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20mph Research Study

Supporting Technical Appendix
Methodology Description Report

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1. Introduction

In July 2014, Atkins, AECOM and Professor Mike Maher of University College London, were commissioned by the Department for Transport to evaluate the effectiveness of 20mph signed only speed limits, based on twelve case study schemes in England and various comparator areas with a 30mph limit in place.

The purpose of the research is to:

- strengthen the evidence base regarding the effectiveness of 20mph limits;
- inform future policy development on 20mph speeds and limits at a national and local level;
- identify lessons learned regarding the implementation and monitoring of 20mph signed only speed limits, to guide local authorities considering introducing 20mph limits.

The study comprises a **process evaluation** which looks at why and how case study schemes were delivered, and an **impact evaluation** which examines the effectiveness of schemes in delivering intended changes in attitudes and behaviour of residents and other road users.

The overall aims of the research are:

1. Evaluate the effectiveness of 20mph speed limits in terms of the range of outcomes and impacts;
2. Examine the perceptions and attitudes of different user groups towards 20mph speed limits; and
3. Evaluate the processes and factors which contribute to the effectiveness of 20mph speed limit schemes.

This report sets out the detailed methodology used to undertake the evaluation. It describes:

- the use of case study schemes as a key source of evidence for the research, supplemented by a Rapid Evidence Review, and interviews with national stakeholders;
- the evaluation framework used to guide the research, including the theory of change model applied to the case study schemes, process and impact evaluation elements, and the use of a contribution analysis approach; and
- the data sources which form the evidence base for the research, and their role in addressing the research questions.

2. Case study approach

2.1. Introduction

The overall research approach is primarily based on evidence from twelve case studies, comprising a variety of area types (city/metropolitan to small town locations), different road types (e.g. in terms of geometry, land-use and on-street parking), and scale (small-scale and area-wide). These 'core schemes' inform both the process and impact evaluation elements of the research.

A further three case studies cover local authorities that have chosen not to implement a 20mph limit scheme ('no schemes'), and are used to understand the barriers and considerations behind such decisions.

In addition, three comparator areas are used to identify background trends in speeds on 30mph roads with similar characteristics to the 'core schemes'; and regional-based data is used to identify background trends in collisions and casualties on similar 30mph roads.

2.2. Case study selection process

A comprehensive and robust process was undertaken to identify the case study schemes (Figure 2-1), with the chosen schemes meeting the following criteria:

- willingness to participate in the research;
- scheme implemented less than three years before the start of the study (in the majority);
- no / minimal presence of zones within the scheme area;
- availability and quality of 'before data' (accident, speed, flow, etc.) and availability or commitment to collect consistent 'after data' (accident, speed, flow, etc.).

In addition, the chosen schemes comprise a range of geographical locations, authority types, scheme locations and contexts.

The selected case studies are summarised in Table 2-1.

2.3. Case study typologies

Core schemes

The twelve core schemes informing both the process and impact evaluation, cover nine authorities (three metropolitan, two county and four urban unitary), with three authorities providing two case study schemes (either two separate schemes or two contrasting areas of a large area-wide scheme).

The schemes have been categorised as:

- either **predominantly residential areas (including schools)**, or **city centre and adjacent residential areas**; and
- **small scale standalone schemes** comprising a small cluster of self-contained residential roads surrounded by conventional 30mph roads, or **area-wide** covering a larger proportion of the town or city.

This gives the following breakdown:

- predominantly residential and schools – small scale standalone (R-SM) **(two schemes)**;
- predominantly residential and schools – area-wide (R-AW) **(eight schemes)** - *reflecting the main focus of 20mph schemes more widely*;
- city or town centre and adjacent residential areas (TC-AW) **(two schemes)**.

Figure 2-1 Case study selection process

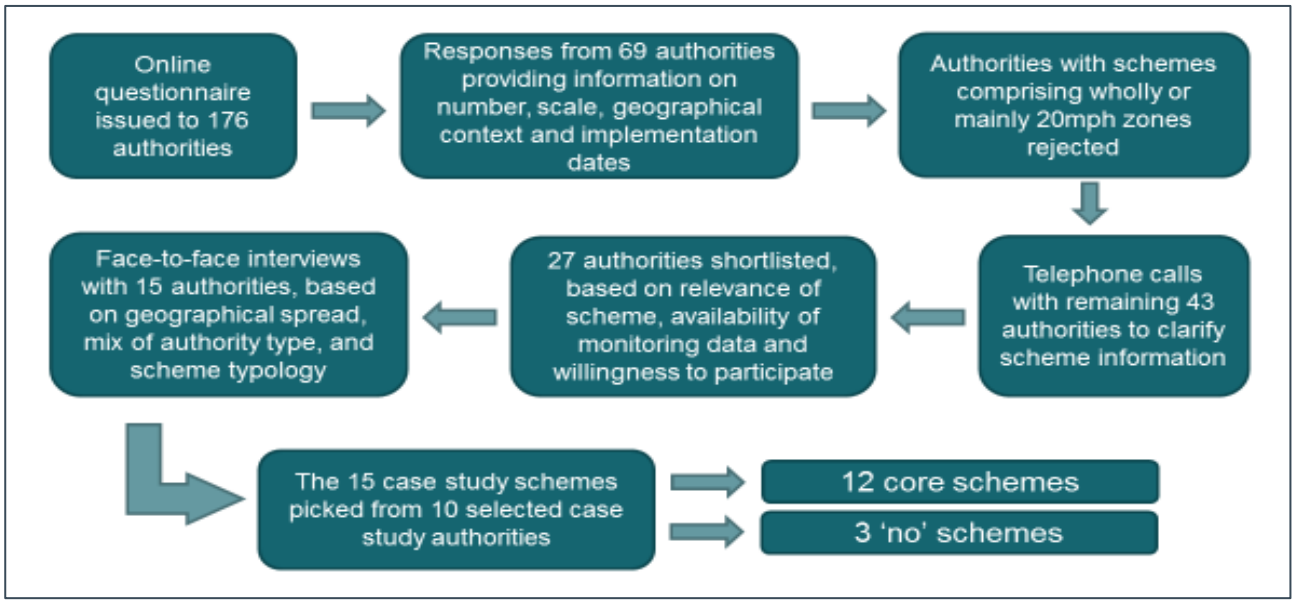


Table 2-1 Summary of case study schemes (12 core schemes)

Case Study ID	Typology	Area-wide / Standalone	Geography	Authority Type	Implementation Date
R-SM1 Walsall (Rushall)	Predominantly residential and schools	Small scale standalone scheme	Large city Midlands	Metropolitan unitary authority A	Mar 2014
R-SM2 Winchester (Stanmore)	Predominantly residential and schools	Small scale standalone scheme	Medium town / city South of England	Large county authority A	Jul 2014
R-AW1a (Area A) Liverpool (Area 7)	Predominantly residential and schools (city centre periphery)	Area-wide scheme	Large city North of England	Metropolitan unitary authority B	Apr 2014
R-AW1b (Area B) Liverpool (Area 2)	Predominantly residential and schools	Area-wide scheme	Large city North of England	Metropolitan unitary authority B	Jan 2015
R-AW2 Middlesbrough	Predominantly residential and schools	Area-wide scheme	Large industrial town North of England	Urban unitary authority A	Mar 2012 – Jun 2013
R-AW3 Calderdale (Phase 1)	Predominantly residential and schools	Area-wide scheme	Large urban area North of England	Metropolitan unitary authority C	Jun 2015
R-AW4 Nottingham (Bestwood)	Predominantly residential and schools	Area-wide scheme	Large city Midlands	Urban unitary authority B	Apr 2014
R-AW5 Brighton (Phase 2)	Predominantly residential and schools	Area-wide scheme	Large town / city South of England	Urban unitary authority C	Jun 2014
R-AW6 Portsmouth	Predominantly residential and schools	Area-wide scheme	Large town / city South of England	Urban unitary authority D	Pre-2010
R-AW7[1] Chichester	City centre + residential and schools	Area-wide scheme	Small town / city South of England	Large county authority B	Jul 2013

[1] Classified as 'predominantly residential' to reflect the area used for the social research.

Case Study ID	Typology	Area-wide / Standalone	Geography	Authority Type	Implementation Date
TC-AW1 Brighton (Phase 1)	City centre and adjacent residential areas	Area-wide scheme	Large town / city South of England	Urban unitary authority C	Apr 2013
TC-AW2 Winchester (City Centre)	City centre and adjacent residential areas	Small scale standalone scheme	Medium town / city South of England	Large county authority A	Sep 2014

No schemes

The three case studies where schemes have not been implemented for various reasons are summarised in Table 2-2.

Table 2-2 Summary of 'no schemes'

Case Study ID	Typology	Area-wide / Standalone	Geography	Authority Type	Implementation Date
No-Scheme1 London Borough	No schemes being considered	-	Large city	London Borough A	Not implemented
No-Scheme2 Metropolitan Borough	Predominantly residential and schools	Small scale standalone scheme	Large city Midlands	Metropolitan unitary authority A	Not implemented
No-Scheme3 County Borough	Predominantly residential and schools	Area-wide scheme	Medium town South of England	Large county authority B	Not implemented

2.4. Overview of core case studies

The twelve case study schemes vary in terms of date of implementation, size, street environment and context and overall design.

Date of implementation - Eleven of the core case study schemes were implemented between 2012 and 2015, with the remaining one (a pioneering area-wide scheme in Portsmouth) implemented before 2010, allowing longer term impacts to be observed.

Scheme size – The case study schemes have been implemented over a wide range of scales, varying from individual neighbourhoods to area-wide schemes covering large metropolitan cities. The length of new 20mph limit (signed only) varies from 6km in Walsall (Rushall) to 160km in Brighton Phase 2 (one of three phases covering the whole of the city).

Both the small-scale residential schemes were part of a programme of pilot schemes being implemented by the respective authorities to determine the effectiveness of 20mph limits in delivering a range of objectives.

The Liverpool, Middlesbrough, Calderdale, Nottingham, and Brighton case studies are all part of a wider city-based initiative implemented in phases, but are still substantial areas in their own right.

Hours of operation – All schemes operate 24 hours a day, 7 days a week.

Nature of street environments and inclusion / exclusion of different road types – The case study schemes comprise a mix of housing types and ages, carriageway and road widths, and levels of on/off-street parking.

- The two small scale residential case studies both comprise a blanket 20mph limit[2] within an area bounded by strategic routes (A and B roads), and other natural boundaries (e.g. a railway line, and areas of green space) which provides a clear distinction between roads with 20mph speed limits and those without.

[2] *With the exception of one un-adopted highway in one of the case study areas.*

- The area-wide schemes typically cover most roads within the town / city. However, none of the schemes have applied a blanket 20mph limit. All schemes exclude some roads, typically strategic routes (e.g. A and B roads), but in some cases also key bus routes, distributor roads, streets with non-residential frontages, and wider roads. Some schemes also exclude streets with average speeds >24mph or with known speeding issues - where a lower speed limit is expected to be less appropriate or unlikely to be self-enforcing. Exceptions to these 'exclusion rules' often occur near schools, community facilities and commercial areas where there are high levels of pedestrian activity, justifying a 20mph limit.

  Some authorities (e.g. Portsmouth) have kept in streets which were considered to be less suited to a 20mph limit, in order to avoid isolated 30mph roads surrounded by 20mph limits, and to provide consistency in signage and road user perceptions.

  Some authorities (e.g. Brighton) had excluded individual or clusters of roads on the basis of opposition from residents at consultation stage. This has led to a less contiguous scheme.

Case Study Example 2.1 – Examples of excluded streets in areas-wide schemes
Liverpool *- Excludes classified 'A' and 'B' roads, main bus routes with high frequency services, distributor roads, industrial estates, roads with no residential frontages, and roads which are wider than one carriageway.*
However, 20mph limits have been introduced on some shopping streets classified roads or main bus routes, due to the high levels of pedestrian activity. A small number of non-residential roads have also had 20mph limits introduced, to promote them as quiet cycling routes (these often run parallel to busier main roads).
Advisory 20mph signs have been introduced where schools are located on main roads.
Middlesbrough *- Excludes strategic routes, those fronted by non-residential uses, residential streets with no direct frontage, wider roads and those with speeding problems.*
Brighton *- Excludes main roads and key arterial routes; but some A and B roads included on the basis of flow, speeds, casualties, and layout. Further roads / areas were excluded following consultation with residents.*

- Two of the schemes cover city centre areas. Brighton Phase 1 is part of an area-wide scheme which covers the whole of the city of Brighton. Phase 1 covers the core city centre area and the adjacent residential neighbourhoods. Winchester City Centre scheme comprises a blanket 20mph limit across all roads within the scheme area. Here, the boundary has been kept very tight around the city centre, coinciding with the historic city wall, so that drivers observe the change in the environment, recognise that they are entering the main city centre area, and know to adopt a different driving style.

Presence of pre-existing 20mph limits / zones – Almost all of the case studies have some pre-existing 20mph limits or zones in place; often outside schools. In most areas the 20mph zones have been adopted into the 20mph speed limit scheme, with traffic calming measures (such as road humps and chicanes) left in place. However, in one case (Middlesbrough), the Council removed approximately a third of the existing traffic calming measures, following a residents' campaign for their removal. Residents felt that physical measures were no longer required once the area-wide 20mph limit had been introduced.

3. Evaluation framework

3.1. Process and impact evaluation

The study approach comprises both process and impact evaluation elements, to fully address the requirements of the research specification.

The **process evaluation** focuses on the delivery process, in terms of:

- the rationale for scheme implementation, the objectives, and the resources and processes associated with the development and implementation of schemes (i.e. the inputs);
- the specifications of the schemes (i.e. the outputs); and
- the barriers and enablers which influence the extent to which actual outputs are delivered and match the original specification.

The **impact evaluation** draws on a combination of qualitative and quantitative evidence to monitor direct transport outcomes, such as traffic speeds, flows and casualty rates; as well as the wider impacts relating to environment, health, community, and economy. It evaluates the effectiveness of schemes in delivering intended benefits in different contexts.

3.2. Theory of change approach

Our overall approach to undertaking the evaluation is informed by a **theory of change** (or logic map) which describes the assumed process or logic by which 20mph speed limits are intended to deliver changes in traffic speed and casualty rates, influence travel behaviour, and lead to associated environmental, health, community and economic benefits. The theory of change model can be thought of as a set of underlying hypotheses, to be tested through the research. It is based on a core input-output-outcome/impact model (which represents the relationship between 20mph speed limit introduction and the change on the ground), along with consideration of barriers and enablers to delivery and wider context and external factors:

- **Inputs** - Inputs are the resources which are invested in implementing the project. This includes funding but also human resources such as the time invested, skills required and other inputs such as equipment, technology and research.

- **Outputs** are the tangible deliverables – 20mph roadside signs, 20mph roundels on the carriageways, etc. along with a description of the number and coverage, and an understanding of the user groups which the intervention is designed to impact on.

- **Transport outcomes** - Outcomes are the observable changes in travel behaviour, attitudes and perceptions, driven by the above intervention (outputs). Evaluation of outcomes enables assumptions to be tested about the effectiveness of outputs to deliver anticipated benefits.

- **Wider impacts** - Impacts are the longer-term effects which result from the delivery of the primary outcomes, and typically extend beyond the transport sphere, e.g. environmental, health, community, and economic objectives.

- **Barriers and enablers** - Barriers are factors which influence the extent to which the actual outputs delivered match the original specifications, in terms of scale, quality, location, timescales, etc. For example, delivery may get delayed due to lack of design resources, or scaled down due to budget cuts. These factors may explain why the observed outcomes are more / less significant or different from those originally anticipated.

- **Wider context and external factors** - External factors are changes in the wider environment which support or hinder achievement of intended outcomes, e.g. the urban form, the presence of other road safety and speed reduction interventions in the locality, and local attitudes. A sound understanding of the current and changing context in each of the locations will be important in understanding the effectiveness of measures in the different case studies and the extent to which the findings are transferable to other locations.

A baseline **theory of change** (**or logic map**) was produced during the study scoping stage, based on existing published research (identified through a Rapid Evidence Review) and interviews with national stakeholders. This mapped the *possible* causal pathways from the implementation of a generic 20mph limit scheme in order to deliver scheme objectives in line with the Department for Transport's Circular 01/2013, and identified evidence gaps.

Feedback on the baseline map, and its applicability to each of the case study typologies, was then sought from local case study stakeholders. Three separate maps were subsequently developed to demonstrate the different causal pathways for the three different scheme types: predominantly residential schemes (small scale); predominantly residential schemes (area-wide); and predominantly city centre schemes (Figures 3-1 to 3-3).

The black text describes stakeholders' understanding of how the schemes were expected to deliver their intended outcomes; while the red text highlights potential negative impacts which are not intended, but which may occur nevertheless. The grey shaded boxes help illustrate the differences between the logic maps.

The logic maps were used to inform the data collection and analysis elements of the study, helping to define questionnaires and topic guides and develop the methodologies for analysing speed and collision/casualty data which addressed the research questions and the requirements of the evaluation.

3.3. Contributional analysis approach

Demonstrating a causal link between observed outcomes and the implemented case study schemes is challenging, requiring different approaches and sources of evidence to provide a convincing explanation of observed change. A contribution analysis approach has therefore been adopted, involving the following key elements:

- **Analysis of intervention logic** – A logic mapping approach has been adapted to examine how the case study schemes are intended to achieve their outcomes through a series of logical pathways or causal chains.

- **Contextual analysis** - Experience in undertaking complex evaluation studies has demonstrated the importance of a clear understanding of the scheme context, scheme details and intended vs. actual outcomes, in determining the effectiveness of interventions.

- **Use multiple data sources -** The evidence base for the research comprises a mix of quantitative and qualitative sources, allowing us to:

  - triangulate evidence and identify a range of viewpoints and alternative explanations;
  - test for consistency and divergence in the emerging findings;
  - undertake in-depth investigation to identify causes behind conflicting evidence and explanations; and
  - identify a best fit answer based on a range of evidence available.

- **Define and test alternative explanations** - Stakeholder interviews and focus groups have enabled us to explore alternative explanations for observed changes (e.g. delivery of a town-wide road safety education programme simultaneously with a 20mph limit implementation). Understanding the contribution of each intervention through end user consultation is central to robust research.

- **Identify and measure behaviour changes** - The evidence base combines qualitative and quantitative research which together provides observations of behaviour change, and indications of causality.

3.4. Comparator analysis

To strengthen the evidence relating to changes in speed and collisions / casualties, data for comparator areas has been used to compare case study trends with background trends on 30mph roads with similar characteristics to the case study areas. This provides a more robust methodology than a simple before and after analysis, and provides evidence on the extent to which case study changes can be attributed to the introduction of 20mph limits.

Figure 3-1 Theory of change – Logic map illustrating intended benefits process for predominantly residential schemes (small scale)

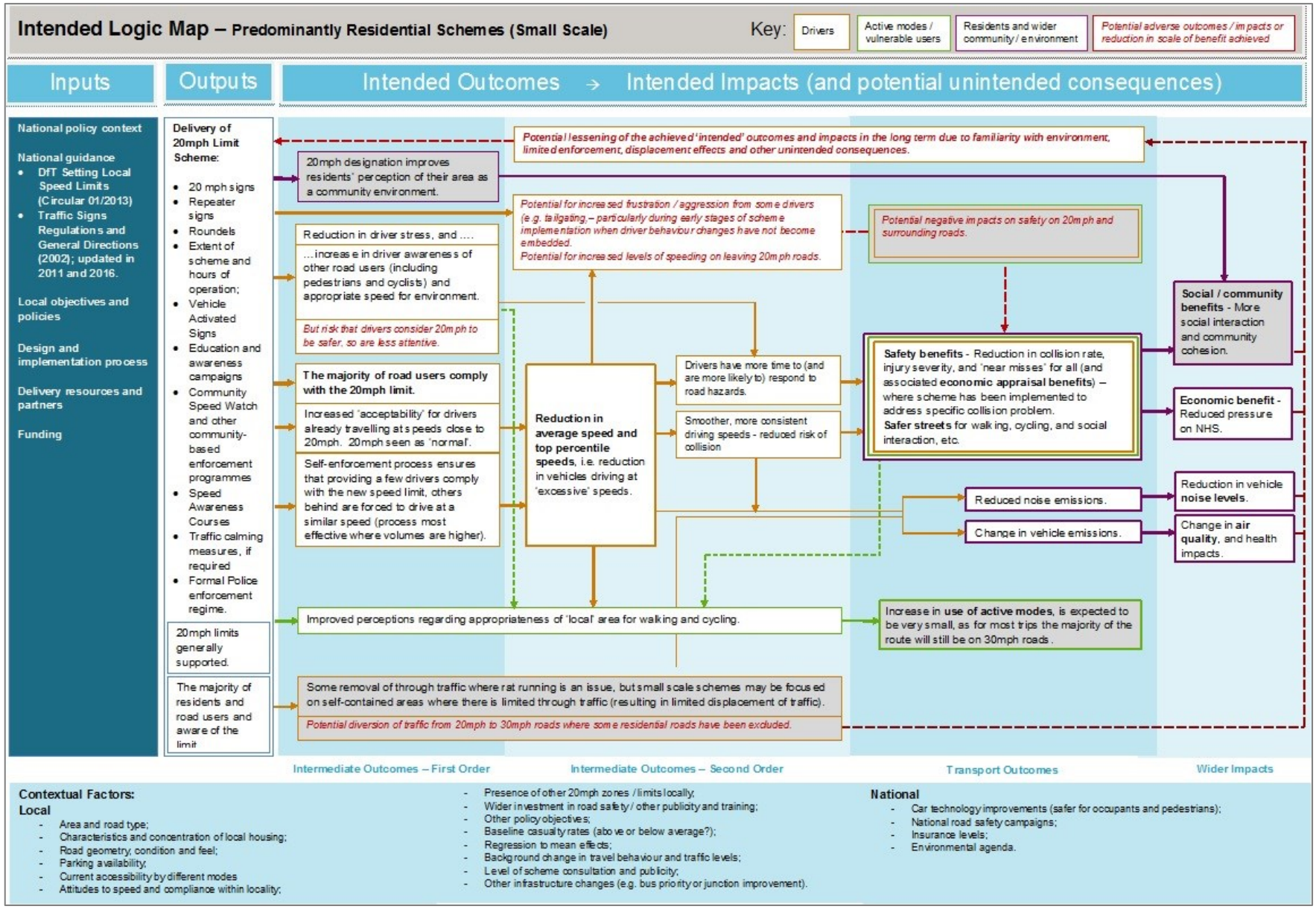


Figure 3-2 Theory of change – Logic map illustrating intended benefits process for predominantly residential schemes (area wide)

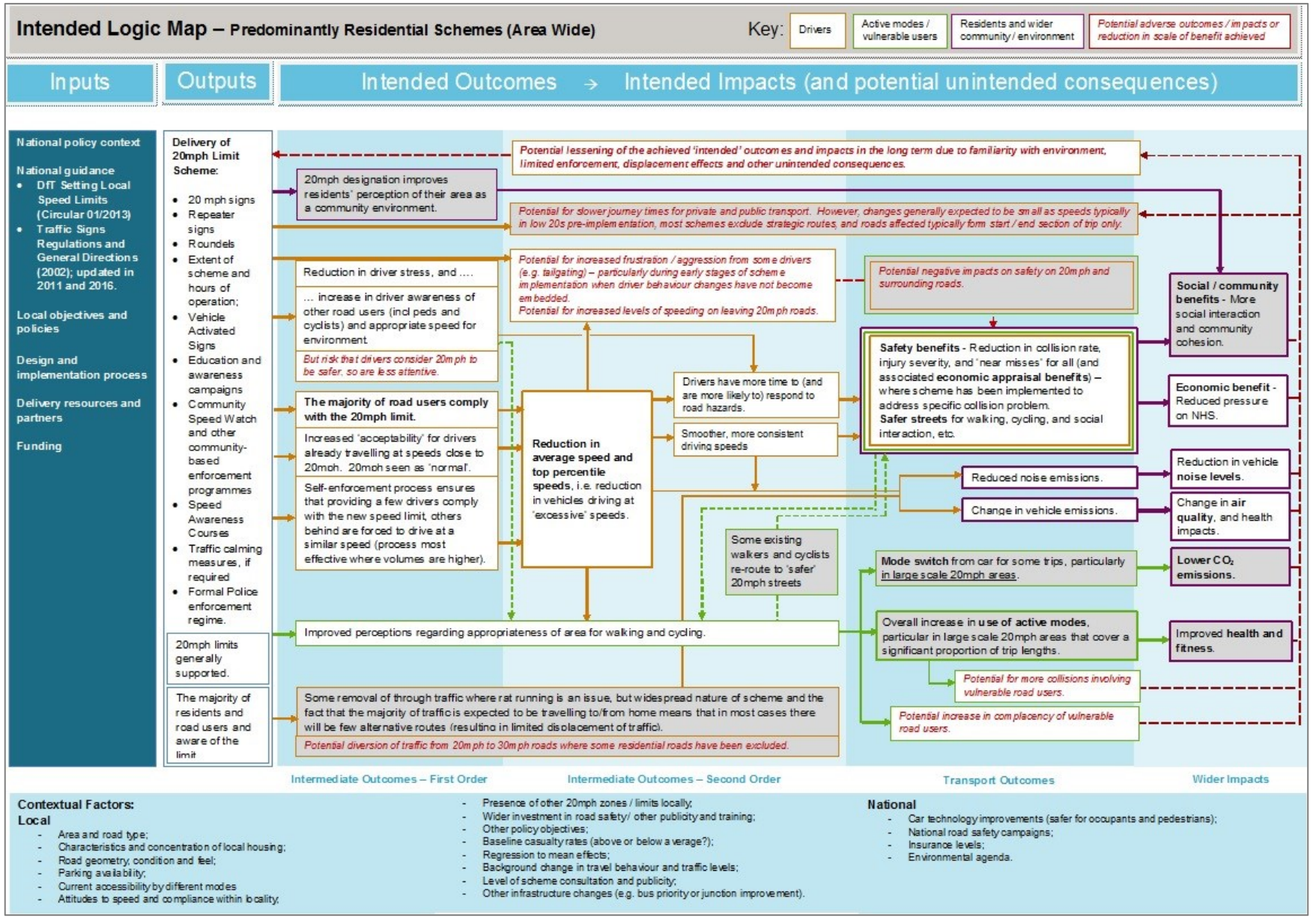
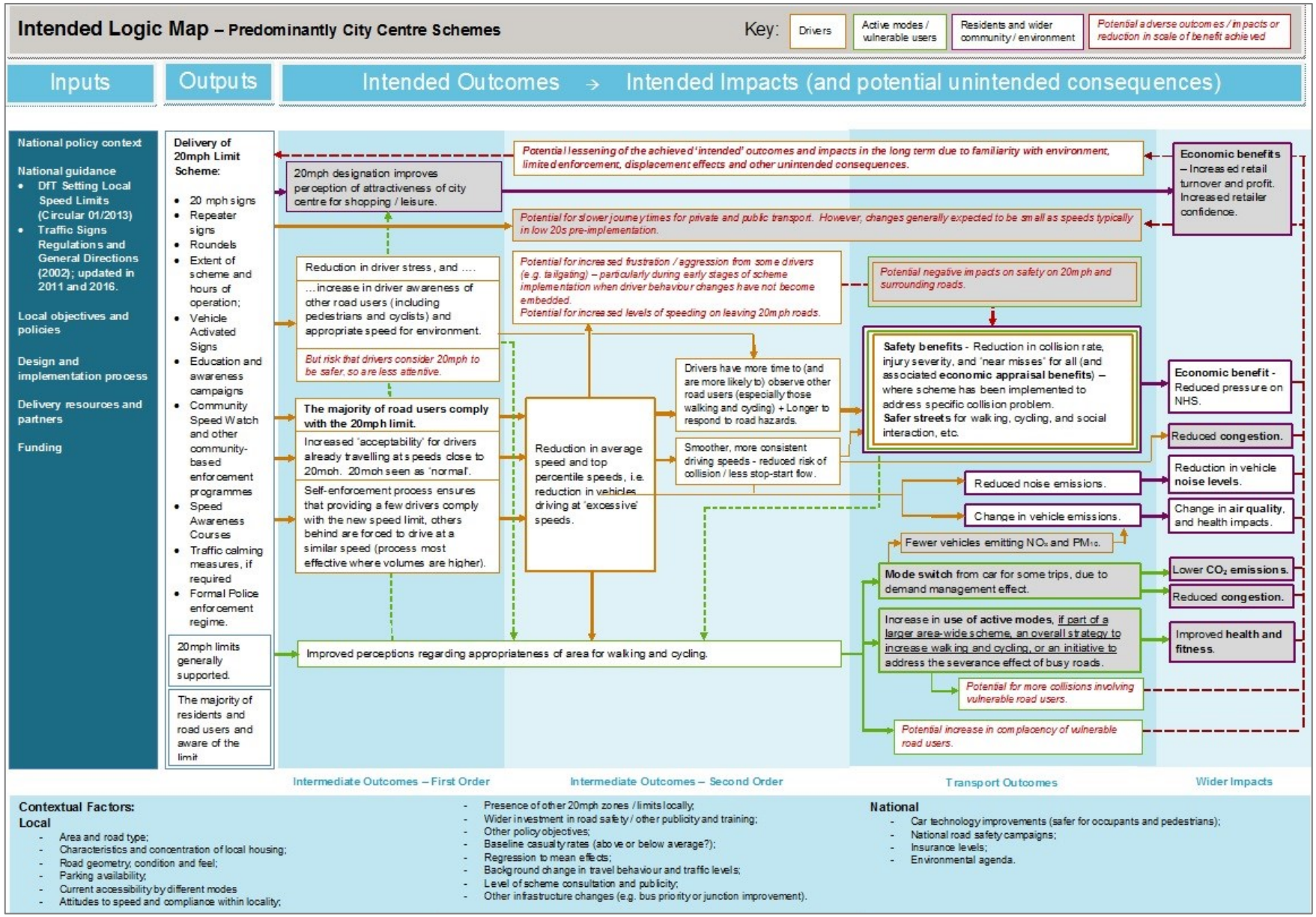


Figure 3-3 Theory of change – Logic map illustrating intended benefits process for predominantly residential schemes (city centre)



4. Evidence base

4.1. Introduction

The evaluation is based around the following national and case study-based evidence sources:

- a Rapid Evidence Review summarising published research;
- semi-structured interviews with a range of national stakeholders during the scoping stage;
- semi-structured interviews with local case study stakeholders at various stages during the study;
- questionnaire surveys with residents and non-resident drivers/riders in the case study areas;
- nationwide online questionnaire surveys with cyclists and motorcyclists;
- in-depth interviews with 176 drivers participating in the drivers' questionnaire survey;
- nine focus groups with specific user groups in the case study areas;
- area-wide journey speed data from in-car GPS devices (based on over 3 million vehicle kilometres of data for new 20mph limit roads) and instantaneous spot speed data collected by local authorities (covering over 400 monitoring sites); and
- STATS19 collision and casualty data.

These are described in further detail below.

4.2. Rapid Evidence Review

A rapid evidence review was undertaken during the scoping phase to determine what evidence already exists in respect to 20mph limits, zones, and advisory schemes; confirm gaps in current understanding; and inform the baseline logic map.

4.3. In-depth interviews with national stakeholders

Semi-structured interviews were undertaken with a range of national stakeholders (Table 4-1) during the scoping stage to clarify the objectives of the research; identify useful evidence sources; and obtain national perspectives on scheme drivers, objectives, and effectiveness.

Table 4-1 National stakeholders interviewed during scoping phase

Organisation
• Department for Transport (DfT) • PACTS Parliamentary Advisory Council for Transport Safety, an All-Party Parliamentary Group • Chartered Institution of Highways and Transportation (CIHT) • Association of Chief Police Officers (ACPO) • Public Health England (PHE) • Road Safety Great Britain (RSGB) • 20's Plenty for Us • Association of British Drivers (ABD)

4.4. In-depth interviews with local case study stakeholders

In-depth interviews were undertaken with a range of local case study stakeholders (Table 4-2) in summer / autumn 2015. The purpose was to inform the process evaluation; provide qualitative evidence on scheme outcomes and impacts to challenge or enrich the quantitative evidence from the residents and drivers' questionnaires / interviews; review data collected through direct monitoring; and hypothesise about causal links. At the time the majority of case study schemes had been in place for approximately 2 years or less.

Further interviews were undertaken with local authority officers in 2016 and 2017, to obtain additional information on scheme costs, obtain any additional monitoring data collected, and to address other gaps in the research evidence.

Table 4-2 Local stakeholders interviewed during main research phase

Stakeholder type	Organisation	Number of case studies represented	
Involved in scheme delivery	Local authority officers	12 core schemes	3 'no' schemes
	Local Councillors	9 core schemes	2 'no' schemes
	Police	6 core schemes	1 'no' scheme
	Primary Care Trust / Public Health Officer	2 core schemes	-
	Community engagement representatives	2 core schemes	-
Users	Local bus operator	3 core schemes	1 'no' scheme
Campaign and local community groups	Cycle campaign groups	3 core schemes	-
	Climate change campaign groups	1 core schemes	-
	Pro-20mph campaign groups	1 core schemes	1 'no' scheme
	Anti -20mph campaign groups	-	1 'no' scheme

Several attempts were made to arrange interviews with schools in two of the case study areas, but it was not possible to undertake any interviews. However, two focus groups were held with parents with children aged 7-10.

4.5. Residents and drivers/riders questionnaire

4.5.1. Residents' doorstep questionnaire

Household face-to-face questionnaire interviews were conducted to identify attitudes, perceptions and behaviours amongst the following groups:

- **residents living on the road with a 20mph limit** - **directly affected by the scheme** - surveyed in all core case studies, except R-AW6 (Portsmouth) which was implemented more than 5 years ago.

- **residents living on adjoining / connecting streets – likely to be indirectly affected in some way** – surveyed in two locations where there are adjacent 30mph streets providing an alternative route. For the majority of case studies this is not the case because: the 20mph roads do not offer a cut-through to elsewhere and therefore people living on adjacent roads will not have been impacted by the scheme; the areas adjacent to the case study areas are also in 20mph limits or zones; or the area is bounded by a major road.

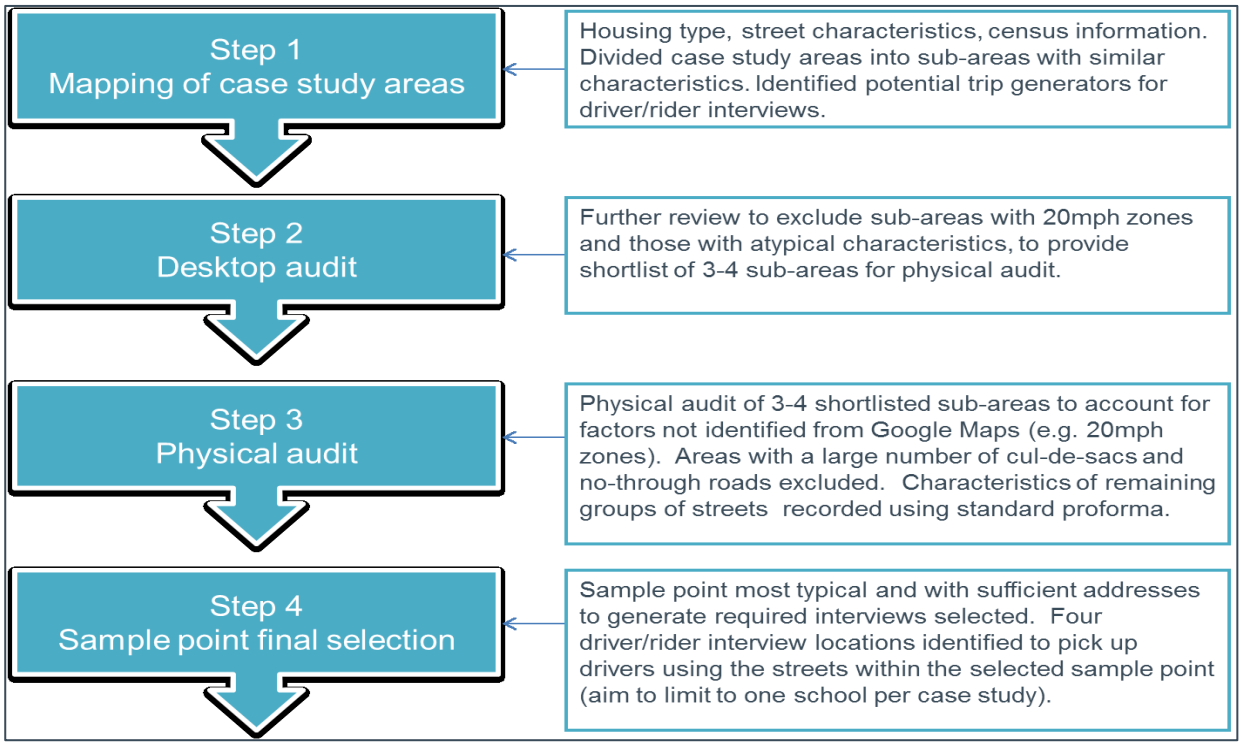
The questionnaire design was informed by the baseline logic map.

Each of the case study schemes comprises a broad diversity of road types and environments, which would introduce significant 'noise' into the data if a random sampling approach was applied across the entire area. Instead sampling was restricted to a cluster of adjacent streets which were homogeneous in terms of their physical characteristics, and which were broadly representative of the case study area characteristics. Clusters were chosen to reflect a broad range of characteristics across the entire case study sample in terms of relative affluence / deprivation, age groups, road width and distance from road to properties, proportion of green space, land use, level of on-street parking, and signage. This approach minimises data 'noise' at a case study level, but enables regression analysis to be undertaken across the entire sample to determine the role of these contributory factors on the perceptions and behaviours of drivers.

Once a sample area was selected, interviews were attempted at all households (i.e. a census approach); or at every nth household if the sample area was too large for such an approach, taking into account the expected response rate.

The approach was piloted in two case study areas at the end of June / early July 2015, with interviews for the remaining case studies staggered through end of July to November 2015.

Figure 4-1 Process for selecting sample areas



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The sample sizes achieved across each case study are summarised below (Table 4-3). A minimum sample size of 175 was set for each residential scheme spanning both direct and indirect residents, and 210 for schemes covering town centres. The sample size for R-AW3 (Calderdale) is lower because it was intended that indirect residents would also be surveyed here, but the area was found to be unsuitable for this following the physical audit. The number of interviews achieved with indirect residents in R-AW4 (Nottingham) was lower than the target 100 once fieldwork had been completed and all addresses exhausted. The total sample size achieved was 2170 against a target of 2125.

The response rate (i.e. the proportion of residents interviewed) was 33% across the 11 sample areas, varying from 25% to 48%.

Table 4-3 Sample sizes by case study (questionnaires and in-depth interviews)

Case Study ID	Direct residents	Indirect residents	Drivers / Riders	Drivers / Riders Int
Walsall (Rushall) (R-SM1)	180 (35%)	-	110	16
Winchester (Stanmore) (R-SM2)	173 (35%)	-	110	16
Liverpool (Area 7) (R-AW1a)	210 (29%)	-	124	16
Liverpool (Area 2) (R-AW1b)	180 (25%)	-	110	18
Middlesbrough (R-AW2)	110 (35%)	102 (35%)	110	16
Calderdale (Phase 1) (R-AW3)	133 (25%)	-	112	16
Nottingham (Bestwood) (R-AW4)	177 (35%)	75 (39%)	112	16
Brighton (Phase 2) (R-AW5)	193 (37%)	-	110	16
Portsmouth (R-AW6)	-	-	-	-
Chichester (R-AW7)	214 (34%)	-	113	16
Brighton (Phase 1) (TC-AW1)	209 (48%)	-	132	16
Winchester City Centre (TC-AW2)	214 (28%)	-	112	14
Total	**1993**	**177**	**1256**	**176**

% of households interviewed shown in brackets.

The profile of residents interviewed is summarised in Table 4-4. Although the exact population demographics of residents in the sample areas is unknown, both the direct and indirect samples show a high proportion of female, older (60+) and non-working respondents.

Table 4-4 Profile of residents and drivers / riders interviewed

Characteristic	Description	Direct residents	Indirect residents	Drivers and riders
Age group	17-34	19%	15%	19%
	35-59	41%	39%	53%
	60+	41%	46%	28%
Gender	Female	56%	55%	47%
Working status	Not working	55%	62%	30%
Ethnicity	White British	86%	74%	93%
Drive	Yes	84%	84%	100%
Household composition	Adults 18 or over only	73%	-	-
	Children aged 11-17	8%	-	-
	Children aged 0-10	14%	-	-
	Children aged 0-10 and 11-17	5%	-	-

4.5.2. Non-resident drivers / riders on-street questionnaire

Face-to-face on-street questionnaire interviews were conducted with **drivers/ riders passing through but not living within the 20mph limit scheme areas**, in all core case study areas except R-AW6 (Portsmouth) which was implemented more than 5 years ago. The questionnaire focused on attitudes, perceptions and behaviours, and any evidence of leakage, displacement or unintended consequences (e.g. displacement of traffic to other routes, driver frustration, etc.).

As above, the questionnaire design was informed by the baseline logic map.

Interviews were conducted with drivers / riders parked at or visiting a number of sites within or just outside each of the sample areas selected for the residents questionnaires. In order to ensure a range of different drivers/journey purposes, interviews were conducted in at least four different locations within each sample area covering retail areas, leisure areas, industrial areas, employment sites, medical services, and schools and colleges, depending on availability. Drivers/riders who were not familiar with driving/riding in the sample area, and those already living in the sample area were excluded.

In general, interviews were attempted with all potential driver/riders due to the low levels of non-residential traffic. Fieldworkers monitored journey purpose, age and gender at the end of each interview shift, and if a reasonable mix of respondents had not been obtained, the locations for future shifts were changed.

The approach was piloted in two case study areas at the end of June / early July 2015, with interviews for the remaining case studies staggered through end of July to November 2015.

Sample sizes achieved across each case study are summarised above (Table 4-3). A minimum sample size of 110 was set for sample area.

The profile of drivers and riders interviewed is also summarised above (Table 4-4). This shows clear differences between the residents and the drivers/riders sample. The drivers/riders sample shows a greater spread in terms of age, gender and working status, with an almost equal split for gender and a higher proportion of both those aged 35-59 (53%) and working respondents (70%).

Drivers were also asked a number of questions about their journeys. The majority of drivers were travelling in a car (85%); with recreation/ leisure the main journey purpose (68%), followed by work commute (14%) and work business (12%). Over four fifths (86%) were frequent users of the roads in the area.

4.5.3. Headline findings

The questionnaire results were analysed by:

- respondent type (residents living on a 20mph limit road, residents living on an adjacent street, and non-resident drivers / riders);
- case study typology (residential – small scale, residential – area wide, and city centre); and
- case study area.

4.5.4. Regression analysis

Logistic regression analysis was then undertaken to gain insight into what factors (represented by so called independent variables) influence the following key outcome-related research questions (represented by so called dependent variables), using data collected from the residents and driver questionnaires and site visits:

- Do drivers, residents and local workers support 20mph speed limits?
- Do drivers and riders comply with 20mph speed limits?
- Do 20mph speed limits achieve their objectives - speed?
- Do 20mph speed limits achieve their objectives - perceptions of environment and safety?
- Do 20mph speed limits achieve their objective - mode shift?
- Do 20mph speed limits achieve their objectives - driver assessment of risk?
- Do outcomes of 20mph speed limits vary according to road type?
- What effect is there on traffic volumes within the scheme itself and on neighbouring roads?

In particular, the regression analysis seeks to understand:

- how outcomes such as level of support, compliance with limit, and change in speed vary amongst different groups and in different types of areas; and
- to test for association between variables identified as causal factors in the logic maps developed for the three different types of 20mph limit-only schemes (area-wide residential, small scale residential, and city centre).

The dependent variables cover respondent characteristics (demographic features and driving style), characteristics of the area, and behaviour and attitudinal statements (based on the residents and drivers/riders' questionnaires).

Separate models were run for residents and drivers/riders.

The regression models test for association only, rather than causality.

4.6. Drivers and riders telephone in-depth interviews

Drivers/riders taking part in the on-street questionnaires were asked if they were willing to participate in a more in-depth semi-structured telephone interview, conducted by a researcher at a convenient time. The in-depth interviews lasted approximately 30 minutes and respondents were offered a £15 voucher incentive to participate (paid on completion).

Topics covered included:

- reasons for choice of route and use of 20mph roads;
- how perceptions regarding compliance and enforcement have been formed;
- perceived impacts of the scheme on local residents and drivers / riders and reasons;
- comparison of driving experiences in 20mph limits, 20mph zones, and 30mph areas;
- perceptions of risk, to themselves and other road users;
- reasons for level of support for the scheme.

At least 16 in-depth interviews were conducted in each of the 11 core case study sample areas (Table 4-3). Quotas were set to ensure a representative cross-section of responses by journey purpose, age and gender.

4.7. Focus groups

Focus groups were undertaken in spring and summer 2017 to:

- support the findings of the residents and drivers/riders questionnaires, and explore issues where the questionnaire findings indicate a range of opinions or responses;
- provide additional in-depth evidence on scheme-specific issues emerging from the questionnaire and stakeholder interview evidence;
- capture the views of specific user groups (existing cyclists, new cyclists, young drivers, and parents with young children) to address gaps in the evidence base.

In all cases, participants were local residents, able to provide feedback on a wide range of scheme-related impacts. The topic guide comprised a core set of questions, designed to test hypotheses developed through the theory of change / logic maps. Supplementary questions were also included to address specific location or user group topics.

Each focus group comprised 8 participants, lasted for 1.5 hours, and was conducted by an experienced facilitator. All discussions were recorded and transcribed. Each participant received £30 on completion of the focus group.

Where feasible, participants for focus groups were recruited from the same 20mph limit roads used for the recruitment of questionnaire responders, to ensure compatibility of responses.

Table 4-5 Details of focus groups undertaken

Focus Group	Location	Recruitment approach, participant characteristics, and case study issues
Residents living on 20mph limit roads	Walsall (Rushall)	Recruitment approach and criteria: • Household-based recruitment in case study area. • All participants to have lived on a new 20mph road, since before the 20mph limit was introduced. • All participants to hold a full driving license, with experience of driving in the local area on a regular basis. • Mix of gender, ages, and employment status. Characteristics of participants: • 8 participants. Three lived on Barn Lane. Other criteria broadly met. Key issues: • High levels of pre- and post-scheme opposition. Low levels of reported compliance (in questionnaire surveys). Higher proportion of drivers avoiding the area than elsewhere (drivers' questionnaire).
Residents living on 20mph limit roads	Brighton Phase 1 (City Centre and adjacent area)	Recruitment approach and criteria: • Household-based recruitment. • All participants to have lived on a new 20mph road, since before the 20mph limit was introduced. • All participants to hold a full driving license, with experience of driving in the local area on a regular basis. • Mix of gender, ages, and employment status. Characteristics of participants: • 8 participants. The recruitment criteria were largely met, although half the participants lived on nearby 20mph roads, rather than the roads used for the recruitment of questionnaire responders. There are a large number of flats and multi-occupancy dwellings on the identified roads, and the recruiter struggled to recruit a sufficient number of participants from the core roads identified. This is not thought to have affected the discussion. Key issues: • Residents and drivers most supportive before implementation but least supportive after. High proportion said limit should be changed back to 30mph. Positive reported impacts on driver behaviour, but high levels of driver frustration. (Based on questionnaire responses)

Focus Group	Location	Recruitment approach, participant characteristics, and case study issues
Regular cyclists living on 20mph limit roads	Brighton Phase 2 (Suburban area)	Recruitment approach and criteria: • On-street recruitment, in areas with known cycle parking. Areas targeted included Brighton Station, the City Centre, and Hove High Street. • All participants to have lived on a new 20mph road, since before the 20mph limit was introduced. • Cycle at least once a month, either on the roads in Brighton or on dedicated cycle paths, mainly for utility purposes. • Mix of gender, ages, and employment status. Characteristics of participants: • 8 participants. The recruitment criteria were largely met. 4 were recruited in the Hove area, 2 were from Brighton Station, 1 was recruited in the city centre and 1 in the Brighton area. 5 cycled at least once a week, and 3 at least once a month. Key issues: • Patchy implementation in Phase 2 area with some residential roads choosing to remain at 30mph; low levels of deprivation.
New cyclists	Nottingham (citywide)	Recruitment approach and criteria: • Recruitment via online survey sent to RideWise's email distribution list. RideWise is a Nottingham based charity dedicated to supporting the use of greener forms of transport. It works to help train and educate people about cycling - whether they're budding novices or experienced riders. • All participants to have lived on a new 20mph road (anywhere in Nottingham), since before the 20mph limit was introduced. • Now regular cyclists. • Mix of gender, ages, and employment status. Characteristics of participants: • 6 participants. Criteria broadly met, although level of experience was higher than expected. Ridewise (Nottinghamshire Individual Cycle Training) had been completed by one participant. Key issues: • Cyclist awareness, behaviour and perceptions about safety. Sample comprised local residents, including some local drivers, so were able to provide feedback on a range of 20mph issues.
Parents with children aged 7 to 10 (x1)[1] living on 20mph limit roads	Middles-brough	Recruitment approach and criteria: • Household-based recruitment. • All participants to have lived on a new 20mph road, since before the 20mph limit was introduced. • All participants to hold a full driving license, with experience of driving in the local area on a regular basis. • Mix of gender, ages, and employment status. • Parents with a child aged between 7 and 10, attending a local school. Characteristics of participants: • 5 participants. The recruiter struggled to obtain recruits from the identified roads, therefore the recruitment area was extended to 20mph signed only limit roads in nearby areas, that were also included in the 20mph implementation. Most children walked to school. Key issues: • Parents attitudes, perceived benefits, behaviour, Travel to school, outside play, etc. • High levels of support, pre- and post- implementation.

Focus Group	Location	Recruitment approach, participant characteristics, and case study issues
Parents with children aged 7 to 10 (x1)[1] living on 20mph limit roads	Liverpool Area 2 (Suburban area)	Recruitment approach and criteria: • Household-based recruitment. • All participants to have lived on a new 20mph road, since before the 20mph limit was introduced. • All participants to hold a full driving license, with experience of driving in the local area on a regular basis. • Mix of gender, ages, and employment status. • Parents with a child aged between 7 and 10, attending a local school. Characteristics of participants: • 11 participants. The recruiter struggled to obtain recruits from the identified roads, therefore the recruitment area was extended to 20mph signed only limit roads in nearby areas. The other recruitment criteria were broadly met. Key issues: • Parents attitudes, perceived benefits, behaviour, Travel to school, outside play, etc. • High levels of support and positive outcomes. (Based on questionnaire responses) • Strong health link and very high profile community engagement campaign. Tease out role of public engagement campaign in Liverpool.
Non-drivers living on 20mph limit roads	Liverpool Area 7 (Adjacent to City Centre area)	Recruitment approach and criteria: • Household-based recruitment. • All participants to have lived on a new 20mph road, since before the 20mph limit was introduced. • Non-drivers. • Mix of gender, ages, and employment status. Characteristics of participants: • 8 participants. The recruiter struggled to obtain participants from the identified recruitment streets, and as a result most lived on nearby 20mph limit roads. All were non-drivers. 2 working full time (30+ hours a week), 4 not working, 1 retiree and 1 looks after her children. Key issues: • Strong health link and very high profile community engagement campaign. • High levels of support and positive outcomes reported in questionnaires. • Topic guide focused on attractiveness of area for walking and cycling, and potential improvement in quality of life; also role of public engagement campaign in Liverpool.
Young drivers	Chichester	Recruitment approach and criteria: • Students attending Chichester College. • Mix of genders. Characteristics of participants: • 5 participants. Two learner drivers; two new drivers (1-2 years' experience). Key issues: • Age at which driver habits / attitudes are formed, which may last into later life. Not used to the roads previously being 30mph. May be more vulnerable to pressures from other drivers, when trying to do the right thing.

1 – Agreed with DfT and Steering Group to focus on parents with children aged 7 to 10; rather than those with older children. This reflects government policy (which focuses on promoting walking and cycling amongst primary school children). In addition, these parents are likely to be accompanying their children and will have first-hand experience of the route.

4.8. Cyclist online survey

An online survey was conducted in September 2017 to capture the views and experiences of cyclists. This was circulated through Sustrans via their Twitter account and their LinkedIn profile. The survey was 'live' for approximately 3 weeks. It was targeted at cyclists across the UK, not just those living in the case study areas.

Responses were received from 1,655 cyclists.

The sample is predominantly comprised of regular cyclists, with half of respondents (50%) riding several times a week and 40% riding every day. Most (65%) used a road bike; 69% cycled mainly on the road, primarily in towns / cities; and most were riding for day-to-day utility purposes (40%) or for a mix of utility and leisure purposes (39%). Only 28% stated that they lived on a 20mph road.

Just over half of respondents (52%) were aged between 35 and 54 years old (52%); 14% were aged less than 35; and 35% were aged over 54 years. Overall, 71% of respondents were male in comparison to 26% female. Some 62% of respondents were in full-time time employment; 16% were part time, and 15% retired. Some 88% of respondents categorised themselves as White – British.

4.9. Motorcyclist online survey

An online survey was conducted in September 2017 to capture the views and experiences of motorcyclists. This was circulated through the IAM Road Smart electronic newsletter. The survey was 'live' for approximately 3 weeks. It was targeted at all IAM Road Smart members, not just those living in the case study areas.

Responses were received from 352 motorcyclists.

Nearly all respondents (at least 96%) rode a motorcycle with more than 125cc and had a full motorcycle license. The majority of respondents (54%) rode for leisure purposes and would class themselves as regular or frequent riders. The majority of respondents (57%) rode mainly on single carriageway rural roads. Some 24% mostly rode in built-up areas, with speed limits of 40mph or less. It is these riders who are most likely to have regular experience of 20mph limits. Only 14% stated that they lived on a 20mph road.

The majority of respondents were aged between 45 and 74 years old, with over a quarter of respondents aged 45 to 54 years old. Just 9% of respondents were aged below 44 years old, and 3% were aged over 75 years old. Overall, 92% of respondents were male in comparison to 8% female. Some 54% of respondents were in full-time time employment; and 32% were retired. Some 90% of respondents categorised themselves as White – British.

4.10. Speed data

Evidence on actual speed outcomes in the case study areas is based on two data sources:

- GPS area-wide journey speed data provided by TomTom for the 12 case study areas; and
- spot speed data collected by local authorities representing the 12 case study areas, using inductive loops, radar devices or similar technology.

The two data sources measure speed in very different ways. GPS data measures **journey speed**. This is the effective speed of the vehicle on a journey between two points (e.g. from one end of a road to another). It is calculated by dividing the distance between the two points by the total time taken for the vehicle to complete the journey, including any stopped time. It is therefore influenced by any delays occurring between the two points, such as slowing down to give way to on-coming vehicles, and accelerating / decelerating at junctions. In contrast, spot speed surveys measure the **instantaneous speed** of a vehicle as it passes a specified location.

A summary of the relative strengths and limitations of GPS and spot speed data are summarised in Table 4-6.

Table 4-6 Journey speed and spot speed data – strengths and limitations

GPS area-wide journey speed data	Spot speed data
Strengths	**Strengths**
• Historically available, in a consistent format. • **Provides information on speeds across the whole of the network.** • **Very large sample size when aggregated across all case study areas**. • Data can cover a long time period (e.g. one year before and one year after) - so not biased by seasonality or behaviour on a specific day.	• **Captures data for every single vehicle passing the detection point.** • More accurately represents 'free flow speed' if located in a suitable location. • Allows detailed analysis of behaviour at specific locations. • Provides supporting information on traffic flow and mode split. Some equipment also reports speed data by mode. • Raw data can be analysed by time of day, day of week, etc.
Limitations	**Limitations**
• Only captures vehicles with GPS devices (connected or actively being used). This may result in an affluence or behaviour bias. • Based on full segment traversal, so will record lower speeds where vehicles are stopping or slowing down mid-segment (e.g. to post a letter, to pass a parked car or let another vehicle past); and will be affected by acceleration / deceleration at junctions. • Records are not kept unless vehicles drive from end to end of segment – data for cul-de-sacs is lost. • Low segment samples, compared to spot speeds - maybe just 3% of sample per day. • Aggregated days – cannot filter down to specific days in range chosen.	• Not historically available. • Risk that before and after data are not fully compatible. • Provides data for a limited number of locations only. • Site locations can be biased towards busier and more important routes, and those where speeding has been reported as an issue or are expected to have low level of 20mph compliance. • Data is typically collected for a short period only - can be affected by seasonality issues or biased by behaviour on a specific day. • Devices can malfunction resulting in missing or mis-leading data. • Data is typically collected for a short period only (normally a maximum of two weeks, but often less).

4.10.1. GPS area-wide journey speed data

Description – TomTom stores second-by-second probe data from all TomTom GPS devices where users voluntarily and explicitly agree to share the journey time statistics anonymously. All TomTom navigation systems record their location each second, and this data can be uploaded to TomTom either automatically (in the case of connected devices) or during the installation of periodic software updates when connected to a personal computer. The TomTom database includes data from personal navigation devices (PNDs), embedded in-car devices, fleet management systems and navigation apps on smartphone handsets.

A growing proportion of the data comes from in-car fitted connected devices which are recording all of the time, even when not actively being used for navigation. The rest of the data comes from stand-alone devices, which only record data when actively being used for navigation.

All data received is processed to protect privacy and filter out potentially anomalous results before storing it within a geographic database (known as the Traffic Stats Database) which can be queried online. The database attaches individual GPS probes to road 'segments'. Segments are short sections of the road network (typically less than 100m long in urban areas), which represent the lowest level of granularity that data can be spatially disaggregated to.

Before and after timespans – GPS journey speed data from TomTom data was purchased for one year before and one year after the introduction of 20mph limits.

- The before data covers the period **12-24 months before** implementation (i.e. leaving a gap of one year), to avoid any changes in behaviour in the run up to implementation as a result of consultation and education activities, disruption due to works, or phased implementation in the immediate area. However, it is noted that some case study schemes are part of a wider city-based initiative, and implementation activities focused on other parts of the city may have had some influence on behaviour in the case study

area during this period (e.g. Liverpool, Nottingham, Brighton).

- The 'after' data starts **6 months after** implementation, to allow time for the scheme outcomes to have become established.

There is one exception, Portsmouth, where two 'after' years have been analysed (instead of one year before and one year after), to examine how effectiveness varies over time. This scheme was implemented substantially earlier than other case study schemes, enabling long term analysis of outcomes to be undertaken.

Across the 12 case study areas, over 1,100kms of roads and 18 million vehicle kilometres[3] of speed data has been analysed. This comprises 3.1 million vehicle-kilometres on new signed only 20mph roads, 0.6 million vehicle-kilometres on other 20mph roads, and 15.0 million vehicle-kilometres on 30 and 40mph roads surrounding the case study areas.

Table 4-7 Sample of vehicle kilometres of journey speed data for case study areas

Study Area	Dist-ance (KM)	Before			After		
		New 20mph (signed only)	Other 20mph roads[1]	30mph and 40mph roads	New 20mph (signed only)	Other 20mph roads[1]	30mph and 40mph roads
All case study areas	1,187	1,424,730	297,029	6,521,510	1,697,779	340,223	8,473,359

1. Combines New 20mph limits (existing calming), Older 20mph limits (with calming), and Older 20mph limits (signed only), which were all analysed separately.

The 'after' sample sizes are higher than the 'before' sample sizes, due to the increased number of TomTom users over time. Nevertheless, both datasets represent substantial quantities of observed data.

Analysis metrics – Analysis of GPS data uses the median (denoted as the value lying at the midpoint of a frequency distribution of observed values) to measure average speeds. This helps to dampen the impact of slow moving vehicles (e.g. vehicles slowing to allow an on-coming vehicle to pass).

Speed bands and 85th percentile speeds are used to examine the profile of speeds.

Comparator analysis – A key element of the methodology involves undertaking similar analysis in a set of 30mph limit comparator areas, to estimate whether the change in speed in the 20mph limit case study areas is likely to be due to the introduction of the 20mph limit, or part of a wider trend in speeds affecting both 20mph and 30mph roads.

Three comparator areas were selected[4], with similar average characteristics to three groupings of case studies (Table 4-8):

Table 4-8 Case study groupings for speed-based comparator analysis

Group	Description (RUC[5] and Region)	Case studies included
Group A	Urban City and Town classification - South	• Winchester (Stanmore) • Brighton (Phase 2) • Chichester, Brighton (Phase 1) • Winchester (City Centre)

[3] Vehicle kilometres are a measure of traffic volume that considers the total distance travelled by users rather than just the number of users. This is determined by multiplying the number of vehicles on a set of road segments by the corresponding length of the segments.

[4] This represented a more cost-effective approach than selecting a separate comparator for each case study area.

[5] The Rural Urban Classification (RUC) system is an Official Statistic used to distinguish rural and urban areas. Categories include Urban Major Conurbation, Urban Minor Conurbation, Urban City and Town, Urban with Significant Rural, Largely Rural, Mainly Rural. Used here as a proxy for geographical characteristics, e.g. population density, land-use, road types, traffic volumes, etc.

Group	Description (RUC[6] and Region)	Case studies included
Group B	Urban Major and Minor Conurbation classification – Midlands and North	• Walsall (Rushall) • Liverpool (Area 7) • Liverpool (Area 2) • Calderdale (Phase 1) • Nottingham (Bestwood)
Group C	Urban City and Town classification - North	• Middlesbrough

The above groupings ensure that the three biggest case study areas (Brighton, Liverpool, and Middlesbrough) are all covered by separate comparator areas. In general, Rural-Urban Classification[7] was given more importance than region, as this is more likely to identify factors relevant to vehicle speeds (in terms of geographical characteristics).

It was not possible to purchase separate timespans for each case study area. Instead, data was purchased for up to two sets of timespans (each comprising one year before and one year after) for each comparator area. The case study implementation dates within each group were sufficiently similar to justify this approach.

Statistical analysis was then undertaken to compare the change in median speed observed on 20mph roads for each of the case studies with the change on 30mph roads in the matched comparator areas. The size of each comparator area is approx. 20km^2 to broadly reflect the size of the largest case study areas.

Selecting and defining the comparator areas – Comparator areas (Table 4-9) were selected on the basis of the following characteristics, to be as similar as possible to the case study areas:

- region;
- Rural Urban Classification;
- Index of Multiple Deprivation (IMD)[8] Income Quintile;
- size and shape of urban area[9]; and
- absence of 20mph area-wide limit in the vicinity of the area.

Road type (in terms of coverage of important strategic roads, important local roads, and minor local roads) has been considered in the analysis stage.

Table 4-9 Selected comparator areas

Category	Comparator area
Comparator A (Urban City and Town classification - South)	**Worthing** The biggest case study area in Group A is Brighton (population 155,000); so the selection criteria is skewed towards matching the characteristics of the Brighton area. Worthing has a large population (100,000); lends itself well to the selection of a 20km^2 rectangle; and is known to have rejected proposals for an area-wide 20mph limit following a very high profile and confrontational campaign in 2014. The selected area includes a broad range of residential areas. It is also a seaside location, with some similarities with Brighton in terms of housing type, and attracting visitors (although to a less extent than Brighton).

[6] The Rural Urban Classification (RUC) system is an Official Statistic used to distinguish rural and urban areas. Categories include Urban Major Conurbation, Urban Minor Conurbation, Urban City and Town, Urban with Significant Rural, Largely Rural, Mainly Rural. Used here as a proxy for geographical characteristics, e.g. population density, land-use, road types, traffic volumes, etc.

[7] The Rural Urban Classification (RUC) system is an Official Statistic used to distinguish rural and urban areas. Categories include Urban Major Conurbation, Urban Minor Conurbation, Urban City and Town, Urban with Significant Rural, Largely Rural, Mainly Rural.

[8] The Index of Multiple Deprivation (IMD) is the overall measure of multiple deprivation experienced by people living in an area. It is calculated for all LSOAs in England. LSOAs are then ranked according to their deprivation relative to other areas. The 2015 indices are based on 37 separate indicators, organised across 7 domains of deprivation, when are then combined using weighting to calculate an overall IMD score. The 7 domains of deprivation are: Income Deprivation; Employment Deprivation; Education, Skills and Training Deprivation; Health Deprivation and Disability; Crime; Barriers to Housing and Services; and Living Environment Deprivation. The income element of the IMD data was used in this study to provide a proxy for urban density, road environment and socio-economic characteristics.

[9] TomTom GPS journey speed data is purchased on a rectangular area basis. A test was therefore carried out to ensure a 20km^2 rectangle area of built up development could be selected, given the size and shape of the urban area.

	The centre of Worthing is used as a comparator to Brighton City Centre and Winchester City Centre schemes.
Comparator B (Urban Major / Minor Conurbation classification – North and Midlands)	**Wolverhampton** Group B includes the two Liverpool case studies, Nottingham (Bestwood) and a small case study area in Rushall (all relatively deprived areas); and Calderdale (a more affluent area). The selected comparator area is Wolverhampton, as the area has a clearer distinction between city centre and residential areas, than other options. This enables the city centre area to be discarded to focus on the comparison of residential areas.
Comparator C (Urban City and Town classification - North)	**Sunderland** Group C includes Middlesbrough (Urban City and Town). Hartlepool and Sunderland were identified as the potential comparators. Both comprise a simple geographical area, with a clear city centre area which would be removed from the TomTom datasets to ensure focus on residential areas. Both have a small number of 20mph zones in place, but accounting for less than 2% of roads. Both have plans for area-wide 20mph limits, but beyond the timescales of our analysis. On balance, Sunderland was selected, as this is a larger city with a population closer to that of Middlesbrough.

Comparator metrics – The comparator data for the selected areas was processed in the same way as the case study data. The following metrics were generated for each comparator area, disaggregated by road type (e.g. important local roads, minor local roads):

- distance of 30mph roads (kms);
- sample of vehicle kilometres observed (vkms);
- median speed, change in median speed;
- 85th percentile speed, change in 85th speed.

The comparator data is based on substantially larger sample sizes than the case study data.

Statistical analysis – A weighted least squares analysis (to take account of the different sample sizes) was then undertaken to examine the change in speeds for case study areas against the comparator areas (representing a difference in difference approach[10]).

The model was specified as follows:

$$E(xB_i) = \mu_i^{(x)}$$
$$E(xA_i) = \mu_i^{(x)} + d_i + \beta$$
$$E(yB_i) = \mu_i^{(y)}$$
$$E(yA_i) = \mu_i^{(y)} + d_i$$

with weights mxB_i, mxA_i, myB_i and myA_i respectively (based on sample vehicle kilometres). Where, x refers to the case study area and y to the comparator area; B refers to the before period and A to the after period, and i refers to the individual case study areas and corresponding comparator areas.

So:

$E(xB_i)$ = Expected speed* in case study area i in the before period B

$E(xA_i)$ = Expected speed* in case study area i in the after period A

$E(yB_i)$ = Expected speed* in comparator area i in the before period B

$E(yA_i)$ = Expected speed* in comparator area i in the after period A

$\mu_i^{(x)}$ = Sample speed* for case study area i

[10] Comparing the change over time in the case study areas to the change over time for the comparator areas (control areas)

$\mu_i^{(y)}$ = Sample speed* for comparator area i

d_i = Background change in speed in the comparator area relevant to case study i (which is assumed to apply equally to both the case study and comparator area)

β = Treatment effect (the change in speed as a result of the change in speed limit).

** Refers to median speed, 85th percentile speed, or 15-85th percentile range, depending on the model in question.*

The crucial parameter is β which is the difference between the change in speed in the case study areas and the change in speed in the corresponding comparator areas, as a result of the change in speed limit.

The statistical analysis was undertaken for all roads (based on an aggregation of the datasets for all three road types), just major strategic roads, just important local roads and just minor local road respectively. Separate tests were undertaken to test the relative change in median speed, 85th percentile speed, and 15-85th percentile range. 95th percent confidence intervals have been calculated to determine the statistical significance of changes observed.

Although the statistical approach uses data for each individual case study area, the result (in terms of a statistically significant change or not) applies to the set of case studies as a whole, and does not identify whether the change in any one particular case study area is significant.

The case study and comparator data was weighted using sample vehicle kilometres to give more emphasis to the larger case study areas. A version of the statistical model was also tested without weights. This treats all of the case studies equally, and is more of a measure of scheme performance rather than driver behaviour.

Some example data is provided below, to illustrate the inputs to the model (Table 4-10).

Table 4-10 Example input data for weighted least squares analysis - artificially generated (median speeds and weightings for case study and comparator areas)

	Case study areas				Corresponding comparator areas			
Area	Median speed Before	Median speed After	Vehicle kilometres Before	Vehicle kilometres After	Median speed Before	Median speed After	Vehicle kilometres Before	Vehicle kilometres After
i	xB	xA	mxB	mxA	yB	yA	myB	myA
1	26.12	25.37	14.06	14.41	32.06	30.21	18.38	21.92
2	30.14	30.99	11.78	11.57	28.02	31.42	24.35	29.50
3	28.91	30.05	7.84	8.17	29.15	29.82	21.58	26.07
4	25.35	27.13	10.93	13.08	28.49	32.04	21.84	21.59
5	26.83	19.23	5.58	5.43	30.47	28.91	17.28	21.85
6	27.15	22.44	6.38	7.22	31.00	35.67	17.66	20.83
7	25.29	27.80	16.07	14.51	30.78	34.74	22.05	20.21
8	22.55	22.17	5.30	6.02	31.76	31.90	17.42	21.39
9	23.80	25.53	7.57	8.71	30.14	30.50	16.59	15.83
10	31.00	23.39	15.62	18.80	29.57	28.88	22.41	25.25
11	30.01	29.00	13.73	13.26	30.72	29.97	19.31	20.88

4.10.2. Local authority spot speed data

Description – Spot speed data refers to data recorded at a specific location or set of locations on the network, using:

- inductive loops on the road (e.g. two rubber tubes laid across the carriageway, linked to a recorder box at the side of the road);

- radar devices mounted to street furniture, or similar technology[11].

The site-specific data obtained using these monitoring approaches typically includes:

- vehicle flow;
- mean and 85th percentile speeds; and
- speed bins (i.e. the number of vehicles travelling 5-10mph, 10-15mph, etc.) – but not available for all case studies.

Some local authorities have also used vehicle activated signs (VAS) to collect speed data as part of an enforcement or speed awareness campaign. These signs activate if an approaching vehicle is detected to be exceeding a pre-set speed threshold. The speed limit and/or a warning message will illuminate on the sign to remind the driver/rider to slow down. These signs are intentionally much more visible and are installed with the purpose of influencing driving speeds.

Data provided by case study authorities – Local authority collected spot speed data was provided for 9 of the case study schemes, covering 410 sites (of which 223 were located in Portsmouth). In the case of Nottingham (Bestwood) resource challenges meant that 'after' monitoring did not take place, although before and after monitoring was undertaken in other parts of the city. Spot speed surveys were undertaken in the two Liverpool case study areas but were not available within the timescales of this study.

Approach – In all locations, before and after speeds and flows were monitored using inductive loops or speed detection radar to measure spot (instantaneous) speed and flow across a sample of locations (varying from 3 to 223). Across the five biggest case study areas, coverage equated to 1 site for every 2.1km of new limit[12].

In general, monitoring was undertaken over a 7-day period, 24hrs/day. In Portsmouth, monitoring was undertaken on just one day, but the large number of sites (223) involved improves the robustness of the data if analysed at an aggregate level.

In most cases, before and after surveys were undertaken in neutral months[13] when flows are considered to be most representative of the yearly average, but not necessarily in the same month.

Before and after timespans – The timescales for before monitoring vary substantially but before surveys were typically conducted less than 24 months before implementation, with after monitoring taking place between 3 and 12 months post-implementation to allow some time for scheme outcomes to establish. Most authorities undertook one phase of after surveys, but in two cases subsequent monitoring has been undertaken to enable a longer-term analysis of outcomes.

Analysis metrics – For the spot speed data, the mean is used to measure average speeds (rather than the median, which is used for the journey speed data), to reflect the full range of instantaneous speeds. Speed bands and 85th percentile speeds are used to examine the profile of speeds.

In general, the case study authorities were unable to provide comprehensive reporting of analysis undertaken and the findings. For the purpose of this study, it was therefore necessary to re-analyse the raw data. In some cases, authorities were unable to provide the raw data, which limited the analysis which could be undertaken – typically limiting it to an analysis of mean and 85th percentile speeds, and excluding speed profile analysis. A two-tiered approach to analysis was therefore adopted, which involved:

- Examining headline results for a core set of metrics available for the majority of case study areas (mean, 85th percentile, and % driving below 20mph) to examine speed outcomes at a case study and site-specific level.
- Undertaking more detailed speed profile analysis of the raw data for a sample of schemes where robust and comprehensive raw data was provided and covering a range of different scheme types and environments – Walsall (small-scale residential), Brighton Phase 2 (area-wide residential), and

[11] Radar devices are typically less noticeable to drivers than tubes, and as such will give a truer reading for speed.

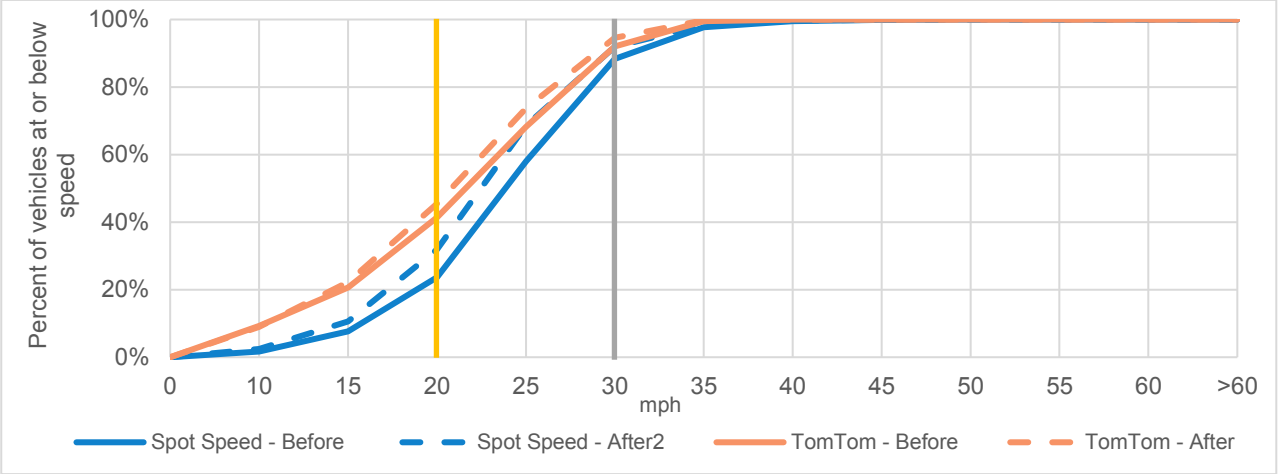
[12] Middlesbrough (25 sites across 97kms of new limit), Brighton Phase 2 (46 sites across 106kms), Portsmouth (223 sites across 341kms), Chichester (35 sites across 67kms), and Brighton Phase 1 (47 sites across 108kms).

[13] DfT Guidance on Data Sources and Surveys (Transport Analysis Guidance Unit M1.2) states that surveys should be carried out during a 'neutral', or representative, month avoiding main and local holiday periods, local school holidays and half terms, and other abnormal traffic periods. Neutral months are considered to be late March, April, May, June, late September, October, and November.

Winchester City Centre (city centre). This enabled a comparison to be made between the journey speed and spot speed findings. This shows similar patterns of before and after change, but spot speed surveys generally record higher average and 85th percentile speeds as they measure instantaneous speed at a specific location (Figure 4-2).

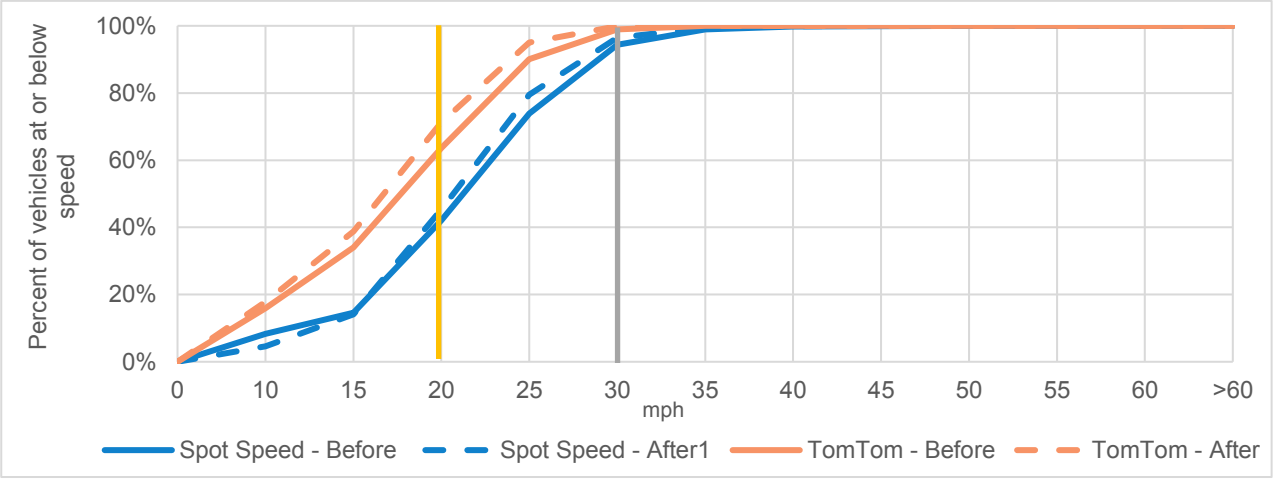
Figure 4-2 Spot speed vs journey speed data – cumulative speed distribution

Example 1 (Area-wide residential)



TomTom analysis compares 12-24 months before vs. 6-18 months after. Spot speed analysis compares 12 months before implementation (Jun, 7 days) vs. 24 months after (Jun, 7 days). Moderate compatibility with TomTom data spans.

Example 2 (City centre and adjacent residential area)



TomTom analysis compares 12-24 months before vs. 6-18 months after. Spot speed analysis compares 12-30 months before implementation (Apr and Sep, 7 days) vs. 7-8 months after (Apr and May, 7 days). Good compatibility with TomTom data spans.

***Interpretation of cumulative distribution graphs** – Figure 6 shows the percentage of driver vehicle kilometres (vkms) travelling at or below a specific speed; with 20mph and 30mph speeds highlighted by vertical lines to show the before and after speed limits.*

Example 1 shows that prior to the reduction in speed limit (i.e, during the 'before' period, represented by the solid orange and blue lines), approximately 40% of vehicles were travelling at less than 20mph based on TomTom GPS data (and 60% were travelling at faster speeds), while the spot speed data suggests that only about 20% were travelling at less than 20mph (and 80% were travelling at faster speeds). This demonstrates that the spot speed data is recording higher speeds than the GPS journey speed data.

Following the change in speed limit (i.e, during the 'after' period, represented by the dashed orange and blue lines), the proportion of vehicles travelling at or below 20mph increases for both datasets, moving the distribution curve to the left. The larger the shift to the left (and the bigger the gap between the before and after period), the higher percentage of drivers now travelling at lower speeds. The orange curves (representing the TomTom GPS data) is to the left of the blue curve (representing to the spot speed data) across the whole of the speed profile indicating generally lower speeds for the GPS journey speed data. In addition, the dashed curves are consistently to the left of the solid curves indicating slower speeds in the after period across the whole of the speed profile. The same pattern is also evident in Example 2.

4.11. Casualty and collision data

Evidence on actual safety outcomes is based on the following data sources:

- **STATS 19 data**, provided by the Department for Transport (DfT) for the period Jan 2005 to December 2016. This includes accident, casualty, vehicle and contributor factors data. The 'before' analysis is based on five years of data, and the 'after' analysis uses between 17 and 42 months (between 1.4 and 3.5 years) of data reflecting the different implementation dates for the various case study schemes.
- A **TomTom mapping GIS file** for each 20mph case study scheme, marked up with the pre and post-scheme speed limits, and categorising 20mph roads as new or pre-existing, and with or without traffic calming. The TomTom map product was also used to identify appropriate 30mph roads in comparator areas.

Of the 12 case studies, Portsmouth was implemented substantially earlier than the other case study authorities. Background trends in casualty rates at the time were very different to more recent trends affecting all of the other case studies. Data for Portsmouth was therefore been excluded from the main safety analysis. This is consistent with the approach adopted for the analysis of speed outcomes using GPS data, which treated Portsmouth separately.

STATS19 data – Personal injury collisions (PICs) on public roads that are reported to the Police, are recorded using the STATS19 accident reporting form. This data contains details of the incident severity, casualty severity and numbers, and a subjective coding of contributory factors. This information is stored, and available for analysis in two databases maintained by the DfT – an Accident Database and a Contributory Factors Database.

The following data limitations need to be considered when interpreting the findings presented in this report:

Accident Database

- The Accident Database comprises an Accident Table, Casualty Table, and Vehicle Table, detailing the relevant information for each reported collision.
- The dataset only includes collisions where an injury is reported. Damage only incidents are not included in the dataset. This represents a gap in our analysis, as a substantial proportion of collisions in 20mph limit areas are expected to be damage only collisions. No other reliable sources of data on damage only collisions is available.
- Not all personal injury accidents are reported to the police.
- The collision details are not always recorded accurately or consistently by the police, and the level of quality assurance undertaken by local authorities varies hugely. Nevertheless, the error within the data is likely to be similar for both the before and after periods. Additionally, before publishing their statistics, the DfT carry out substantial cleaning and validation for values that are outside of the expected range and include data from other sources.
- There is an issue around the comparability of the 2016 data, following the introduction of the CRASH reporting system - an online tool designed to provide standardised collection, storage and validation of police casualty data, currently used by around half of police forces. Data entry and validation now becomes the responsibility of the police rather than local authority staff with long standing skills and experience in this field. There is a risk that only the minimum amount of data required by the system may be reported, leaving valuable supplementary data unrecorded.
- In addition, an important innovation pioneered by CRASH is the improved recording of the nature of injuries suffered by victims. However, in the short-term, this may result in substantial deviation between the number of casualties classified as 'serious' by forces that use CRASH, compared with both preceding years, and with forces that do not. Early indications suggest that this has resulted in an increase in the proportion of casualties categorised as 'serious'. **It has therefore not been possible to undertake any meaningful statistical analysis by casualty severity as part of this study**.

Contributory Factors Database

- The DfT also maintains a database of road collision contributory factors data, which provides a subjective coding of factors which may have contributed to the collision. Each collision can be attributed between none and six contributory factors believed to be related to the collision. The contributory factors are for information purposes only and not intended to assign blame.

- Not all collisions are included in the contributory factor data. Only collisions where the police attended the scene and reported at least one contributory factor are included. A total of 77% of all collisions reported to the Police in 2015 met these criteria. This proportion, however, is likely to be much lower in 20mph limits, as most injuries are likely to be slight injuries and incidents are less likely to be attended by the Police.

- Police officers do not need to carry out a full investigation of the incident before allocating contributory factors. They usually use professional judgement about what they can see at the scene. Some contributory factors, such as exceeding the speed limit, may not be obvious to the officer and are therefore likely to be under-reported.

Given the above caveats, and the small number of collisions involved, contributory factors are used to provide background context only. The findings should be treated as indicative only.

Comparator analysis – A generalised linear model[14] of multiplicative form and employing a poisson / negative binomial error structure was used to look at the number of collisions before and after the introduction of 20mph limits and compare the collision rates. The model attempts to take account of other background factors (e.g. background reductions in collision rates, weather, economic trends, etc.) by using comparator areas with similar characteristics to the case study areas to adjust for these impacts in the time periods used.

The model takes the following form:

$E(y_{it}) = k_i R_{it}$ for the *before* period; and

$E(y_{it}) = k_i R_{it} \propto$ for the *after* period (with a dummy variable used to represent the after period).

Where:

$E(y_{it})$ = Expected number of collisions in case study area *i* in quarter *t*

R_{it} = Number of collisions in comparator area *i* in quarter *t*

k_i = Coefficient measuring the relative magnitudes of the collisions rates in the study and comparator areas *i*.

α = The factor by which collision rate is multiplied in the after period.

The crucial parameter is α, which is the factor by which collision rate is multiplied in the after period, and indicates the extent to which the implementation of the lower speed limit has led to a decrease in collisions. If α is less than 100%, then collisions have reduced, and if greater than 100%, then collisions have increased.

Based on purely artificial data, Table 4-11 illustrates the inputs to the model. Note that the period indicator variable is 1 for the before period and is 2 for after period (the dummy variable).

[14] A generalised linear model is a version of an ordinary linear regression model that allows for response variables that have error distribution models other than a normal distribution.

Table 4-11 Example input data for generalised linear model - artificially generated

Area *i*	Quarter *t* *(i.e. 3 month period)*	Case study area collisions y_{it}	Comparator area collisions R_{it}	Period (1 = before, 2 = after)
1	1	10	100	1
1	2	8	107	1
1	3	11	124	1
1	4	9	97	2
1	5	13	121	2
2	1	8	65	1
2	2	11	76	1
2	3	6	88	2
2	4	9	56	2
3	1	16	127	1
3	2	12	135	1
3	3	7	98	1
3	4	5	76	2
4	1	20	212	1
4	2	17	189	1
4	3	20	167	1
4	4	13	188	2
4	5	9	156	2
4	6	8	178	2

Fitting a model as described above, would give an output as follows (Table 4-12):

Table 4-12 Example input data for generalised linear model - artificially generated

	Estimate	Standard Error	Z Value	$Prob\ (>\|z\|)$
(Intercept)	-2.26754	0.14827	-15.293	<2e-16 ***
site2	0.28194	0.22193	1.270	0.2039
site3	-0.07494	0.21314	-0.352	0.7251
site4	-0.12780	0.17673	-0.723	0.4696
period2	-0.30038	0.14872	-2.020	0.0434 *

The principal parameter of interest is the one on the last line, labelled 'period2'. This is the estimate of the log of the parameter α. So, the estimate of $\propto = exp(-0.30038) = 0.741$. This indicates (in this artificial scenario) the implementation of the lower speed limit has led to a decrease in collisions of around 26%.

A 95% confidence interval on α can be estimated using the standard error and can be calculated as $\propto = (0.553, 0.991)$. Therefore, the 95% confidence interval in this example is marginally significant at the 5% level (i.e. the confidence interval does not contain the value 1 which would indicate "no change").

In addition to giving the 95% confidence interval and testing if the estimate of $\propto$ is significantly different from 1 at any specified significance level (e.g. 5%), we can also state the p value – in this case p = 4.34%. This is the significance level at which the result would be right on the boundary of statistical significance.

The likelihood of being able to detect a change in collisions or casualties with a defined level of probability, depends on the scale of change in the data and the amount of data available (the sample size). The larger the sample size, the greater the likelihood of being able to detect a smaller change. Due to the small number of collisions in each area, the analysis is likely to be more conclusive if all case study areas are

considered together. The statistical analysis is therefore primarily reported at an aggregate level, with less emphasis on the change within individual case study areas.

Key strengths of approach are as follows:

- Does not require all schemes to have opened at the same time, and does not require all case studies to have the same amount of before and after data. This means that all data available (to December 2016) can be used.
- Aggregation of areas maximises the sample of data and increases the opportunity to measure an impact if one exists.
- Background trends are picked up by the model using comparator areas to understand the relative impacts.

Selection of comparator areas – A key element of the approach is the identification of a separate comparator area for each case study scheme. The purpose of the comparator is to control for background trends in collisions, and other factors such as environment, road type, weather, economic trends, traffic growth, etc. i.e. anything which could affect driver behaviour and the number of collisions expected in 20mph areas independently of the change in speed limit.

The comparator area should generally comprise a larger number of collisions to provide a clear background trend; but still be representative of the case study area in other characteristics that are likely to impact on safety outcomes (e.g. land use and area type, socio-demographic characteristics, and road type and function). For the purpose of this analysis, the comparator needs to comprise collisions on 30mph roads, with similar characteristics and function to the 20mph roads in the case study areas.

Consequently, a decision was made to use the Urban and Rural Area Definitions developed by central government in 2011, to identify suitable region-based comparator areas for each case study. This approach draws comparator data from a number of settlements within the same region, which are considered 'similar' to the case study area (see Table 4-13).

Table 4-13 Case study rural urban classifications and size of comparator areas within the same region

Case Study	Case Study size (km^2)	RUC Classification	Region	Comparator Area size[1]
Walsall (Rushall) (R-SM1)	0.5	Urban Major Conurbation	West Midlands	872 km^2
Winchester (Stanmore) (R-SM2)	3.6	Urban City and Town	South East	4,184 km^2
Liverpool (Area 7) (R-AW1a)	15.8	Urban Major Conurbation	North West	1,589 km^2
Liverpool (Area 2) (R-AW1b)	19.3	Urban Major Conurbation	North West	1,589 km^2
Middlesbrough (R-AW2)	18.6	Urban City and Town	North East	737 km^2
Calderdale (Phase 1) (R-AW3)	4.2	Urban Major Conurbation	Yorkshire and the Humber	830 km^2
Nottingham (Bestwood) (R-AW4)	7.9	Urban Minor Conurbation	East Midlands	359 km^2
Brighton (Phase 2) (R-AW5)	24.9	Urban City and Town	South East	4,184 km^2
Chichester (R-AW6)	7.6	Urban City and Town	South East	4,184 km^2
Brighton (Phase 1) (TC-AW1)	7.0	Urban City and Town	South East	4,184 km^2
Winchester (City Centre) (TC-AW2)	1.0	Urban City and Town	South East	4,184 km^2

1. The comparator areas exclude all other case study areas within the region.

Analysis undertaken shows that the comparator areas selected provide good guidance in terms of collision trends (for seasonal variation and long-term drift in the mean collision rate), when compared with the case study areas.

The analysis also considered whether the fit of the model could be improved by undertaking a weighted analysis, where the collision data for the respective lengths of the three road classes[15] in comparator areas were weighted to represent the relative proportions in the case study areas. The results showed little difference between the weighted and unweighted analyses, with both models showing good fit.

Before and after timespans – A key strength of the approach, is the ability to make use of all data available for each case study, however, limited or extensive.

The 'before' data covers 5 years and leaves a gap of one year prior to implementation of the 20 mph limits in the case study areas, to avoid any changes in behaviour in the run up to implementation.

The 'after' data covers between 17 and 44 months, depending on the case study in question. No post implementation gap has been left, in order to maximise the amount of data available.

Table 4-14 Before and after data spans for case study schemes

Case Study	Scheme Implementation Date	Before period (5 years before, with 1 year buffer)	After period (no buffer)	Number of months of after data
Walsall (Rushall) (R-SM1)	Mar 2014	01 Apr 2007 – 31 Mar 2013	01 Apr 2014 – 31 Dec 2016	33 months (2-3 years)
Winchester (Stanmore) (R-SM2)	Jul 2014	01 Aug 2007 – 31 Jul 2013	01 Aug 2013 – 31 Dec 2016	29 months (2-3 years)
Liverpool (Area 7) (R-AW1a)	Apr 2014	01 May 2007 – 30 Apr 2013	01 May 2013 – 31 Dec 2016	32 months (2-3 years)
Liverpool (Area 2) (R-AW1b)	Jan 2015	01 Feb 2008 – 31 Jan 2014	01 Feb 2015 – 31 Dec 2016	23 months (1-2 years)
Middlesbrough (Phase 1, Phase 2) (R-AW2)	Mar 2012 – Jun 2012; Mar 2013 – Jun 2013	01 Jul 2005 – 30 Jun 2011	01 Jul 2013 – 31 Dec 2016	42 months (>3 years)
Calderdale (Phase 1) (R-AW3)	Jul 2015	01 Aug 2008 – 31 Jul 2014	01 Aug 2015 – 31 Dec 2016	17 months (1-2 years)
Nottingham (Bestwood) (R-AW4)	Apr 2014	01 May 2007 – 30 Apr 2013	01 May 2014 – 31 Dec 2016	32 months (2-3 years)
Brighton (Phase 2) (R-AW5)	Jun 2014	01 May 2007 – 30 Jun 2013	01 Jul 2014 – 31 Dec 2016	30 months (2-3 years)
Chichester (R-AW7)	Jul 2013	01 Aug 2006 – 31 July 2012	01 Aug 13 – 31 Dec 2016	41 months (>3 years)
Brighton Phase 1 (TC-AW1)	Apr 2013	01 May 2006 – 30 Apr 2012	01 May 2013 – 31 Dec 2016	44 months (>3 years)
Winchester (City Centre) (TC-AW2)	Sep 2014	01 Oct 2007 – 30 Sep 2013	01 Oct 2014 – 31 Dec 2016	27 months (2-3 years)

Regression to the mean (RTM) – RTM arises in traffic safety studies through the site-selection process. If sites are selected for treatment on the basis of a high accident frequency in the preceding (typically) three years, then a before/after comparison will almost inevitably lead to an exaggerated estimate of the effect of the treatment. The magnitude of this bias can be appreciable (and easily be on a par with the magnitude of the treatment effect itself), as previously studies have demonstrated[16].

One approach to avoid RTM is to collect historical accident STATS19 data for the sites from a number of years before the scheme implementation, and use this as the baseline period to compare with the after data. As the case study schemes are intended to deliver area-wide benefits, and are not wholly safety driven, we

[15] Roads in the TomTom base map were categorised as Major strategic roads (FRC 1-3), important local roads (FRC 4-5), and minor local roads (FRC 6-7).

[16] For example, see Appendix H of the DfT 4-year evaluation report on speed cameras: http://webarchive.nationalarchives.gov.uk/20090104005813/http:/www.dft.gov.uk/pgr/roadsafety/speedmanagement/nscp/nscp/thenationalsafetycameraprogr4597).

do not consider RTM to be a problem for this study. Nevertheless, the use of five years of before data will mitigate against any effect which might exist.

5. Use of data sources and evidence

5.1. Introduction

Table 5-1 shows how the above data sources and analysis have been used to address the evaluation themes and priority research questions.

Table 5-1 Use of data sources to address priority research questions

	Rapid Evidence Review	In-depth interviews with national stakeholders	In-depth interviews with local stakeholders	Residents questionnaires	Drivers / riders questionnaires / interviews	Focus groups	Speed data (GPS journey speed data)	Speed data (Local authority spot speed data)	Collision data	Other secondary data sources
Existing evidence										
Q1. What evidence exists already in respect of 20mph limits/ zones/ advisory	✓	✓	✓							
Process evaluation (15 case studies)										
Q2. What outcomes, impacts and wider benefits are 20mph Speed Limits aiming to achieve?	✓	✓	✓							
Q3. How do 20mph speed limits aim to achieve their outcomes?			✓							
Q4. How have 20mph speed limits been implemented? Barrier and enablers? Decisions not to proceed?			✓							
Impact evaluation (12 case studies)										
Q5. Do drivers and riders comply with 20mph speed limits?	✓		✓	✓	✓		✓	✓		✓
Q6. Do drivers, residents and local workers support 20mph speed limits?			✓	✓	✓	✓				✓
Q7. Do 20mph speed limits achieve their objectives and other wider outcomes?	✓		✓	✓	✓	✓	✓	✓	✓	✓
Q8. Are the outcomes similar across area-wide 20mph limited schemes and hybrid 20mph limits/zones?	✓		✓							
Q9. Do outcomes of 20mph speed limits vary according to road type? Why?	✓		✓	✓	✓	✓	✓	✓	✓	✓
Q10. How do outcomes of 20mph speed limits compare with those in similar 20mph zones?	✓		✓		✓					✓
Q11. How do 20mph speed limits compare with those in similar 30mph speed limits, in terms of outcomes?	✓		✓		✓					✓
Q12. What effect is there on traffic volumes within the scheme itself and on neighbouring roads?			✓	✓	✓	✓				
Q13. What is the effect of schemes on collision and casualty levels on neighbouring roads?			✓						✓	✓
Lessons (12 case studies)										
Q14. In terms of good practice what data collection would be useful for future schemes to undertake?	✓		✓							

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