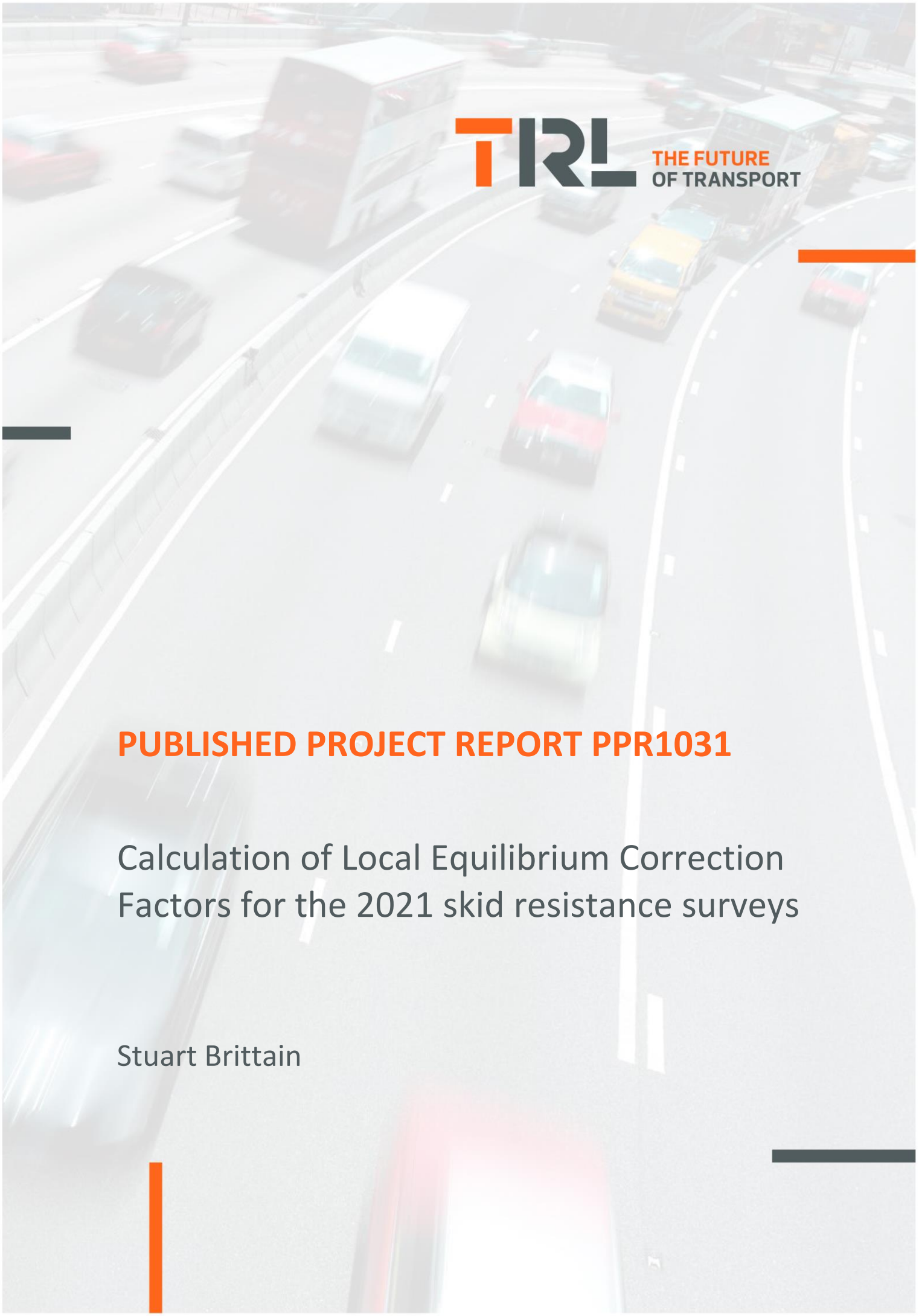

THE FUTURE OF TRANSPORT

PUBLISHED PROJECT REPORT PPR1031

Calculation of Local Equilibrium Correction Factors for the 2021 skid resistance surveys

Stuart Brittain

Report details

Report prepared for:	National Highways, SES		
Project/customer reference:	SPaTS 2: T0098		
Copyright:	© TRL Limited		
Report date:	27/05/2022		
Report status/version:	1.0		
Quality approval:			
Anton Watts (Project Manager)	**Anton Watts**	Martin Greene (Technical Reviewer)	**Martin Greene**

Disclaimer

Contents amendment record

This report has been amended and issued as follows:

Version	Date	Description	Editor	Technical Reviewer
1.0	27/05/2022	Published version	S Brittain	M Greene

Executive Summary

As part of the process for managing skid resistance on its network (the Strategic Road Network or SRN), National Highways carries out single annual skid resistance surveys (SASS). This data is used to identify sites where there is a need to undertake an investigation to determine whether a treatment to improve skid resistance would be beneficial in mitigating the risk of skidding collisions at a site. Further details on the site investigation process is given in the Skidding Resistance part of the DMRB (DMRB CS 228). In addition, this data feeds into the KPI for pavement condition.

The measurements from these surveys are corrected for seasonal variation by the application of correction factors called the "Local Equilibrium Correction Factors" (LECF). The procedure used since 2007 to calculate the LECFs was used again during 2021. This document provides a record of the procedure used to derive the LECFs that have been applied to the 2021 skid resistance survey data.

A high percentage (98.2%) of the National Highways Areas was surveyed in 2021, with each National Highways Area having at least 96.1% coverage of survey data. In addition to the National Highways Areas, LECFs were provided for the A1 Darrington to Dishforth, M25 and Second Severn Crossing DBFOs.

All of the Areas and DBFOs where LECFs were calculated were surveyed within their target survey period (apart from some additional surveys agreed by National Highways).

The spread of survey dates exceeded 28 days for a large number of localities which will have a slight negative effect on the robustness of the seasonal corrections applied.

Surveys of lanes other than lane 1 were undertaken for some Areas and DBFOs. For the Areas and DBFOs where LECFs were calculated these surveys were carried out in the same period as the lane 1 surveys and therefore had the lane 1 LECF applied.

Previous research by TRL identified that concrete does not appear to experience seasonal variation to the same degree as other surfacings. Therefore an LECF of 1.000 (i.e. no correction) was applied to concrete sections. An investigation into the application of LECFs on concrete sections using the 2021 data found no conflict with the previous investigations into concrete. Therefore, due to the unsuitability of the calculated LECFs for concrete it is recommended that the application of an LECF of 1.000 for concrete sections is continued.

Analysis of the spread of 2021 survey data values suggests that there was a fairly low level of variation over the survey season.

The weighted average LECF value was 1.01 for 2021, showing that the measured skid resistance of the network (i.e. before correction) was slightly lower than the average of the previous three years. Analysis of data from the National Highways benchmark sites that monitor long term trends in skid resistance across the network (Brittain, 2022) also identified that 2021 was slightly lower than the average of the previous three years.

Table of Contents

1 Introduction

As part of the process for managing skid resistance on its network (the Strategic Road Network or SRN) National Highways carries out single annual skid resistance surveys (SASS). The test season for these surveys is broadly over the summer months, and is divided into three survey periods (early, middle and late). The network has been divided so that approximately a third of its length is tested in each survey period; the survey period rotates to ensure that each length of the network is tested once in each period over three years. Skid resistance levels vary during the course of the year with the lowest levels of skid resistance generally experienced in the middle of the summer. The general trend for skid resistance is shown diagrammatically in Figure 1.1. Levels of skid resistance can also fluctuate from year to year.

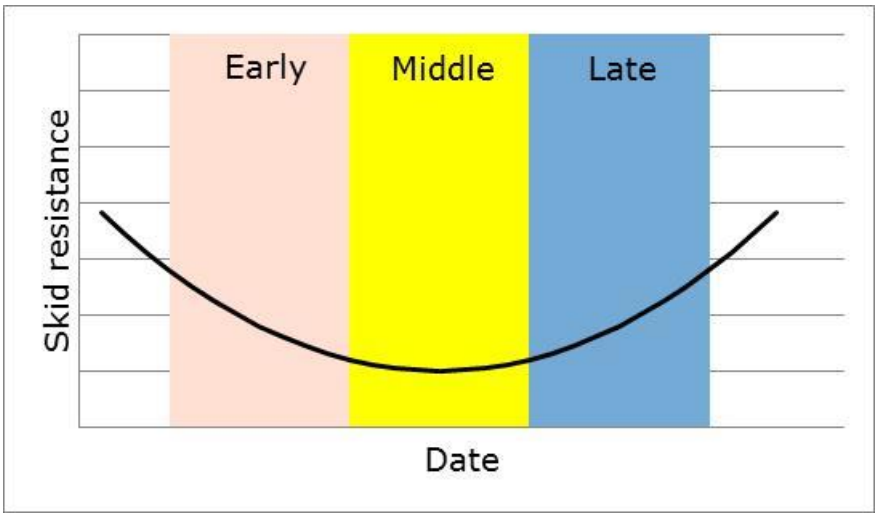

Figure 1.1: Idealised seasonal variation of skid resistance over the summer

In order to correct for this seasonal variation (both within and between years), Local Equilibrium Correction Factors (LECFs) are calculated which are then applied to the speed corrected skid resistance data (SC). Once this data has been seasonally corrected it is termed the Characteristic Skid Coefficient (CSC). Further details on the use of CSC data are provided in CS 228 of the Design Manual for Roads and Bridges (DMRB CS 228).

The network is split into “localities”, consisting of the length of each road within a specified National Highways Maintenance and Improvement Area, and a LECF value is assigned to each of these localities. The LECF is calculated from the average of the past three years’ SC data for the locality (known as the Local Equilibrium SC or LESC) and the current average for the locality (known as the Local Mean SC or LMSC).

For each locality two types of LECF are calculated. The first, known as the road LECF, is calculated using the data available for that locality only. The other LECF is called the Area LECF and uses all of the data available for the Area that contains the locality. The Area LECF uses data from surveys which can be spread over several weeks and are over a wide area. Since fluctuations in skid resistance can occur within this period of time, this generally

means that the Area LECF is less robust than the road LECF. However, some localities are quite small and therefore have little data available for calculation of a robust road LECF. A minimum length is therefore applied for the calculation of a road LECF. If a locality has 25km or more of valid SC data (i.e. SC data for the current year and a suitable dataset for the past years) then the road LECF is applied, otherwise the Area LECF is used. Full details of the LECF calculation procedure are given in Appendix A.

Once the LECF values have been calculated for each survey period, they are loaded into National Highways' Pavement Management System (HAPMS) so that they can be used in conjunction with the skid resistance survey data.

This document provides a record of the procedure used to derive the LECFs that have been applied to the 2021 skid resistance survey data.

The procedure developed in 2007 (Brittain, 2007) which incorporates a visual analysis and was refined in 2008 to include an automated analysis (Brittain, 2009) was used again this year.

A summary of the survey coverage and range of survey dates is given in section 3.1. Section 4 contains an overview of the calculation and delivery of the 2021 LECF values, along with any issues identified. Additional observations from the 2021 LECF calculation are discussed in Section 5 and Appendix B contains tables of the LECF values calculated.

2 Changes affecting the LECF calculation

Measures in place during 2020 to combat the COVID-19 pandemic (specifically work from home orders and travel restrictions) meant that lower levels of traffic were seen on the National Highways SRN. It is believed that a significant proportion of the seasonal variation of skid resistance values is caused by the interaction of traffic, particularly heavy vehicles, with detritus on the road surface. Therefore, changes in traffic levels as a result of Covid-19 restrictions, could impact the suitability of using the 2020 survey data in the LECF calculation.

However, it is noted that although traffic levels were reduced, this was primarily a reduction in light vehicles and heavy vehicles levels were less affected. The analysis of the 2020 data for the National Highways' benchmark sites (Brittain, 2021) did find some small variation in the levels of skid resistance over the year relative to previous years. However, the analysis was complicated by the fact the late surveys were carried out with a different survey vehicle which may have potentially had some influence on the results.

It was therefore decided that during the calculation of the 2021 LECFs the suitability of the 2020 data for the analysis would be reviewed, and the process amended if appropriate.

Data from both SASS and the benchmark site surveys for 2020 were compared to data from previous years. This analysis found that the 2020 data did not appear to be significantly more variable than the previous trends seen. In addition, the variations seen could not easily be reconciled with the dates of lockdown and the expected impact of reduced traffic levels. It was therefore expected that the impact of lockdown would not significantly affect the LECF calculation.

However, in addition to the standard LECF calculation using the previous three years (i.e. 2020, 2019 and 2018), a second calculation was completed using the data from one year back in each case (i.e. 2019, 2018 and 2017). Examination of the differences between these two sets of LECFs found little difference between the resulting CSC values. Therefore, it was decided that the data from the 2020 surveys would be used in the 2021 LECF calculation.

3 Data quality

3.1 Survey Coverage

The survey coverage obtained for 2021 is presented in Table 3.1. In some cases the value shown for "Over year" does not equal the sum of the percentages surveyed in the survey periods. This is because the same length was surveyed in more than one survey period.

A high percentage of the network survey was achieved (98.2% total coverage for National Highways Areas) with at least 96.1% coverage in each National Highways Area. All of the National Highways Areas were surveyed in the target survey period (with some additional surveys in the following survey period as discussed in section 3.1.1). The spread of survey dates is discussed further in section 3.3.

High survey coverage was also seen for the DBFOs loaded into HAPMS with a defined (SASS compatible) survey rotation. As with previous years some data has also been loaded for some of the other DBFOs. All of the DBFOs with survey data loaded into HAPMS are discussed further in section 4.4.

Table 3.1: Survey coverage in 2021 (analysis run 5th January 2022)

Target period	Area	Percentage of Area surveyed (lane 1 not Ox Bow Lay-by)				
		Early	Middle	Late	Very Late[1]	Over year
Early	South West	99.1%	0.1%[2]	-	-	99.2%
	Area 6	99.6%	-	-	-	99.6%
	Area 7	98.8%	0.1%[2]	-	-	98.9%
	Area 10	98.5%	0.3%[2]	-	-	98.8%
	Second Severn Crossing	80.7%	-	-	-	80.7%
	A249 DBFO	-	-	-	-	-
Middle	Area 4	-	96.7%	-	-	96.7%
	Area 13	-	99.1%	-	-	99.1%
	Area 14	-	97.7%	-	-	97.7%
	M25 DBFO	-	98.2%	0.2%[2]	-	98.4%
	A1DD DBFO	-	100.0%	-	-	100.0%
	A69 DBFO	-	-	-	-	-
Late	Area 3	-	-	96.9%	-	96.9%
	Area8	-	-	97.8%	-	97.8%
	Area 9	-	-	96.1%	-	96.1%
	Area 12	-	-	99.1%	-	99.1%
DBFOs with no defined survey rotation	A19 DBFO	-	-	-	-	-
	A1M DBFO	1.0%	1.0%	1.0%	-	1.0%
	A30/A35 DBFO	-	-	-	-	-
	A417/A419 DBFO	47.4%	50.5%	49.9%	-	50.5%
	M40 DBFO	-	-	-	-	-
n/a	NH Areas	n/a	n/a	n/a	n/a	98.2%

[1] Surveys conducted between the end of the survey season (20th October) and the end of the calendar year.

[2] The contractor identified some sections that have been missed and were possible to survey in the following survey period. These are discussed further in section 3.1.1.

3.1.1 Additional surveys

During the survey season the survey contractor recognised that there were some sections which have been regularly missed over previous years and identified that they could survey them (however not in the target survey period). These lengths were discussed with the survey contract manager at National Highways and it was agreed that these surveys would be undertaken so that some data would be available. However, it is noted that due to the small amount of data (and no data that could be used to improve the robustness e.g. from neighbouring localities in the same survey period) it would not be possible to provide suitable LECF values for these surveys.

3.1.2 Survey load dates

After the surveys are conducted, the data are loaded into HAPMS and undergo independent checks (further discussed in section 3.2). The survey contract states that the Contractor must ensure that data has been loaded, passes the independent checks and is ready for further analysis (i.e. the LECF calculation) by specified dates. These dates are given in Table 3.2. The percentage of the data loaded by these dates for each Area is given in Table 3.3 (excluding the additional surveys discussed in section 3.1.1).

Table 3.2: End of survey period and target data availability dates

Survey period	End of survey period	Target date for data available for LECF calculation
Early	27th June	9th August
Middle	24th August	7th October
Late	20th October	30th November

Table 3.3: Percentage of current data loaded by target date (analysis run 5th January 2022)

Target survey period	Area	Percentage of current data loaded by expected survey load date
Early	South West	100.0%
	Area 6	100.0%
	Area 7	100.0%
	Area 10	100.0%
	Second Severn Crossing	100.0%
	A249 DBFO[1]	-
Middle	Area 4	100.0%
	Area 13	100.0%
	Area 14	100.0%
	M25 DBFO	100.0%
	A1 Darrington to Dishforth DBFO	100.0%
	A69 DBFO[1]	-
Late	Area 3	100.0%
	Area 8	100.0%
	Area 9	100.0%
	Area 12	100.0%

[1] The A249 DBFO and A69 DBFO are not covered in the National Highways SASS contract. As such these DBFOs may have different target delivery dates.

It can be seen from Table 3.3 that all of the survey data for the National Highways surveys was loaded by the expected load date and not modified after this date due to the independent checks.

3.2 Suitability of data loaded

During the survey season the survey data is inspected visually to help identify any issues that should be resolved. This process was undertaken after each survey period when the survey contractor had loaded and carried out initial checks on the data for that period.

The types of anomalies that are looked for in this review include:

- Lengths where the data suggests that either the test wheel was up or it had experienced a puncture
- Lengths where the data appears to be misaligned relative to the previous years' data (i.e. the section markers may be in the wrong place)
- Lengths which exhibited oscillating data or otherwise anomalous data
- Lengths with duplicate surveys loaded

During the review the following anomalies were found:

- Possible misalignment

The lengths identified by this analysis were supplied to National Highways and the survey contractor for review and, where necessary, amendment.

3.3 Survey spread

The purpose of the LECFs is to correct for the seasonal and between year variations in skid resistance experienced on the network. However, the longer the timescale for the survey of a road the more likely the correction will start to become unsuitable for parts of the survey due to changes in the weather. Therefore, in order to obtain the most robust data it is necessary to conduct surveys within an Area in a short timescale, with particular attention paid to the time taken to survey an individual road. The survey contract states that the time between the start and end of a survey for each locality is no more than 28 days. In addition, any surveys not conducted in the target survey period will cause issues with the calculation of LECF values in future years (or would not be used).

The spread of survey dates for each Area is shown in Figure 3.1. The coloured bars represent the extent of the period during which the survey for that Area was undertaken, the vertical red lines show the survey period boundaries, and the crosses mark dates when surveys were conducted. As the additional surveys discussed in section 3.1.1 were not used in the LECF calculation these surveys have been excluded from the plots.

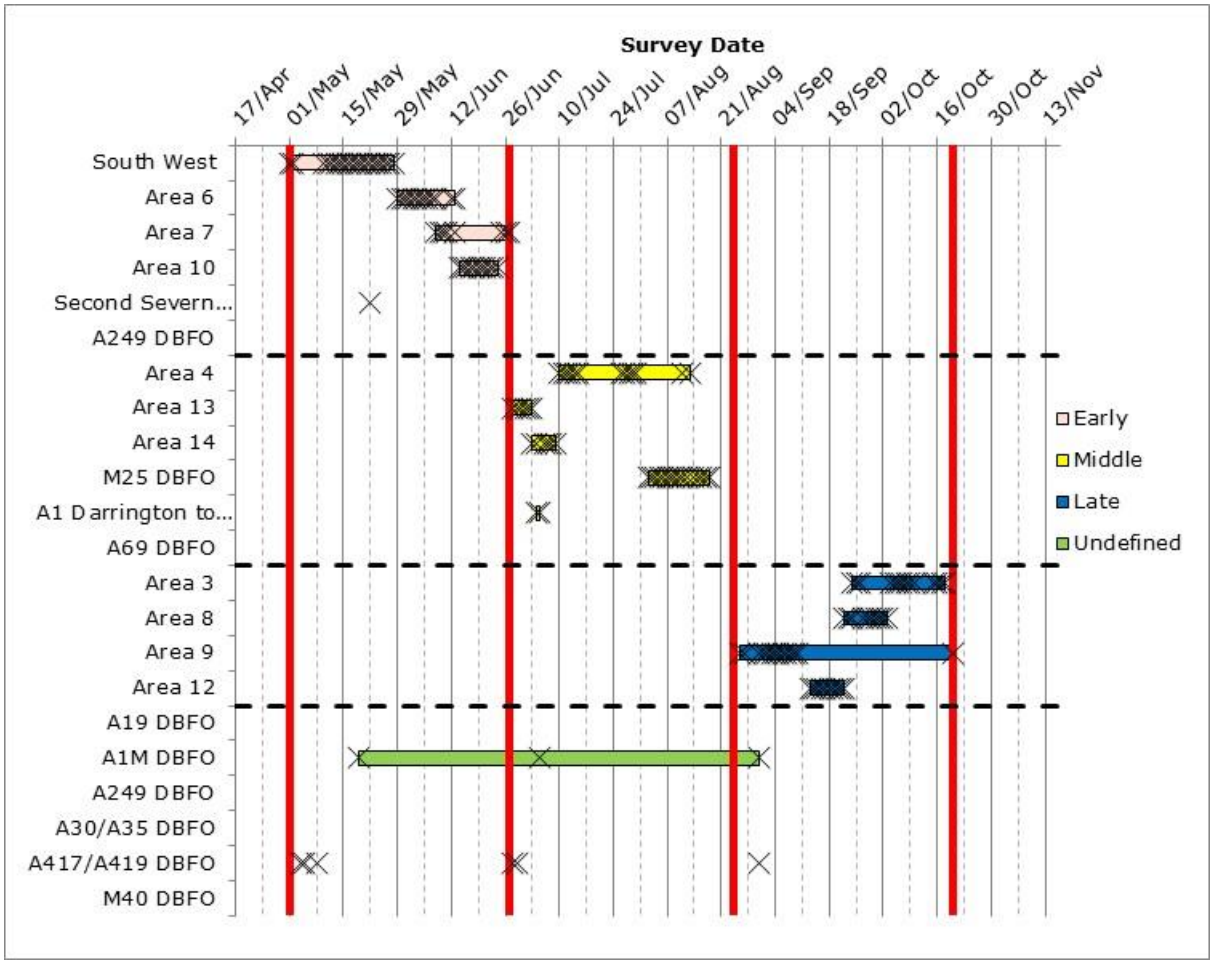

Figure 3.1: Spread of survey dates in 2021 (Lane 1 surveys)

The spread of survey dates was quite high for a number of Areas, notably South West, Area 4 and Area 9. The spread of survey dates by road for these Areas are shown in Figure 3.2 to Figure 3.4.

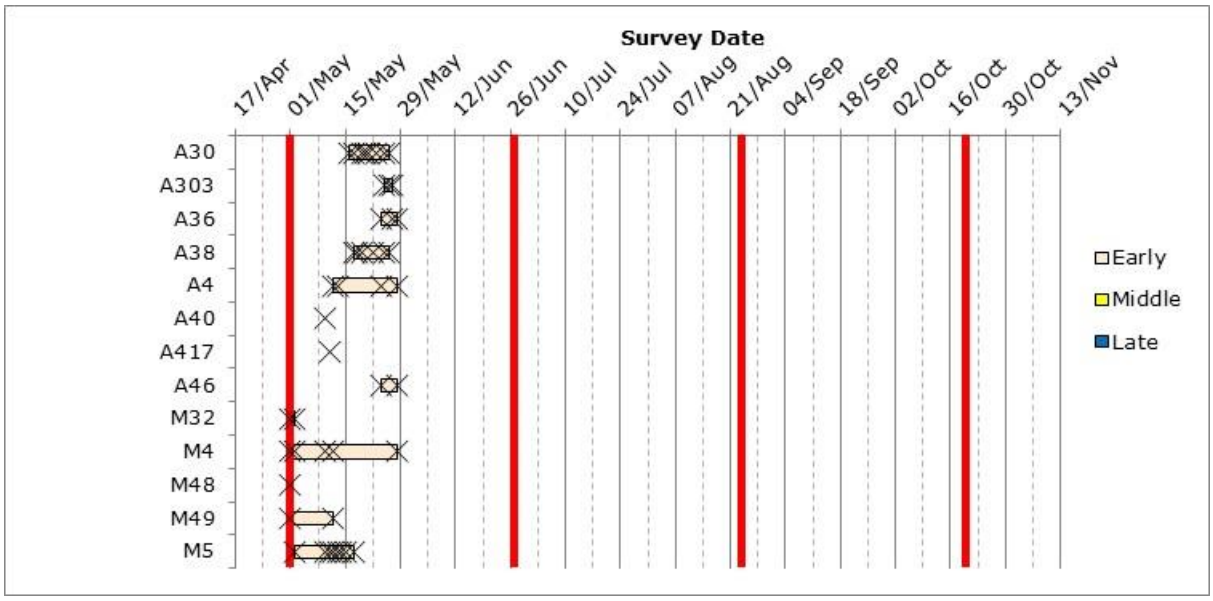

Figure 3.2: Spread of survey dates in 2021 in South West (Lane 1 surveys)

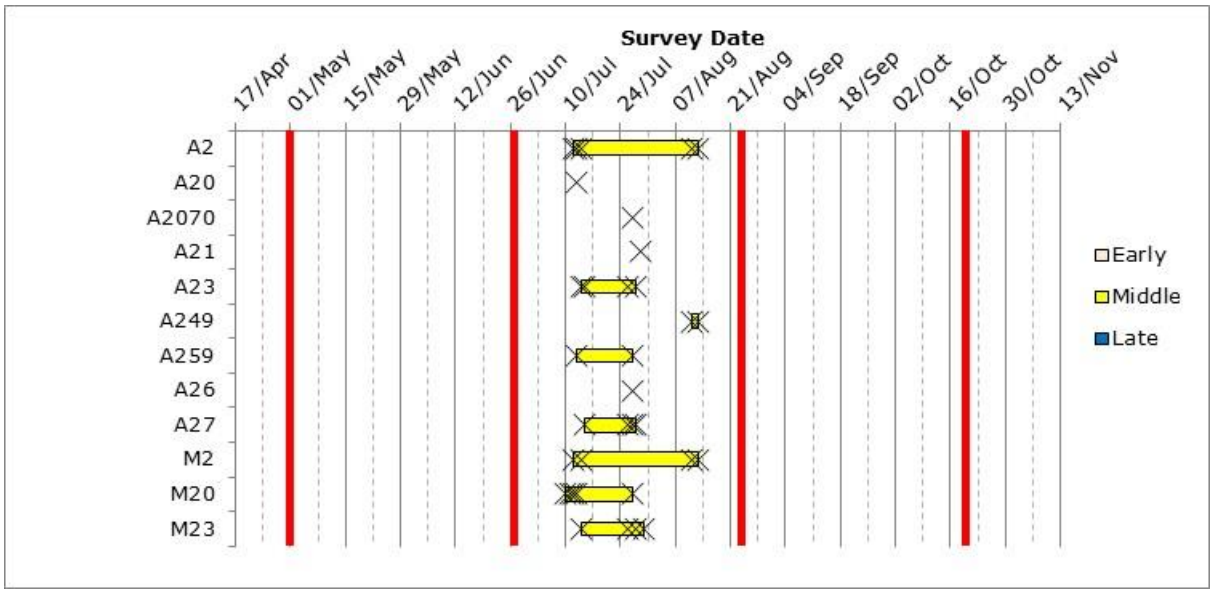

Figure 3.3: Spread of survey dates in 2021 in Area 4 (Lane 1 surveys)

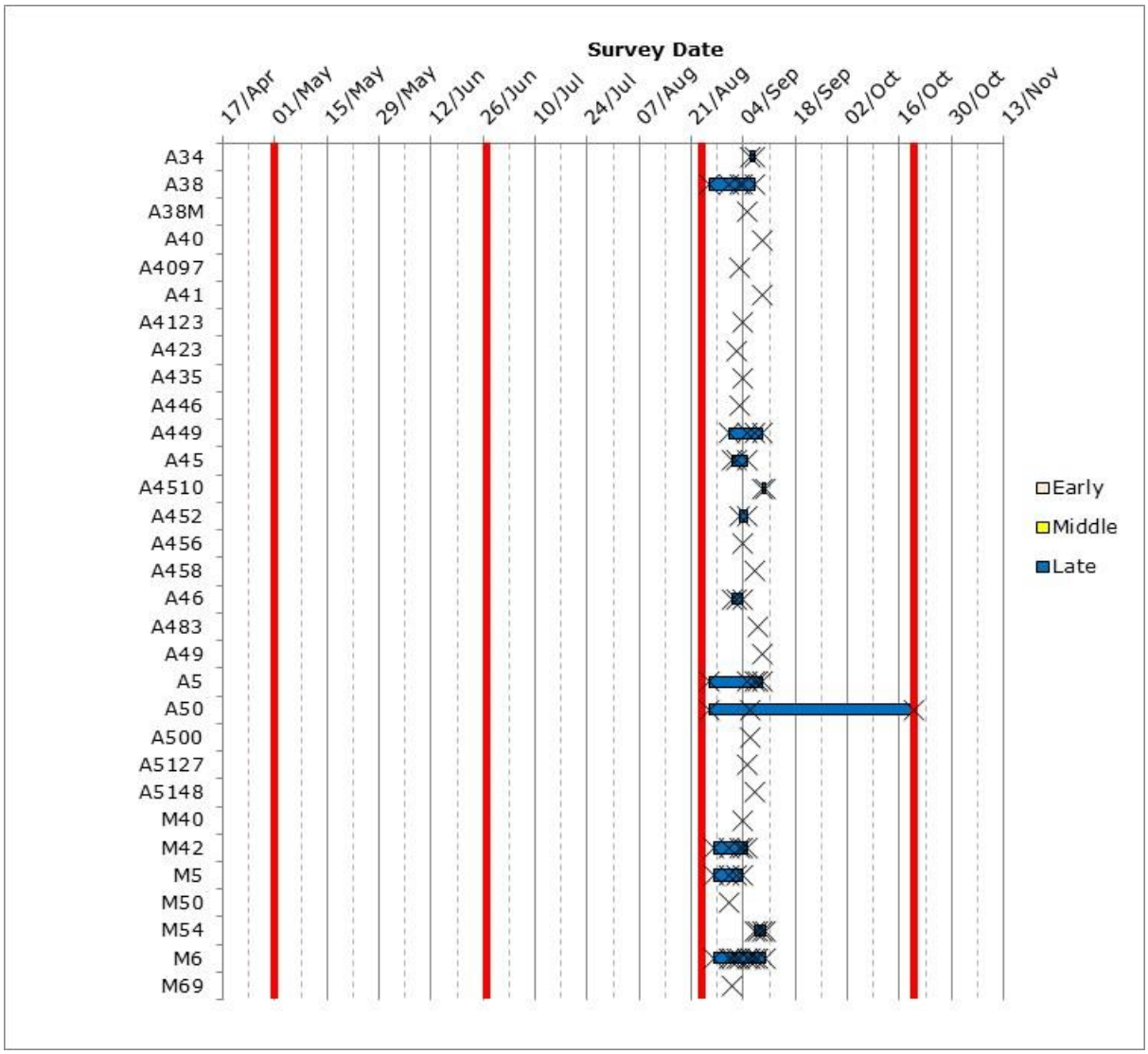

Figure 3.4: Spread of survey dates in 2021 in Area 9 (Lane 1 surveys)

From these graphs it can be seen that not only were these Areas surveyed over a period of 28 days or more, so were some of the roads within the Areas. While this will result in less robust CSC data, it will still be possible to consider the SC values for use in future LECF calculations. It is recommended that the survey contractor is consulted to identify if these instances can be reduced in length and frequency in future.

4 LECF Calculation and visual analysis

4.1 Early Period LECFs

An examination of the survey rotation for the past three years of surveys found that all Areas with a target of an Early survey in 2021 had a suitable combination of survey periods for calculation of the LESCs.

Visual analysis carried out on the early survey data identified a number of sections that needed to be removed from the LECF analysis due to anomalies (localised differences between the survey data from different years, for example, as a result of maintenance). The length of data removed and the length with skid resistance data remaining is shown in Table 4.1.

Table 4.1: Data removed as a result of visual analysis for early surveys

Area	Length removed by analysis (km)	Remaining length with data (km)
South West	222.47	1,623.80
Area 6	212.65	1,110.76
Area 7	193.97	1,470.40
Area 10	180.73	1,097.19
Second Severn Crossing DBFO	5.22	22.79

Twenty five localities which had early surveys in 2021 had a significant length of data removed (>10km). These were:

- A30, A303, A36, A38, M4 and M5 in South West
- A11, A12, A120, A14, A47 and M11 in Area 6
- A1, A14, A43, A45, A46, A5, A52, M1 and M69 in Area 7
- M53, M6, M60 and M62 in Area 10

Most localities that had sufficient data to calculate a road LECF prior to the visual analysis still had enough data for a road LECF calculation after the removal of anomalies identified by the visual analysis. The exceptions to this were the A46 in South West and the M69 in Area 7.

The remaining length of the second Severn crossing DBFO was lower than the threshold for a road LECF, however it was still deemed suitable for use.

4.2 Middle Period LECFs

As with the early period surveys, the past years' survey rotation was examined prior to calculation of the mid period LECFs. It was found that the standard past years' survey rotation was suitable for all Areas.

The visual analysis of the middle period surveys identified a number of sections for removal from the analysis, spread over the Areas as shown in Table 4.2.

Table 4.2: Data removed as a result of visual analysis for middle surveys

Area	Length removed by analysis (km)	Remaining length with data (km)
Area 4	66.87	939.71
Area 13	49.74	766.11
Area 14	57.38	584.28
A1DD DBFO	21.88	102.21
M25 DBFO	123.57	876.77

Eleven localities had a significant length of data removed (>10km). These were:

- A27, M2 and M20 in Area 4
- A66 and M6 in Area 13
- A1, A1M and A66 in Area 14
- A1M in A1DD DBFO
- M25 and M4 in M25 DBFO

All but two localities that had enough data to calculate a road LECF prior to the visual analysis still had sufficient data following the removal of anomalies identified by the visual analysis. These localities were the A19 in Area 14 and the A282 in M25 DBFO.

4.3 Late Period LECFs

An examination of the survey rotation for the past three years of surveys found that all Areas had a suitable combination of survey periods for calculation of the LESCs.

The visual analysis carried out on the late period surveys identified a number of sections for removal. The lengths removed and the remaining lengths used in the LECF calculation, by Area, are shown in Table 4.3.

Table 4.3: Data removed as a result of visual analysis for late surveys

Area	Length removed by analysis (km)	Remaining length with data (km)
Area 3	80.72	1,153.58
Area 8	149.30	718.07
Area 9	295.82	1,424.85
Area12	107.12	1,103.31

Twenty-one localities had significant lengths of data removed (>10km). These were:

- A3, A303, A34 and M27 in Area 3
- A11, A14, A5 and M1 in Area 8
- A38, A458, A46, A5, M42, M5, M50, M54 and M6 in Area 9
- A180, M1, M18 and M62 in Area 12

All but three localities that had sufficient data to calculate a road LECF prior to the visual analysis still had enough data for a road LECF calculation after the removal of anomalies identified by the visual analysis. These localities were the A458, A50 and M69 in Area 9.

4.4 DBFOs

LECFs are also calculated, where possible, for any DBFOs that have data loaded into HAPMS. No issues were identified for the A1 Darrington to Dishforth, and M25 DBFOs. The other DBFOs are discussed below.

4.4.1 Second Severn Crossing DBFO

The Second Severn Crossing DBFO contains just over 25km of main carriageway and approximately 2km of slip roads. This is only just over the threshold for a road LECF, and therefore it is likely that in most years (due to maintenance or anomalous data) this DBFO would not have sufficient data for the calculation of a LECF (if the rules are applied strictly). However, the DBFO is wholly contained within the South West Area (which is surveyed in the same survey period) and other lengths of the two roads which make up the DBFO are also present in this Area. Therefore, in years with low survey coverage (or high maintenance) the LECFs calculated for the South West can be used for this DBFO. In 2021 approximately 23km of data remained for this DBFO after the visual analysis. As such it was deemed suitable to use the data to calculate a road LECF value for the DBFO.

4.4.2 A249 DBFO and A69 DBFO

In previous years, data for the A249 DBFO and the A69 DBFO were loaded into HAPMS with a suitable survey rotation for the calculation of LECF values. By the time of the analysis for this report no data was loaded into HAPMS for the 2021 survey of either of these DBFOs.

4.4.3 A1M DBFO and A417/A419 DBFO

This year, data was also loaded into HAPMS for the A1M, and A417/A419 DBFOs. However, both of these appear to be undertaking surveys for a Mean Summer Skid Coefficient (MSSC) style calculation (i.e. were surveyed in all three survey periods) and the data are therefore unsuitable for calculating LECF values.

4.5 Surveys in lanes other than lane 1

Surveys were loaded into HAPMS for lanes other than lane 1 for some Areas and DBFOs. These surveys were all undertaken in the same survey period targeted for the lane 1 surveys. Therefore, the LECFs calculated for the lane 1 surveys can be applied to the additional surveys.

5 Additional observations and further work

5.1 Applying LECFs on concrete sections

During the calculation of the 2007 LECFs (Donbavand & Brittain, 2007; Brittain, 2007) it was identified that concrete surfaces did not appear to experience seasonal variation to the same degree as other surface types. Therefore, an LECF of 1.000 (i.e. no correction) was applied to concrete sections. To determine if this assumption remains valid an additional investigation has been carried out in parallel to the calculation of the LECF values in subsequent years.

The effectiveness of the LECF correction can be determined by comparing the current year's SC data (i.e. the data prior to being corrected for seasonal variation) and the current year's CSC data (i.e. seasonally corrected data) to the average of the past years' SC data. The process of applying the LECF correction should make the average of this year's CSC data match the average of the past three years. Therefore, in this data set, the past years' average is effectively the expected value. If the LECF is reducing seasonal variation then the difference between the CSC data and this expected value should be less than the difference between the SC data and the same expected value. This can be visualised by plotting the distribution of these differences. In these plots a data set which has low seasonal effects would have a mean close to zero (i.e. on average the value of the data set is the same as the average of the past years' data). In addition, a seasonally corrected data set should have a lower standard deviation for these differences (i.e. more of the data set is closer to the past years' data).

This analysis was undertaken for HRA sections (approx. 2,100km), Thin Surfacing (TSCS) sections (approx. 8,700km) and concrete sections (approx. 400km), and the results are presented in Figure 5.1, Figure 5.2 and Figure 5.3 respectively. For the concrete sections (Figure 5.3), the CSC value shown is the value that would have been generated if the LECF calculated for that road/Area was used rather than the factor of 1.000 that was actually applied.

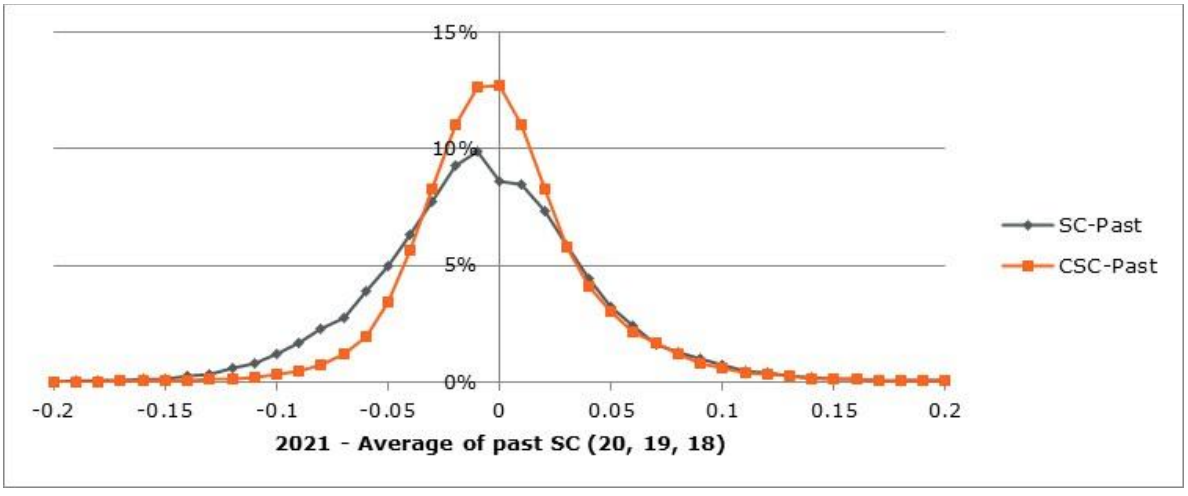

Figure 5.1: 2021 data – Past year average for HRA surveys

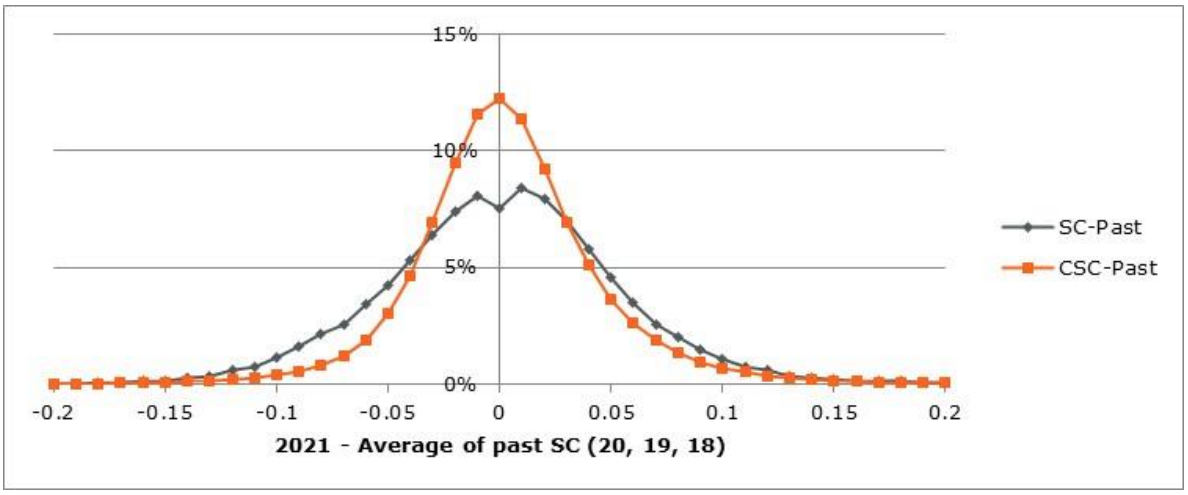

Figure 5.2: 2021 data – Past year average for TS surveys

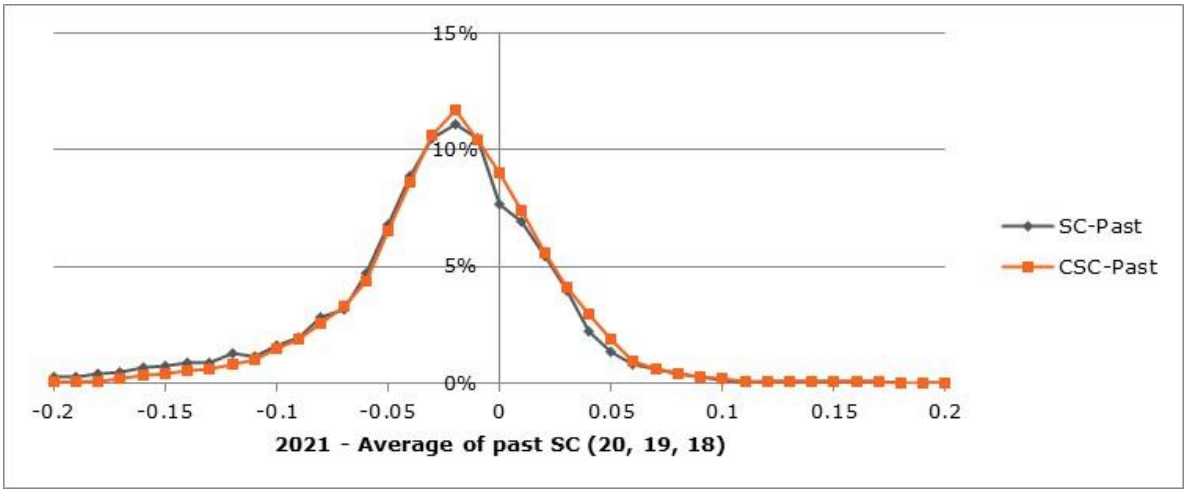

Figure 5.3: 2020 data – Past year average for concrete surveys

As expected, the LECFs reduce the seasonal variation for the HRA and TSCS sections. This can be seen by the narrower distribution/higher mid peak (with mean close to zero) in Figure 5.1 and Figure 5.2 for the 2021 CSC minus the average of past SC values in comparison to the same distribution for the 2021 SC data. The concrete sections (Figure 5.3) show no significant change in the distributions of the two datasets. This verifies the assumption that concrete sections do not experience the same seasonal variation as HRA and TSCS sections. It is noted that the concrete data is offset to the left (signifying lower skid resistance values in 2021), whereas the HRA and TSCS sections are close to the mean. Although not a concern at this stage this should be monitored in future analyses to confirm that there is not an ongoing drift between the surfacing types.

It can also be seen that mean of the distribution of the 2021 SC data minus the average of past SC values was close to zero for both the HRA and TSCS sections. This means that the 2021 data was close to the average of the past three years (i.e. does not appear to be either a high or low skid resistance year).

5.2 LECF Distribution by date

As stated previously, the levels of skid resistance vary during the course of the year. To investigate this effect and to monitor the suitability of the survey dates, the spread of LECF values was plotted. This investigation has been carried out at the same time as the LECF calculation since 2008 and is discussed further in the annual reports on the LECF calculation for each year.

The first part of this analysis is to plot the LECF values by date (2021 data shown in Figure 5.4), which gives an impression of the spread of values. However, this can be hard to interpret in terms of SC data and therefore a second plot is generated. This second plot is created by taking a typical value for CSC (0.5 is used in this case) and dividing by the LECF to determine an estimated SC value (2021 data shown in Figure 5.5).

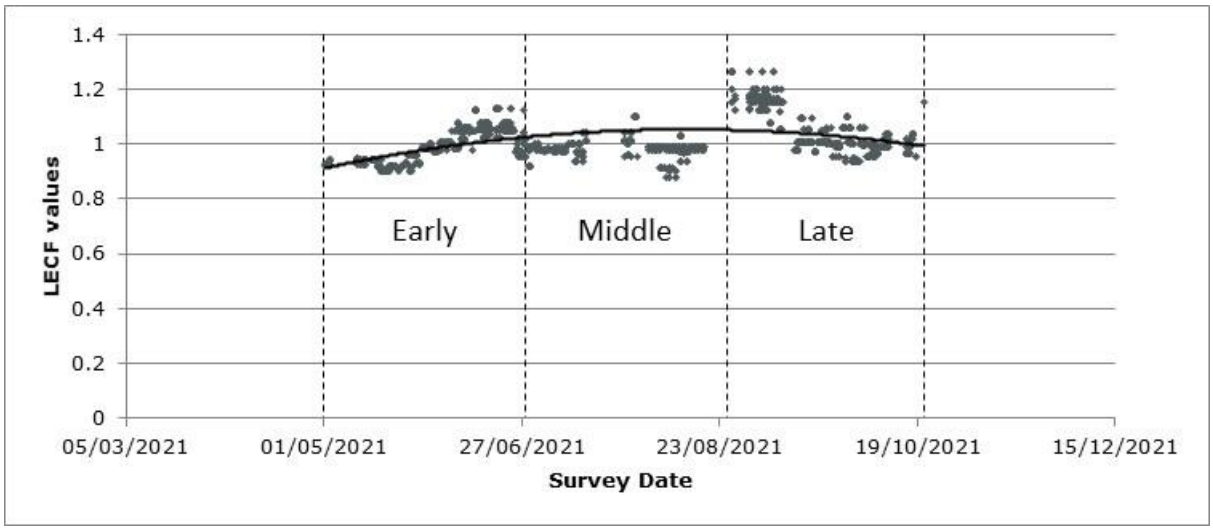

Figure 5.4: Distribution of LECF values by date from SASS analysis

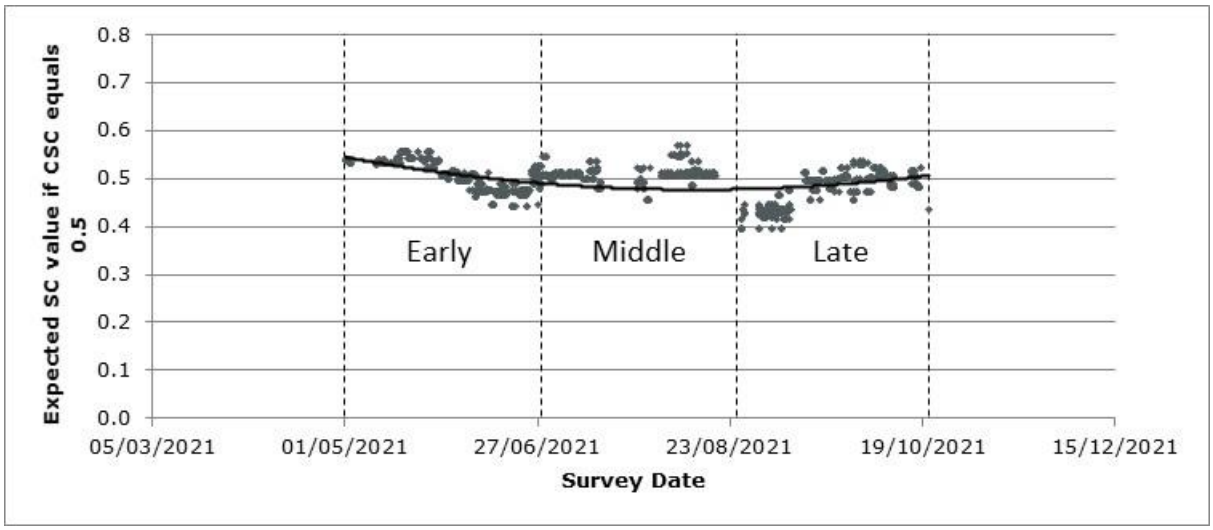

Figure 5.5: Expected SC if CSC equals 0.5 from SASS analysis

From the analysis of the 2021 data, it can be seen that the typical shape of skid resistance over the survey season (see Figure 1.1) does appear to be present, with the minimum value positioned on the middle/late boundary. However, the trend appears to be quite shallow, which suggests that there does not appear to be significant within year seasonal variation during 2021.

It is recommended that the suitability of the survey periods should continue to be reviewed on an annual basis.

5.3 Usage of LECF values by length

Figure 5.6 shows the length of the network to which each LECF value was applied (excluding concrete sections). The weighted average of the LECF for 2020 is 1.01 which corresponds to a very slightly low skid resistance year compared to the previous three years (similar to the observations noted in section 5.1).

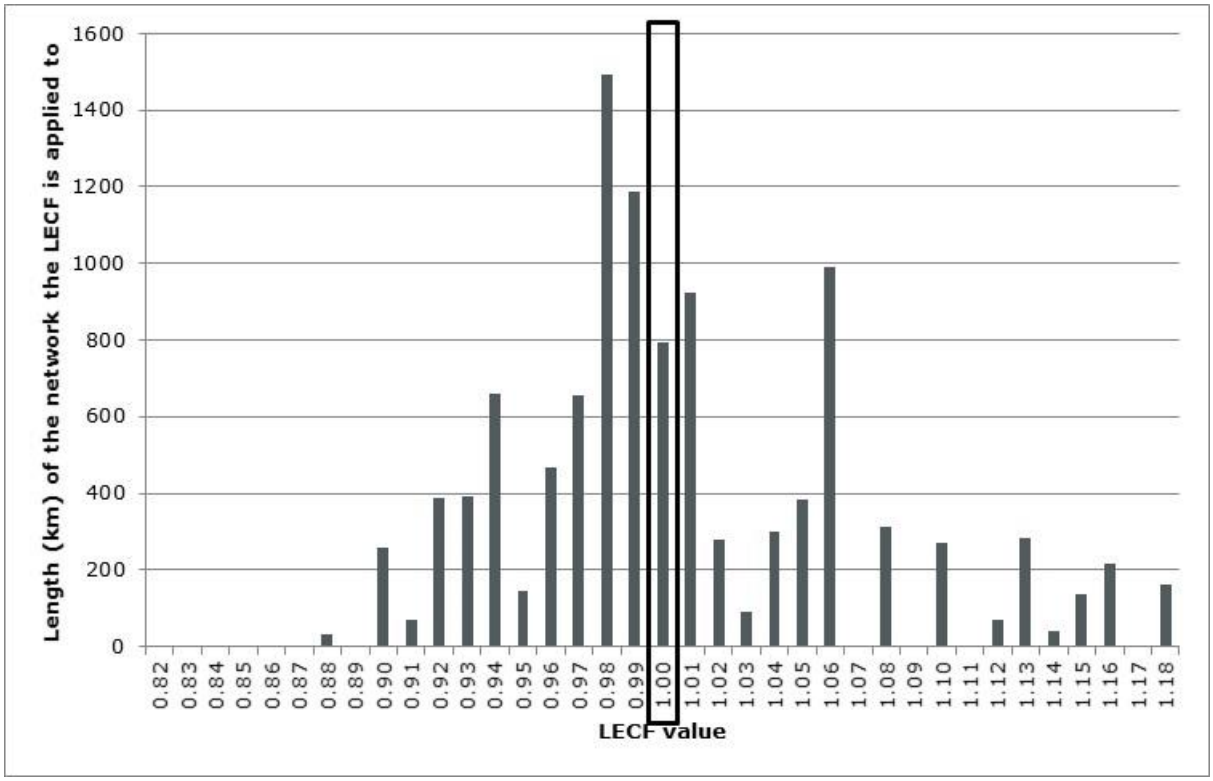

Figure 5.6: Length to which each LECF was applied

5.4 Seasonal trend and the skid resistance benchmark sites

In addition to the work done in analysing the SASS network data and resulting LECFs, National Highways also commissions annual surveys of benchmark sites to examine long term trends in skid resistance on the network. The analysis of the 2021 data (Brittain, 2022) also found that the minimum value appeared to occur on the middle/late boundary and that the 2021 values were slightly low when compared to the average of the previous three

years. However, the benchmark site analysis also found an increased variability in the skid resistance values over the course of the year.

The seasonal trend analysis discussed in this report provides an estimate of ongoing trends of the overall seasonal variation of the network, however it is complicated by the fact it uses data from different areas for each period to perform the analysis. Therefore, the trend seen from the benchmark sites work is generally the more reliable of the two when considering the overall trend in skid resistance over time. However, in terms of estimating future CSC values for the network, the results from the LECF analysis should be used (as it is using the same data that would be used in future LECF calculations).

6 Summary

6.1 Lane 1 survey coverage

When combined together 98.2% of the length of the National Highways Areas had data coverage. Individually each of the National Highways Areas had at least 96.1% data coverage.

Survey coverage for the DBFOs loaded into HAPMS with defined survey rotations for LECF calculation (A1 DD, M25 and Second Severn crossing) also had high survey coverage and provided data suitable for the LECF calculation. Two DBFOs that normally have survey data loaded into HAPMS (A249 and A69) did not have any data loaded at the time of the analyses for this report. Two more DBFOs had data loaded into HAPMS, however the survey pattern suggested the MSSC approach is being used for these DBFOs and was therefore unsuitable for LECF calculation.

The skid resistance survey contract states that survey data should be loaded into HAPMS, pass independent checks and be ready for further analysis (i.e. the LECF calculation) by specified dates. For the 2021 surveys these dates were met for all of the National Highways Areas.

6.2 Suitability of data loaded

During the processing of the data for the LECFs a few anomalies were found with the data. The types of anomalies identified were:

1. Possible misalignment

The lengths identified by this analysis were supplied to National Highways and the survey contractor for review and where necessary amendment.

6.3 Lane 1 survey dates and timescales

With the exception of some additional surveys carried out, all of the surveys of the National Highways Areas were surveyed within the target survey period. All of the DBFOs with data loaded into HAPMS with defined LECF compatible survey rotations were also surveyed within the target survey period.

The spread of survey dates was 28 days or more for Areas South West, 4 and 9 (after excluding the additional surveys from the analysis). On examination of the localities (road and Area combination) within the affected Areas it could be seen that there were several localities where the spread of the survey data was also above this range. As only one LECF is applied to each locality this spread in survey data will result in a reduced robustness to the seasonal correction of the data for that locality. Therefore, where possible the spread of survey dates for each locality should be kept as small as possible.

6.4 Calculation of LECF

The modified LECF procedure used since 2007 (Brittain, 2007) was used again for the 2021 data. To aid the visual analysis of the data the automated analysis developed during 2008 (Brittain, 2009) was also used.

The survey rotation pattern established for the National Highways Areas meant that, for the lane 1 surveys, all of the Areas had valid past years' data in the standard years (2020, 2019 and 2018).

Visual analyses of the survey data were carried out which identified several sections for removal. All but seven localities that had sufficient data to calculate the more robust road LECF prior to the visual analysis still had enough data for that calculation following removal of lengths identified during the visual analysis.

As with previous years, the lane 1 LECFs were calculated for DBFOs with sufficient data loaded into HAPMS. This year LECFs were calculated for the A1DD, M25 and Second Severn Crossing DBFOs.

6.5 Surveys of lanes other than lane 1

Surveys were loaded into HAPMS for lanes other than lane 1 for some Areas and DBFOs. In the locations where LECFs were calculated these additional surveys were completed in the same period as the lane 1 surveys. Therefore the LECFs calculated for the lane 1 surveys are suitable for use with the additional lane surveys.

6.6 Seasonal variation of concrete sections

An investigation into the application of LECFs on concrete sections confirmed the findings from previous studies that concrete sections do not experience the same seasonal variation as asphalt sections.

6.7 Variation of LECF values during the survey season

As with previous years, the spread of LECF values (by date) was investigated. This analysis suggests that for 2021 the minimum value occurred slightly later than expected. In addition, the weighted average LECF value for the network was 1.01 which corresponds to a very slightly low skid resistance year compared to the previous three years. The benchmark sites analysis (Brittain, 2022) found similar conclusions.

References

Note: this list of references contains both unpublished reports (UPR) and client project reports (CPR) produced for National Highways. Please make a personal application to National Highways if you wish to obtain a copy of either a UPR or CPR.

Brittain, S. (2007). *Task 1 Methodology for deriving Local Equilibrium Correction Factors for the 2007 SCRIM surveys (UPR/IE/213/06).* Wokingham: TRL.

Brittain, S. (2009). *Task 1: Methodology for deriving Local Equilbrium Correction Factors for the 2008 SCRIM surveys (CPR 215).* Wokingham: TRL.

Brittain, S. (2021). *Skid resistance benchmark surveys 2020 (PPR 989).* Wokingham: TRL.

Brittain, S. (2022). *Skid resistance benchmark surveys 2021 (PPR1030).* Wokingham: TRL.

DMRB CS 228. (n.d.). *Design Manual for Roads and Bridges Volume 7 Section 1, CS 228 Skidding resistance*. London: The Stationery Office.

Donbavand, J., & Brittain, S. (2007). *Task 3: Review of Correction Factors (UPR/IE/213/06).* Wokingham: TRL.

Donbavand, J., & Kennedy, C. (2010). *Task 2: Benchmark Surveys 2009 (UPR/IE/07/08).* Wokingham: TRL.

Appendix A Calculating the LECF

A.1 Derivation of LECF

The following equation is used to calculate an LECF:

$$LECF = \frac{Local\ Equilibrium\ Skid\ Coefficient\ (LESC)}{Local\ Mean\ Skid\ Coefficient\ (LMSC)} \quad \textbf{A.1}$$

where LESC is the estimate of the local, long term skid resistance obtained from the average of the previous 3 years' surveys and LMSC is the average of the current year's survey in the same locality as the LESC.

The LESC incorporates one survey from each of the 3 survey periods to avoid bias in the estimate of long term skid resistance. Table A.1 shows all possible combinations of early (E), middle (M) and late (L) survey periods for the past years and current year that were used to calculate a LECF. For each current year survey period a length-weighted average[1] LECF was calculated for three localities: each road individually within each Area, for all roads within each Area, and for all roads in all Areas.

Table A.1: LECF Calculation

Combination of past years' survey periods			Current survey period	LECF calculation All combinations combined to give length weighted value for the 3 current year survey periods for each Area, road and survey period
2018	2019	2020	2021	
E	M	L	E	
E	L	M	E	E • By road • By Area • By Survey period
M	E	L	E	
M	L	E	E	
L	E	M	E	
L	M	E	E	
E	M	L	M	
E	L	M	M	M • By road • By Area • By Survey period
M	E	L	M	
M	L	E	M	
L	E	M	M	
L	M	E	M	
E	M	L	L	
E	L	M	L	L • By road • By Area • By Survey period
M	E	L	L	
M	L	E	L	
L	E	M	L	
L	M	E	L	

[1] An Average of all six valid combinations of past and current surveys, weighted by the length of road that each individual combination was based on.

The LECFs are applied by locality because the influence of climate and the type of road could affect the within year skid resistance variation and hence the LECF. Table A.2 shows the order of LECF allocation that is applied to each road. If an LECF by road does not exist or the length of road data is less than 25km[2], the Area LECF is applied; this also occurs when a given road is surveyed but does not have a valid combination of past years' data. If an LECF by road or by Area does not exist, an LECF by survey period is applied; in practice this has only occurred in 2005 on a few sections where there was no valid past years' data for any road in a given Area and survey period. There has been no occurrence of this since then.

Table A.2: Allocation of LECFs

Order of allocation	Calculation type	Description
1	Road	Calculation by individual road within an Area
2	Area	Calculation by all roads within an Area
3	Survey Period	Calculation by all roads and all Areas

A.2 Survey period boundaries

The current survey period boundaries for skid resistance surveys are given in Table A.3.

Table A.3: Survey period boundaries from the 2010 survey season onwards

Survey Period	Start Date	End Date
Early	1 May	27 June
Middle	28 June	24 August
Late	25 August	20 October

These dates were developed based on work carried out on the National Highways benchmark sites, which are used to monitor long term trends in skid resistance, (Donbavand & Kennedy, 2010). Prior to 2010 the survey periods were the dates shown in Table A.4.

Table A.4: Survey period boundaries prior to the 2010 survey season

Survey Period	Start Date	End Date
Early	1 May	20 June
Middle	21 June	10 August
Late	11 August	30 September

[2] This was implemented to ensure that the LECFs by road were not based on small lengths that could have been unrepresentative of the overall road length that it was applied to. It was originally set at 50km, however after investigation into the effects during the 2007 LECF calculation it was reduced to 25km.

To help smooth the transition from the MSSC (Mean Summer Skid Coefficient) approach to the SASS (Single Annual Skid Survey) method, introduced in 2005, extended survey period boundaries were used when extracting the data. This approach was taken to maximise the lengths upon which the LECF was calculated. This was originally required due to the smaller time scales allowed for the survey season, which on occasion resulted in surveys conducted outside of the planned dates. Due to the extension of the survey season in 2010, extending the dates for extraction of data is no longer necessary. The dates for these extended survey periods are shown in Table A.5.

Table A.5: Extended survey period boundaries for data before 2010

Survey Period	Start Date	End Date
Early	1 May	27 June
Middle	14 June	17 August
Late	4 August	7 October

A.3 Construction cut-off

Data from roads re-surfaced during the 5 year period covering the current year, 3 past years and a wear in year were excluded from the analysis because a comparison in skid resistance between past years and the current year was not valid. To ensure that these sections were not included in the analysis a construction cut-off date was employed to ignore any such maintenance. For the 2021 LECFs this meant that the construction cut off was 1st May 2017. Employing an extra gap of one year before the first year of the past years' data means that new surfaces will have had time for the skid resistance level to stabilise; therefore, the within year skid resistance variation for the data will not be influenced by early life skid resistance changes.

A.4 Concrete sections

It was observed in 2007 (Donbavand & Brittain, 2007; Brittain, 2007) that concrete sections do not experience seasonal variation in the same manner as asphalt sections. National Highways therefore decided that concrete sections would have an LECF of 1.00 applied (i.e. no correction). Given this, it is therefore necessary to exclude all sections which include concrete from the LECF analysis.

A.5 Visual Analysis

A visual analysis of the survey data is carried out in order to identify data which do not conform with the general pattern; these data can then be investigated further and, where appropriate, removed from the LECF calculation. The visual analysis process consists of an inspection of line charts of the current and historic data, and can be used to identify sections which appear to have been resurfaced (but do not have appropriate construction records) and other anomalies (e.g. negative skid resistance values). Once a section has been identified it is removed if more than 20% of the section is deemed to be unrepresentative.

A.6 Verification of LECF values

Once the LECF values have been calculated they are then verified in order to identify any inconsistencies. Two processes are used to do this:

1. The difference (absolute value) between the past years' values and the current year's CSC values are compared to the difference between the past years' values and the current year's SC values (values which have not had the LECF correction applied). If there is an issue with the LECF then the current year's SC values will be closer to the past years' values than the current year's CSC values.
2. The line charts for the current year's CSC values against the past years' CSC values are inspected and compared to the line chart for the current year's SC values against the past years CSC values. If an LECF value is unsuitable then the lines seen in these charts would have similar shapes, i.e. they are representative of the same surface, but the average values would be different.

The verification processes were found to be particularly useful during the calculation of the Early 2007 LECFs. During the survey period, one of the survey machines underwent a repair. The verification process identified that the skid resistance values were found to be characteristically different before and after the repair. This was particularly relevant to the M25 which had surveys carried out with the machine in both states. This was resolved by producing two LECF values for the M25 (along with two "Area" LECFs), one for before the repair and one for after.

A.7 Example detail of LECF calculation – Area 3 (Late 2005 surveys)

The tables below show the LECF calculation process for late period surveys in Area 3. Table A.6 shows the length weighted LECF calculated for each road that had valid combinations of current year and past years' data. These values were applied as the preferred option.

Table A.7 shows the LECF calculated for all roads in the Area, which was applied as a secondary option where there were roads with insufficient valid data for a LECF to be calculated or if the LECF was based on less than 25km of data. These two options would provide a LECF for the majority of roads. The final option was to apply a national LECF calculated by survey period, which is shown in Table A.8. This is based on all roads and Areas and reflects the seasonal variation experienced for England as a whole for the late period survey in comparison to the surveys in the previous years.

The LECF method applied to Area 3 2005 late surveys is shown in Table A.9. Seven of the road based LECFs were applied, with four roads requiring the Area LECF; two of which were due to the application of the minimum 25km data rule.

Table A.6: LECF calculated by road

Area	Road	Calculation Length (km)	LESC	LMSC	LECF
Area 3	A27	83	0.565	0.577	0.980
Area 3	A3	112	0.516	0.492	1.049
Area 3	A303	138	0.523	0.519	1.008
Area 3	A308M	0	-	-	-
Area 3	A31	101	0.543	0.495	1.097
Area 3	A34	139	0.530	0.535	0.991
Area 3	A3M	0	-	-	-
Area 3	A404	37	0.576	0.574	1.004
Area 3	A404M	16	0.565	0.575	0.982
Area 3	M27	3	0.532	0.519	1.026
Area 3	M271	28	0.499	0.500	0.998
Area 3	M3	288	0.522	0.520	1.003
Area 3	M4	77	0.524	0.521	1.005

Table A.7: LECF calculated by Area

Area	Calculation Length (km)	LESC	LMSC	LECF
Area 3	1023	0.530	0.523	1.013

Table A.8: LECF calculated by survey period

Area	Calculation Length (km)	LESC	LMSC	LECF
All Areas	5423	0.496	0.481	1.031

Table A.9: Application of LECF to 2005 surveys (Area 3 – late season surveys)

Area	Road	LECF	Calculation Type
Area 3	A27	0.979	Road
Area 3	A3	1.049	Road
Area 3	A303	1.007	Road
Area 3	A308M	1.013	Area
Area 3	A31	1.097	Road
Area 3	A34	0.991	Road
Area 3	A3M	1.013	Area
Area 3	A404	1.004	Road
Area 3	A404M	1.013	Area
Area 3	M27	1.013	Area
Area 3	M271	0.998	Road
Area 3	M3	1.003	Road
Area 3	M4	1.005	Road

Appendix B 2021 LECF values

Note: the dates shown here refer to the cut off (applied at midnight) for the surveys, i.e. a survey end date of 28th June here would include all of the surveys on the 27th but none of the surveys on the 28th.

Table B.1: Early season surveys

Area	Road	LECF	Type	Survey period start date	Survey period end date
South West	A30	0.921	AREA & ROAD	01/05/2021	28/06/2021
South West	A303	0.96	AREA & ROAD	01/05/2021	28/06/2021
South West	A36	0.933	AREA & ROAD	01/05/2021	28/06/2021
South West	A38	0.901	AREA & ROAD	01/05/2021	28/06/2021
South West	A4	0.928	AREA	01/05/2021	28/06/2021
South West	A40	0.947	AREA & ROAD	01/05/2021	28/06/2021
South West	A417	0.928	AREA	01/05/2021	28/06/2021
South West	A46	0.928	AREA	01/05/2021	28/06/2021
South West	M32	0.928	AREA	01/05/2021	28/06/2021
South West	M4	0.927	AREA & ROAD	01/05/2021	28/06/2021
South West	M48	0.928	AREA	01/05/2021	28/06/2021
South West	M49	0.928	AREA	01/05/2021	28/06/2021
South West	M5	0.942	AREA & ROAD	01/05/2021	28/06/2021
Area 6	A1	0.992	AREA	01/05/2021	28/06/2021
Area 6	A11	1.05	AREA & ROAD	01/05/2021	28/06/2021
Area 6	A12	1.006	AREA & ROAD	01/05/2021	28/06/2021
Area 6	A120	0.976	AREA & ROAD	01/05/2021	28/06/2021
Area 6	A14	1.001	AREA & ROAD	01/05/2021	28/06/2021
Area 6	A47	0.983	AREA & ROAD	01/05/2021	28/06/2021
Area 6	M11	0.972	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A1	0.975	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A14	1.125	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A38	1.02	AREA	01/05/2021	28/06/2021
Area 7	A42	1.08	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A43	0.984	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A45	1.001	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A453	0.954	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A46	1.044	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A5	0.972	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A50	1.02	AREA	01/05/2021	28/06/2021
Area 7	A5111	1.02	AREA	01/05/2021	28/06/2021
Area 7	A516	1.02	AREA	01/05/2021	28/06/2021
Area 7	A52	0.952	AREA & ROAD	01/05/2021	28/06/2021
Area 7	A6	1.02	AREA	01/05/2021	28/06/2021
Area 7	M1	1.058	AREA & ROAD	01/05/2021	28/06/2021
Area 7	M45	1.02	AREA	01/05/2021	28/06/2021

Area	Road	LECF	Type	Survey period start date	Survey period end date
Area 7	M6	1.02	AREA	01/05/2021	28/06/2021
Area 7	M69	1.02	AREA	01/05/2021	28/06/2021
Area 10	A41	1.058	AREA	01/05/2021	28/06/2021
Area 10	A483	1.058	AREA	01/05/2021	28/06/2021
Area 10	A494	1.058	AREA	01/05/2021	28/06/2021
Area 10	A5036	1.058	AREA	01/05/2021	28/06/2021
Area 10	A5103	1.058	AREA	01/05/2021	28/06/2021
Area 10	A5117	1.058	AREA	01/05/2021	28/06/2021
Area 10	A55	1.058	AREA	01/05/2021	28/06/2021
Area 10	A550	1.058	AREA	01/05/2021	28/06/2021
Area 10	A556	1.058	AREA	01/05/2021	28/06/2021
Area 10	A56	1.058	AREA	01/05/2021	28/06/2021
Area 10	A580	1.058	AREA	01/05/2021	28/06/2021
Area 10	A59	1.058	AREA	01/05/2021	28/06/2021
Area 10	A627M	1.058	AREA	01/05/2021	28/06/2021
Area 10	A663	1.058	AREA	01/05/2021	28/06/2021
Area 10	M53	1.062	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M56	1.077	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M57	1.065	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M58	1.034	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M6	1.056	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M60	1.05	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M602	1.058	AREA	01/05/2021	28/06/2021
Area 10	M61	1.13	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M62	1.076	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M65	1.025	AREA & ROAD	01/05/2021	28/06/2021
Area 10	M66	1.058	AREA	01/05/2021	28/06/2021
Area 10	M67	1.058	AREA	01/05/2021	28/06/2021
Second Severn Crossing	M4	0.998	AREA	01/05/2021	28/06/2021
Second Severn Crossing	M48	0.998	AREA	01/05/2021	28/06/2021

Table B.2: Middle season surveys

Area	Road	LECF	Type	Survey period start date	Survey period end date
Area 4	A2	0.971	AREA & ROAD	28/06/2021	25/08/2021
Area 4	A20	1.002	AREA	28/06/2021	25/08/2021
Area 4	A2070	1.002	AREA	28/06/2021	25/08/2021
Area 4	A21	1.1	AREA & ROAD	28/06/2021	25/08/2021
Area 4	A23	1.041	AREA & ROAD	28/06/2021	25/08/2021
Area 4	A249	1.002	AREA	28/06/2021	25/08/2021
Area 4	A259	0.961	AREA & ROAD	28/06/2021	25/08/2021
Area 4	A26	1.002	AREA	28/06/2021	25/08/2021
Area 4	A27	1.014	AREA & ROAD	28/06/2021	25/08/2021
Area 4	M2	0.935	AREA & ROAD	28/06/2021	25/08/2021
Area 4	M20	1.002	AREA	28/06/2021	25/08/2021
Area 4	M23	0.957	AREA & ROAD	28/06/2021	25/08/2021
Area 13	A585	0.98	AREA	28/06/2021	25/08/2021
Area 13	A590	1.001	AREA & ROAD	28/06/2021	25/08/2021
Area 13	A595	0.978	AREA & ROAD	28/06/2021	25/08/2021
Area 13	A66	0.981	AREA & ROAD	28/06/2021	25/08/2021
Area 13	A69	0.98	AREA	28/06/2021	25/08/2021
Area 13	A7	0.98	AREA	28/06/2021	25/08/2021
Area 13	A74M	0.98	AREA	28/06/2021	25/08/2021
Area 13	M55	0.918	AREA & ROAD	28/06/2021	25/08/2021
Area 13	M6	0.99	AREA & ROAD	28/06/2021	25/08/2021
Area 14	A1	0.982	AREA & ROAD	28/06/2021	25/08/2021
Area 14	A167	0.974	AREA	28/06/2021	25/08/2021
Area 14	A168	0.974	AREA	28/06/2021	25/08/2021
Area 14	A177	0.974	AREA	28/06/2021	25/08/2021
Area 14	A184	0.974	AREA	28/06/2021	25/08/2021
Area 14	A19	0.974	AREA	28/06/2021	25/08/2021
Area 14	A194M	0.974	AREA	28/06/2021	25/08/2021
Area 14	A195M	0.974	AREA	28/06/2021	25/08/2021
Area 14	A1M	0.986	AREA & ROAD	28/06/2021	25/08/2021
Area 14	A6055	0.974	AREA	28/06/2021	25/08/2021
Area 14	A61	0.974	AREA	28/06/2021	25/08/2021
Area 14	A66	0.979	AREA & ROAD	28/06/2021	25/08/2021
Area 14	A66M	0.974	AREA	28/06/2021	25/08/2021
Area 14	A68	0.974	AREA	28/06/2021	25/08/2021
Area 14	A689	0.974	AREA	28/06/2021	25/08/2021
Area 14	A690	0.974	AREA	28/06/2021	25/08/2021
Area 14	A696	0.974	AREA	28/06/2021	25/08/2021
A1DD DBFO	A1M	0.987	AREA & ROAD	28/06/2021	25/08/2021
A1DD DBFO	A63	0.987	AREA	28/06/2021	25/08/2021
M25 DBFO	A1	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A10	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A1001	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A1023	0.977	AREA	28/06/2021	25/08/2021

Area	Road	LECF	Type	Survey period start date	Survey period end date
M25 DBFO	A1089	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A12	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A127	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A13	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A1M	0.998	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	A2	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A20	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A21	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A23	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A282	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A3	0.914	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	A30	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A3113	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A312	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A316	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A40	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	A405	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	M1	1.028	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	M11	0.912	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	M20	0.903	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	M23	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	M25	0.99	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	M26	0.881	AREA & ROAD	28/06/2021	25/08/2021
M25 DBFO	M3	0.977	AREA	28/06/2021	25/08/2021
M25 DBFO	M4	0.964	AREA & ROAD	28/06/2021	25/08/2021

Table B.3: Late season surveys

Area	Road	LECF	Type	Survey period start date	Survey period end date
Area 3	A27	0.992	AREA	661.972	25/08/2021
Area 3	A3	1.038	AREA & ROAD	118.844	25/08/2021
Area 3	A303	0.969	AREA & ROAD	74.169	25/08/2021
Area 3	A308M	0.992	AREA	661.972	25/08/2021
Area 3	A31	0.967	AREA & ROAD	61.655	25/08/2021
Area 3	A34	0.999	AREA & ROAD	139.008	25/08/2021
Area 3	A346	0.992	AREA	661.972	25/08/2021
Area 3	A3M	0.992	AREA	661.972	25/08/2021
Area 3	A404	0.992	AREA	661.972	25/08/2021
Area 3	A404M	0.992	AREA	661.972	25/08/2021
Area 3	M27	1.02	AREA & ROAD	48.825	25/08/2021
Area 3	M271	0.992	AREA	661.972	25/08/2021
Area 3	M3	0.992	AREA & ROAD	68.891	25/08/2021
Area 3	M4	0.955	AREA & ROAD	86.544	25/08/2021
Area 8	A1	0.935	AREA & ROAD	51.666	25/08/2021
Area 8	A1081	1	AREA	521.76	25/08/2021
Area 8	A11	0.995	AREA & ROAD	34.843	25/08/2021
Area 8	A1307	1	AREA	521.76	25/08/2021
Area 8	A14	1.062	AREA & ROAD	67.466	25/08/2021
Area 8	A141	1	AREA	521.76	25/08/2021
Area 8	A1M	0.946	AREA & ROAD	37.765	25/08/2021
Area 8	A414	1	AREA	521.76	25/08/2021
Area 8	A421	1.06	AREA & ROAD	53.311	25/08/2021
Area 8	A428	0.943	AREA & ROAD	39.639	25/08/2021
Area 8	A5	1.098	AREA & ROAD	39.319	25/08/2021
Area 8	A5183	1	AREA	521.76	25/08/2021
Area 8	M1	1.006	AREA & ROAD	108.174	25/08/2021
Area 8	M11	0.94	AREA & ROAD	48.606	25/08/2021
Area 9	A34	1.151	AREA	1014.37	25/08/2021
Area 9	A38	1.267	AREA & ROAD	55.552	25/08/2021
Area 9	A38M	1.151	AREA	1014.37	25/08/2021
Area 9	A40	1.121	AREA & ROAD	29.2	25/08/2021
Area 9	A4097	1.151	AREA	1014.37	25/08/2021
Area 9	A41	1.151	AREA	1014.37	25/08/2021
Area 9	A4123	1.151	AREA	1014.37	25/08/2021
Area 9	A423	1.151	AREA	1014.37	25/08/2021
Area 9	A435	1.151	AREA	1014.37	25/08/2021
Area 9	A446	1.151	AREA	1014.37	25/08/2021
Area 9	A449	1.151	AREA	1014.37	25/08/2021
Area 9	A45	1.185	AREA & ROAD	27.352	25/08/2021
Area 9	A4510	1.151	AREA	1014.37	25/08/2021
Area 9	A452	1.151	AREA	1014.37	25/08/2021
Area 9	A456	1.151	AREA	1014.37	25/08/2021
Area 9	A458	1.151	AREA	1014.37	25/08/2021

Area	Road	LECF	Type	Survey period start date	Survey period end date
Area 9	A46	1.199	AREA & ROAD	87.713	25/08/2021
Area 9	A483	1.151	AREA	1014.37	25/08/2021
Area 9	A49	1.055	AREA & ROAD	121.096	25/08/2021
Area 9	A5	1.2	AREA & ROAD	118.037	25/08/2021
Area 9	A50	1.151	AREA	1014.37	25/08/2021
Area 9	A500	1.077	AREA & ROAD	39.241	25/08/2021
Area 9	A5127	1.151	AREA	1014.37	25/08/2021
Area 9	A5148	1.151	AREA	1014.37	25/08/2021
Area 9	M40	1.135	AREA & ROAD	37.144	25/08/2021
Area 9	M42	1.126	AREA & ROAD	96.492	25/08/2021
Area 9	M5	1.177	AREA & ROAD	104.821	25/08/2021
Area 9	M50	1.13	AREA & ROAD	39.6	25/08/2021
Area 9	M54	1.151	AREA	1014.37	25/08/2021
Area 9	M6	1.163	AREA & ROAD	160.302	25/08/2021
Area 9	M69	1.151	AREA	1014.37	25/08/2021
Area 12	A1	1.01	AREA	662.181	25/08/2021
Area 12	A1033	1.01	AREA	662.181	25/08/2021
Area 12	A160	1.01	AREA	662.181	25/08/2021
Area 12	A162	1.01	AREA	662.181	25/08/2021
Area 12	A180	1.01	AREA	662.181	25/08/2021
Area 12	A1M	1.048	AREA & ROAD	34.33	25/08/2021
Area 12	A57	1.01	AREA	662.181	25/08/2021
Area 12	A58	1.01	AREA	662.181	25/08/2021
Area 12	A61	1.01	AREA	662.181	25/08/2021
Area 12	A616	1.01	AREA	662.181	25/08/2021
Area 12	A62	1.01	AREA	662.181	25/08/2021
Area 12	A628	1.01	AREA	662.181	25/08/2021
Area 12	A63	1.054	AREA & ROAD	33.838	25/08/2021
Area 12	A631	1.01	AREA	662.181	25/08/2021
Area 12	A638	1.01	AREA	662.181	25/08/2021
Area 12	A64	0.971	AREA & ROAD	104.148	25/08/2021
Area 12	M1	0.976	AREA & ROAD	115.905	25/08/2021
Area 12	M18	1.006	AREA & ROAD	70.14	25/08/2021
Area 12	M180	1.097	AREA & ROAD	56.781	25/08/2021
Area 12	M181	1.01	AREA	662.181	25/08/2021
Area 12	M606	1.01	AREA	662.181	25/08/2021
Area 12	M62	1.009	AREA & ROAD	129.795	25/08/2021
Area 12	M621	1.01	AREA	662.181	25/08/2021

Calculation of Local Equilibrium Correction Factors for the 2021 skid resistance surveys

National Highways manages skid resistance on their network by carrying out single annual skid resistance surveys. This data is used to identify sites where there is a need for an investigation to identify if a resurfacing treatment would help mitigate the risk of skidding collisions. This data also feeds into the KPI for Pavement Condition. This document discusses the calculation of the correction factors to seasonally correct the 2021 surveys.

Other titles from this subject area

PPR 990	Calculation of Local Equilibrium Correction Factors for the 2020 Skid resistance surveys. S Brittain. 2021
PPR 951	Calculation of Local Equilibrium Correction Factors for the 2019 Skid resistance surveys. S Brittain. 2020
PPR 906	Calculation of Local Equilibrium Correction Factors for the 2018 Skid resistance surveys. S Brittain. 2019
PPR 862	Calculation of Local Equilibrium Correction Factors for the 2017 Skid resistance surveys. S Brittain. 2018

TRL
Crowthorne House, Nine Mile Ride,
Wokingham, Berkshire, RG40 3GA,
United Kingdom
T: +44 (0) 1344 773131
F: +44 (0) 1344 770356
E: enquiries@trl.co.uk
W: www.trl.co.uk

ISSN 2514-9652

ISBN 978-1-915227-15-7

PPR1031