date			
Closure comment			
Investigator's details			
Investigator's additional Comments			
Investigator's Name			
Investigation Date			
Skid Manager's approval			
Approver's additional comments			
Approver's Name			
Approval Date			

Annex C: Annual Reporting Template

SKID POLICY ANNUAL REPORTS

The purpose of the annual report is to consolidate all the skid policy work undertaken in a calendar year into one document. This assists Transport Scotland in monitoring compliance with the skid policy and identifying any issues that could lead to improvements in the skid guidance, software or other aspects of the policy implementation.

The following suggested report sections should therefore be used in preparing the Operating Companies Skid Policy Annual report.

Introduction

Overview of years activities

Staffing arrangements

Details of Skid Manager and team involved with a brief overview of the process that the OC has used to ensure those involved are competent. Details of any staff delegations relevant to the skid policy.

Review of Actions from previous years

A follow up on the sites investigated in the previous cycle (e.g. the 2017 report would report on sites where actions were recommended during the 2016 investigation cycle). This should include what has happened on site, and importantly identify any sites where the recommended action has not been completed.

This should include all recommendations including Routine Maintenance, changes to Site Category & IL, etc.

Where recommendations are outstanding from previous years, these should be identified and progress reported.

Prioritised site listing

Overview of numbers of sites identified. If appropriate discussion on changes from previous year (i.e. if there are significantly fewer or more sites a general discussion on why this may be).

Initial Investigations

A description of the process adopted, including staff involved, number of sites reviewed and outcomes. (Note separate records of the sites investigated in a spreadsheet or tabular form is of great value – this could be included in report, or provided separately). Include timescale for preliminary investigation work.

Any key observations from initial investigations –especially those that could assist in improving the process (e.g. the including of old SCRIM data/ CL2 etc.)

If the initial investigation review involved assessing collision records a general description of the process adopted, and any findings.

If there have been any sites reviewed due to customer/ stakeholder feedback a description of the sites and the methodology applied should be included.

Any programmes of work that the OC has undertaken that are complementary to the Skid policy (e.g. bend assessments/ route safety assessments etc.).

Detailed Investigations

A description of the process adopted, including staff involved.

Number of sites investigated and outcomes. (Record of sites is of value as for the initial investigation). Include timescale for initial investigation work. Identify any safety issues involved in inspecting sites.

Where sites have been linked an overview of the methodology applied. (E.g. to cover extent of bend feature/ all approaches to junctions etc.)

A description of the process of reviewing initial investigations and any key outcomes.

Site Category Review

The site category review is an important part of managing the skid policy. A review of the data held suggests that there may be a significant length of the network for which the site category is incorrect.

The 3 year review programme – identifying roads/ sections reviewed in the previous year, the current year and for the subsequent two years.

A description of the process adopted, including staff involved. Identify sources of alignment data used, and how features were identified. Discuss the use of low/ medium and high Investigatory levels in accordance with the guidance.

Use of slippery road signs

Overview of process, list of signs erected, signs remaining on the network from previous years and signs removed.

Grip tester surveys

Description of work undertaken with Grip tester and any key findings (e.g. Grip Tester used to monitor retexturing/ TS2010).

Skid Policy User Group/ skid audit

Overview of input to SPUG and feedback from audit. Identification of any areas for improvement or opportunities for collaborative working.

Plan for following year

A brief overview of the plan for the following year, noting change in personnel, processes etc.

ANNEX D: Transport Scotland guidance on assessing collision data for CS 228 Investigations

Collision data is held in the pavement management system in a series of linked tables. These are the Collision¹, Vehicle, Casualty and Contributory Factors tables. These provide the full record of collisions as recorded in STATS19.

Collision numbers are used within the CS 228 prioritisation process; however, it is evident that some collisions are not related to road surface condition, and therefore any prioritisation using these collisions should be reviewed.

The purpose of collision validation is to review the circumstance regarding collision(s) and assess whether road surface condition may be a factor in the collision or the severity of collision. The following may be of assistance in collision validation.

Collision table

- Road – fitted section/ chainage
- Date/ time
- Severity
- Light conditions
- Weather
- Road surface
- Special conditions
- Carriageway hazards

Casualty table

- Age/ sex
- Class (i.e. driver/ passenger)

Contributory factors

Up to six – including confidence

Vehicle table

- Direction
- Type
- Manoeuvres
- Hit object
- Skidded /overturned
- Leave carriageway
- Breath test

Collision validation for CS 228 investigations

Collision validation is part of the Initial Investigation process. The objective is to review the site to determine whether the assigned priority should be reviewed based on the circumstances of the collision.

The starting presumption is that all collisions held in AMPS are considered valid; however, after a review of the collision data the circumstances for some collisions are such that the site should be reprioritised, without the respective collision.

¹ The pavement management system uses the terminology ‘accident’. For the purpose of this annex collision and accident are used interchangeably. Where the reference is to date held in the pavement management system accident is used.

Collision date

For the annual prioritised list 3 full years of collisions are used, with those collisions that have been loaded to AMPS at the time the prioritised listing is run. This typically means 3 ½ years collisions are used. This collision set is to be treated as the 'definitive' listing for the purpose of preliminary investigations.

Collision location

Collisions are fitted to the Transport Scotland network using fitting software from the collision data provided by Police Scotland. On single carriageways they are not fitted to a lane but to the carriageway.

Unless there is clear evidence that the collision is wrongly located (e.g. it refers to a junction where there is no junction present) the location should be taken as accurate.

Collision details

Road surface conditions: Indicate whether the road was wet or dry. If the 'flood/ frost/ ice/ snow' is flagged **the collision can be considered not to be valid and the site reprioritised**.

Special conditions: Indicate a range of circumstances that may be present at collision. If 'Roadworks/ oil or diesel/ mud' is flagged **the collision can be considered not to be valid and the site reprioritised**.

Contributory factors

Transport Scotland have identified contributory factors in Reported Road casualties . These were developed to provide insight into why and how road collisions occur. Their aim is to help identify the key actions and failures that led directly to the actual impact: to aid investigation of how it might have been prevented. Care should always be taken when interpreting the factors as they:

- reflect the reporting officer's opinion at the time of reporting the collision (or the opinion of a person whose duties include deciding which CFs should be recorded based on the officer's report).
- are based on the information which was available at that time, so may not be the result of subsequent extensive investigation (indeed, subsequent enquiries could result in the reporting officer's opinion changing).

A reporting officer attending the scene of a road collision may select up to 6 contributory factors (from a list of 77) to assign to that collision. Multiple factors may be listed against any participant or vehicles in the collision.

Because of this, analysis of contributory factor information requires careful consideration; figures will differ depending on the focus of the analysis. Care should be taken when interpreting tables provided here which consider different aspects of the data (i.e. collisions, vehicles/participants, casualties and frequencies).

STAT20 – Instructions for the Completion of Road Collision Reports from non- CRASH Sources (2011) (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/230596/stats20-2011.pdf) provides guidance on the contributory factors. Indication is given of whether each factor is very likely or possible.

Contributory Factors are grouped as follow:

- Road Environment Contributed
- Vehicle defects
- Injudicious action
- Driver/ rider error or reaction
- Impairment or distraction
- Behaviour or experience
- Vision affected by
- Special codes (typically vehicle stolen/ emergency call)

There are a number of contributory factors with a strong correlation to road surface condition and skidding resistance (e.g. Poor or defective surfacing, loss of control etc.)

It is recommended that any collisions with the following flags are always considered valid:

Skidded (unless road surface condition is flood, snow or frost/ ice)

Poor or defective road surface

Slippery Road (due to weather) unless road surface condition is flood, snow or frost/ ice

Loss of control

For all other collisions an assessment of all the data will be required to determine whether the collision is valid

Many contributory factors have a less strong correlation to road surface condition, but may be considered valid. The following are examples:

Animal or object in carriageway: this may imply a failure to stop in time and therefore could be considered valid.

Following too close: this may indicate a failure to stop in time and therefore could be considered valid.

There are a number of contributory factors where the link to the road surface condition and skidding resistance is limited and probably can be evidence to eliminate a collision. Examples include, distraction in vehicle, not displaying lights and most vehicle defects.

Vehicle details

This includes direction of travel for all vehicles involved, the results of a breath test, a flag for 'manoeuvre,' 'skidding and overturning,' 'hit object in carriageway,' 'vehicle leaving carriageway.'

Combined with contributory factors this can assist in building a picture of each collision, and whether there is a link to the road surface condition. The direction of travel can be significant if the investigation feature is specific to one direction (e.g. approach feature) and the collision is for the other direction.

Casualty details

This can provide more details on the actions of pedestrians in particular.

Use in CS 228 Detailed Investigations

Through reviewing all fields within the collision record in AMPS it should be possible to determine whether the road surface condition influenced the collision circumstances or severity.

An underlying assumption is that all collisions are valid unless the available evidence indicates otherwise.

A series of tests include:

1. Did the collision happen, or begin to happen on the carriageway?
2. Did the collision happen because of a failure to stop, slow down, or safely manoeuvre regardless of driver/riders reaction time or behaviour?
3. Was the vehicle moving forward at the time?
4. Is there clear evidence to indicate that road condition or layout did not contribute to the collision or it's severity?

Invalid collision may include, but not be limited to:

- Falls/ slips inside or getting on/ off buses
- Reversing into objects
- Pedestrian collision not involving vehicle
- Collision due to vehicles evading the police.