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UPDATED TRANSPORT PROOF OF EVIDENCE ANTHONY JONES BSC (HONS) MCIHT

IN RESPECT OF

OUTLINE PLANNING APPLICATION FOR LAND AT NEWGATE LANE (NORTH), FAREHAM – APPEAL A

AND

OUTLINE PLANNING APPLICATION FOR LAND AT NEWGATE LANE (SOUTH), FAREHAM – APPEAL B

ON BEHALF OF FAREHAM LAND LP AND BARGATE HOMES LIMITED

LPA REF: P/18/1118/OA AND P/19/0460/OA

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1. SCOPE OF EVIDENCE

1.1 This updated Proof of Evidence (PoE) is provided to address the new evidence introduced in Mr Gammer's rebuttal PoE, which introduced a calculation for a revised benefit cost ratio (BCR) values for Newgate Lane East accounting for the impact of the appeal schemes. The revised BCR values has been calculated by Systra in its Technical Note (TN) appended to Mr Gammers rebuttal PoE (NG6).

1.2 The revised BCR values derived by Mr Gammer and Systra seek to consider the increase in delay per vehicle per second associated with the indicative arrow signalised junction improvement scheme proposed by the appellants between Newgate Lane East and Old Newgate Lane; as well as the delay per vehicle per second that could be associated with the proposed TOUCAN signalised pedestrian crossing at the existing uncontrolled pedestrian crossing point between Woodcote Lane and Brookers Lane. The Systra TN and Mr Gammer's rebuttal evidence concludes that the additional delay associated with the appeal schemes will reduce the BCR value of the Newgate Lane East improvement scheme to a 'low' threshold and remove any benefits that the implementation of the Newgate Lane East improvement scheme is considered to provide.

1.3 This updated PoE refers to a new PoE prepared by Mr Patel of Sweco on behalf of the appellant to specifically address the appropriateness of the use of BCR as a system of measurement to assess the transport impacts of development schemes via planning applications / appeals. The PoE prepared by Mr Patel also comments on the appropriateness of the methodology used by Systra to calculate the revised BCR values.

1.4 This updated PoE has also been informed by a Technical Note (TN) prepared by Ms Wilson of Red Wilson Associates appended to Mr Patel's PoE (ref: Appendix B). The TN prepared by Ms Wilson reviews and responds to Mr Gammer's rebuttal PoE with respect to the appropriateness of using a LinSig model to derive vehicle delay associated with the proposed TOUCAN crossing. It also sets out alternative vehicle delay values using the VISSIM micro-simulation package and the model that has, in fact, been agreed with the highway authority with the introduction of a TOUCAN crossing.

2. FORECAST VEHICLE DELAY ASSOCIATES WITH THE APPEAL SCHEMES

2.1 I consider for the purposes of the Inquiry that it would be beneficial to summarise the appellants and Council's position with respect to the forecast increase in vehicle delay that could be associated with the appeal schemes with the implementation of the indicative arrow signalised junction between Newgate Lane East and Old Newgate Lane and the proposed TOUCAN crossing between Woodcote Lane and Brookers Lane. This includes for the appellant's latest position as set out in Ms Wilson TN appended to Mr Patel's PoE addressing the revised BCR values derived in Mr Gammers Rebuttal PoE and the supporting TN prepared by Systra.

2.2 Paragraphs 6.18 to 6.20 of my main PoE advises that the proposed indicative signalised arrow signalised junction scheme could be associated with delay of between nine to 31 seconds per cycle for both northbound and southbound traffic during the morning peak periods. The variance in the results depends on the proportional usage split of the lanes assessed.

2.3 The 70 / 30 percentage lane usage split, that Ms Hoskins considers is more reflective of how the junction will operate in reality in her main PoE, and which I concur, could result in a delay of around 11 seconds to northbound and southbound travelling vehicles in the morning peak hour. Ms Hoskins main PoE also confirms that the proposed signalised junction with an indicative method of control could result in delay of between four to six seconds per cycle for both northbound and southbound traffic during the evening peak periods.

2.4 My main PoE did not assess or account for the delay associated with the TOUCAN crossing that is agreed to be provided by the appellant further to the highway authority's request. This is because the impact on delay to through vehicles on Newgate Lane East associated with its implementation was not raised as any issue for consideration at any time during the course of the outline planning applications by the highway authority.

2.5 In my view, if delay to through vehicles on Newgate Lane East is considered to be a material issue with the implementation of the TOUCAN by the highway authority, it should have requested Pegasus Group to assess this during the planning application submission before requesting the S106 contributions sums. The fact that the highway authority did not do this, suggests that, at that time, it did not consider that the delay to through vehicles on Newgate Lane East because of the implementation of the TOUCAN was a material factor over and above the pedestrian safety benefits that the facility could provide.

2.6 The first time that the appellant was notified of any issues that the highway authority had with respect to delay to through vehicles on Newgate Lane East associated with the implementation of the TOUCAN was upon receipt of Mr Gammer's main PoE. It was not included as an issue in the Council's Statement of Case. Mr Gammer's main PoE, in addition to the junction modelling results for the indicative arrow signalised junction, also submitted junction modelling results for the TOUCAN crossing using the LinSig modelling software programme.

2.7 Mr Gammer's main PoE advises at Table 6 that the combined total delay that the highway authority considers could be associated with the both the implementation of the indicative arrow signalised junction and TOUCAN crossing for 190 dwellings equated to circa 34-35 seconds in the morning peak hour and 122.9 seconds in the evening peak hour.

2.8 As set out at paragraph 2.8 of Mr Patel's PoE, Mr Gammer's rebuttal PoE provided updated delay values for the proposed TOUCAN crossing. This is because the traffic flow scenarios used to derive the delay to vehicles on Newgate Lane East associated with the appeal schemes in Mr Gammers main PoE did not use the agreed traffic flow scenarios confirmed in paragraph 5.17 of the planning Statement of Common Ground.

2.9 Mr Gammer's assessment of the revised total delay values to vehicles travelling on Newgate Lane East for both the indicative arrow signalised junction and the TOUCAN crossing accounting for the agreed traffic flow scenarios are set out in Table 4 of his rebuttal PoE. This suggests that the total additional delay value accounting for the appeal schemes in the morning peak hour equates to 74.4 seconds and 19.1 seconds in the evening peak hour. I don't agree with these values as set out in detail below.

2.10 Ms Hoskins Rebuttal PoE at Chapter 3 responded to the modelling of the TOUCAN crossing within Mr Gammers main evidence and concludes that the traffic flows used in the model were not the agreed 2024 traffic flows, as stipulated in paragraph 5.17 of the main planning Statement of Common Ground.

2.11 Paragraph 3.5 of Ms Hoskins rebuttal PoE also sets out her view that the apparent assumption made by Mr Gammer that vehicles will be stopped twice at both the TOUCAN and the proposed indicative signalised junction, and the delay times added together, is not a realistic representation of how the local highway network will operate in the future, should the appeal schemes be granted planning consent. This is due to the high green times provided to the main flow of through traffic on Newgate Lane East and the short separation distance between them of approximately 500 metres. As such, Ms Hoskins concludes that it is not appropriate to 'add' delay to provide a cumulative delay value accounting for both highway improvement schemes. I concur with this view.

2.12 Furthermore, the TN prepared by Ms Hoskins appended to the PoE prepared by Mr Patel advises at paragraphs 2.1 to 2.4 that the modelling assumptions made by Mr Gammer in the LinSig model that assesses the TOUCAN crossing are incorrect. It also notes that demand modelling is typically used to recalculate BCR, such as SATURN, or on occasions, more localised micro-simulation models such as VISSIM.

2.13 As advised in paragraph 2.4 of Ms Hoskins TN appended to Mr Patel's PoE, Ms Hoskin's has inputted the proposed TOUCAN crossing into the agreed VISSIM to model the impact of the facility more accurately on vehicle delay on Newgate Lane East.

2.14 Table 2.1 of Ms Hoskins TN compares the vehicle delay that could be experienced by vehicles on the current layout of Newgate Lane East travelling both northbound and southbound in the agreed 2024 future base scenario with the increase in delay associated with the additional traffic from 190 dwellings and the provision of the TOUCAN crossing.

2.15 Table 2.1 shows that the total increase in vehicle delay equates to circa two seconds for northbound travelling vehicles and circa five seconds for southbound travelling vehicles in the morning peak hour. In the evening peak hour, this equates to circa two to three seconds both northbound and southbound travelling vehicles. These levels of delay are in my view considered to be negligible.

2.16 **Table 1** below compares the increase in delay that could be associated with the proposed TOUCAN crossing derived by Ms Hoskins with those values derived by Mr Gammer.

Table 1 – TOUCAN Delay Per Seconds

Direction	A. Appellants Additional Delay with TOUCAN compared to the 2024 Base (delay per seconds)	B. Mr Gammers TOUCAN Delay Values (delay per seconds)	C. Difference between Appellants and Mr Gammers Additional Delay Values (B-A) (delay per seconds)
Morning Peak Hour			
Northbound	+1.84	+62	+60
Southbound	+4.75	+4	-0.75
Evening Peak Hour			
Northbound	+2.29	+5.1	+2.8
Southbound	+2.42	+5.3	+2.9

2.17 **Table 1** above demonstrates that the delay values for the implementation of the TOUCAN crossing derived by Mr Gammer, in particular for the morning peak hour, are significantly exaggerated compared to those levels derived by Ms Hoskins. As also noted in **paragraph 2.12** above, the modelling assumptions made by Mr Gammer in the LinSig model that assesses the TOUCAN crossing are incorrect and cannot be relied on to assess the transport impact of the appeal schemes.

3. BENEFIT COST RATIO

3.1 The PoE prepared by Mr Patel deals with the appropriateness of the methodology of deriving a revised BCR value for the Newgate Lane East scheme accounting for the impact of the appeal schemes. It also addresses the appropriateness of the use of BCR as a system of measurement to assess development schemes via planning applications and appeals.

3.2 In summary, it concludes:

a. The use of LinSig, the underestimation of saturation flow and the overcapacity of the model all lead to exaggerated and inaccurate delay results;

b. Within the revised BCR calculations undertaken there is an absence of any 'without scheme' delay meaning that the assumption has been made that there is zero vehicle delay on all approaches without the implementation of the Appellant's scheme;

c. The Solent Transport Sub-Regional Transport Model (SRTM) used to extract traffic demand, has not been updated to reflect the development scenarios considered;

d. The revised BCR calculation completed by Systra and Mr Gammer include inconsistencies in the use and application of various inputs and factors. These include inconsistencies in the use and application of the current version of the TAG Databook, as well in the application of the years represented by the traffic demand and vehicle delay; and

e. The revised BCR calculation undertaken by Systra and Mr Gammer do not include any costs associated with either the signals and / or the TOUCAN crossing. The costs of delivering the Appellant's scheme are to be covered by the private sector. These private sector contributions should be included within the BCR calculation as additional benefits thereby resulting in greater benefits being derived.

3.3 The use of a BCR to inform decision making for planning applications is not the correct system and method of measurement. The impacts of a planning application span further than is covered and can be captured by calculating a BCR.

3.4 Furthermore, the Department for Transport's (DFT) "Value for Money (VfM) Framework" states that the VfM assessment determines whether resources from the public budget available for transport are being used in a way that maximises public value. With reference to the Appellant's scheme, as this is being funded privately, there will not be an impact on the public budget and therefore no reason to be considering VfM and BCR as part of the appeals.

3.5 As advised in detail in Mr Patel's PoE, the use of BCR to inform decision making for planning applications and appeals is not the correct system and method of measurement. Mr Patel advises that the main purpose of calculating BCR is to understand whether resources from the public budget available for transport schemes are being used in a way that maximises public value. BCR therefore forms part of an exercise considering VfM for the aim of obtaining highways infrastructure funding and to assist in decisions to allocate governmental highway infrastructure budgets.

3.6 I concur with this view. I have not had any personal experience or have knowledge of other planning applications where BCR values have been used as a system of measurement to account for the impact of development schemes as part of decision making for planning applications. To my knowledge, BCR is not a system of measurement that highway authorities use when responding as a key stakeholder to planning applications. If this were the case, it is my view that highway authorities would ask applicants and appellants to consider the impact of planning applications on the BCR value of strategic highway improvements schemes, such as Newgate Lane East, as part of the initial agreed scope of transport works to support planning application submissions. This is not the case associated with the appeal schemes. The first time that the impact of the appeal schemes on the BCR value of Newgate Lane East was raised as an issue was in Mr Gammer's Rebuttal PoE.

3.7 I concur with Mr Patel's view that considering the impact of development schemes on the BCR value of a scheme that has already been allocated governmental funding and implemented is very unusual and meaningless.

4. IMPACT ON NEWGATE LANE EAST

4.1 It is my view that decision making for planning applications and appeals that considers the assessment and mitigation of development schemes to avoid unacceptable or "severe" impacts on the operation of the local highway network should be informed via the normal industry standard way of junction capacity modelling.

4.2 This approach typically uses industry standard junction modelling software programmes such as LinSig, Junctions 9, and where appropriate micro-simulation modelling such as VISSIM. These junction modelling software programmes are used to assess the impact of the appeal schemes proposed for an agreed design year with and without the traffic associated with the development scheme with consideration to the changes in the operational capacity, queues and delays of the junctions assessed. Mitigation is proposed where the changes that occur as a result of the scheme are deemed unacceptable in terms of highway safety, or the residual cumulative impacts on the road network are forecast to be severe.

4.3 As set out in paragraph 2.4 of my main PoE, the Transport Assessment has been prepared based on an agreed scope of work with the highway authority using the methodology identified in **paragraph 4.5** above. Using this approach, as also stated in paragraph 2.45 of my main PoE, the planning Statement of Common Ground agrees that the appeal schemes will not have a material impact on the safety and operation of the following junctions:

i. Speedsfield Park roundabout and HMS Collingwood signal junction;
ii. Peel Common signalised roundabout; and
iii. Newgate Lane East / Longfield Avenue / Davis Way roundabout.

4.4 It is acknowledged that the introduction of both a signalised junction and a TOUCAN controlled pedestrian crossing will add some levels of delay to through traffic on Newgate Lane East that they do not currently experience on this section of the road.

4.5 As advised in **Table 1** above, it is considered that the provision of a TOUCAN controlled pedestrian crossing will only result in average delay per vehicle of around two seconds for northbound traffic and around five seconds for southbound traffic in the morning peak hour; and circa two to three seconds in both directions in the evening peak hour, when compared to those level of delays per second that drivers could be experience associated with the operation of existing highway network layout for the future base year of 2024.

4.6 It is therefore my view that the increase in delay as a result of the provision of a TOUCAN controlled pedestrian crossing will not have a material effect on the operation of Newgate Lane East. It is also my view that its provision is considered to provide a material benefit to the operation of the pedestrian network.

4.7 As advised in Ms Hoskins rebuttal PoE, it is considered that the indicative arrow signalised junction will operate efficiently with the proportion of traffic using the northbound through lanes varying from one cycle to another and that traffic will redistribute to reduce the delay experienced by road users. It will in effect be a self-regulating system with road users responding to any delay they experience. The forecast levels of delay of 11 seconds for both northbound and southbound vehicles in the morning peak hour and four to six seconds in the evening peak hour, as set out in detail in **paragraph 2.3 above,** are also not considered to be material levels of additional delay to users of Newgate Lane East.

4.8 As also advised in **paragraph 2.11** above, it is considered highly unlikely that a vehicles travelling northbound or southbound will be stopped twice on Newgate Lane East between the Peel Common roundabout or the HMS Collingwood signalised junction at both the TOUCAN controlled pedestrian crossing and the proposed indicative signalised junction. This is due to the high green times provided to the main flow of through traffic on Newgate Lane East at these proposed highway improvement schemes and the separation distance of circa 500 metres. It is my view that it is therefore not appropriate to 'add' delay to provide a cumulative delay value accounting for both highway improvement schemes.

4.9 It should also be noted that the provision of an indicative arrow signalised junction will allow vehicles egressing the minor arm to do so unopposed every cycle stage.

4.10 The highway authority is opposed to the proposals to provide an indicative arrow right turn stage for vehicles seeking to access Newgate Lane from Newgate Lane East across two lanes of traffic. However, the main and rebuttal PoEs submitted by Ms Hoskins confirm that it is the appellants view that the indicative arrow signalised junction scheme between Newgate Lane East and Old Newgate Lane is designed in accordance with national guidance and appropriate for the location.

4.11 My main proof of evidence at paragraphs 6.9 and 6.10 confirms that the highway authority in its email dated 21st August 2020 agreed that the proposed signalised junction layout is geometrically compliant with guidance set out in Design Manual for Road and Bridges (DMRB) CD/123 – Geometric Design of at-grade priority and signal-controlled junctions.

4.12 DMRB 'CA 185 – Vehicle Speed Measurement Revision 0' (formerly TA 22/81) is the appropriate document that sets out the requirements for the measurement of vehicle speeds and for determining 85th percentile speeds on existing all-purpose trunk roads. This is included at **Appendix A**. The data derived using this document can be used where existing vehicle speeds are necessary to set the basis for design. Such schemes can include the setting of speed limits, minor improvements to existing roads and altering or designing new priority junctions, accesses or signal controlled junctions.

4.13 Paragraph 2.8.2 and the associated NOTE 1 of DMRB CA 185 states:

4.14 *"Speed measurements should be undertaken outside of peak traffic flow periods"*

"NOTE 1 Non-peak periods are typically between 10am and noon and 2pm and 4pm. In some cases these times need to be varied to take account of site-specific circumstance e.g. if a school is nearby that closes at 3pm."

4.15 DMRB CA185 does not provide any reference to considering 85th percentile speed measurements during the evening and night-time periods. Furthermore, the highway authority did not request the appellant to consider different non-peak periods to determine the 85th%ile vehicle speeds on Newgate Lane East as part of the planning application submissions.

4.16 Paragraph 3.1.1 of DMRB CA185 states:

"Where speed measurements have been taken either partially or entirely in wet weather conditions, the following values should be added to each individual speed recorded in wet weather: 1) 8kph for dual carriageways; and 2) 4kph for single carriageways."

4.17 With consideration to DMRB CA 185, **Table 2** below summarises the observed 85th%ile northbound vehicle speeds.

Table 2 – Summary of Speed Survey Counts

Direction of travel	**Northbound 85th percentile vehicle speeds between 10:00 – 12:00**	**Northbound 85th percentile vehicle speeds between 14:00 – 16:00**	**Northbound 85th percentile vehicle speeds between 10:00 – 12:00 (+ 4kph wet weather)**	**Northbound 85th percentile vehicle speeds between 14:00 – 16:00 (+ 4kph wet weather)**
Southernmost count – 24th February 2020 to 1st March 2020				
Northbound	38.5mph	39.8mph	40.9mph	42.2mph
Northernmost count – 27th September 2018 to 3rd October 2018				
Northbound	40.8mph	42.3mph	43.2mph	44.7mph

4.18 **Table 2** demonstrates that the northbound 85th percentile speeds on Newgate Lane East between the non-peak periods of 10am and noon and 2pm and 4pm are below 45mph.

4.19 The volume of right turners turning into Old Newgate Lane from Newgate Lane East with the addition of traffic associated with the appeal schemes is forecast to be low with only 1-2 vehicles per cycle during both the morning and evening peak hours. It is Ms Hoskins view, and which I concur with, that these vehicles can either, turn in appropriate gaps in northbound traffic or, if not available, during the intergreen time of six seconds that is available between the completion of the green time for northbound vehicles on Newgate Lane East and the commencement of the green time for vehicles seeking to egress the minor old Newgate Lane arm. I consider that six seconds is sufficient time to allow two vehicles to turn and clear the right turn lane.

4.20 It is therefore my view that a safe and appropriate highway improvement scheme, designed in accordance with guidance set out in DMRB CD/123 – Geometric Design of at-grade priority and signal-controlled junctions, can be provided at the junction between Newgate Lane East and Old Newgate Lane that operates efficiently with no material levels of queues and delay.

4.21 It is also my view that the appeal schemes will not have a severe impact on operation of the local highway network or the strategic aspirations of the Improving Access to the Fareham and Gosport strategy.

APPENDIX A

DMRB – CA 185 – VEHICLE SPEED MEASUREMENT REVISION 0

Design Manual for Roads and Bridges

Road Layout
Appraisal

CA 185
Vehicle speed measurement

(formerly TA 22/81)

Revision 0

Summary
This document contains the requirements for the measurement of vehicle speeds and for determining 85th percentile speeds on existing all-purpose trunk roads.

Application by Overseeing Organisations
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Nov 2019	CA 185 replaces TA 22/81. This full document has been re-written to make it compliant with the new Highways England drafting rules.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes TA 22/81, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This document provides requirements and advice on:

1) the measurement of vehicle speeds on existing all-purpose trunk roads; and
2) how to calculate 85th percentile speeds.

The primary purpose of this document is to provide a consistent approach to measuring and calculating 85th percentile speeds. It describes methods that are to be used when obtaining speed data using manual or automatic measurement methods.

The data derived using this document can be used where existing vehicle speeds are necessary to set the basis for design. Such schemes can include the setting of speed limits, minor improvements to existing roads and altering or designing new priority junctions, accesses or signal controlled junctions.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] apply to this document.

Abbreviations

Abbreviations

Abbreviation	Definition
kph	kilometres per hour

Terms and definitions

Terms

Term	Definition
All motor vehicle types	All the types of motor vehicles observed during an individual speed measurement period.
Free flow traffic	A condition where a driver is able to drive at a speed of their own choice, unimpeded by factors such as: 1) the proximity of other vehicles in front; 2) non-permanent obstructions to the road layout such as roadworks, or a broken down vehicle; or 3) adverse weather. NOTE: Examples of adverse weather are snow, ice, fog and torrential rain.
Individual speed measurement period	A period of time during which vehicle speeds are continuously measured at a specific location.
Journey speed	The effective speed of a vehicle relative to how long it has taken to travel between two points.
Spot speed	The instantaneous speed of a vehicle measured at a particular point.
85th percentile speed	The speed at and below which 85% of vehicles within a measurement sample are travelling.

1. Scope

Aspects covered

1.1 This document shall be used for the measurement of vehicle speeds and for determining 85th percentile speeds on existing all-purpose trunk roads.

NOTE *This document is not applicable to motorways.*

Implementation

1.2 This document shall be implemented forthwith on all schemes involving the measurement of vehicle speeds and the determination of 85th percentile speeds on the Overseeing Organisations' all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 1.N].

Use of GG 101

1.3 The requirements contained in GG 101 [Ref 1.N] shall be followed in respect of activities covered by this document.

2. Vehicle speed measurement

Spot speed and journey speed measurements

Speed limits

2.1 When speed limits are to be determined based on speed measurement, one of the following methods shall be used:

1) spot speed measurements of cars only; or
2) spot speed measurements of all motor vehicle types with a conversion factor applied.

NOTE 1 Section 3 of this document includes the conversion factor to be applied when calculating 85th percentile speeds for the purpose of determining speed limits based on spot speed measurements of all motor vehicle types.

NOTE 2 Department for Transport Circular 01/2013 (DfT Circular 01/2013 [Ref 1.I]) provides advice on setting speed limits.

Traffic signal installations

2.2 When design parameters for traffic signal installations are to be determined based on speed measurement, spot speed measurements of all motor vehicle types shall be used.

2.2.1 Spot speed measurements on the approach to proposed, upgraded and existing traffic signal installations should be taken between 150 and 200 metres back from the existing/proposed stop line but as close to 160 metres as practicable.

2.2.2 Spot speed measurements on the approach to proposed, upgraded and existing traffic signal installations should be taken where there are no parked vehicles within 100 metres of the measurement point.

2.2.3 Spot speed measurements on the approach to existing signal controlled junctions should be taken:

1) when traffic flows are between 20% to 40% of the maximum capacity of the junction; and
2) only during a green phase where no queues are present.

Other scheme types

2.3 When design parameters for anything other than speed limits and traffic signal installations are to be determined based on speed measurement, journey speeds of all motor vehicle types shall be used.

NOTE Journey speed measurements are used for highway schemes such as new priority junctions/direct access and minor improvements to existing roads etc.

2.4 Measurements for journey speed shall be taken on the approaches to the scheme extents.

NOTE Measuring journey speeds on the approaches to the scheme extents can be achieved by matching registration numbers at the time of passing the two points.

Free flow conditions

2.5 All speed measurements (spot and journey speed) shall be undertaken in free flow conditions where vehicles are unlikely to be accelerating or braking, unless the measurements are to be taken in connection with changes to an existing feature that naturally impacts the free flow of traffic.

NOTE 1 Examples of where the road geometry can cause vehicles to slow down and speed up (or accelerate/brake) include isolated sharp bends, gradients and road narrowings.

NOTE 2 Improvements to an existing junction is an example of where speed measurements can be taken in conditions that are not entirely free flow.

NOTE 3 *In urban environments such as residential streets where persistent parking is typical, it would not be possible to undertake speed measurements in entirely free-flow conditions. In this particular scenario, the persistent parking can be considered a feature that naturally impacts the free flow of traffic and therefore equivalent to free-flow conditions.*

2.5.1 All speed measurements should be taken in dry weather conditions.

Minimum number of vehicles speeds to be recorded

2.6 A minimum of 200 vehicles speeds shall be recorded during each individual speed measurement period.

2.6.1 As many vehicles speeds as practicable should be recorded during each individual speed measurement period.

2.6.2 Similar numbers of vehicles speeds should be recorded as part of each individual speed measurement period and for each direction of travel in the case of two-way roads.

Speed measurement frequency and timing

2.7 Spot speed and journey speed measurements shall comprise a minimum of two individual speed measurement periods, undertaken on different days of the week, and at different times of the day.

2.8 On two-way roads, the individual speed measurement periods shall include separate measurements taken for both directions of traffic flow.

2.8.1 The minimum two individual speed measurement periods should be undertaken in different months and at least one month apart from each other, or in a neutral month if the former is not feasible.

2.8.2 Speed measurements should be undertaken outside of peak traffic flow periods.

NOTE 1 *Non-peak periods are typically between 10am and noon and 2pm and 4pm. In some cases these times need to be varied to take account of site specific circumstance e.g. if a school is nearby that closes at 3pm.*

NOTE 2 *A neutral month is a month that is not impacted by seasonal variation in traffic flows. Typical neutral months are April, May, June, September and October.*

2.9 Speed measurements shall not be undertaken during a local event that can result in traffic flows and speeds that are atypical for the road in question.

NOTE *Local events can include market days, local holidays, fetes and race meetings etc. It can also include situations where traffic is diverted along the route in question due to road works occurring on other parts of the network.*

2.10 Speed measurements shall not be undertaken at weekends.

2.11 Speed measurements on rural roads shall not be undertaken on bank holidays.

2.11.1 Speed measurements on urban roads should not be undertaken on bank holidays.

2.12 Where there is a difference in the 85th percentile speeds derived from the individual speed measurements periods, the higher value shall be used in the subsequent design.

Speed measurement methods

2.13 Speed measurements shall be undertaken using either manual or automatic methods.

NOTE *A variety of manual and automated methods of speed measurement are available, including:*

1) handheld radar speedometers (manual);

2) radar traffic classifiers (automated);

3) pneumatic tubes (automated);

4) inductive loops (automated).

Automatic speed measurement methods

2.14 When installing and operating automatic speed measurement equipment, the manufacturer's installation and operating instructions shall be followed.

NOTE *Automated speed measurements can reduce the risk of errors, provide greater volumes of data and reduce the risk of the results being artificially skewed (as a result of a the presence of a surveyor influencing driver behaviour); however, equipment such as inductive loops and pneumatic tubes can not always fully distinguish between different vehicle types due to classification being based on axle spacing. In this situation a correction factor can be applied (refer to Section 3: 85th percentile speed calculation)*

2.14.1 Vehicle speed measurement tools should be checked for accuracy prior to a survey being undertaken.

NOTE *A vehicle fitted with a calibrated speedometer can be used on site for a broad check of the accuracy of the readings given by the vehicle speed measurement tools being used.*

Manual speed measurement methods

2.15 For dual carriageway roads, speed measurements using manual methods shall be conducted on the same side of the road as the flow of traffic that is being surveyed.

2.15.1 For single carriageway roads, speed measurements using manual methods should be conducted on the same side of the carriageway as the flow of traffic that is being surveyed.

2.15.2 For manual speed measurements, as many of the vehicles that pass during a particular survey period should be recorded as possible.

2.15.3 A minimum of two surveyors should be utilised when undertaking manual speed measurements.

NOTE 1 *The use of a minimum of two surveyors (one taking readings and the other recording them) allows for a greater proportion of all passing vehicles to be recorded, if not all of them. It also helps to reduce errors and produce a more robust data set.*

NOTE 2 *A sampling method can be used if traffic flows are too high to allow all or most vehicles to be surveyed using manual methods.*

2.16 Any sampling technique used for manual methods of speed measurement shall be unbiased.

NOTE 1 *A unbiased sampling technique needs to be representative of the overall vehicle speeds during the survey period. A method that looks to record the vehicle speed of every 'x' number of vehicles where 'x' can provide sufficient time to measure and record the data could be used.*

NOTE 2 *On dual carriageways, surveys can be completed for specific lanes at a time to reduce the risk of vehicles being missed when trying to measure vehicle speeds across multiple lanes at the same time. The results of these individual lane surveys can then be added together to provide a set of results for the carriageway as a whole.*

2.16.1 When undertaking manual speed measurements, surveyors and their equipment (such as a vehicle) should not be located in a position that impacts the speed or flow of vehicles.

NOTE *Surveyors at the side of a road with a radar device in clear view of approaching traffic can potentially artificially skew traffic speeds as motorists can slow down as a result. Surveyors situated in a vehicle away from the carriageway with their equipment positioned inconspicuously reduces this risk.*

3. 85th percentile speed calculation

3.1 85th percentile vehicle speeds shall be calculated where designs are to be based on measured vehicle speeds.

NOTE 1 85th percentile vehicle speeds can be calculated using a variety of methods, including:

1) built-in functions in spreadsheet software;

2) statistical formulae; and

3) listing out the measured speeds in ascending order and counting down from the highest value until 15% of the values have been passed (the value that is arrived at is the 85th percentile speed).

NOTE 2 The method of listing out the measured speeds in ascending order and counting down to establish the 85th percentile is only suitable for samples that include 200 or more vehicles.

3.1.1 Where speed measurements have been taken either partially or entirely in wet weather conditions, the following values should be added to each individual speed recorded in wet weather:

1) 8kph for dual carriageways; and

2) 4kph for single carriageways.

NOTE Wet weather conditions includes periods after rainfall when the road surface is still wet.

3.1.2 Equations 3.1.2a to 3.1.2d should be used to derive the 85th percentile speed when using the statistical formula method.

Equation 3.1.2a 85th percentile speed

$$p85 = m + s$$

where:

p 85	is the 85th percentile speed
m	is the mean of the measured vehicle speeds
s	is standard deviation of the measured vehicle speeds

Equation 3.1.2b Mean of the measured vehicle speeds

$$m = \frac{\sum v}{n}$$

where:

$\sum v$	is the sum of all measured vehicle speeds
n	is the number of measured vehicle speeds

Equation 3.1.2c Standard deviation of measured vehicle speeds

$$s = \sqrt{\frac{\sum (v-m)^2}{n-1}}$$

Equation 3.1.2d provides a useful relationship to assist in deriving $\sum (v-m)^2$

Equation 3.1.2d Additional formula for deriving the standard deviation of measured vehicle speeds

$$\sum (v-m)^2 = \sum v^2 - \frac{\left(\sum v\right)^2}{n}$$

NOTE 1 *The formula given in Equation 3.1.2a is based on the established shape of speed distributions, which are to all intents and purposes normal (Gaussian). For a normal distribution, the 85th percentile is 1.037 standard deviations above the mean.*

NOTE 2 *The value derived using Equation 3.1.2a is rounded to the nearest whole number.*

NOTE 3 *The standard deviation (s) is approximately one sixth of the mean (m). This relationship can be used as a quick check to determine if the standard deviation calculated using Equation 3.1.2c is likely to be correct.*

NOTE 4 *Figure 3.1.2N4 provides a worked example of how to calculate the 85th percentile speed using Equations 3.1.2a to 3.1.2d. In this example, a spot speed survey recorded the speeds of 200 vehicles. The sum of the 200 vehicle speeds equals 9,400 and the sum of the squares of the 200 vehicle speeds equals 450,810. Rounding to the closest whole number gives an 85th percentile speed of 54kph.*

Figure 3.1.2N4 Example of how to derive 85th percentile speed using equations 3.1.2a to 3.1.2d.

Step 1

$$m = \frac{\sum v}{n}$$

$$m = \frac{9{,}400}{200}$$

$$m = 47$$

Step 2

$$\sum (v-m)^2 = \sum v^2 - \frac{(\sum v)^2}{n}$$

$$\sum (v-m)^2 = 450{,}810 - \frac{9{,}400^2}{200}$$

$$\sum (v-m)^2 = 450{,}810 - 441{,}800$$

$$\sum (v-m)^2 = 9{,}010$$

Step 3

$$s = \sqrt{\frac{\sum (v-m)^2}{n-1}}$$

$$s = \sqrt{\frac{9{,}010}{200-1}}$$

$$s = \sqrt{45.28}$$

$$s = 6.73$$

Step 4

$$p85 = m + s \qquad p85 = 47 + 6.73 \qquad p85 = 53.73$$

3.2 For the setting of speed limits where the speeds of all motor vehicle types have been used, the following shall be added to the calculated 85th percentile speed for every 15% of heavy good vehicles in the sample:

1) 1kph for single carriageway roads; and
2) 2kph for dual carriageway roads.

NOTE *When speed measurements that include all motor vehicle types are used for the purpose of setting speed limits, it is necessary to adjust the calculated 85th percentage speed based on the percentage of heavy goods vehicles in the sample. The adjustment ensures that the resultant 85th percentile speed reflects that of cars only.*

4. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'

5. Informative references

The following documents are informative references for this document and provide supporting information.

Ref 1.I	Department for Transport. DfT Circular 01/2013 , 'Setting local speed limits'