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20mph Research Study

Supporting Technical Appendix
Analysis of spot speed data in case study areas

November 2018

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Notice

This document and its contents have been prepared and are intended solely for Department for Transport's information and use in relation to the analysis of speed outcomes in 20mph limit areas using local authority spot speed data for 12 case study areas.

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Document history

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V3	Updated to include Brighton Phase 1 spot speed analysis	JR	-	-	-	19/04/18 06/08/18
V4	Minor updates	JR	-	-	-	29/08/18

Key analysis files

P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1g. Walsall\Task 3.6 Spot Speed Analysis/Walsall SPEED DATA ANALYSISv1.0.xls (and corresponding locations for other case study areas)

P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Task 3.6 Speed Data\4. Local Authority Data\ Spot_Speed_Analysis_Summary_Regression_v01.xls

Quality assurance

Details of the quality assurance process are set out in Appendix M.

1. Introduction

1.1. Background

Atkins, Aecom and Professor Mike Maher were commissioned by the Department for Transport (DfT) in 2014, to address a gap in the evidence available on 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.

A key element of the study involves examining the impact of 20mph limits on speeds in the twelve case study areas, using a variety of data sources:

- area-wide speed data from in-car GPS devices in each of the case study areas;
- spot speed data collected by local authorities representing the 12 case study areas, using pneumatic loops, radar devices or similar technology;
- questionnaire responses from residents and drivers in each of the case study areas; and
- focus group responses.

This document reports on the analysis of speed outcomes in 20mph limit areas using spot speed data provided by the local authorities for the twelve case study areas selected for this research. Spot speed data refers to data recorded at a specific location or set of locations on the network, using:

- on-road medium, such as pairs of pneumatic (rubber) road tubes laid across the roadway, piezo-electric sensors embedded in the roadway, or inductive loops cut into the roadway, linked to a recorder box at the side of the road; or
- radar devices mounted to street furniture, or similar technology.

The key results for each scheme are presented in the core report, while a detailed description of the data collected by each case study authority is presented in the appendices.

The results from other data sources are reported separately, and the key findings from each data source are bought together in the overall Technical Report for the study.

20mph limits and 20mph zones

There are two distinct types of 20mph schemes:

- 20mph limits - indicated by speed limit (and repeater) signs only; and
- 20mph zones - designed to be 'self-enforcing' through the introduction of traffic calming measures (e.g. speed humps, chicanes).

The study is primarily interested in looking at speed outcomes (e.g. % compliance, median speed, speed profile) of **new 20mph limits (signed only)**. 'New' refers to the roads where the speed limit was reduced from 30mph to 20mph following implementation of the main area-wide scheme.

In some case study areas, the limits were introduced on roads with existing traffic calming, enabling a comparison of the outcomes associated with the two scheme types – 'new 20mph limit (signed only)' and 'new 20mph limit (existing calming)' – to be compared.

In addition, some of the case study schemes had small pockets of existing 20mph limits and zones (introduced prior to the main area-wide case study scheme). These areas provide contextual evidence of the broader decline / increase in speeds that may be happening in the area, in the absence of any speed limit change; and enable levels of compliance to be compared.

None of the case studies contain new 20mph zones (involving the introduction of a lower limit at the same time as new physical traffic calming measures). This was not the purpose of the research, and the outcomes of 20mph zones have been covered in other research studies.

Case study scheme typologies

The twelve case studies have been categorised into the following scheme typologies:

- Predominantly residential and schools – small scale standalone: Walsall (Rushall) and Winchester (Stanmore).
- Predominantly residential and schools – area-wide: Liverpool (Area 7), Liverpool (Area 2), Middlesbrough, Calderdale (Phase 1), Nottingham (Area 3), Brighton (Phase 2), Portsmouth, Chichester.
- City or town centre and adjacent residential areas: Brighton (Phase 1), Winchester (City Centre).

1.2. Summary of existing evidence on speeds in 20mph zones and limits

1.2.1. Evidence on 20mph zone

Since the publication Circular Roads 4/90 by the Department for Transport in December 1990, local traffic authorities have been able to implement 20mph speed limit zones – comprising a 20mph limit and physical traffic calming measures such as speed humps, chicanes, and raised junctions.

Two extensive studies undertaken by the Transport Research Laboratory (Webster & Mackie, 1996[1]; and Webster and Layfield, 2003[2]) suggest that 20mph zones can result in substantial reductions in average speed of around 9mph. In both studies, the average before speeds for these schemes were around 25mph, dropping to well below 20mph post implementation.

- Webster & Mackie (1996) researched the before and after speeds of 20mph zones across England, implemented in the early 1990s.

  At the time, Circular 4/90 stated that 20mph zones could only be implemented if traffic calming was installed as part of the scheme or if a short stretch of road had a significant reason for speed reduction (for example high incident rate). Schemes were initially implemented for a temporary period of up to 18 months. Authorities were not required to undertake speed measurements prior to scheme implementation, but in order for a scheme to be granted permanent status by the then Department of Transport, it had to be demonstrated that the average speed in the area had dropped to 20mph or below at two or more representative locations within the zone area.

  At the time of the study, 200 schemes had been installed in the UK, and 82 had been granted permanent status. The most quoted reason for applying for authorisation was accident reduction. The average length of road included within zone areas was 2.5km. About 80% were in residential areas, with the remainder in shopping and commercial areas.

  Of the 200 zones considered within the study, before and after speed data had been collected for 32 schemes. This showed an average reduction in speed of 9.3mph, from 25.2mph to 15.9mph (see Figure 1-1). The report also found that traffic flow reduced by 27% within zones and increased by 12% outside the zones, although data was only available for 19 schemes, and not necessarily the same schemes as those included in the speed data analysis.

- A similar study of 20mph zones in London was undertaken by Webster and Layfield in 2003.

  In 1999, the Road Traffic Regulation Act was amended to allow local authorities to designate 20mph speed limits without prior approval of the Secretary of State. Two distinct types of 20mph speed limits were made possible: 20mph limits indicated by speed limit and repeater signs only, and 20mph zones designed to be self-enforcing through the introduction of physical traffic calming measures.

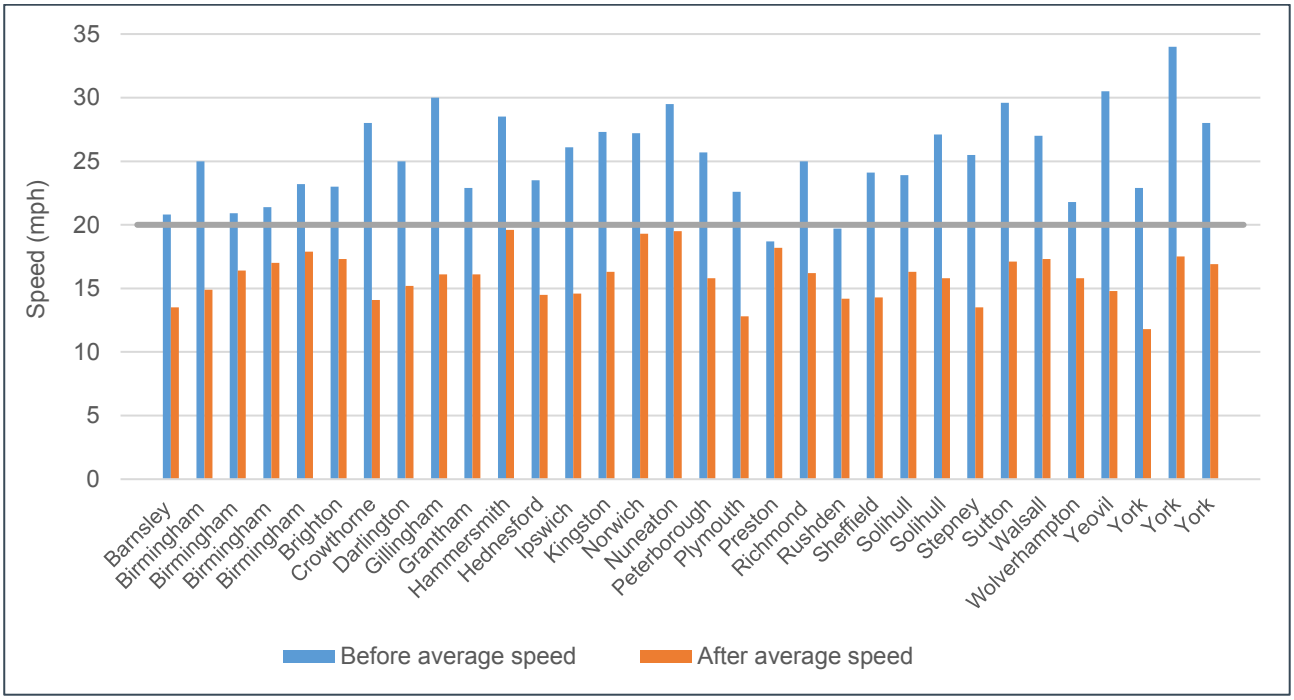
  Initial contact with the London Boroughs indicated that the number of 20mph zones being installed in London had increased from 5 per year (up to 1999) to over 30 per year by 2002, with 137 zones in place

[1] Webster, D.C and Mackie, A. M (1996*); Review of Traffic Calming Schemes in 20mph Zones*. Road Safety Division. Transport Research Laboratory.
[2] Webster, D.C and Layfield, R.E (2003); Review of 20mph Zones In London Boroughs. Transport Research Laboratory.

at the time of the study. Most of the zones were in residential areas, with over half containing schools and colleges. The average length of road in each zone was 3.4km.

Before and after speed data was only available for 14 of the schemes. The data showed average traffic speed reductions of 9.1mph following implementation. The report does not provide the before and after speeds for these schemes, but does report an average after speed of 16.6mph across 22 schemes, suggesting average speeds before implementation were around 25mph. Traffic flow reduced by an average of 15% in the 11 schemes for which flow data was available.

Figure 1-1 Before and after average speeds for thirty-two 20mph zones implemented across England in the early 1990s (Webster and Mackie, 1996)



Furthermore, Allot & Lomax in a report for DETR (2001)[3] investigated speed impacts in six 20mph zones in the north west of England. They found mean speeds fell by 8.7mph in traffic calmed locations, and by 5.5mph at locations in between.

The above UK findings are supported by similar findings from Northern Europe. For example, research by Engel & Thomsen (1992)[4] in Denmark reported mean speed reductions of 11km/h as a result of the traffic calmed 30km/h streets. In addition, Janssen (1991) (cited in Toy et al. 2012[5]) reported that average speeds fell by 22% in two large demonstration projects (Eindhoven and Rijswijk) implemented in the Netherlands in the 1970s.

Other research has been undertaken, but there seems to be a lack of clarity about whether the evidence relates to pure zones, pure speed limits or hybrid schemes (see Rapid Evidence Review for further information).

1.2.2. Evidence on 20mph limits (signed only)

Evidence available on UK signed only schemes, at the time this study was commissioned, was more limited.

[3] Department of the Environment, Transport and the Regions (DETR) (2001) Urban Street Activity in 20mph zones – Final Report (Allott & Lomax – Babtie Group)
[4] Engel U. & Thomsen L.K. (1992) Safety effects of speed reducing measures in Danish residential areas in Accident Analysis & Prevention, 24(1)
5 Toy et al. (2012) Delivering soft measures to support signs-only 20mph limits, UWE Bristol

- Between 1998 and 2000, a national trial programme of *advisory 20mph speed limits* was undertaken, involving 75 residential areas across Scotland. Burns et al. (2001)[6] analysed the impact of the *advisory limits* over 18-24 months after they were implemented. The overall average speed reduction was 1.2mph (from 23.4mph before the scheme was introduced to 22.2mph after). The closer the average speed of the road was to 20mph, the smaller the reduction in the average speed. The 85th percentile speed dropped by an average of 1.1mph (from 29.4mph to 28.3mph), with smaller reductions where the before 85th percentile was closer to 20mph.

- An early evaluation of the city-wide scheme implemented in Portsmouth in 2008-09 (Atkins, 2010)[7] reported an average speed reduction of 1.3mph (from 19.8mph to 18.5mph). The biggest reductions speed occurred at sites with higher before speeds: less than 20mph = -0.7mph, 20-24mph = -2.3mph, more than 24mph = -7.4mph.

- In 2010, Bristol City Council implemented 20mph pilots in Inner South and Inner East Bristol, covering some 500 roads and 30,000 households. The monitoring and evaluation report (BCC, 2012)[8] reported slight reductions in mean average speeds of between 0.9mph (23.6mph to 22.7mph) in Inner South Bristol and 0.5mph (23.4mph to 22.9mph) in Inner East Bristol.

- In 2012, Edinburgh City Council implemented a pilot 20mph Limit (signed only) in South Edinburgh. Forty-eight 'before' speed surveys were undertaken across a sample of street locations in the pilot area, including streets on the external boundary. Surveys were undertaken at the same locations after implementation. Of these, 20 locations remained with a 30mph limit, while 28 locations changed to the new 20mph limit. The evaluation report (ECC, 2013)[9] shows a reduction in average speeds of 1.9mph (from 22.8 to 20.9mph) at the sites where the speed limit reduced to 20mph. After speeds also reduced at the 20 locations that retained a 30mph limit, the reduction was only 0.8mph (to 25.4mph) - less than the fall witnessed across 20mph limit streets.

In continental Europe, 30kph (~20mph) speed limits, with and without physical traffic calming measures, have been more common place in recent decades, and this provides some further evidence on the effectiveness of signed only limits.

- Mackie (1998)[10] reviewed research undertaken by Pfundt et al (1989) into the effects/outcomes of twenty-four 30kph schemes with traffic calming measures against thirty-six 30kph schemes without any physical measures (signs only). The analysis showed reductions in the 85th percentile vehicle speeds in signed only schemes averaged just 1kph, compared to 4kph for schemes with traffic calming measures. The average before speed for both sets of schemes was 48kph.

- In Europe, the city of Graz in Austria introduced a city-wide 30kph trial between 1992 and 1994 which covered approximately 75% of the total road network. The trial was part of a city wide traffic plan which included a strategy to promote walking, cycling and public transport through improving infrastructure and an education/awareness campaign to limit the volume and speed of traffic in the city. Research by Wernsperger and Sammer (1995)[11] showed that the average and 85th percentile speeds dropped immediately at the commencement of the trial (from 46.9kmph to 42.7kmph). There was a sharp reduction in the higher speeds, with the proportion travelling at more than 50kph in the 30kph limits falling from 7.3% to 3%. However by 2002, the mean and 85th percentile speeds had increased and the speed reduction was only 0.4kph for mean speeds and 1.9kph for 85th percentile speeds (Fischer, 2010)[12].

6 Burns, A et al (2001) 20mph Speed Reduction Initiative. Scottish Executive Central Research Unit and Society of Chief Officers of Transportation in Scotland (SCOTS)

7 Atkins and Portsmouth City Council (2010); Interim Evaluation of the Implementation of 20 mph Speed Limits in Portsmouth, Department for Transport.

8 Bristol City Council, (2012), *20mph speed limit pilot areas: Monitoring Report*.

9 Edinburgh City Council (2013); South Central Edinburgh 20mph Limit Pilot Evaluation, Transport and Environment Committee, 27th August 2013.

10 Mackie A M (1998); Urban speed Management Methods, TRL Report 363, Transport Research Laboratory, Crowthorne.

11 Wernsperger, F and Sammer, G (1995); Results of the scientific investigation accompanying the pilot trial of 30 kph limit in side streets and 50 kph limit in priority streets. Transport Research Laboratory.

12 Fischer, T (2010); Traffic Safety in Graz, Reggio Emilia.

Summary of findings

Existing research suggests 20mph zones can achieve substantial reductions in average speed, of around 9-10mph. This evidence is largely based on schemes which are small scale (typically covering a few kms of road length), have a before speed well above 20mph (typically around 25mph), and were implemented in the 1990s and early 2000s primarily to address location-specific safety issues.

Evidence for 20mph limits, although more limited, suggests that signed only schemes deliver much smaller reductions in average speed (typically around 1-2mph). The schemes involved tend to be large area-wide initiatives, with lower before speeds (closer to 20mph), and have been introduced to deliver an area-wide change rather than address location-specific issues.

This evidence provides a benchmark against which the results from this study can be compared.

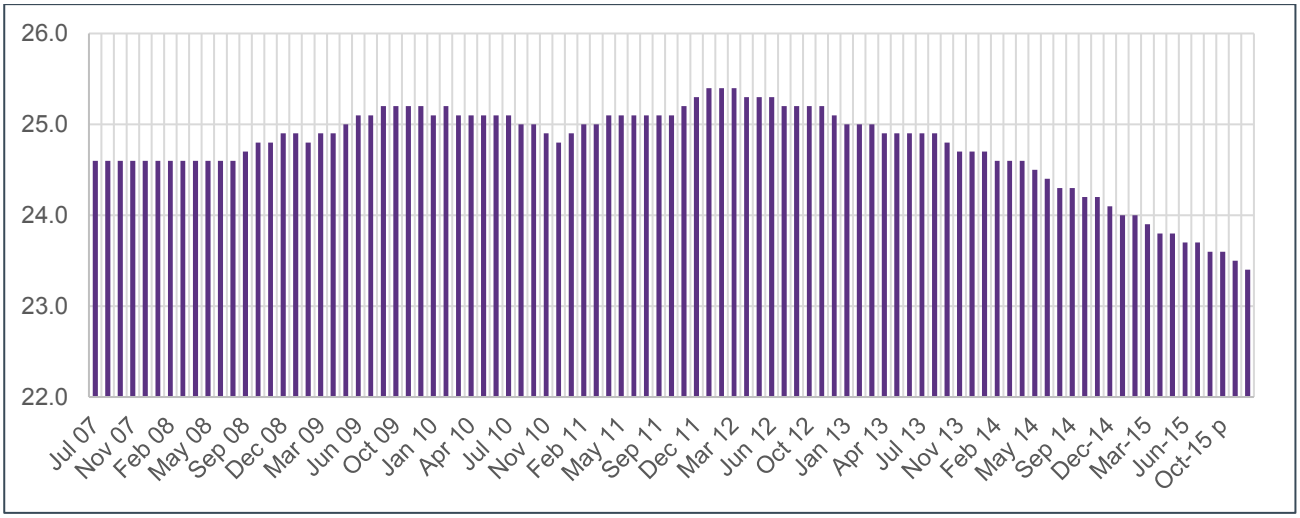
1.3. Wider speed trends

The results presented in this report also need to be considered against the backdrop of wider trends in vehicle speeds.

1.3.1. Local authority A roads

DfT published statistics on average speeds on local authority A roads (Department for Transport, 2017)[13] suggest that average speeds fell between 2014 and 2016: by 1.0mph across all A roads (all day), by 0.8mph in urban areas (all day), and by 0.7mph in rural areas; and by 0.9mph in the weekday morning peak, and by -1.1mph in the weekday evening peak. This corresponds to the 'after' period for many of the case study schemes.

Figure 1-2 Average vehicle speeds (flow-weighted) during the weekday morning peak on locally managed 'A' roads (mph) – to Dec 2015



Figures for October 2015 – December 2015 are provisional only (p).
P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\60 Documents Incoming\DfT Average speeds on LA A Roads

The dataset weights speed observations from a sample of vehicles by associated traffic flows so that it is representative of traffic volumes on the roads in different locations and at different times of day. These statistics are compiled of journey time data from in-vehicle global positioning systems (GPS) and flows estimated using automatic traffic counters and the Department's manual traffic count data.

Previous statistics suggest that speeds had been dropping steadily on these roads since 2011. Between December 2011 and December 2015, average vehicle speeds during the weekday morning peak dropped at

[13] Department for Transport (2017) Average speed on local 'A' roads: monthly and annual averages (Table CGN0501) – updated May 2017. https://www.gov.uk/government/statistical-data-sets/average-speed-and-delay-on-local-a-roads-cgn05

a fairly consistent rate by 1.9mph, from 25.4mph to 23.5mph (Figure 1-2) (Department for Transport, 2016)[14]. The methodology used for calculating the average weekday morning peak statistics changed in 2016 so more recent statistics are not directly comparable.

1.3.2. National free flow speeds

Since 2011, the Department for Transport has published estimates of compliance with speed limits in free flowing conditions on roads in Great Britain[15]. These are based on speed data collected from a sample of DfT's Automatic Traffc Counters (ATCs), chosen to exclude locations where external factors might restrict driver behaviour (e.g. junctions, hills, sharp bends and speed enforcement cameras). A total of 116 sites are used, of which 29 sites are on 30mph roads and 9 sites are on 20mph roads. The statistics provide insights into speeds at which drivers choose to travel when free to do so, but are not estimates of average speeds across the whole network.

The results show:

- For all vehicle types, speed limit compliance in 2016 was highest on national speed limit single carriageways and lowest on 20mph roads. On single carriageways, only 8% of cars exceeded the 60mph limit' on 30mph roads, 53% of cars exceeded the limit; and on 20mph roads with free-flow conditions, 81% of cars exceeded the limit.

- For all vehicle types, average free flow speeds were very close to the appropriate speed limits on 30mph roads (28 to 31mph), above the speed limit on 20mph roads (21 to 25mph) and under the speed limit on other road types.

- Cars and vans are most likely to exceed a 20mph limit, and most likely to be travelling more than 30mph in a 20mph limit (Table 1-1).

Table 1-1 Compliance by mode in freeflow conditions in 20mph roads (2016)

	% >20mph	% 20-25mph	% 25-30mph	% >30mph
Car	81%	37%	29%	15%
Light commercial vehicle (van)	80%	35%	28%	16%
Rigid HGV	73%	39%	23%	10%
Articulated HGV	71%	45%	21%	5%
Short buses (under 12m)	54%	46%	6%	2%
Long buses (over 12m)	62%	33%	24%	4%

- Between 2011 and 2016, there has been a gradual increase in compliance with speed limits for most vehicles on most roads. This reflects a slight reduction in average free flow speeds for cars – of just over 1% on motorways, and less than 1% on national speed limit single carriageways and 30mph roads. Data for 20mph roads is only available for 2015 and 2016, and over this period, speeds fell by less than 1 mph, and compliance increased from 16% to 19%.

Table 1-2 Free flow car speeds on 30mph roads in Great Britain, 2011 to 2015

	2011	2012	2013	2014	2015	2016
Average free flow speed	31mph	31mph	31mph	31mph	31mph	31mph
Exceeding speed limit (%)	55%	55%	55%	54%	54%	53%
Exceeding limit by 5mph or more (%)	20%	20%	20%	19%	19%	19%

[14] Department for Transport (2016) Average vehicle speeds (flow-weighted) during the weekday morning peak on locally managed 'A' roads, by local authority in England: annual average from year ending July 2007 (Table CGN0206) – last update in February 2016. https://www.gov.uk/government/statistical-data-sets/cgn02-flow-weighted-vehicle-speeds

[15] Department for Transport (2017) Free flow vehicle speeds in Great Britain: 2016 tables https://www.gov.uk/government/statistics/free-flow-vehicle-speeds-in-great-britain-2015

Free flow speeds on 40mph roads – Free flow speeds on a small sample of 40mph roads have been monitored in previous years, but this data is not currently considered sufficiently robust to provide reliable evidence.

1.3.3. Comparator GPS journey speed data (from Tomtom)

As part of the analysis of TomTom GPS journey speed data, undertaken for this study and reported separately, three comparator areas were selected with similar geographical characteristics to the case study areas. Journey speed data for these locations shows a small decline in median speed of up to 1mph, over the core period of analysis used for the main case study areas. See separate Technical Appendix for further information.

Summary of findings

The above evidence suggests that there has been a small downward trend in speeds in recent years, across a range of road types – locally managed A roads and 30mph roads. This trend is expected to have extended to 20mph roads, but potentially to a lesser extent as levels of enforcement are typically lower on 20mph roads. It is therefore possible that a small reduction in speeds would have occurred on these roads even if the new limit had not been introduced. Evidence from three comparator areas selected as part of the analysis of GPS journey speed data supports this, and shows a small decline in median speed of up to 1mph over the period of analysis used for the main case study areas. This small downward trend in speeds on urban roads outside the case study areas needs to be taken into account when interpreting the findings presented in this report.

Detailed statistical analysis comparing the change in speed in case study and similar comparator areas has been undertaken as part of the analysis of GPS journey speed data[16], reported separately and in the main Technical Report. This estimates the extent to which the observed change in speed in the 20mph limit case study areas is likely to be due to the introduction of the 20mph limit, rather than part of a wider trend in speeds affecting both 20mph and 30mph roads.

The spot speed data presented in this report represents the actual change in speed observed in the case study areas. No statistical analysis has been undertaken here, to estimate the extent to which the changes are due to the introduction of 20mph limits, rather than background trends in speed. This report should therefore be read in conjunction with the main Technical Report.

[16] Atkins (2018) 20mph Research Study. Analysis of GPS journey speeds in case study areas. (Supporting Technical Appendix)

2. Research themes and hypotheses

2.1. Introduction

The purpose of this strand of the research is:

- to examine speed outcomes in the 20mph case study areas based on spot speed data;
- provide a comparator for the findings of the TomTom (GPS journey speed) analysis, undertaken as part of this study and reported separately; and
- contribute towards the evidence base for speed-related research themes developed for the study.

2.2. Speed-related research themes and hypotheses

Table 2-1 summarises the speed-related research themes and hypotheses to be addressed in the study, along with the relevant data sources. The research themes have been identified from the logic maps, developed as part of the wider study methodology to provide focus to the analysis.

The key research themes to be addressed using the spot speed data cover:

- % compliance;
- Average speed
- Speed profile (i.e. the distribution of speeds);
- Relationship between after speeds and characteristics of area
- Effectiveness of 20mph limits over time
- Perceptions about speed
- Speed displacement impacts

These themes have also been examined as part of the TomTom (GPS journey speed) analysis undertaken as part of this study. Evidence from the social research elements of the study (residents and drivers questionnaires, and focus groups) also contributes to the overall evidence base for these themes, and the other research areas identified in Table 2-1.

Table 2-1 Speed-related research themes to be examined in the 20mph research study

Theme	Description	GPS vehicle data	Local authority spot speed data	Residents and drivers questionnaires, focus groups
1. % compliance	- Before vs. after compliance - Level of compliance - Relationship between compliance and before speed - Relationship between compliance and time of day (as proxy measure for volume of traffic)	✓ *(Based on before and after comparison of area-wide data)*	✓ *(Where speeds are reported using appropriate speed bands, e.g. Portsmouth, Winchester Stanmore, Winchester City Centre)*	✓ *(Based on reported driver behaviour responses)*
2. Average speed	- Change in average speed - Relationship between before speed and change in average speed	✓ *(Based on before and after comparison of area-wide data)*	✓	✓ *(Based on perceived changes in driver behaviour)*
3. Speed profile	- Overall profile - Top and bottom percentile speeds - Proportion driving at 20mph, 24mph, 30mph (or similar)[17]	✓ *(Based on before and after comparison of area-wide data, interpolated from data regarding each 5th percentile speed)*	✓ *(Where speeds are reported using appropriate speed bands, e.g. Portsmouth, Winchester Stanmore, Winchester City Centre)*	✓ *(Based on perceived changes in driver behaviour)*
4. Relationship between after speeds and characteristics of area	- Change in % compliance, average speed and 85th percentile speeds by (i) Functional Road Class, (ii) land use type, and (iii) street environment (based on road width, distance from road to houses, age of housing, amount of greenspace, etc.).	✓ *(Based on before and after comparison of area-wide data, by Functional Road Class)*	✓ *(By analysing images of the road environment for locations demonstrating good or poor compliance)*	✓ *(Based on use of regression analysis to determine association between street environment and perceived changes in driver behaviour)*

[17] Threshold values of less than or equal to 20mph, over 24mph and over 30mph have been selected for the following reasons:

- less than or equal to 20mph – to test compliance with the new limit;
- over 24mph – to examine to what extent self-enforcement is it effective over 24mph and below 24mph (Research Question 3a), and to test existing guidance (DfT Circular 2013/01) regarding the likelihood of 20mph limits being self-enforcing; and
- over 30mph – to reflect the previous speed limit and test what impact the new limit has had on the proportion driving at speeds which are no longer considered appropriate for the environment (also the fastest drivers).

Note - Circular (01/2013, DfT), Setting Local Speed Limits states that if the mean speed is already at or below 24mph on a road, introducing a 20mph speed limit through signage alone is likely to lead to general compliance with the new speed limit.

Theme	Description	GPS vehicle data	Local authority spot speed data	Residents and drivers questionnaires, focus groups
5. Effectiveness of 20mph limits over time	- Change in % compliance, median speed, speed profile and 85th percentile speeds over time	✓ *(Based on 1 year and 7 year post implementation data for Portsmouth only)*	×	×
6. Relationship between after speeds and socio-demographic factors or driver behaviour	- Change in % compliance, average speed and 85th percentile speeds by (i) gender-age-affluence (ii) typical compliance behaviour, and (iii) local / regular drivers.	×	×	✓ *(Based on use of regression analysis to determine association between street environment and perceived changes in driver behaviour)*
7. Relationship between after speeds and levels of support / awareness	- Change in % compliance, average speed and 85th percentile speeds by (i) levels of support (ii) awareness of 20mph limits.	×	×	✓ *(Based on use of regression analysis to determine association between street environment and perceived changes in driver behaviour)*
8. Accuracy of perceptions about speed	- On problem streets with on-going speeding issues	×	✓ *(Based on analysis of speed data collected for roads identified as having on-going speeding problems - e.g. Portsmouth, Middlesbrough)*	×
9. Speed displacement impacts	- Change in speed compliance on surrounding roads: i) other residential streets with 30mph limits (ii) strategic routes.	✓ *(Based on before and after comparison of area-wide data)*	✓ *(Some data for Brighton)*	✓ *(Based on perceived changes in driver behaviour)*
10. Effectiveness of 20mph limits versus 20mph zones	- How do outcomes (e.g. % compliance) of 20mph speed limits compare with those in similar 20mph zones?	✓ *(Based on before and after comparison of area-wide data, by type of 20mph limit)*	×	✓ *(Indirectly, based on perceived need for traffic calming)*

3. Spot speed data

3.1. Data sources

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

- on-road medium, such as pairs of pneumatic (rubber) road tubes laid across the roadway, piezo-electric sensors embedded in the roadway, or inductive loops cut into the roadway, linked to a recorder box at the side of the road; or
- radar devices mounted to street furniture, or similar technology.

Pneumatic road tubes are generally used for temporary studies to study a sample of traffic (e.g. on selected 20mph roads), while piezo-electric sensors and inductive loops are used for permanent studies which can ascertain seasonal traffic trends and are often used in congestion monitoring on major roads. Pneumatic road tubes work by recording the number of air pulses generated by passing vehicle axles, and dividing by two to estimate the number of vehicles. Speed is determined by timing the vehicle across a known distance between the two hoses, typically about 6 foot. Vehicle type can be estimated based on the distance between axles, and number / grouping of axles, but can be prone to error, with slow speeds or close spacing of cars affecting accuracy.

Radar devices emit a radio wave, which moves at the speed of light, and bounces back to the radar device when it encounters an object in its path. When a radar is used to detect speed (for example, the rate at which a car is moving), the radio wave frequency of the returned signal is altered because the car is moving. If the car is moving toward the radar device, the return signal has a shorter distance to travel and the radio wave frequency increases. The radar device can then use the change in frequency to determine the speed at which the car is moving. Radar devices can be used for temporary or permanent studies. They are typically less noticeable to drivers than pneumatic tubes, and as such will give a truer reading for speed.

Table 3-1 Spot speed data sources

Source	Data collected	Strengths	Limitations
On-road medium (pneumatic tubes, piezo-electric sensors, or inductive loops)	Traffic speed ✓ Traffic volume ✓ Vehicle type ✓	Can measure traffic volume, speed and vehicle type. Pneumatic tubes are relatively cheap and quick to install, and can be readily moved from location to location. Raw data gives full distribution of speeds.	Can easily get pulled up on busy roads and are more prone to vandalism than radar. Represents 'spot' speeds only, i.e. in one particular location. Results influenced by specific location (e.g. speed readings will be lower if placed near a junction, at a bend, near parked cars, etc.).
Radar / Video Recorders	Traffic speed ✓ Traffic volume ✓	Detect vehicles without the need for a hard equipment on the ground (such as tubes) – are therefore less noticeable to drivers and as such will give a truer reading for speed. Raw data gives full distribution of speeds.	Generally more expensive than tubes or loops. Represents 'spot' speeds only, i.e. in one particular location. Results influenced by specific location.
Vehicle Activated Signs	Traffic speed ✓ Traffic volume ✓	Signs activate if an approaching vehicle is detected to be exceeding a pre-set speed threshold. Raw data gives full distribution of speeds.	Expensive, so coverage of sites is typically limited and covers short periods only. Presence of signs likely to influence driving speeds. Represents 'spot' speeds only, i.e. in one particular location. Results influenced by specific location.

Some local authorities have also used **vehicle activated signs (VAS)** 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 may influence driving speeds.

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

- mean and 85th percentile speeds*;
- speed bins (i.e. the number of vehicles travelling 5-10mph, 10-15mph, etc.);
- vehicle flow; and
- vehicle type (in the case of on-road medium, such as pneumatic loops, but not obtainable from radar devices or vehicle activated signs).

** The 85th percentile speed is the speed at which 85% of vehicles are travelling at or below. The 85th percentile speed is a widely used traffic statistical metric, and is assumed to represent the speed below which the majority of drivers are travelling. It also represents the speed above which the fastest drivers are travelling. It is used in this study to examine what impact 20mph limits have on the speed adopted by the fastest drivers.*

3.2. Spot speed data collected by case study authorities

Table 3-2 summarises the spot data collected by case study authorities. Further detail can be found in the appendices at the end of this report.

Number and location of sites - The number of sites with before and after data varies by case study, generally reflecting the size of the scheme area. Sites are generally chosen to be representative of the scheme area, but there is a tendency to specifically include 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. *Note – TomTom (GPS journey speed) data captures speeds on nearly all 20mph roads in a scheme area, so is more representative.*

The sites identified in Table 3-2 are based on the same case study scheme areas covered in the TomTom (GPS journey speed) data analysis, for compatibility. In some cases (e.g. Walsall, Winchester, Calderdale, Nottingham), similar data has also been collected for other areas within the authority or other scheme phases. Nottingham City Council collected before data in the Bestwood area, but due to limited resources (both funding and staffing), after monitoring was not undertaken. The Council did, however, undertake before and after monitoring in the pilot area of Sherwood, and the results are presented in Appendix F, for information. *Note - Sherwood isn't a case study area, so there isn't any comparable TomTom data for the Sherwood area.*

A number of case study authorities have increased the number of monitoring sites post implementation, to monitor roads where speeding is expected to be an issue (e.g. Portsmouth, Middlesbrough).

Approach – Monitoring is undertaken using a mix of inductive loops and speed detection radar.

Duration – In general, monitoring is undertaken over a 7-day period, 24hrs/day; with Middlesbrough and Chichester adopting a longer period. Extending the period to two weeks allows two sets of data to be collected for each day of the week, and reduces the impact of any unusual circumstances (e.g. inclement weather). DfT's Transport Analysis Guidance (TAG Unit M1.2, 3.3.35) advises two weeks for undertaking flow counts.

In Portsmouth, monitoring was undertaken on just one day, but the large number of sites involved improves the robustness of the data if analysed at an aggregate level.

Table 3-2 Spot speed data collected by case study authorities

ID	Case study area	No. of sites	Location of sites	Monitoring approach	Monitoring duration	Before monitoring period (and month)	After1 monitoring period	After2 monitoring period	Flow data	Mean / 85th speed	Speed bin data	Other speed data	Monitoring Report provided	Quality of evidence (see Appendix)
Small-scale residential schemes														
R-SM1	Walsall (Rushall)	10	Representative locations across scheme area	Pneumatic loops	7 days (24hr)	6 months pre (Sep 2013)	4 months post (Jul 2014)	30 months post (Sep 2016)	✓	✓	✓	Vehicle Activated Sign data.	No	Moderate
R-SM2	Winchester (Stanmore)	3	Representative locations across scheme area	Speed detection radar	7 days (24hr)	15+ months pre (Aug 2009, Mar 2013)	-	17-21 months post (Nov 2015, Mar 2016)	✓	✓	(✓)	By AM and PM Peak.	No	Moderate
Area-wide residential schemes														
R-AW1a	Liverpool (Area 7)	*No monitoring data provided.*		-	-	-	-	-	-	-	-	-	-	-
R-AW1b	Liverpool (Area 2)	*No monitoring data provided.*		-	-	-	-	-	-	-	-	-	-	-
R-AW2	Middlesbrough (Phase 1)	15	Generally on more important routes	Speed detection radar	14-21 days (24hr)	Up to 4 years pre (Aug 2008 to Feb 2009, across 8 diff months)	9-12 months post (Mar to Jun 2013) + two sites 4 months post (Oct 12). Across 7 diff months.	-	✓	✓ (Mean only)	✓	After(only) monitoring of problem sites.	No	Limited (no raw data provided)
R-AW2	Middlesbrough (Phase 2)	10	Generally on more important routes	Speed detection radar	14-21 days (24hr)	2.5 to 3.5 years pre (Oct 2009 to Jan 2011, across 5 diff months)	3 months post (Jul 2013) + 2 sites 1 year post (Mar 2014 / Jul 2014)	-	✓	✓ (Mean only)	✓	After(only) monitoring of problem sites.	No	Limited (no raw data provided)
R-AW3	Calderdale (Phase 1)	3	Mainly on busier through routes	Pneumatic loops	7 days (24hr)	At least 1 month pre (May 2015)	3 months post (Oct 2015)	-	✓	✓	×	-	No	Limited (no raw data provided)
R-AW4	Nottingham (Bestwood)	*No after monitoring data collected.*		-	-	-	-	-	-	-	-	-	-	-
R-AW5	Brighton (Phase 2)	46	Representative locations across scheme area (+ sites with complaints about speeding)	Pneumatic loops	7 days (24hr)	12 months pre (Jun 2013)	12 months post (Jun 2015)	24 months post (Jun 2016)	✓	✓	✓	By day of week + 28 sites on 30mph roads + journey time runs (after only).	No	Moderate
R-AW6	Portsmouth (City-wide)	223	Representative locations across city	Pneumatic loops	1 day (16 hrs)	4 months to 4 years pre (Jun 2004 to Feb 2007, various months)	6-18 months post, in general (Jun 2007 to Nov 2009, various months)	-	✓	✓ (Mean only, aggregated)	×	After data for sites with speeding complaints from residents.	Yes (Interim Evaluation Report)	Moderate
R-AW7	Chichester (City-wide)	35	Representative locations across scheme area (+ sites where higher speeds likely)	Pneumatic loops	7-10 days (24hrs)	15 months to 8 years pre (16 sites in Mar 2012, 20 sites in various months during 2005 to 2011)	8 months post (Mar 2014)	-	(✓)	✓	(✓)	-	Yes	Limited-Moderate
City centre and adjacent residential area schemes														
TC-AW1	Brighton (Phase 1)	47	Representative locations across scheme area (+ sites with complaints about speeding)	Pneumatic loops	7 days (24hr)	10 months pre (Jun 2012)	13 months post (May 2014)	26 months post (Jun 2015)	✓	✓	(✓)	Journey time runs (after only).	No (High level reporting in Cabinet Reports)	Moderate
TC-AW2	Winchester (City Centre)	11	Representative locations across city	Speed detection radar	7 days (24hr)	12-30 months pre (1 site in Apr 2012, 1 in Apr 2013, 3 in Jul 2013, 6 in Sep 2013)	7-8 months post (Apr/May 2015)	-	✓	✓	✓	By AM and PM Peak	No	Moderate

✓ **Data collected by case study authority and analysed for this study.** ✓ **Data collected by case study authority but not provided.** (✓) **Data provided by case study authority but not feasible to analyse as part of this study.**

Before timescales – The timescales for before monitoring vary substantially, from 1 month prior to implementation to up to 4 years before; but are typically less than 24 months before implementation.

In some cases, the data was collected within 6 months of implementation, and may have been affected by changes in behaviour in the run up to implementation, e.g. consultation, education and awareness initiatives, disruption due to works, or phased implementation in the surrounding area.

In other cases, some before data has been collected several years before implementation (as part of a separate monitoring exercise), and may be influenced by background trends in speed. In these cases, the older data has generally been supplemented by new data to provide a more comprehensive coverage of the scheme area. Use of historic data can reduce the cost of monitoring, but can also reduce the robustness of the evidence if the data is collected at different times of the year, or at different points in time when background trends may have differed. It may also bias the location of sampling points.

Scheme areas where historic monitoring sites have been used include:

- Winchester (Stanmore) – one site surveyed in 2009 (5 years before implementation) and two sites surveyed in 2013 (15 months before implementation);
- Middlesbrough – sites in Phase 1 area monitored up to 4 year period prior to implementation (Aug 2008 to Feb 2009), sites in Phase 2 area monitored 2.5 to 3.5 years before implementation (Oct 2009 to Jan 2011);
- Portsmouth – sites monitored between 4 months and 4 years before implementation (Jun 2004 to Feb 2007);
- Chichester – just under half of the sites were monitored in March 2012 (15 months pre-implementation) but the remainder were historic sites, monitored between 2005 and 2011.

Other case studies also used historic survey data, but this generally represented a small proportion of the overall sample.

After timescales – Most case study authorities undertook after monitoring between 3 and 12 months of implementation. This allows some time for scheme outcomes to establish.

Walsall and Brighton Councils undertook two periods of after monitoring, enabling a longer term analysis of outcomes to be undertaken. Others, such as Portsmouth, have an on-going programme of after monitoring in place, focused on roads where speeding complaints are received from the Council.

Impact of background trends on survey data – Where there is a substantial gap between before and after surveys, the results may be affected by background trends.

Survey months – Only a few case studies undertook before and after monitoring in the same month: Walsall (Before and After 2 surveys undertaken in September); Brighton Phase 2 (Before, After 1 and After 2 surveys undertaken in June); and Brighton Phase 1 (Before, After 1 and After 2 surveys undertaken in May/June). Traffic flow is known to vary by time of year, due to the influence of weather, increases the comparability of the data. Nevertheless, in most other cases, before and after surveys have been undertaken in neutral months[18] when flows are considered to be most representative of the yearly average. This ensures that the before and after data is broadly comparable, although to a lesser extent than if undertaken in the same month. In a small number of cases, surveys have been undertaken in non-neutral months (e.g. January, February, July and August), limiting the comparability of the data.

Data metrics – The majority of case study authorities collected data on:

- vehicle flow (and sometimes type);
- mean and 85th percentile speeds;
- speed bins (i.e. the number of vehicles travelling 5-10mph, 10-15mph, etc.).

[18] 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.

The raw data is generally recorded on an hourly basis, by direction, and for each survey day. The Winchester data also summarises the data for the AM and PM peak periods; while the Portsmouth on-going monitoring data also summarises the data by vehicle type.

Reporting – In general, the case study authorities were unable to provide a formal report setting out the findings of the monitoring data. Some provided analysis spreadsheets, while others referred the study team to Cabinet papers, which provide a high-level summary of the results. In general, however, documentation of any analysis was poor. So, while the authorities generally collected a substantial amount of monitoring data, there is a question about whether the data has been used effectively.

Availability and quality of evidence for this study – A summary of the availability and quality of evidence for this study is presented in Table 3-2, with further explanation provided in the relevant appendices.

Given the lack of in-depth reporting available from the case study authorities, it has been necessary to undertake our own analysis of the raw data. To make the most effective use of the budget available, this has focused on schemes where a substantial amount of data has been collected, which has been provided in a consistent format which can be readily analysed; and areas which cover a range of different scheme types and environments – namely Walsall (small-scale residential), Brighton Phase 2 (area-wide residential), and Winchester City Centre (city centre). For other areas, headline statistics only are reported. *See Chapter 4 for further information.*

In some cases, authorities have been unable to provide the raw data, for various reasons, which has limited the extent of the analysis which can be undertaken – typically limiting it to an analysis of mean and 85th percentile speeds, and excluding speed profile analysis. In other cases, the format of the data has changed between the before and after periods, and it has not been possible to analyse the data within the budget available for this element of the study.

A detailed analysis of the data files provided by the case study authorities highlighted several quality-related issues, which are summarised below. These should be considered when interpreting the findings presented in this report, and provide some lessons for future monitoring:

- In a small minority of cases, the reported 85th percentile speed is less than the reported mean speed, which is not a logical outcome. Further investigation showed that this is because the overall site mean and 85th percentile speed is calculated as the average of the mean and 85th percentile speeds for each 15 or 60 minute periods, weighted by flow. Mean speeds are reported for all 15 or 60 minute periods where at least one vehicle is detected, but 85th percentile data is only reported if the 15 or 60 minute flow exceeds 10 vehicles. As a result, the average 85th percentile speed for the site was based on data for part of the day only, and was not directly comparable with the average mean speed for the site (based on data for the whole day). See Appendix A for further information. *Sites where this occurred have been excluded from the analysis. This issue was not apparent in data for other scheme areas.*
- Some before and after data was collected in different months, which means that the data is not directly comparable for all sites.
- Some of the speed bins used are not well suited to monitoring 20mph compliance. In one area the before data was based on 0-15mph, 15-30mph, and then 5mph bands. These were the standard bands historically used by the Council when monitoring speeds on 30, 40 and 60mph roads, but were found to be unsuitable for monitoring 20mph compliance.
- Due to on-street parking or changes to street furniture, there are occasional incidents where monitoring equipment had to be moved in the after survey.
- In one case, the before data comprised a mix of historic data, based on weekdays only, and new sites where data was collected over a 7-day period. The after data is all reported based on a 7-day average. The data reported for some sites therefore appears to be inconsistent.

3.3. Comparison of spot speed and GPS (TomTom) data

The 20mph Research Study uses both TomTom (GPS journey speed) and spot speed data, to provide a comprehensive picture of speed outcomes, taking account of the relative strengths and limitations of each data set.

The two data sources measure speed in two very different ways. GPS data measures **journey speed**. This is the effective speed of the vehicle on a journey between two points and is the distance between the two

points divided by the total time taken for the vehicle to complete the journey, including any stopped time. In contrast, spot speed surveys measure the **instantaneous speed** of a vehicle at a specified location.

TomTom (GPS journey speed) data provides information on speeds across the whole of the network being examined, covering a year before and a year after implementation, but based only on drivers with TomTom devices. This data may be skewed by drivers driving differently when using a sat-nav - although connected devices transmit speed data all the time, even when not actively being used as a navigation device. There may also be an affluence bias in the characteristics of TomTom users which may translate to driving behaviour - although the cost of devices has come down in recent years.

In contrast, spot speed surveys collect data for every single vehicle passing the detection point, but for a limited number of survey locations across the network and based on a limited number of survey days. Data is typically collected for a short period only. The data can be affected by seasonality issues or biased by behaviour on a specific day. As with any equipment, devices can malfunction resulting in missing data.

A summary of the relative strengths and limitations of TomTom (GPS journey speed) and spot speed data are summarised in Table 3-3.

Table 3-3 TomTom (GPS journey speed) and spot speed data – strengths and limitations

TomTom 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 (averaged across all segments). • 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).

Spot speed data is likely to provide a higher estimate of speeds than GPS journey speed data. There are two main reasons for this.

Firstly, GPS journey speed data is based on full segment traversal[19], so will record lower speeds where vehicles are stopping or slowing down mid-segment, and will include the acceleration and braking phases on the exit/approach to a junction. However, spot speed data measures speeds at a single point only, so is less likely to be affected by these issues and more likely to represent 'free flow speed,' if located in a suitable location.

Secondly, monitoring locations for spot speed surveys tend to 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.

These issues are examined further in Section 5.3.

[19] Segments are short sections of road network (typically less than 100m long in urban areas), which represent the lowest level of granularity that TomTom GPS data can be spatially disaggregated to).

4. Analysis approach

4.1. Overview

The data collected by local authorities varies substantially in terms of scale and type, as does the extent of the analysis and reporting undertaken, and the provision of data for this study (in raw or aggregated format).

A summary of speed and flow data provided for each of the case study schemes is presented in Table 3-2. In some cases, only average before and after data has been provided, with no information about traffic flow or sample size, or speed profile. In other cases, the monitoring programme has been extensive, and detailed raw data has been provided.

In general, authorities have not provided comprehensive monitoring reports summarising the monitoring results. It has therefore been necessary to undertake detailed analysis of the raw data files, where provided, to address the research issues outlined in Chapter 2 in a consistent manner.

A tiered analysis approach has therefore been adopted. This involves:

- Examining headline results for a core set of metrics available for the majority of case study areas (mean, 85th percentile, and % driving below 20mph). *Purpose: To examine speed outcomes in the 20mph case study areas, based on spot speed data.*
- Undertaking more detailed speed profile analysis of the raw data for a sample of the case study schemes, where robust and comprehensive raw data has been provided, and covering a range of different scheme types and environments – Walsall (small-scale residential), Brighton Phase 2 (area-wide residential); and Winchester City Centre (city centre). *Purpose: To provide a comparator for the findings of the TomTom (GPS journey speed) analysis.*
- Analysing supplementary data provided by some authorities to address specific issues, e.g.
  - analysis of vehicle activated signs installed as part of an enforcement / speed awareness initiative (Walsall) – *to examine the impact of VAS on speeds;*
  - on-going monitoring at sites where the public have complained about speeding (Portsmouth) – *to compare perceived vs. actual speeds, and on-going incidents of excessive speeds;*
  - comparison of speed profile curves for different vehicle types (Portsmouth) – *to examine compliance by vehicle category and mode (this is the only dataset which provides speed bin data by vehicle type).*

Before and after data ranges

The TomTom (GPS journey speed) analysis focuses on the following data ranges or time spans:

- The 'one year 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, because of consultation and education activities, disruption due to works, or phased implementation in the immediate area.
- The one year after data covers the period 6-18 months after implementation, to allow time for the scheme outcomes to settle.

Ideally, the spot speed analysis would focus on the same timespans, but a more flexible approach is required to reflect the data available.

The spot speed analysis is therefore presented for the following periods:

- Before – Up to 4 months before implementation, but generally within 2 years.
- After1 – 0-18 months (0-1.5 years)* post implementation – *to examine short term trends (represents good compatibility with TomTom data spans)*.
- After2 – 18-30 months (1.5-3.0 years) post implementation – *to examine longer term trends.*

**Data collected less than 6 months after implementation has been excluded from the analysis, if later monitoring data is available (e.g. Walsall).*

4.2. Headline results

The following headline metrics are produced by most of the monitoring software packages used by the case study authorities:

- vehicle count or flow
- mean speed (mph)
- 85th percentile speed (mph)
- % driving <=20mph.

These metrics are therefore used to summarise speed outcomes across the case study schemes, on a consistent basis. The data is presented as a 7-day average, for consistency with the TomTom (GPS journey speed) approach.

Where possible, the mean speed, 85th percentile speed, and percent driving less than 20mph metrics are weighted by flow to give an average across all sites, representative of all drivers monitored within the area. This is similar to the approach adopted for the TomTom analysis, although this also weighted the data by the segment length (which is not applicable in the case of the spot speed data which is for a spot location only).

Use of the mean - Average speeds are represented by the mean, rather than the median (which is used in the TomTom analysis). The mean is the standard output produced by the monitoring software, and is available for the majority of the case study areas. The median is not a standard output, and can only be estimated from the speed bin data. Where speed bin data is available, this is generally provided for 5mph bands requiring an interpolation between bands to estimate the median value. Comparison of actual vs estimated 85th percentile values for Walsall, shows that the interpolation approach resulted in errors of up to 1.1mph. A similar scale of error is likely to affect median estimations. Given that the change in the median and 85th percentile speeds identified in the TomTom analysis were only -0.7mph and -1.2mph in residential areas, and -0.9mph and -1.6mph in city centre areas, this is considered a large margin of error.

The median – denoted as the value lying at the midpoint of a frequency distribution of observed values – was identified as the preferred metric for the TomTom analysis, because it is least affected by slow moving vehicles.

Speeds in TomTom are calculated as the journey time along a segment, divided by the segment length. Speeds are calculated for all vehicles travelling along the full segment length. Some vehicles are recorded as having very slow speeds due to the length of time taken to traverse the segment. This can be due to a range of factors:

- unusual or random behaviour, e.g. looking for a parking space, stopping to talk to a neighbour, or similar;
- environmental constraints, e.g. slowing to allow another car to pass, due to parked cars reducing the width of the carriageway;
- congestion, which may constrain speeds due to the volume of traffic on the network;
- accelerating from a junction, or braking to a junction.

The presence of these slower moving vehicles can substantially dampen the calculated mean, and is likely to produce a figure which is much lower than the speed at which most users would intuitively assume to be the average. The median is also dampened by slower moving vehicles, but to a much lesser extent than the mean. The median produces a higher average value, which more closely represents typical freeflow driving speeds.

In the case of spot speed data, the difference between the mean and the median is expected to be less marked. Speeds are measured at one point along the road only, and the proportion of drivers travelling slowly (for any of the above reasons) at the spot location, is expected to be low. Use of the mean is therefore considered appropriate for spot speed analysis.

Measuring profile changes – The mean tells us that the profile of speeds above the average is balanced by the profile below the average, but does not tell us how many people are driving above or below the average point, or anything about the profile either side of the average. The 85th percentile speeds, and where available the proportion travelling less than 20mph, will therefore also be reported to examine changes in the profile of speeds.

4.3. Detailed speed profile analysis

One of the requirements of the analysis is to provide a comparison with TomTom (GPS journey speed) results. Comparison of mean speeds from the spot speed analysis with median speed from the TomTom data will not provide a useful check. However, comparison of the percentage driving less than or equal to 20mph, over 24mph and over 30mph will provide a meaningful comparison.

Speed bin data is not available in an accessible format for all case study schemes. Detailed speed profile analysis is therefore limited to a sample of schemes, where robust and comprehensive raw data has been provided, and which cover a range of different scheme types and environments – Walsall (small-scale residential), Brighton Phase 2 (area-wide residential); and Winchester City Centre (city centre).

Threshold values of less than or equal to 20mph, over 24mph and over 30mph have been selected for the following reasons:

- less than or equal to 20mph – to test compliance with the new limit;
- over 24mph – to examine to what extent self-enforcement is it effective over 24mph and below 24mph[20] (Research Question 3a), and to test existing guidance regarding the likelihood of 20mph limits being self-enforcing; and
- over 30mph – to reflect the previous speed limit and test what impact the new limit has had on the proportion driving at speeds which are no longer considered appropriate for the environment (also the fastest drivers).

[20] Circular (01/2013, DfT), Setting Local Speed Limits states that if the mean speed is already at or below 24mph on a road, introducing a 20mph speed limit through signage alone is likely to lead to general compliance with the new speed limit.

5. Speed outcomes in case study areas

5.1. Introduction

This chapter summarises the key results from the spot speed surveys undertaken by the case study authorities. In particular, it:

- provides a summary of the site characteristics - *to provide the context for interpreting outcomes*;
- outlines the headline results for each scheme area - *average mean speed, 85th percentile speed, and compliance*;
- examines speed profile curves for three schemes in Walsall (small-scale residential), Brighton Phase 2 (area-wide residential); and Winchester City Centre (city centre) – *to show how spot speed data compares with TomTom (GPS journey speed) data and to compare findings for different road types and before speeds*; and
- examines site specific performance and identifies the characteristics of sites reporting the biggest reduction in speed and highest speeds – *to examine the relationship between speeds and site environment*.

For consistency with the analysis of speed outcomes undertaken using TomTom (GPS journey speed) data, 20mph roads have been categorised as 'major strategic roads', 'important local roads', and 'minor local roads', based on Functional Road Class (FRC) categories defined by TomTom[21].

5.2. Context – site characteristics

Table 5-1 summarises the characteristics of the monitoring sites used in this analysis.

Flow – Average 7 day, 24 hr flow varies from 3,668 vehicles to 183,022 vehicles across the scheme areas.

Road type – The majority of spot speed monitoring sites are located on minor local roads and / or roads with a before mean speed of <=24mph.

Across the eight scheme areas with comprehensive site data (Walsall, Winchester Stanmore, Middlesbrough, Calderdale, Brighton Phase 2, Chichester, Brighton Phase 1 and Winchester City Centre):

- 1% are on major strategic roads;
- 31% are on important local roads; and
- 68% are on minor local roads.

Across these same scheme areas:

- 20% of sites had a mean before speed <=20mph;
- 39% had a mean before speed of 20-24mph;
- 41% had a mean before speed of >24mph; and
- 4% had a mean before speed of >30mph.

The above findings exclude data for Portsmouth. The 20mph scheme here was one of the first to be implemented in the country, and pre-dated the other case study schemes by at least three years. A much higher proportion of monitoring sites (66%) already had a mean speed of <=20mph, compared with elsewhere; providing less scope for an overall reduction in speed. The precise location of monitoring sites is unknown.

A number of case study authorities report a bias towards busier and more important roads, and those with known / expected speeding problems, when identifying spot speed monitoring sites (see Section 3.2). This

[21] TomTom classifies roads according to their Functional Road Class, from Motorways (FRC = 0) through to local roads of minor importance (FRC = 7). This is a good proxy for the size and nature of each road. For the purpose of this analysis, 20mph roads have been grouped into three categories: Major strategic roads (FRC 1-3), Important local roads (FRC 4-5), and Minor local roads (FRC 6-7).

suggests that the above sample of monitoring sites comprises an under-representation of minor local roads / roads with slower speeds generally, which may influence the outcomes observed.

Mode share – Mode share data was only available for two sites. In both cases, the vast majority of vehicles at the monitored sites were cars (87% in Walsall, 88% in Brighton Phase 2). The Walsall sites had a relatively high proportion of LGVs (9%), presumably reflecting the proximity of the scheme area to an industrial estate; and the Brighton Phase 2 sites had a relatively high proportion of buses (7%).

Table 5-1 Spot speed site characteristics

ID	Case study area	No. of sites with before mean:				No. of sites on:			Mode share:					Before sample size (veh)	Before 7 day avrg flow (veh)
		<=20 mph	20-24 mph	>24 mph	>30 mph	Major strategic road	Important local road	Minor local road	M'cycles	Cars	LGVs	Buses	HGVs		
Small-scale residential schemes															
R-SM1	Walsall (Rushall)	30%	30%	40%	30%	0%	30%	70%	2%	87%	9%	0%	2%	121,012	17,827
R-SM2	Winchester (Stanmore)	0%	33%	67%	0%	0%	33%	67%	-	-	-	-	-	25,102	3,668
Area-wide residential schemes															
R-AW1a	Liverpool (Area 7)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R-AW1b	Liverpool (Area 2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R-AW2	Middlesbrough (Phase 1)	0%	20%	80%	13%	0%	33%	67%	-	-	-	-	-	Not available	Not available
R-AW2	Middlesbrough (Phase 2)	0%	20%	80%	20%	0%	20%	80%	-	-	-	-	-	Not available	Not available
R-AW3	Calderdale (Phase 1)	0%	67%	33%	0%	0%	67%	33%	-	-	-	-	-	59,828	8,547
R-AW4	Nottingham (Bestwood)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R-AW5	Brighton (Phase 2)	17%	54%	28%	0%	2%	17%	80%	3%	88%	0%	7%	1%	806,567	115,225
R-AW6	Portsmouth (City-wide)	63%	22%	14%	-	-	-	-	-	-	-	-	-	Not available	Not available
R-AW7	Chichester (City-wide)	14%	54%	31%	0%	0%	40%	60%	-	-	-	-	-	Not available	Not available
City centre and adjacent residential area schemes															
TC-AW1	Brighton (Phase 1)	34%	30%	36%	0%	2%	23%	74%	-	-	-	-	-	1,281,151	183,022
TC-AW2	Winchester (City Centre)	36%	18%	45%	0%	0%	82%	18%	-	-	-	-	-	600,113	85,731
Total (Incl. Portsmouth)		**44%**	**30%**	**26%**	**2%**	**-**	**-**	**-**	-	-	-	-	-	-	-
Total (Excl. Portsmouth)		**20%**	**39%**	**41%**	**4%**	**1%**	**31%**	**68%**							

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5.3. Scheme area results

Table 5-2 summarises the headline results for each of the scheme areas. Site-specific data has been averaged, and weighted by flow data where available, to give average mean, 85th percentile, and compliance levels for each scheme area.

Flow – The change in flow between the before and after periods varies substantially, with some scheme areas showing marked increases, e.g. +22% in Winchester (Stanmore), and -13% in Calderdale. The extent to which this reflects a real long term increase in flow in these scheme areas, as opposed to specific circumstances during the monitoring periods for these sites, is unclear. It is worth noting, however, that both scheme areas had 3 monitoring sites only. The other three scheme areas with data (all with a larger number of monitoring sites) reported much smaller changes in flow (-2% to +8%).

In general, however, the flow has either increased or not changed, suggesting that drivers have not tried to avoid 20mph roads.

Average mean speed – The unweighted and weighted difference in mean speed is presented in Table 5.2. Un-weighted metrics treat all sites equally, and reflect average difference in speeds across the chosen sites. Flow-weighted metrics place more emphasis on higher flow sites and are more representative of the behaviour of all drivers. Unweighted data is available for nine case study areas, and provides more comprehensive scheme-level data. Flow-weighed data is arguably more interesting in terms of understanding driver behaviour and is more comparable with the TomTom (GPS journey speed) analysis undertaken (reported separately[22]), but is only available for six case study areas, two of which comprise only three monitoring sites each.

The average unweighted mean speeds for the scheme areas, prior to the introduction of the new 20mph limits, varied from 19.8mph in Portsmouth to 26.8mph in Middlesbrough. This indicates a large variation in speeds across the scheme areas. In Portsmouth, a high proportion of drivers were already travelling at 20mph or less; while in Middlesbrough a substantial proportion were driving closer to 30mph prior to the introduction of the new limit. Flow-weighted mean speeds are typically higher, reflecting higher speeds on busier roads.

Statistical analysis[23] shows a significant reduction in mean speed in four case study areas based on unweighted speed data:

- Middlesbrough: -2.3mph within the first year;
- Chichester: -1.7mph within the first year; and
- Brighton Phase 2: -0.9mph after 12 months, and -0.9mph after 24 months;
- Brighton Phase 1: -1.3mph after 13 months and -1.2mph after 26 months.

In the two Brighton case studies, flow-weighted differences were also found to be significant and show slightly bigger reductions in mean speed, reflecting a bigger reduction on busier roads:

- Brighton Phase 2: -1.1mph after 12 months, and -1.4mph after 24 months;
- Brighton Phase 1: -1.6mph after 13 months and -1.3mph after 26 months.

In addition, the flow weighted difference in Calderdale Phase 1 (-1.5mph) was significant, although the findings are based on 3 sites only.

No significant change in mean speed was found in:

- Walsall (Rushall), Winchester (Stanmore) and Winchester City Centre.

It was not possible to calculate confidence intervals for Portsmouth as speed data is not readily available in disaggregated format.

[22] Atkins (2018) 20mph Research Study. Analysis of GPS journey speeds in case study areas. (Supporting Technical Appendix).
[23] A paired t-test was used for the unweighted data, and a weighted least squares model for the weighted data.

85th percentile speeds – The average unweighted 85th percentile speeds for scheme areas, prior to the introduction of the new 20mph limits, varied from 25.9mph in Winchester City Centre to 31.7 in Calderdale Phase 1. This data was only available for seven scheme areas, but again indicates a large variation in higher end speeds across the different locations. Flow-weighted mean speeds are typically higher, reflecting higher speeds on busier roads.

Statistical analysis[24] shows a significant reduction in 85th percentile speeds in five case study areas based on unweighted speed data:

- Walsall: -2.1mph after 30 months;
- Calderdale: -2.2mph after 3 months (based on 3 sites only);
- Brighton Phase 2: -0.9mph after 12 months, and -0.9mph after 24 months;
- Brighton Phase 1: -2.0mph after 13 months and -1.9mph after 26 months;
- Chichester: -2.8mph within the first year.

Flow-weighted differences were also found to be significant in Walsall (-1.6mph), Brighton Phase 2 (-1.2mph, -1.4mph), and Brighton Phase 1 (-1.8mph, -1.3mph); but not in Calderdale.

No significant change in mean speed was found in:

- Winchester (Stanmore) and Winchester City Centre.

In general, the change in the 85th percentile speed is greater or equal to the change in mean speed.

Compliance – The level of compliance with the new 20mph limits varies from 14% in Walsall to 71% in Portsmouth, based on evidence available for five scheme areas. This mirrors what was occurring with the mean before speed. Across all the scheme areas with data, Walsall had the highest before mean speed, and Portsmouth had the lowest before mean speed.

Trends over time – Data for Brighton Phase 2 (residential) and Phase 1 (city centre focused) was collected one year and two years post implementation. In both cases, there is no evidence to suggest a statistically significant change in speeds between the two after periods[25].

	Unweighted data		Flow-weighted data	
	Change in mean speed between two after periods	**Change in 85th percentile speed between two after periods**	**Change in mean speed between two after periods**	**Change in 85th percentile speed between two after periods**
Brighton (Phase2)	0.0mph *(not sig)*	0.0mph *(not sig)*	-0.2mph *(not sig)*	-0.2pmh *(not sig)*
Brighton (Phase1)	+0.1mph *(not sig)*	+0.1mph *(not sig)*	+0.3mph *(not sig)*	+0.5mph *(not sig)*

Variability in outcomes between scheme areas – There is relatively little variation in performance across the scheme areas, with no particular schemes standing out as performing particularly strongly or weakly.

[24] A paired t-test was used for the unweighted data, and a weighted least squares model for the weighted data.
[25] A paired t-test was used for the unweighted data, and a weighted least squares model for the weighted data.

Table 5-2 Scheme area results (After 1 = 0-18 months post implementation; After 2 = 18-30 months post implementation) – unweighted and flow weighted (where available)

ID	Case study area	No. of sites	Flow (7 day average)			Mean speed (mph)			85th percentile speed			%<=20mph, >24mph, >30mph		
			Before	After1 (Diff1)	After2 (Diff2)	Before	After1 (Diff1)	After2 (Diff2)	Before	After1 (Diff1)	After2 (Diff2)	Before	After1 (Diff1)	After2 (Diff2)
Small-scale residential schemes														
R-SM1	Walsall (Rushall)	10	17287	-	18590 (+8%)	25.2 (unweighted) 29.5 (flow-weighted)	- -	-0.3 ***(not sig)*** -0.1 ***(not sig)***	30.7 (unweighted) 35.2 (flow-weighted)	- -	-2.1 ***(sig)*** -1.6 ***(sig)***	14%, 76%, 49%	-	14%, 72%, 42% (0%, -3%, -7%)
R-SM2	Winchester (Stanmore)	3	3668	-	4476 (+22%)	25.2 (unweighted) 26.0 (flow-weighted)	- -	+0.4 ***(not sig)*** -0.2 ***(not sig)***	30.9 (unweighted) 31.8 (flow-weighted)	- -	+0.7 ***(not sig)*** 0.0 ***(not sig)***	19%, 58%, 18%	-	20%, 56%, 17% (+1%, -2%, 0%)
Area-wide residential schemes														
R-AW1a	Liverpool (Area 7)	*No monitoring data provided.*				-	-	-	-	-	-	-	-	-
R-AW1b	Liverpool (Area 2)	*No monitoring data provided.*				-	-	-	-	-	-	-	-	-
R-AW2	Middlesbrough (Phase 1)	15	-	-	-	26.5 (unweighted) -	- -	-1.9 *(not tested)* -	- -	- -	- -	-	-	-
	Middlesbrough (Phase 2)	10	-	-	-	27.4 (unweighted) -	- -	-2.8 *(not tested)* -	- -	- -	- -	-	-	-
	Middlesbrough (Phase 1+2)	25	-	-	-	26.8 (unweighted) -	- -	-2.3 ***(sig)*** -	- -	- -	- -	-	-	-
R-AW3	Calderdale (Phase 1)	3	8547	7395 (-13%)	-	24.4 (unweighted) 22.9 (flow-weighted)	-1.8 ***(not sig)*** -1.5 ***(sig)***	- -	31.7 (unweighted) 30.0 (flow-weighted)	-2.2 ***(sig)*** -1.7 ***(not sig)***	- -	-	-	-
R-AW4	Nottingham (Bestwood)	*No after monitoring data collected.*				- -	- -	- -	- -	- -	- -	-	-	-
R-AW5	Brighton (Phase 2)	46	115,226	114,906 (0%)	113156 (-2%)	22.4 (unweighted) 23.7 (flow-weighted)	-0.9 ***(sig)*** -1.1 ***(sig)***	-0.9 ***(sig)*** -1.4 ***(sig)***	27.6 (unweighted) 28.6 (flow-weighted)	-0.9 ***(sig)*** -1.2 ***(sig)***	-0.9 ***(sig)*** -1.4 ***(sig)***	24%, 49%, 12%	30%, 40%, 8% (+6%, -8%, -3%)	32%, 39%, 8% (+8%, -10%, -4%)
R-AW6	Portsmouth (City-wide)	223	-	-	-	19.8 (unweighted) -	-1.3 *(not tested)* -	- -	- -	- -	- -	63%, 14%, -	71%, 9%, - (+8%, -5%, -)	-
R-AW7	Chichester (City-wide)	35	-	-	-	23.0 (unweighted) -	-1.7 ***(sig)*** -	- -	28.7 (unweighted) -	-2.8 ***(sig)*** -	- -	-	-	-
City centre and adjacent residential area schemes														
TC-AW1	Brighton (Phase 1)	54	183,022	186,562 (2%)	183354 (0%)	21.5 (unweighted) 23.0 (flow-weighted)	-1.3 ***(sig)*** -1.6 ***(sig)***	-1.2 ***(sig)*** -1.3 ***(sig)***	27.2 (unweighted) 28.2 (flow-weighted)	-2.0 ***(sig)*** -1.8 ***(sig)***	-1.9 ***(sig)*** -1.3 ***(sig)***	-	-	-
TC-AW2	Winchester (City Centre)	11	85,731	83716 (-2%)	-	21.0 (unweighted) 22.2 (flow-weighted)	-0.4 ***(not sig)*** -0.7 ***(not sig)***	- -	25.9 (unweighted) 26.9 (flow-weighted)	0.0 ***(not sig)*** -0.3 ***(not sig)***	- -	42%, 33%, 6%	45%, 27%, 4% (+3%, -5%, -2%)	-

Significance of difference in mean speed and 85th percentile speeds

The difference in unweighted mean speeds and unweighted 85th percentile speeds has been tested for statistical significance using a t-test (paired two sample for means), based on a 95% confidence level.

The weighted difference in mean speeds and 85th percentile speeds has been tested for statistical significance using a Weighted Least Squares Model, based on a 95% confidence level. The difference in mean and 85th percentile speed has been weighted by flow (7 day average), where the weight (w) = (w1^-1+w2^-1)^-1. w1 = before weight (based on before flow), w2 = after weight (based on after flow).

For results see:
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5.4. Speed profile analysis

This section examines speed profile curves for three schemes in Walsall (small-scale residential), Brighton Phase 2 (area-wide residential); and Winchester City Centre (city centre) – to show how spot speed data compares with TomTom (GPS journey speed) data and to compare findings for different road types and before speeds.

As described above, these areas have been chosen due to the availability of speed bin data in a consistent format which can be readily analysed; and to reflect a range of different scheme types and environments.

Speed bin data has been aggregated across sites to give a flow weighted average speed profile for each of the scheme areas.

5.4.1. Spot speed vs TomTom data

Figure 5-1 and Table 5-3 compares the spot speed and TomTom (GPS journey speed) data, to determine the extent to which the results from the two datasets can be compared in a meaningful way. The spot speed data is based on 7 days of data, generally collected in neutral months, capturing every vehicle passing a limited number of survey points; while the TomTom results are based on a full year's worth of data, covering the majority of 20mph roads in the case study areas, but only for those vehicles with a connected or active GPS device. The purpose of the comparison is to test whether broad themes are the same, rather than compare actual numbers.

Figure 5-1 shows that the spot speed surveys generally record higher speeds than the TomTom (GPS journey speed) data. In all three graphs the spot speed distribution (shown in blue) is located to the right of the TomTom distribution curve (shown in orange). This is as expected, due to the following two reasons, already set out in Chapter 3:

- Firstly, GPS data is 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 include the acceleration and braking phases on the exit / approach to a junction. However, spot speed data measures speeds at a single point only, so is less likely to be affected by these issues and more likely to represent 'free flow speed,' if located in a suitable location.
- Secondly, monitoring locations for spot speed surveys tend to be biased towards busier and more important routes, and those where speeding has been reported as an issue or are expected to have a low level of 20mph compliance. In contrast, the GPS data captures speeds on every road on the network, and weights the data by the sample of vehicles with TomTom devices; so is more representative.

The precise shape of the spot speed cumulative speed distribution will depend on the specific characteristics of the limited number of monitoring sites selected; and will not necessarily closely match the shape of the TomTom (GPS journey speed) curve (based on all roads in the scheme area). Nevertheless, the shape of the curves is similar.

Of most importance is the relative size of the gap between the before and after lines, indicating the scale of change in speeds following the implementation of the 20mph limit. Although there are small differences across the three locations, the spot speed and TomTom data both show a small reduction in speeds between the before and after surveys – generally less than 2mph at any point on the distribution curve.

Table 5-3 also shows similar change in the proportion of vehicles travelling <=20mph, >24mph, and >30mph across the two datasets; despite different starting points.

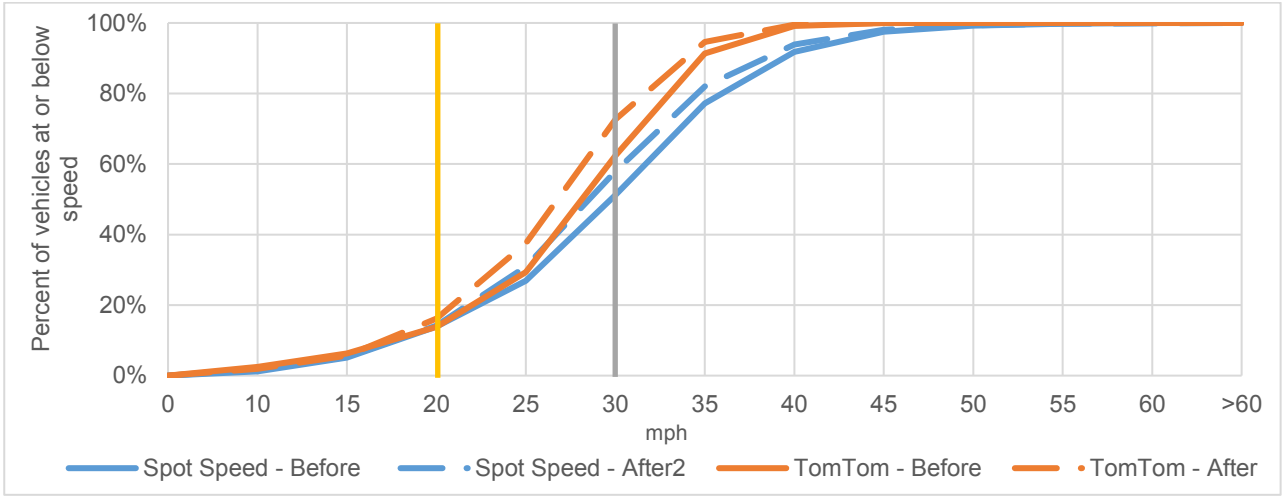
Table 5-3 Spot speed vs TomTom (GPS journey speed) data – overall change

	Spot Speed Data		TomTom Data	
	%<=20mph, >24mph, >30mph		**%<=20mph, >24mph, >30mph**	
	Before	After Diff	Before	After Diff
Walsall	14%, 76%, 49%	**0%**, -3%, -7%	14%, 74%, 38%	**+2%**, -7%, -10%
Brighton (Phase2)	24%, 49%, 12%	**+8%**, -10%, -4%	41%, 37%, 8%	**+4%**, -5%, -3%
Winchester City Centre	42%, 33%, 6%	**+3%**, -5%, -2%	64%, 13%, 1%	**+8%**, -6%, -1%

Change in the proportion travelling <=20mph is highlighted in the table below, for ease of comparison.

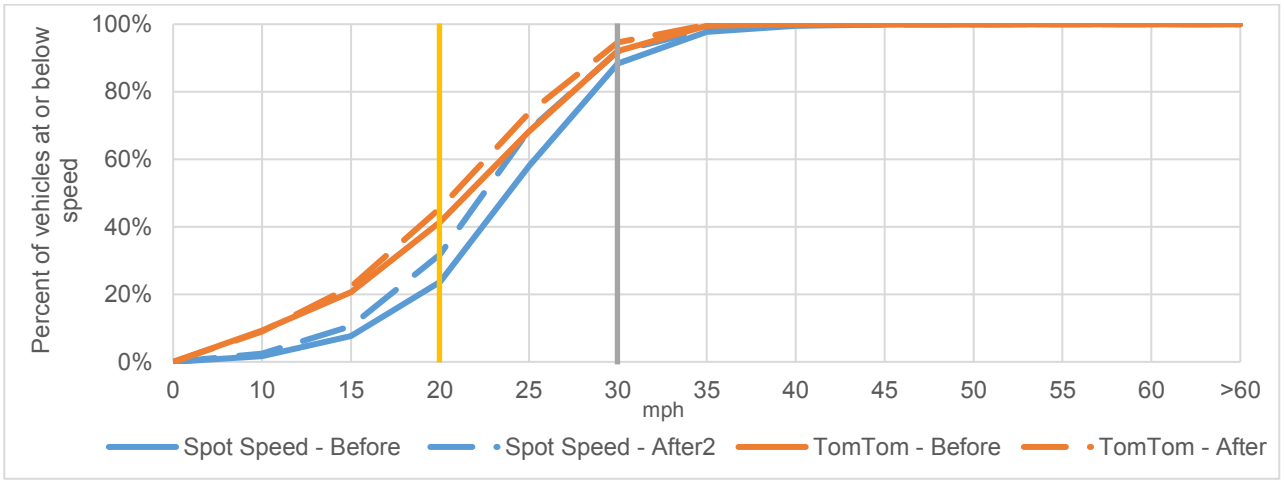
Figure 5-1 Spot speed vs TomTom (GPS journey speed) analysis – cumulative speed distribution

Walsall (Small-scale residential)



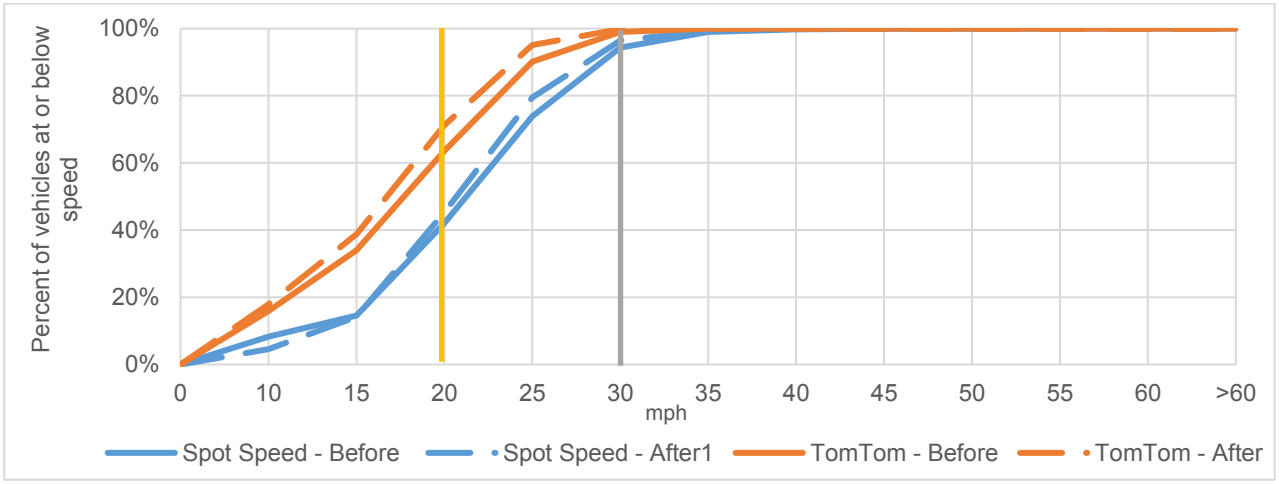
TomTom analysis compares 12-24 months before vs. 6-18 months after. Spot speed analysis compares 6 months before implementation (Sep, 7 days) vs. 30 months after (Sep, 7 days). No overlap with TomTom data spans.

Brighton Phase 2 (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.

Winchester City Centre (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.

5.4.2. By road type (spot speed data)

Figure 5-2 and Table 5-4 compares the before and after results by road type, as defined by TomTom (see Section 5.2).

The results for Walsall and Winchester City Centre reflect the findings of the aggregated TomTom (SPS journey speed) analysis (for all scheme areas), which shows that the major factor relating to how drivers respond to speed limits of 30mph or 20mph is the character of the road itself. The difference in speed between the two road types is far larger than the changes brought about by lowering the speed limit[26].

In contrast, the results for Brighton Phase 2 show very similar results for the two different road types. This is likely to reflect the characteristics of the specific monitoring sites. The TomTom data was undertaken at an aggregate level only, and it is likely that the results for each of the individual scheme areas show some variability around the overall trend.

Table 5-4 Scheme area results, by road type

	Important local roads		Minor local roads	
	%<=20mph, >24mph, >30mph		%<=20mph, >24mph, >30mph	
	Before	After Diff	Before	After Diff
Walsall	5%, 87%, 57%	**+2%**, -6%, -10%	35%, 48%, 29%	**-4%**, +4%, +2%
Brighton (Phase2)	23%, 48%, 11%	**+11%**, -12%, -4%	27%, 49%, 15%	**+5%**, -6%, -4%
Winchester City Centre	42%, 33%, 6%	**+3%**, -5%, -2%	99%, 0%, 0%	**-3%**, +3%, 0%

The above metrics are all flow weighted.

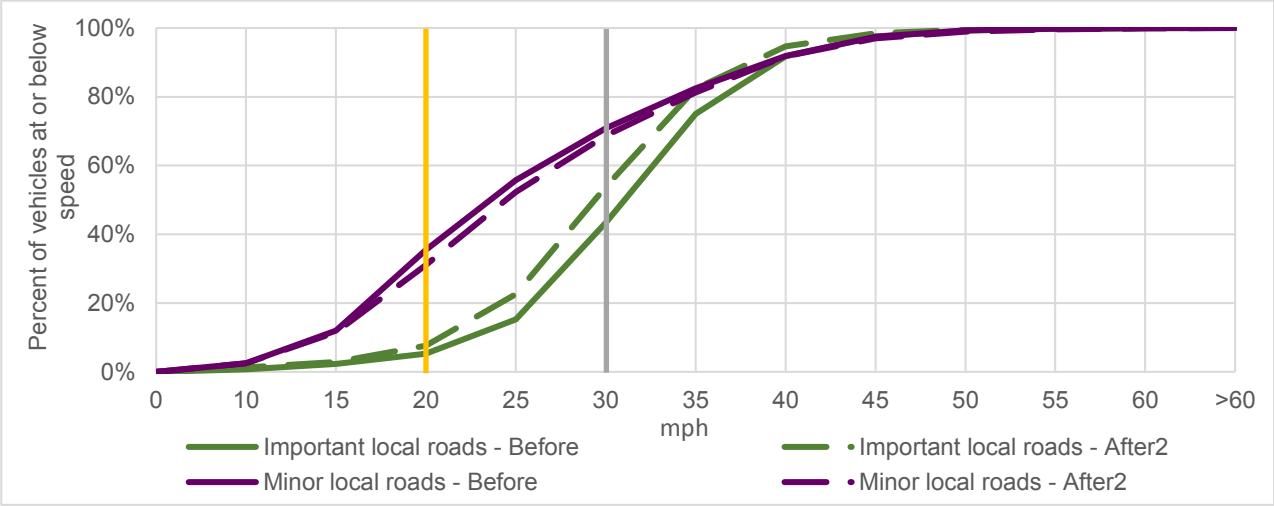
Change in the proportion travelling <=20mph is highlighted in the table above, for ease of comparison.

The three case study schemes are all very different in terms of scale, environment, and driving behaviour. The purpose of this analysis is to 'test' themes identified in the TomTom analysis, rather than compare the schemes with each other.

[26] It is interesting to note that in both cases, speeds have reduced on faster 'important local roads', but increased slightly on 'minor roads'. In Winchester City Centre, a very high proportion of drivers were already travelling below 20mph, and may have seen the introduction of the new limit as a prompt to drive faster – closer to 20mph. The same, however, cannot be said of Walsall, where most drivers are travelling well above 20mph. Some 48% were travelling more than 24mph in the before period, increasing to 52% following the introduction of the new limit; and 29% were travelling more than 30mph in the before period, increasing to 31% afterwards.

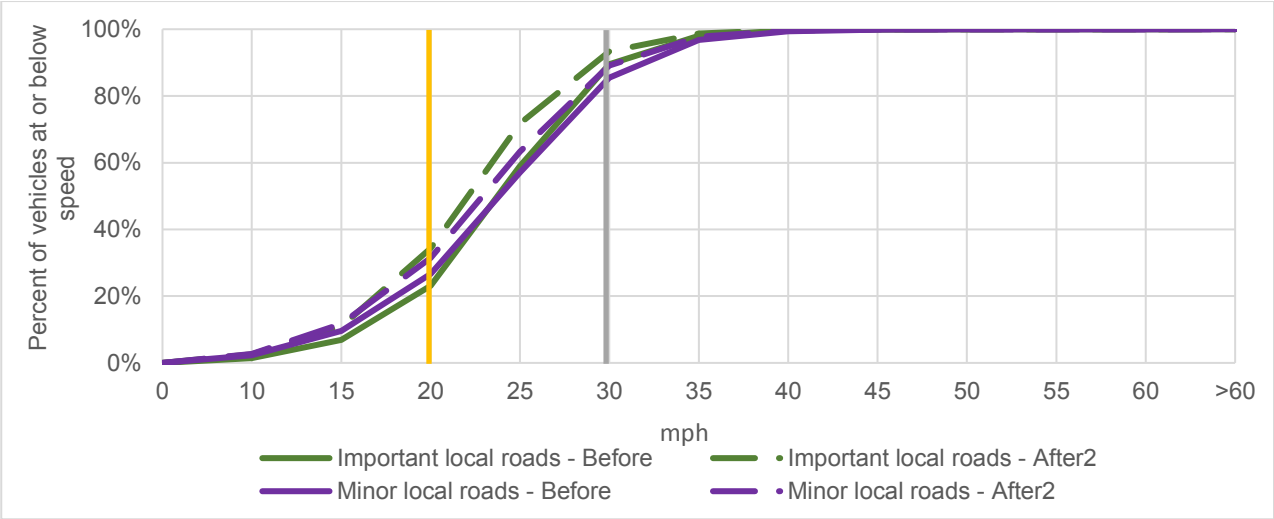
Figure 5-2 Cumulative speed distribution, by road type

Walsall (Before vs After2) (Small-scale residential)



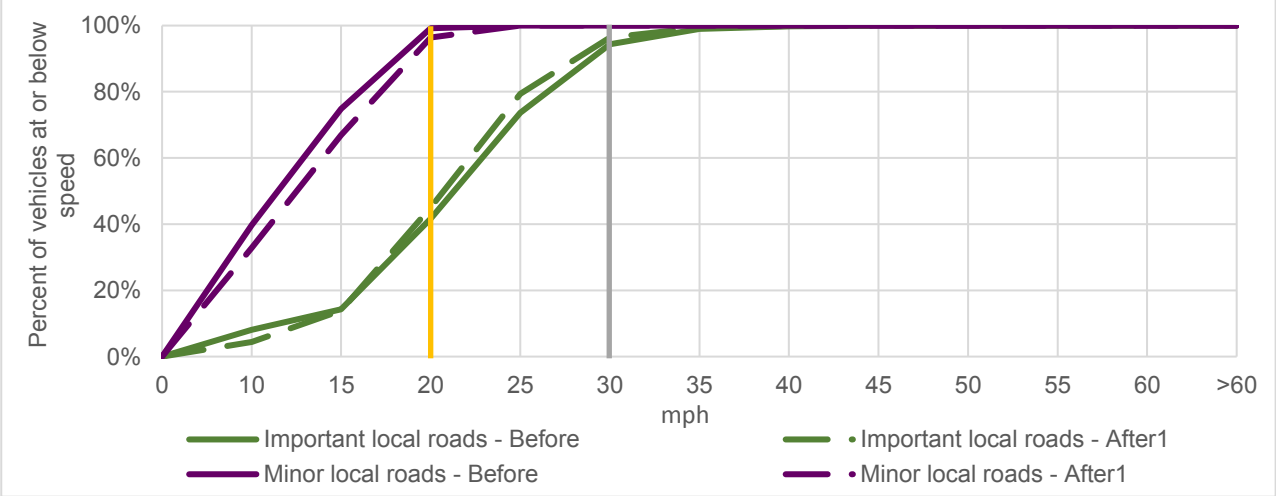
Spot speed analysis compares 6 months before implementation (Sep, 7 days) vs. 30 months after (Sep, 7 days).

Brighton Phase2 (Before vs After2) (Area-wide residential)



Spot speed analysis compares 12 months before implementation (Jun, 7 days) vs. 24 months after (Jun, 7 days).

Winchester City Centre (Before vs After1) (City centre and adjacent residential area)



Spot speed analysis compares 12-30 months before implementation (Apr and Sep, 7 days) vs. 7-8 months after (Apr and May, 7 days).

5.4.3. By before mean speed (spot speed data)

Figure 5-3 and Table 5-5 compares the before and after results by before mean.

The results for all three locations reflect the findings of the aggregated TomTom (GPS journey speed) analysis, which again shows that road characteristics (as approximated by pre-scheme speed) have a much larger impact on the speed that drivers choose to adopt than whether the road has a 30mph or 20mph limit. Figure 5-3 shows that both before and after speeds on roads with a before mean speed of >24mph, are faster than before and after speeds on roads with a speed before speed of 20-24mph, which in turn are faster than the before and after speeds on roads with a mean speed <=20mph. In other words, the gap between the red, blue and grey lines is bigger, than any of the before and after differences.

The results also support the findings of the aggregated TomTom analysis (reported separately[27]), which showed that the introduction of a 20mph limit has a bigger impact on roads with a higher pre-scheme speed, although even on the fastest roads the speed reduction is still small.

Table 5-5 Scheme area results, by before mean speed

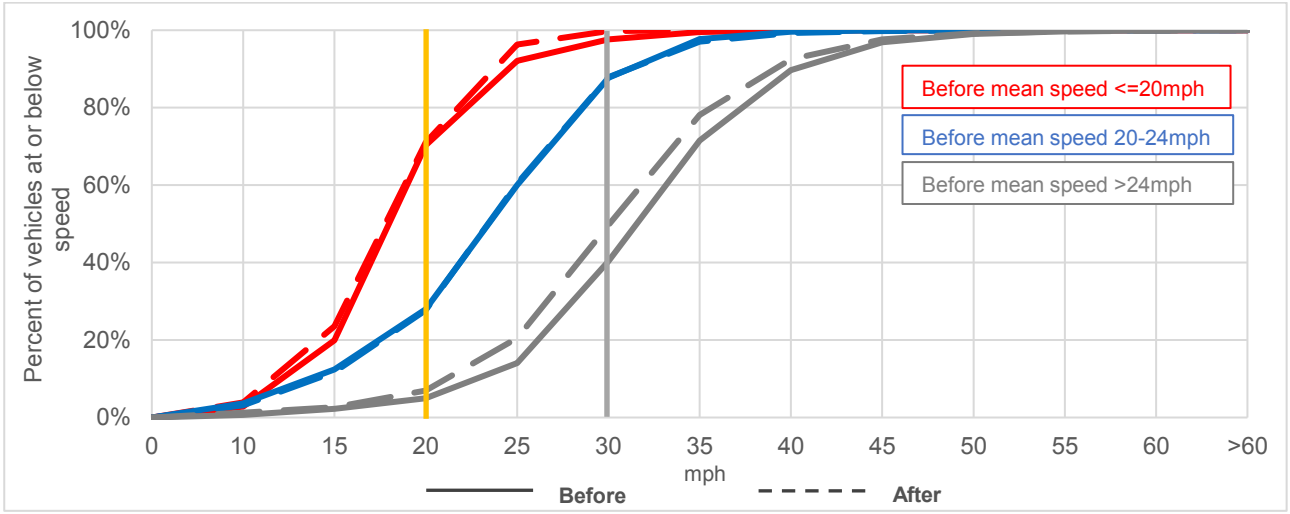
	Mean before speed <=20mph		Mean before speed 20-24mph		Mean before speed >24mph	
	%<=20mph, >24mph, >30mph		%<=20mph, >24mph, >30mph		%<=20mph, >24mph, >30mph	
	Before	After Diff	Before	After Diff	Before	After Diff
Walsall	70%, 12%, 2%	+1%, -3%, -2%	28%, 46%, 12%	0%, 0%, 0%	5%, 88%, 60%	+2%, -6%, -9%
Brighton (Phase2)	62%, 15%, 1%	+9%, -5%, -1%	27%, 42%, 7%	+9%, -10%, -3%	13%, 62%, 18%	+7%, -10%, -5%
Winchester City Centre	90%, 3%, 0%	-5%, +1%, 0%	30%, 33%, 6%	-2%, +5%, 0%	20%, 52%, 9%	+14%, -18%, -5%

The above metrics are all flow weighted.

[27] Atkins (2018) 20mph Research Study. Analysis of GPS journey speeds in case study areas. (Supporting Technical Appendix)

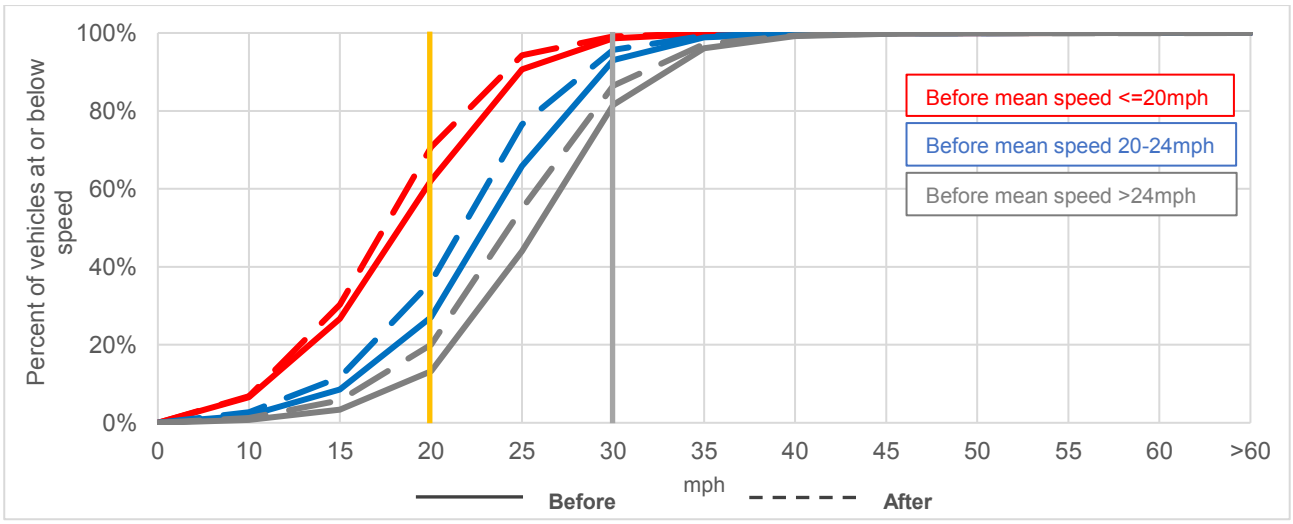
Figure 5-3 Cumulative speed distribution, by mean before speed

Walsall (Before vs After2) (Small-scale residential)



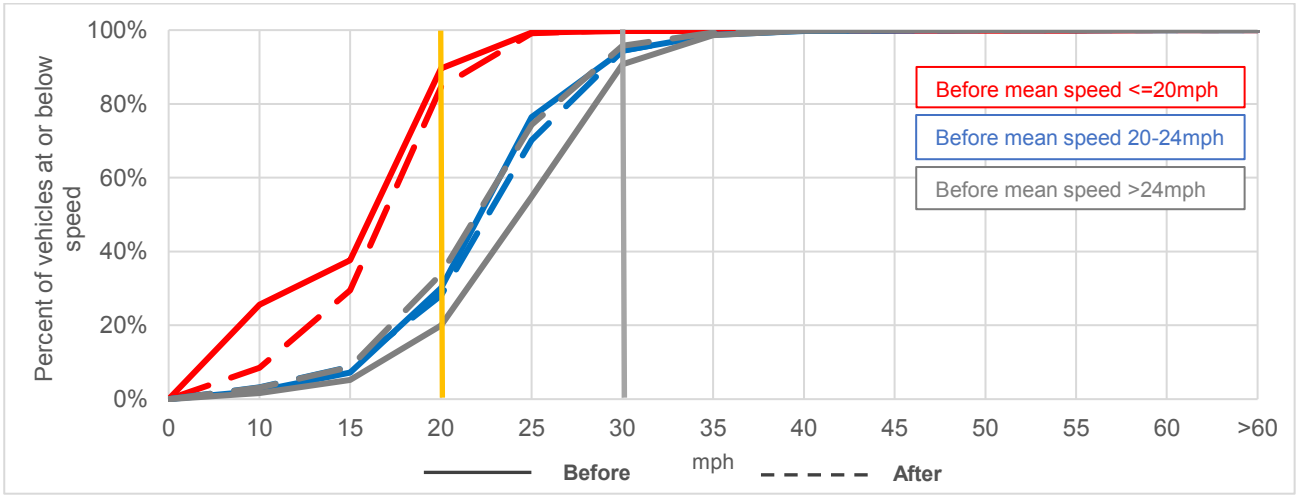
Spot speed analysis compares 6 months before implementation (Sep, 7 days) vs. 30 months after (Sep, 7 days).

Brighton Phase2 (Before vs After2) (Area-wide residential)



Spot speed analysis compares 12 months before implementation (Jun, 7 days) vs. 24 months after (Jun, 7 days).

Winchester City Centre (Before vs After1) (City centre and adjacent residential area)



Spot speed analysis compares 12-30 months before implementation (Apr and Sep, 7 days) vs. 7-8 months after (Apr and May, 7 days).

5.5. Site specific analysis

Sections 5.3 and 5.4 combine site-specific data to calculate average metrics (mean speed, 85th percentile speed, % compliance, and speed profile) for each scheme area. This section (and subsequent sections) examine the performance of individual sites to identify the scale of change at the sites reporting the greatest response to the change in speed limit, and to examine the extent to which performance varies on a site to site basis.

5.5.1. Overview

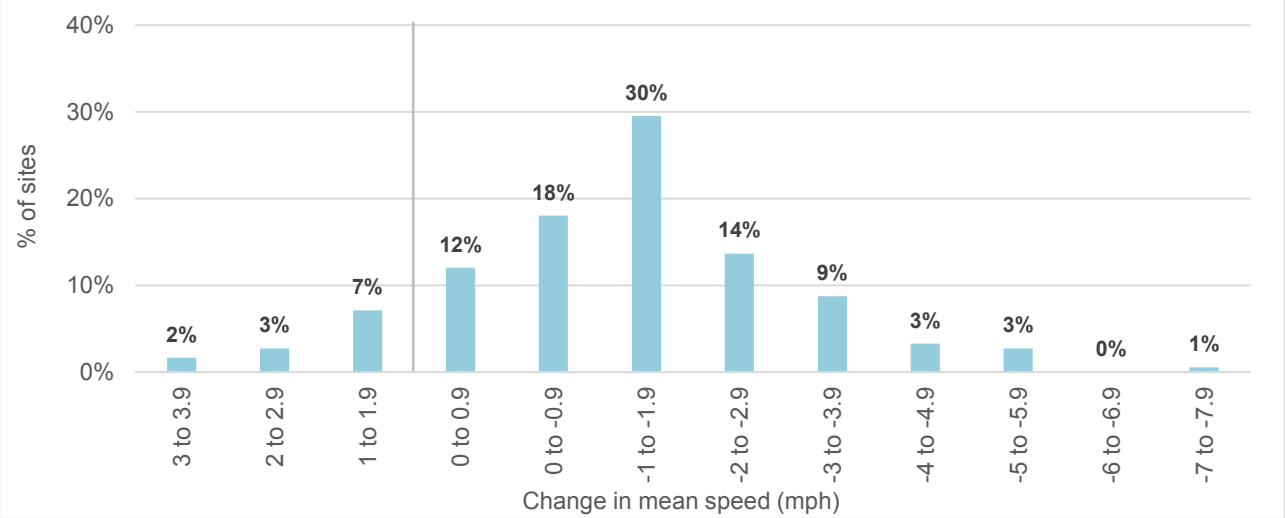
A summary of the site specific performance is presented in Table 5-6.

5.5.2. Change in mean speed

Eight case study schemes[28] have comprehensive data on mean speeds at individual sites, allowing the biggest increases / decreases at specific sites to be identified, along with the percentage of sites reporting a reduction in speed, and the change in the proportion with a mean speed of less than 24mph. Similar information is also available for Portsmouth, but the data is reported at aggregate level and mean speeds at individual sites are not reported.

- Across the 8 case study schemes with comprehensive data on mean speeds, the change in mean speed at individual sites varied from -7.2mph (decrease) to +4.3mph (increase).
- Monitoring data shows a reduction in mean speed at the majority of sites: 77% of sites, excluding Portsmouth; and 62% of sites, including Portsmouth[29]. All 9 schemes (including Portsmouth) report a reduction in speed at at least half of sites; and 4 schemes report a reduction in speed at over three-quarters of sites.
- Overall, the proportion of sites with a mean speed <24mph increased from 59% to 75%, excluding Portsmouth; and from 74% to 84%, including Portsmouth. The proportion of sites increased in 6 scheme areas, remained stable in 2 scheme areas, and dropped in 1 scheme area (but based on data for 3 sites only).
- The proportion of sites experiencing different levels of change is summarised in Figure 5-4.

Figure 5-4 Change in mean speed - % of sites in each change band (excluding Portsmouth)



n = 183 sites in Walsall (Rushall), Winchester (Stanmore), Middlesbrough (Phases 1 and 2), Calderdale, Brighton Phase 2 (After 2), Chichester, Brighton Phase 1 (After 2) and Winchester City Centre.

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[28] Walsall (Rushall), Winchester (Stanmore), Middlesbrough (Phases 1 and 2), Calderdale, Brighton Phase 2, Chichester, Brighton (Phase 1) and Winchester City Centre.

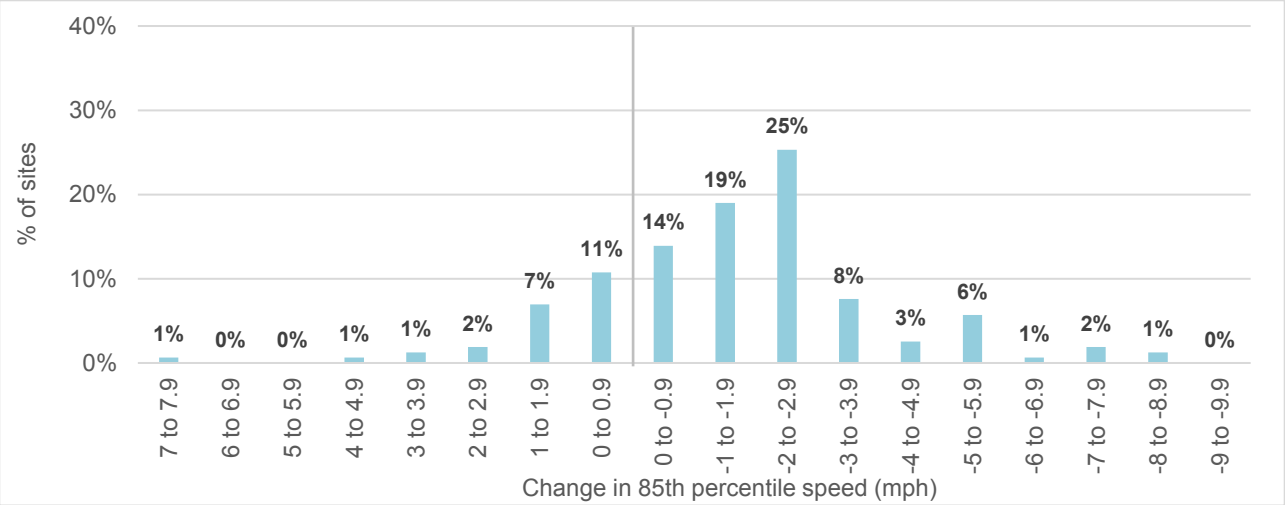
[29] The data for Portsmouth is based on a much larger sample size than elsewhere (which skews the overall results), and the data was collected several years earlier. The overall results are therefore presented with and without the Portsmouth findings.

5.5.3. Change in 85th percentile speed

Seven case study schemes[30] have comprehensive data on 85th percentile speeds at individual sites, allowing the biggest increases / decreases at specific sites to be identified, along with the percentage of sites reporting a reduction in speed, and the change in the proportion with an 85th percentile speed of less than 30mph.

- Across the 7 case study schemes, the change in the 85th percentile speed at individual sites varied from -9.0mph (decrease) to +7.6mph (increase).
- Monitoring data shows a reduction in 85th percentile speed at three-quarters (78%) of sites.
- Overall, the proportion of sites with an 85th percentile speed of <30mph increased from 70% to 87%. The proportion of sites increased in five scheme areas, and remained stable in two scheme areas.
- The proportion of sites experiencing different levels of change is summarised in Figure 5-5.

Figure 5-5 Change in 85th percentile speed - % of sites in each change band



n = 158 sites in Walsall (Rushall), Winchester (Stanmore), Calderdale, Brighton Phase 2 (After 2), Chichester, Brighton Phase 1 (After 2), and Winchester City Centre.

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[30] Walsall (Rushall), Winchester (Stanmore), Calderdale, Brighton Phase 2, Chichester, Brighton Phase 1, and Winchester City Centre.

Table 5-6 Site specific analysis

ID	Case study area	No. of sites	Mean speed (mph)		% of sites reporting a reduction	% with mean speed <=24mph (Before)	%. with mean speed <=24mph (After)	85th percentile speed		% of sites reporting a reduction	% with 85th speed <=30mph (Before)	% with 85th speed <=30mph (After)	Before mean vs Change in mean		Before 85th^{ile} vs Change in 85th^{ile}	
			Biggest increase	Biggest decrease				Biggest increase	Biggest decrease				Coefficient	R^2	Coefficient	R^2
Small-scale residential schemes																
R-SM1	Walsall(Rushall) (After 2)	10	+1.6 mph	-3.1 mph	60%	60%	60%	+0.9 mph	-7.1 mph	60%	20%	40%	-0.00	0.00	0.04	0.01
R-SM2	Winchester (Stanmore) (After 2)	3	+2.5 mph	-1.8 mph	50%	33%	17%	+3.6 mph	-2.2 mph	17%	33%	33%	-	-	-	-
Area-wide residential schemes																
R-AW1a	Liverpool(Area7)	*No monitoring data provided.*			-	-	-	-	-	-	-	-	-	-	-	-
R-AW1b	Liverpool(Area2)	*No monitoring data provided.*			-	-	-	-	-	-	-	-	-	-	-	-
R-AW2	Middlesbrough (Phase 1 + 2) (After 1)	25	+0.3 mph	-5.9 mph	92%	20%	40%	-	-	-	-	-	-	-	-	-
R-AW3	Calderdale (Phase 1) (After 1)	3	No sites recorded an increase	-2.8 mph	100%	67%	67%	No sites recorded an increase	-2.8 mph	100%	33%	67%	-	-	-	-
R-AW4	Nottingham (Bestwood)	*No after monitoring data collected.*			-	-	-	-	-	-	-	-	-	-	-	-
R-AW5	Brighton (Ph2) (After 1)	46	+1.0 mph	-5.0 mph	70%	72%	78%	+1.3 mph	-5.8 mph	67%	83%	87%	-0.13	0.10	-0.11	0.07
	Brighton (Ph2) (After 2)	46	+2.1 mph	-3.8 mph	72%	72%	87%	+2.2 mph	-3.8 mph	74%	83%	91%	-0.15	0.12	-0.12	0.07
R-AW6	Portsmouth (City-wide) (After 1)	223	-	-	50%	85%	91%	-	-	-	-	-	-	-	-	-
R-AW7	Chichester (City-wide) (After 1)	35	+2.1 mph	-5.4 mph	86%	69%	77%	+0.4 mph	-7.8 mph	91%	71%	89%	-	-	-	-
City centre and adjacent residential area schemes																
TC-AW1	Brighton (Ph1) (After 1)	47	+4.3 mph	-6.3 mph	77%	64%	85%	+3.3 mph	-7.5 mph	91%	74%	89%	-0.19	0.13	-0.13	-0.05
	Brighton (Ph1) (After 2)	47	+3.9 mph	-7.2 mph	77%	64%	87%	+7.6 mph	-9.0 mph	81%	74%	96%	-0.22	0.15	-0.17	-0.06
TC-AW2	Winchester (City Centre) (After 1)	11	+1.9 mph	-3.6 mph	55%	55%	73%	+3.3 mph	-4.3 mph	55%	55%	82%	-0.21	0.32	-0.22	0.23
Total (9 scheme areas)[1]			**-**	**-**	**62%**	**74%**	**84%**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total (Excl. Portsmouth)			**-**	**-**	**77%**	**59%**	**75%**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total (Excl. Portsmouth, Middlesbrough)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**77%**	**70%**	**87%**	**-**	**-**	**-**	**-**

1. Based on After 2 (18-30 months post implementation) for Brighton Phase 2 and Brighton Phase 1.

5.5.4. Change in mean and 85th percentile speed, by before mean speed

Figures 5-6 and 5-7 show the relationship between the before mean speed and:

i) the change in mean speed recorded, and
ii) the change in 85th percentile speed recorded.

The graphs are based on results for all sites with relevant data. The trendlines have been derived using linear regression, and where the dependent variable (y) is the change in mean speed or 85th percentile speed, and the independent variable (x) is the before mean speed or 85th percentile speed.

The steepness of the line (also represented by the x coefficient) indicates the strength of the relationship, i.e. the extent to which lower and higher before mean speeds are associated with smaller and bigger reductions in speed. A p-value of <0.05 indicates that the 'before mean speed' is a statistically significant variable in explaining some of the change in 'after speeds'.

R^2 (the coefficient of determination) measures how well the regression line approximates the real data points. An R^2 value of 1 indicates a perfect fit; while an R^2 value of 0 indicates that the model explains none of the variability of the response data (the y value). An R^2 value of 0.15 for change in mean speed indicates that only 16% of the variability in the data can be explained by the before mean speed; with 85% of the variability due to other factors.

Findings

The results show that there is a weak but significant relationship between the before mean speed and (i) the change in mean speed recorded, and (ii) the change in 85th percentile speed recorded.

Those previously travelling faster have reduced their speed slightly more than other drivers. This reflects the findings presented in Section 5.4.3, which shows that the biggest reduction in speed occurred on roads with a before mean speed of more than 24mph; and also reflects the findings of the aggregated TomTom (GPS journey speed) analysis (reported separately[31]). This is as expected, as these roads have more scope for speeds to reduce.

As shown in Tables 5-7 and 5-8, the relationship between the 'before mean speed' and the change in the speed driven by the fastest drivers (indicated by the '85th percentile speed) is stronger for 'important local roads' (R^2 = 0.153) than for 'minor local roads' (R^2 = 0.023) where speeds are likely to be lower generally.

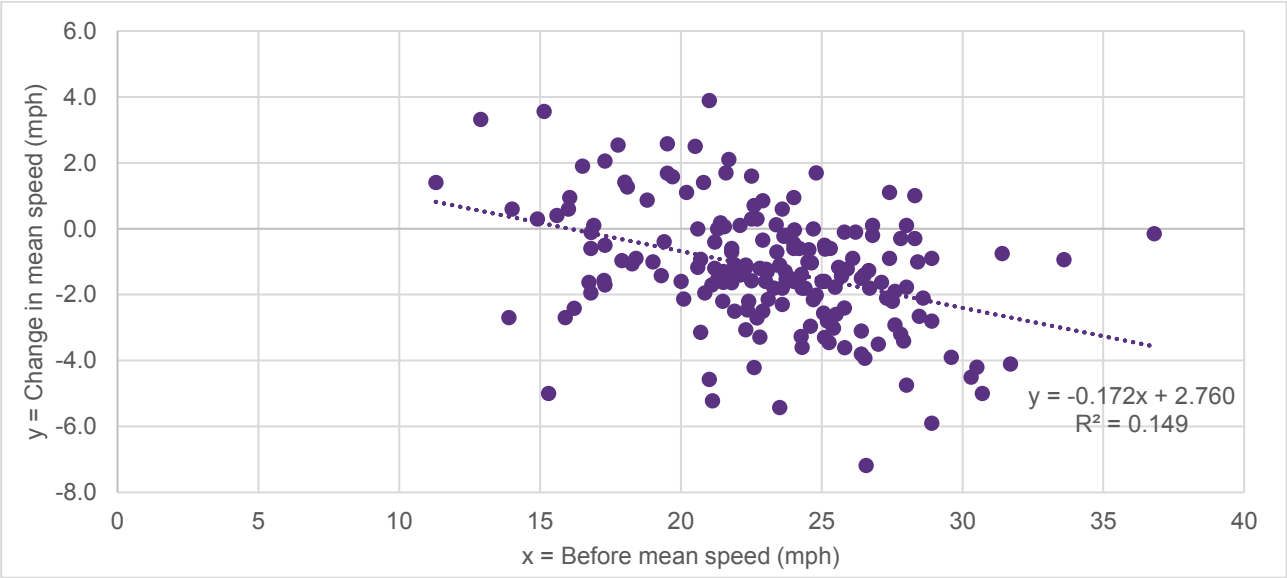
Nevertheless, the result show that mean before speed, on its own, is a poor predictor of change in speed, suggesting other factors (such as the characteristics of the road environment, the types of drivers and vehicles using the road) are influencing the actual change in speed. The role of these other factors is considered further in the subsequent sections of this chapter, and in the regression analysis undertaken using the questionnaire data (reported separately[32]).

[31] Atkins (2018) 20mph Research Study. Analysis of GPS journey speeds in case study areas. (Supporting Technical Appendix)

[32] Atkins (2018) 20mph Research Study. Residents and drivers questionnaires - logistic regression analysis. (Supporting Technical Appendix)

Results for change in mean speed vs. before mean speed

Figure 5-6 Change in mean speed vs. before mean speed



Based on 183 sites across Walsall, Winchester (Stanmore), Middlesbrough (Phase 1 and 2), Calderdale, Brighton Phase 2 (After 2), Chichester, Brighton Phase 1 (After 2), Winchester (City Centre).

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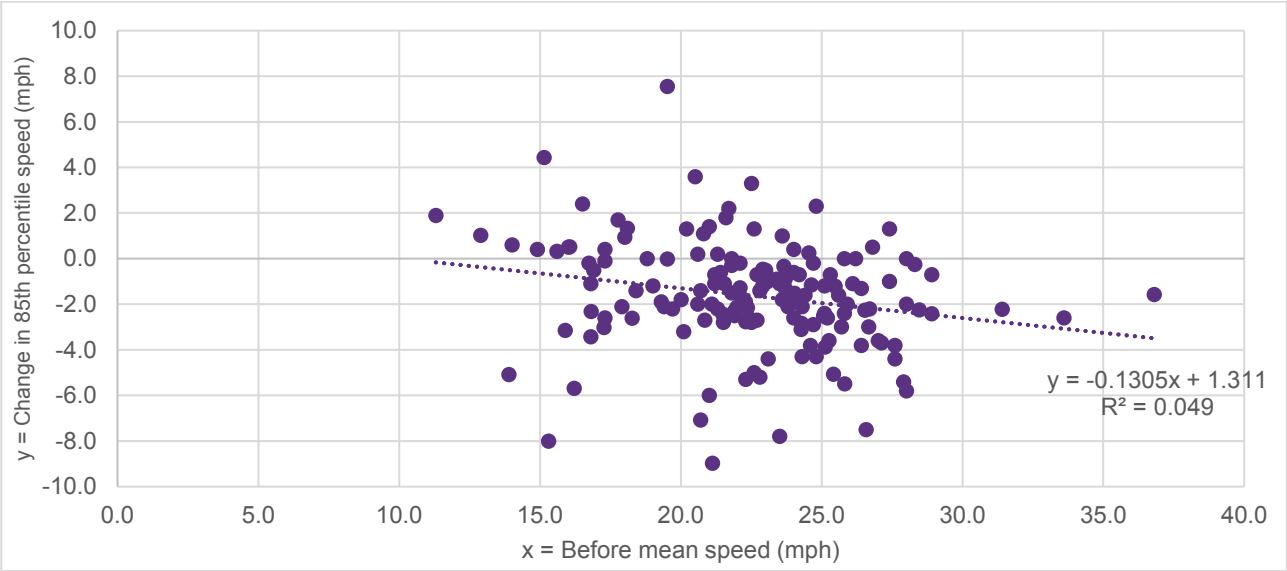
Table 5-7 Regression statistics (change in mean speed vs. before mean speed)

	All roads[a]	Important local roads	Minor local roads
N (number of sites)	183	54	124
R^2 (coeff. of determination)	0.149	0.242	0.111
Fitted line equation	y = 2.760 – (0.172 x)	y = 5.197 – (0.269 x)	y = 2.098 – (0.142 x)
p-value (significance of independent variable)	0.000 (significant)	0.000 (significant)	0.000 (significant)

a. Sample includes some sites on important strategic roads.

Results for change in 85th percentile speed vs. before mean speed

Figure 5-7 Change in 85th percentile speed vs. before mean speed



Based on 158 sites across Walsall, Winchester (Stanmore), Calderdale, Brighton Phase 2 (After 2), Chichester, Brighton Phase 1 (After 2), Winchester (City Centre).

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Table 5-8 Regression statistics (change in 85th percentile speed vs. before mean speed)

	All roads[a]	Important local roads	Minor local roads
N (number of sites)	158	47	106
R^2 (coeff. of determination)	0.049	0.253	0.015
Fitted line equation	y = 1.311 – (0.131 x)	y = 7.340 – (0.365 x)	y = 0.087 – (0.072 x)
p-value (significance of independent variable)	0.005 (significant)	0.000 (significant)	0.206 (not significant)

a. Sample includes some sites on important strategic roads.

5.6. Characteristics of sites with the biggest reduction in speed and poorest / highest compliance

This section summarises the characteristics of sites with:

- the biggest reduction in mean speed between the before and after periods; and
- the highest after speeds (poorest compliance) and lowest after speeds (highest compliance).

The purpose is to determine the extent to which road environment and function affects drivers' speed and compliance.

Maps and images of each survey location are provided Appendix L. Images are from Google StreetView.

The description of each site considers the following characteristics:

Table 5-9 Characteristics used to describe sites

Characteristic	Description
Before mean speed, and before vs after difference	Based on spot speed data
Before 85th percentile speed, and before vs. after difference	Based on spot speed data
Before and after survey periods	Dates and period before / after implementation) – sites based on historic data which is more than 3 years old are shown in grey
Road type	Based on TomTom Functional Road Class, categorised as 'major strategic roads', 'important local roads', and 'minor local roads' for the purpose of this analysis.
Road length	Measured in Google StreetView, based on length of road to which road name applies: Short = <400m, Medium= 400-800m, Long = >800m.
Geometry	Based on visual assessment of Google StreetView image.
Junction density (num/km)	Number of junctions divided by road length.
Frequency of parking on the main carriageway	Based on visual assessment of Google StreetView image: Low = no or occasional parking on the carriageway Medium = on-street parking along some of kerb length High = on-street parking along > third of kerb length (one side) Very high = on-street parking along > third of kerb length (both sides) *Sites where parking is located in bays off the main carriageway are categorised as 'low', with a comment provided in the description of the road environment.*
Carriageway width (kerb to kerb)	Measured in Google StreetView: Narrow = < 6 metres; Medium = 6-7.5 metres; Wide = >7.5 metres.
Road width (carriageway, pavement, kerb)	Measured in Google StreetView: Narrow = < 10 metres; Medium = 10-15 metres; Wide = >15 metres. Provides an indication of perception of space.
Building to building width	Measured in Google StreetView: Narrow = < 20 metres; Medium = 20-25 metres; Wide = >25 metres. Takes into account size of garden, and provides an indication of perception of space.
Description of road environment	Based on visual assessment of Google StreetView image. Description of appearance and features of road environment – one way or two way, considering on-street parking, presence of footpaths and verges, cycle lanes, bus lanes, crossings, etc.
Landuse	Based on visual assessment of Google StreetView image. Main land use, presence of any major trip attractors which may influence driving behaviour (e.g. schools, hospital, shops, etc.) on road, presence of green space which may give a perception of space.

Description of road function	Considers extent to which the road is likely to be used to by local residents only, to access other facilities, as a through route.

5.6.1. Characteristics of sites with the biggest reduction in mean speed

Tables 5-10 and 5-11 show the characteristics of the sites with the biggest reduction in mean speed. Table 5-8 covers the top six sites, where mean speeds reduced by -5.9 to -4.5mph. As some of the sites are based on historic data, Table 5-11 has also been produced based on only those sites where the before and after data was collected within two years of the implementation date. These sites were ranked 4, 6, 11, 13, 14, and 15 overall, and the change in mean speed varied from -4.7mph to -3.3mph.

Key findings:

- The sites are located in Middlesbrough (Phases 1 and 2), Chichester, and Brighton Phase 2. The corresponding area-wide reductions for these scheme areas were -1.9mph, -2.8mph, -1.7mph, and -1.4mph respectively (see Table 5-2).
- Most of the sites had relatively high mean speeds (>24mph) before the change in speed limit, and in two cases the mean exceeded 30mph.
- The sites comprise a mix of minor local roads (4 sites) and important local roads (6 sites). However, most of the roads (9 out of 10) form several functions and are likely to be used by local residents, to access local amenities, and as a through route. This includes those categorised as minor local roads.
- Only one site (Lyndhurst Road) is likely to be used by local residents only, due to its location and land-use characteristics. This site has a narrow road environment, and lower before and after speeds than the other sites, and appears to be an anomaly in these respects. The before data was collected approximately 8 years before the introduction of the 20mph limit was introduced, and it is possible that some of the change in speed occurred prior to implementation.
- Most sites are relatively straight, providing drivers with good sight lines; and the road environment is generally categorised as medium or wide, providing a feeling of space which may have encouraged higher speeds in the before period.
- Most of the sites are on residential-only streets. They typically have pavements on one or both sides of the road, and sometimes grass verges, creating and wider and more open environment. None of the sites have cycle lanes, bus stops, or other similar features in the vicinity of the monitoring site. Three of the sites are in mixed land-use areas (combining housing with shops or local amenities) where there is likely to be more pedestrian activity. These sites tend to have more road features (e.g. parking bays, bus stops, crossing-points) which create a more complex road environment for drivers.
- The site with the biggest reduction in mean speed (Gunnergate Lane) is on a key access road through a post-war housing estate, joining onto the strategic network. The site has a spatial feel, with a wide distance between buildings on either side. Further south, the road has a more rural feel, with vegetation on either side and no frontages directly onto the road.

Based on the limited number of sites analysed here, there is no evidence to suggest that one particular type of road characteristic (e.g. length, width, straight / curved, housing style / size, openness / density of environment) is associated with bigger reductions in mean speed. However, the results do support the findings reported earlier in this report which show larger reductions in speed tend to be associated with more important local roads, and those which support a number of functions (i.e. likely to be used by local residents, other road users to access local amenities, and as a through route).

The findings suggest that the actual change in speed occurring at specific sites is driven by a complex set of factors, which may include a combination of road characteristics, publicity and community engagement, and the behaviour and attitudes of local drivers. The influence of these factors on self-reported and perceived changes in speeds, is examined further in various regression models based on the questionnaire results (reported separately[33]).

Note - The main analysis does not include data for Brighton Phase 1, which was processed at a later date. The site with the biggest reduction overall (-7.2mph) was actually Montpellier Road, an important local road in Brighton Phase 1, with a before speed of 26.6 mph. The characteristics of this site are described below Table 5-11, and are broadly consistent with the above findings.

[33] Atkins (2018) 20mph Research Study. Residents and drivers questionnaires - logistic regression analysis. (Supporting Technical Appendix)

Table 5-10 Characteristics of sites with the biggest reduction in mean speed (all sites)

	Gunnergate Lane (Middlesbrough, Ph2)	York Road (Chichester)	The Derby (Middlesbrough, Ph2)	Summersdale Road (Chichester)	Lyndhurst Road (Chichester)	Earlsdon Avenue (Middlesbrough, Ph1)
Before mean speed	28.9 mph	23.5 mph	30.7 mph	28.0 mph	21.0 mph	30.3 mph
Before vs after difference	-5.9 mph	-5.4 mph	-5.0 mph	-4.7 mph	-4.6 mph	-4.5 mph
Before 85th percentile speed	-	29.5 mph	-	34.4 mph	25.7 mph	-
Before vs after difference	-	-7.8 mph	-	-5.8 mph	-6.0 mph	-
Before period	Jan11 (~2.5 years before)	2005 (~8 years before)	Jun10 (~3 years before)	Mar12 (15 months before)	2005 (~8 years before)	Feb10 (~2 years before)
After period	Jul13 (<3 months aft.)	May14 (10 months)	Jul13 (<3 months aft.)	May14 (10 months aft.)	May14 (10 months aft.)	May13 (12 months aft.)
Road type	Important local road	Minor local road	Minor local road	Important local road	Minor local road	Minor local road
Road length	Long (1900m)	Short (280m)	Medium (585m)	Medium (687m)	Short (260m)	Long (892m)
Geometry	Meandering	L-shaped (straight arms)	Mainly straight	Mainly straight	L-shaped (straight arms)	Meandering
Junction density	9 per km (17 in total)	11 per km (3 in total)	9 per km (5 in total)	10 per km (7 in total)	8 per km (2 in total)	9 per km (8 in total)
Frequency of on-street parking	Low	High	Medium	High (in vicinity of site)	High	Low
Carriageway width (kerb to kerb)	Medium (~6 metres)	Medium (~6 metres)	Medium (~7 metres)	Narrow (~5.5 metres)	Narrow (~5.5 metres; 3.8 m, excluding parking bays)	Medium (~7.2 metres)
Road width (carriageway, pavement, kerb)	Medium (~10.5 metres)	Narrow (~9.5 metres)	Wide (~17.5 metres)	Narrow (~9 metres)	Narrow (~8.5 metres)	Medium (~13 metres)
Building to building width	Wide (~29 metres)	Narrow (~18 metres)	Medium (~23.5 metres)	N/A	Narrow (~15 metres)	Medium (~24 metres)
Description of road environment	Two way. The road is spacious with low levels of on-street parking. Path on one side, grass verge on the other. No cycle lanes, or other similar features in vicinity of monitoring site. Further south, the road has a more rural feel, with vegetation on either side and no frontages onto the road.	Two way. Road is narrow, with many cars parked on-street. Narrow footpaths. No cycle lanes, or other similar features in vicinity of monitoring site.	Two way. Sizeable pavements on both sides of the road and a verge in places. No cycle lanes, or other similar features in vicinity of monitoring site. Hatched central reservation near school (200m south), giving perception of space.	Two way. The road is bounded by a high wall and a high fence and vegetation; which could make it appear narrow. No footpath in parts. No cycle lanes, or other similar features in vicinity of monitoring site. Rural feel to the road further south.	Two way. Small gardens and a lot of on-street parking. Narrow footpaths. No cycle lanes, or other similar features in vicinity of monitoring site.	Two way. The road is fairly spacious with few cars parked on-street. Sizeable pavements on both sides of the road and a verge in places. Hatched central reservation in places, giving perception of space. No cycle lanes, or other similar features in vicinity of monitoring site.
Land Use	Residential - mixed housing. No schools or other land-use in	Residential - flats and Victorian semis; small front gardens. No schools	Residential - mainly post war semis and detached. Primary school at one end	Residential – mixed housing. No schools or other trip attractors in vicinity. Large park and	Residential - victorian terraced housing; small gardens. No schools or other land-use.	Residential - Post war bungalows and semis. Houses have moderate-sized gardens. No

	immediate vicinity. Some areas of green space.	or other land-use. Little open space.	of road (200m south of monitoring site).	university further south, but screened by vegetation, giving rural feel. However, may result in high pedestrian and cycle flow at times.		schools or other land-use in immediate vicinity.
Description of road function	Key access road through housing estate. Joins strategic network. Likely to be used by local residents and those living across the wider estate.	Links B2145 and A259. Likely to be used as a through route as well as by local residents.	Key access road through estate. Joins strategic network. Likely to be used by local residents and those living across the wider estate.	Local access road linking residential areas in the north, university, and city centre. Likely to be used by through traffic as well as local residents.	Road serves local residents, who are likely to be the main users.	Key access road through estate. Likely to be used by local residents and those living across the wider estate.

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Montpelier Road (Brighton Phase 1)

This analysis was does not include data for Brighton Phase 1, which was processed at a later date. The site with the biggest reduction overall (-7.2mph) was actually Montpellier Road, an important local road in Brighton Phase 1, with a before speed of 26.6 mph.

It is long (1.1km), mainly straight, with a low density of junctions (5.5 per km). The carriageway width (7m) is medium, and building to building width (20m) is also medium.

The road is two way. There is a moderate level of on-street parking, but the bays are adjacent to the main carriageway. There are four storey Georgian town houses on either side.

There are no cycle lanes, or other similar features in the vicinity of the monitoring site.

Table 5-11 Characteristics of sites with the biggest reduction in mean speed (sites where before surveys carried out <2 years before implementation)

	Summersdale Road (Chichester)	Earlsdon Avenue (Middlesbrough, Ph1)	Manor Road (Brighton Phase 2)	Sutherland Road (Brighton Phase 2)	The Broadway (Chichester)	Whitehawk Road (Brighton Phase 2)
Before mean speed	As Table 5-10	As Table 5-10	26.4 mph	27.0 mph	27.9 mph	25.1 mph
Before vs after difference	As Table 5-10	As Table 5-10	-3.8 mph	-3.5 mph	-3.4 mph	-3.3 mph
Before 85th percentile speed	As Table 5-10	As Table 5-10	32.0 mph	32.7 mph	33.9 mph	29.5 mph
Before vs after difference	As Table 5-10	As Table 5-10	-3.8 mph	-1.8 mph	-5.4 mph	-2.4 mph
Before period	As Table 5-10	As Table 5-10	Jun13 (12 months pre)	Jun13 (12 months pre)	Mar12 (15 months before)	Jun13 (12 months pre)
After period	As Table 5-10	As Table 5-10	Jun16 (24 months aft.)	Jun15 (12 months aft.)	May14 (10 months aft.)	Jun16 (24 months aft.)
Road type	As Table 5-10	As Table 5-10	Minor local road	Minor local road	Important local road	Important local road
Road length	As Table 5-10	As Table 5-10	Medium (594m)	Medium (556m)	Short (330m)	Medium (690m)
Geometry	As Table 5-10	As Table 5-10	Mainly straight	Mainly straight	Straight	Slight L shaped
Junction density	As Table 5-10	As Table 5-10	10 per km (6 in total)	16 per km (9 in total)	3 per km (1 in total)	7 per km (5 in total)
Frequency of on-street parking	As Table 5-10	As Table 5-10	High (in vicinity of site)	High (in vicinity of site)	Moderate	Moderate – High
Carriageway width (kerb to kerb)	As Table 5-10	As Table 5-10	Medium (~7 metres; 4.8 m, excluding parking bays)	Wide (~9.3 metres; 7.5 excluding parking bays)	Medium (~7 metres)	Wide (~11 metres; 6.8 excluding parking bays)
Road width (carriageway, pavement, kerb)	As Table 5-10	As Table 5-10	Wide (18 metres)	Wide (15.5 metres)	Medium (~14.5 metres)	Wide (18 metres)
Building to building width	As Table 5-10	As Table 5-10	N/A	Narrow (15.5 metres; buildings adjacent to path)	Medium (~21 metres)	Narrow (18 metres)
Description of road environment	As Table 5-10	As Table 5-10	Wide verges, screening footpath from carriageway. Parking bays and bus stop on one side of road. No frontages opening directly onto road.	No frontages opening directly onto road, near site. Footpaths but no grass verges. Parking bays next to main carriageway.	Verge and footpath on one side, adjacent to houses. Grass verge and no footpath on the other side, with brick wall screening flats (no frontages). No cycle lanes, or other similar features.	Wide footways either side, but no verges. Parking bays, and bus stops nearby. Some restrict effective carriageway width, others are set off to the side. Crossing points. Bus route. No cycle lanes. Central reservation in places, increases width.
Land Use	As Table 5-10	As Table 5-10	Mixed land-use – housing and park / community centre close to site.	Mixed land-use. Garages and rear of sports building close to site. Housing, pub, shops further along.	Residential (early 1900s semis, medium-sized gardens).	Mixed land use. Pre-1900 terraced housing, with very small gardens or opening directly on to

			Primary school 200m north.			street. Newer flats. Shops.
Description of road function	As Table 5-10	As Table 5-10	Multi-functional road - likely to be used as a through route, to access park and school, and by locals to access residential areas off Manor Road.	Likely to be used as a through route, and to access local amenities.	Joins A286. Likely to be used by local residents and as a through route.	Joins B2066 and B2137. Bus route. Likely to be used by local residents and as a through route.

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Montpelier Road (Brighton Phase 1)

This analysis was does not include data for Brighton Phase 1, which was processed at a later date. The site with the biggest reduction overall (-7.2mph) was actually Montpellier Road, an important local road in Brighton Phase 1, with a before speed of 26.6 mph.

It is long (1.1km), mainly straight, with a low density of junctions (5.5 per km). The carriageway width (7m) is medium, and building to building width (20m) is also medium.

The road is two way. There is a moderate level of on-street parking, but the bays are adjacent to the main carriageway. There are four storey Georgian town houses on either side.

There are no cycle lanes, or other similar features in the vicinity of the monitoring site.

5.6.2. Characteristics of sites with the highest after speeds (poorest compliance) and lowest after speeds (highest compliance)

Tables 5-12 and 5-13 summarise the characteristics of the sites with the highest and lowest after speeds, representing the poorest and highest compliance respectively. Speeds were surveyed between <3 and 30 months following the introduction of the new 20mph speed limit.

Key findings (poorest compliance):

- The sites with the poorest compliance are all located in Walsall, Middlesbrough or Brighton.
- All have an after mean speed exceeding 27mph, indicating that the vast majority of drivers are exceeding the 20mph posted speed limit by a considerable margin.
- The sites comprise a mix of important local roads (2 sites) and minor local roads (4 sites). However, they generally provide access through the surrounding residential area; have a number of adjoining roads; and often link into more important roads, including the strategic network.
- They are typically straight or mainly straight roads, which are at least 500m in length; providing drivers with good visibility and allowing vehicles to build up speed. Most are medium or wide roads (in terms of carriageway, road and/or building to building width), with pavements on either side of the road, grass verges in some locations, and moderate size gardens. One of the sites is adjacent to a park, providing a feeling of openness. They have limited on-street parking, and where on-street parking does occur it does not impinge on the main carriageway, so does not reduce the effective width of the road.
- The land-use is mainly residential, and in most cases there are no schools or major trip attractors nearby which might generate high levels of walking and cycling.

In general, the above roads are associated with environments which create a perception of space and openness and provide the driver with good visibility. This may encourage drivers to adopt higher speeds, because they do not need to slow down to allow vehicles to pass, and perceive there to be less risk of a collision. The length of the roads allows drivers to progressively build up speed.

The location and nature of the roads means that are likely to be used as a through route as well as by local residents. In many cases they could be used as shortcuts or rat runs, with drivers keen to maintain a higher speed to reach their destination. The highest speeds are on Barns Lane (Walsall), which can be used as a through route, and to provide access to the industrial estate to the east; alongside providing access to local residents driving to/from home.

Key findings (highest compliance):

- The sites with the highest compliance are located in Winchester City Centre, Brighton Phase 2 and Walsall.
- The mean after speed varies from 13.7mph to 16.2mph, well below the 20mph posted speed limit. The corresponding 85th percentile speeds varies from 16.5mph to 21.0mph, indicating that the vast majority of drivers are complying with the limit.
- The sites are all located on ‘minor local roads’. They are typically straight roads with few junctions. Importantly they are all short roads where there is less scope to achieve faster speeds. The road environment is typically narrow (in terms of carriageway, road and/or building to building width), with medium to high levels of on-street parking; which is also likely to encourage slower speeds.
- Most of the sites are on residential streets, which are located within a housing estate / area, such that the traffic is likely to comprise predominantly of local residents leaving or arriving home. Most drivers are likely to be either at the start or the end of their journey.

In general, the roads with the highest compliance are associated with environments which are likely to constrain speeds - because their length provides less opportunity to build-up speed, visibility may be limited, drivers feel that they need to ‘squeeze’ passed parked vehicles and do not feel that they have sufficient space to drive faster, and possibly because they are either starting or ending their journey and are in less of a hurry at this point.

Table 5-12 Characteristics of sites with the highest after speeds (poorest compliance)

	Barns Lane – 4 sites (Walsall)	Moulescoomb Way (Brighton)	Church Lane (Middlesbrough)	Surrenden Road (Brighton)	Mallowdale (Middlesbrough)	Oxford Road (Middlesbrough)	Malvern Drive (Middlesbrough)
After mean speed	32.3 mph (average) (36.6, 30.6, 29.3, 32.7)	28.1 mph	28.0 mph	28.0 mph	27.6 mph	27.5 mph	27.4 mph
Before vs after difference	-0.2 mph (average) (-0.2, -0.8, 1.0, -0.9)	+0.1 mph (increase)	-0.3 mph	-0.9 mph	-4.1 mph	-0.3 mph	-1.0 mph
After 85th percentile speed	36.9 mph (average) (41.6, 35.2, 33.3, 37.4)	33.1 mph	Data not available	32.2 mph	Data not available	Data not available	Data not available
Before vs after difference	-1.7 mph (average) (-1.6, -2.2, -0.3, -2.6)	0 mph	Data not available	-0.7 mph	Data not available	Data not available	Data not available
Before period	N/A	N/A	N/A	N/A	N/A	N/A	N/A
After period	Sep16 (30 months aft)	Jun16 (24 months aft)	Apr13 (10 months aft)	Jun16 (24 months aft)	Jul13 (<3 months aft)	Sep12 (~4 months aft)	Apr13 (12 months aft)
Road type	Important local road	Minor local road	Important local road	Minor local road	Minor local road	Minor local road	Minor local road
Road length	Long (1600m)	Long (1100m)	Medium (525m)	Medium (675m)	Medium (860m)	Long (930m)	Medium (714m)
Geometry	Meandering	Straight (near site)	Mainly straight	Mainly straight	Mainly straight	Straight	Mainly straight
Junction density	7 per km (11 in total)	8 per km (9 in total)	13 per km (7 in total)	6 per km (4 in total)	10 per km (9 in total)	6 per km (6 in total)	8 per km (6 in total)
Frequency of on-street parking	Low	Moderate (but does not impinge on carriageway)	Low	Low	Low	Medium (but mainly on pavement)	Low
Carriageway width (kerb to kerb)	Mainly medium (6.5m,6.1m,5.8m,6.7m)	Wide (8.8m; 6.5 m, excluding parking bays)	Medium (6.2m)	Medium (6.1m)	Medium (7.2m)	Medium (6.1m)	Narrow (5.8m)
Road width (carriageway, pavement, kerb)	Medium (10.1m,11.8m, 10.5m,10.8m)	Wide (18m)	Medium (11.2m)	Wide (30m)	Medium (13.5m)	Medium (11.9m)	Medium (10.5m)
Building to building width	Wide (36m,35.5m, 27m,23.5m)	N/A	Wide (29m)	Wide (55m)	Wide (29m)	Medium (22m)	Medium (23.9m)
Description of road environment	Houses are usually set back from the road with few cars parked on-street. Footpaths on both sides of road, but no verges. No cycle lanes or other similar features in immediate vicinity of sites.	Significant amount of open green space nearby giving the perception of space. On the other side of the road are industrial units and car-park. No frontages directly only street.	On-street parking is low and sporadic. Houses have moderate sized front gardens. No cycle lanes or other similar features in immediate vicinity.	Road is wide with an extensive verge and pavement set back from the road. Houses are large, and set back from the carriageway. No cycle lanes or other similar features in immediate vicinity.	The houses are moderately set back from the road. Wide pavements with grass verges. No cycle lanes or other similar features in immediate vicinity; but some bus stops and on a bus route.	High levels of on-street parking, but mainly on the pavement. Road is long and straight. Footpath on both sides, but no grass verge. No cycle lanes or other similar features in immediate vicinity; but on a bus route.	Houses are moderately set back from the road. Most have driveways. Footpath on both sides, but no grass verge. No cycle lanes or other similar features in immediate vicinity; but on a bus route.

Land Use	Predominantly residential (semi and terraced), with industrial areas to the east of the 20mph area. No schools near monitoring sites.	Industrial / open space at the survey point, but residential to east.	Residential - semis and detached. No schools or other land-use in immediate vicinity. Some open space.	Residential - semis and detached. No schools or other land-use in immediate vicinity. Lots of open space.	Residential - predominantly semi-detached. No schools or other land-use in immediate vicinity.	Residential - semis and terraced. Sportsfield and social club, and local shops at one end.	Residential- bungalows and semi-detached. No schools or other land-use in immediate vicinity. Some areas of open space.
Description of road function	Key access road through estate and serving industrial area to the east. Joins A461. Potential rat-run.	Key access route through residential area. Lots of adjoining roads. Likely to be used as a through route as well as by local residents.	Adjoins A1032. Likely to be used as a through route as well as by local residents.	Links two more important roads. Likely to be used as a through route as well as by local residents.	Links two more important roads. May be used as a through route as well as access road to local estate.	Key access route through residential area. Links to A1032. Likely to be used as a through route as well as by local residents.	Key access route through residential area. Links to A1032. Likely to be used as a through route as well as by local residents.

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Table 5-13 Characteristics of sites with the lowest after speeds (highest compliance)

	Saxon Road (Winchester City Centre)	Stonecross Road (Brighton Phase 2)	Linley Road (Walsall)	Clermont Terrace (Brighton Phase 2)	Montague Place (Brighton Phase 2)	Reeves Hill (Brighton Phase 2)
After mean speed	13.7 mph	14.8 mph	14.9 mph	15.6 mph	16.2 mph	16.2 mph
Before vs after difference	+1.0 mph (increase)	-0.1 mph	-1.9 mph	-1.7 mph	-0.6 mph	-5.0 mph
After 85th percentile speed	19.0 mph	18.6 mph	16.5 mph	20.4 mph	21.0 mph	20.4 mph
Before vs after difference	+1.2 mph (increase)	-0.2 mph	-3.4 mph	-2.6 mph	-1.1 mph	-5.8 mph
Before period	N/A	N/A	N/A	N/A	N/A	N/A
After period	Apr15 (7 months aft)	Jun15 (12 months aft)	Sep16 (30 months aft)	Jun16 (24 months aft)	Jun16 (24 months aft)	Jun15 (12 months aft)
Road type	Minor local road	Minor local road	Minor local road	Minor local road	Minor local road	Minor local road
Road length	Short (250m)	Short (240m)	Short (90m)	Short (210m)	Short (140m)	Short (230m)
Geometry	Mainly straight	Mainly straight	Straight	Straight	Straight	Mainly straight
Junction density	12 per km (3 in total)	No Junctions	No Junctions	No Junctions	14 per km (2 in total)	4 per km (1 in total)
Frequency of on-street parking	High – no off-street parking	Medium - many houses do not have off-street parking	Low – Houses and community centre / apartments have off street parking	High – High volume of apartments with little off street parking	Medium – predominantly on one side of the road. Double yellow lines on the opposite site to parking	Medium – Houses on this road have restricted parking due to hill gradient.
Carriageway width (kerb to kerb)	Medium ~7.4 metres (~3m excluding on-street parking bays)	Narrow (~6 metres)	Narrow (~5.5 metres)	Wide (~7.2 metres)	Narrow (~5.8 metres)	Narrow (~5.4 metres)
Road width (carriageway, pavement, kerb)	Narrow (~9.5 metres)	Medium (~11 metres)	Medium (~11 metres)	Medium (~12 metres)	Narrow (~9.8 metres)	Narrow (~7.2 metres)
Building to building width	Narrow (~14 metres)	Narrow (~19 metres)	Wide (~40 metres)	Wide (~34 metres)	Medium (~21 metres)	Narrow (~14 metres)
Description of road environment	Mixture of housing types along the road. Between Nuns Road and Monks Road predominantly semi-detached houses along one side of the road and the other side is hedgerows. On street parking along both sides of the road. Footpaths on both sides of road, but no	Semi-detached houses line both sides of the road. Footpaths on both sides of road, with a small verge on one side of the road. No cycle lanes or other similar features in immediate vicinity of sites. Road built on a gradient.	Road is lined on one side with semi-detached houses and the other with a community centre / apartments. No cycle lanes or other similar features in immediate vicinity of sites. Small grass verge on both sides of the road. Houses set back away from the road.	Residential area dominated by low rise apartment buildings. High levels of on street parking. Footpaths on both sides of the roads. No verges on either side of the road. No cycle lanes on this road or in the vicinity.	Narrow road with narrow footpath on both sides. No cycle path or grass verge on either side of the road. Restricted off street parking.	Predominantly semi-detached houses along one side of the road, the other side is a field. Footpath along the side of the road lined with houses. No cycle lanes or other similar features in immediate vicinity of sites. Road built on a gradient.

	verges. No cycle lanes or other similar features in immediate vicinity of site.					
Land Use	Predominantly residential (semi and terraced)	Residential (semi-detached predominantly)	Residential and community	Residential (low rise apartments)	Mixed (mix of high density and low density apartment buildings). Church, garage, and council building near site.	Residential and agriculture
Description of road function	Residential road leading to other residential roads. Likely to be mainly used by local residents.	Residential road between other residential roads. Likely to be mainly used by local residents.	Residential road between other residential roads. Likely to be mainly used by those living no Linley Road and other roads within the estate.	Residential road close to a train station. Likely to be mainly used by those living no Linley Road and other roads within the immediate vicinity.	Residential road heading towards the sea front. Links two important E-W through routes. Likely to be used by local residents, those accessing local amenities, and as a through route.	Residential road. Likely to be mainly used by local residents.

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6. Speed outcomes in case study areas (supplementary analysis)

6.1. Introduction

Some case study authorities have undertaken additional monitoring which enables supplementary analysis to be undertaken, in relation to specific issues. These include:

- the impact of Vehicle Activated Signs and enforcement activity on speeds (Walsall case study);
- public perception of speeds versus actual speeds (Portsmouth case study);
- compliance by mode (Portsmouth case study); and
- speed displacement impacts (Brighton Phase 2 case study).

6.2. Impact of Vehicle Activated Signs and enforcement activity on speeds (Walsall case study)

In November / December 2015, Vehicle Activated Speed Signs (VASS) were used to monitor speeds in each of the 20mph pilot areas, as part of a Restorative Justice Enforcement Programme.

In Rushall, VASS were located on Barns Lane / Westgate for a two week period (2-15 Nov). Monitoring undertaken 4 months post implementation showed that speeds on this road were still substantially above 20mph.

During the first week, the VASS units were used to monitor speeds 18 months after implementation; but during the second week, the Police were also out on site, using Prolaser hand-held devices to capture speeding drivers. Low level offenders were invited to attend a 'Speed in the Community Course', while higher level offenders were prosecuted. Four courses were run in February and March 2016, attended by 65 motorists across four pilot areas. The threshold for low and high level offenders was kept confidential by the Police.

The VASS was located on Barns Lane, near Rischale Way, and monitored speeds in the northbound direction only. The nearest ATC comparable to this is Barns Lane (near Linley Road) which is the staggered junction opposite Rischale Way.

Prior to implementation of the 20mph limit, the mean speed on Barns Lane (northbound, near Linley Road) was 31.4mph (Sep 2013). Surveys undertaken 4 months post implementation (July 2014), using pneumatic loops, showed a reduction of -2.2mph on the northbound carriageway at this site. Further surveys were undertaken 30 months post implementation (Sep 2016). These showed that speeds had risen again, and the reduction compared with the before survey was now only -1.2mph.

The mean speed monitored by the VASS in 2015 was 24.4mph, a reduction of 7.0mph when compared with the before data for Barns Road (near Linley Road) , which estimated the mean speed as 31.4mph. The results suggest that VASS units and police enforcement achieved an additional reduction in mean speed of at least 5mph, on top of the change associated with the 20mph limit signs only (estimated as -2.2mph). However, there is no evidence to suggest that the additional enforcement had a lasting affect, with speeds increasing again the following year (the mean speed near Linley Road was estimated as 30.2mph in Sep 2016).

VASS data has been provided for the second of the two weeks only, when the Police were out on site. It has not been possible to compare speeds for the first and second weeks, with and without Police presence.

6.3. Public perception of speeds (Portsmouth case study)

In two case study areas, Middlesbrough and Portsmouth, additional after monitoring has been undertaken to monitor speeds on roads where complaints have been received from the Council. This provides an opportunity to compare public perception of speeds with actual speeds.

Portsmouth Case Study - Complaints about speeding are the most common complaint received by Portsmouth City Council, from the public. The Council therefore have an on-going programme to monitor speeds on roads where complaints have been received by the public.

Since July 2013, three Speed Detection Radar units have been in operation 24hrs a day, for up to 4 week periods (but generally less than 2 weeks) within the 20 mph areas. These are attached to lampposts and used to collect traffic volume and speed data, classified by mode.

Three streets are monitored at a time. Locations chosen are primarily driven by complaints / queries from the public about levels of speeding; although, some surveys are undertaken to inform engineering schemes.

Where speeds are found to be high, Vehicle Activated Signs are introduced for a temporary period, and Community Speedwatch enforcement is undertaken. Over the last couple of years, the annual speed reduction budget has been used to traffic calm the sites with the highest 85th percentile speeds.

Data has been collected for about 80 roads since July 2013; and there is currently a backlog of more than 20 requests for speed monitoring. Some data was collected before July 2013, using older, less reliable units. The extent of monitoring undertaken has been scaled back recently due to resource constraints.

High level results, based on mean speed and 85th percentile speed for each site, are summarised below:

Table 6-1 Mean and 85th percentile speeds for the 79 sites identified by the public as having speeding problems

	Mean speed		85th percentile speed	
<=20 mph	49 sites	62%	13 sites	16%
20-24 mph	27 sites	24%	20 sites	25%
>24 mph	3 sites	4%	46 sites	58%
Total	79 sites	100%	79 sites	100%

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The results show that 58% of sites have an 85th percentile speed of >24mph. In these locations, 15% (or substantially more at some sites) are driving more than 24mph, and are categorised by the Council as 'speeding'. This shows that speeding remains a problem on some roads, and that public concerns about speeding are validated by the actual speed data.

However, some of the roads identified by the public were found to have much lower speeds. On 16% of the identified sites, the 85th percentile speed is <=20mph, suggesting that incidents of speeding (e.g. driving more than 24mph) are relatively low. In these locations, the complaints are likely to have been in response to a small number of isolated incidents of excessive driving speeds, rather than a common problem.

6.4. Compliance by mode (Portsmouth case study)

The data collected by PCC as part of the on-going programme to monitor speeds on roads where complaints have been received by the public, is categorised by vehicle type (bicycle / motorcycle, car, LGV, and HGV). Vehicle type is estimated from the length / size of the vehicle[34], which allows compliance by vehicle type to be analysed.

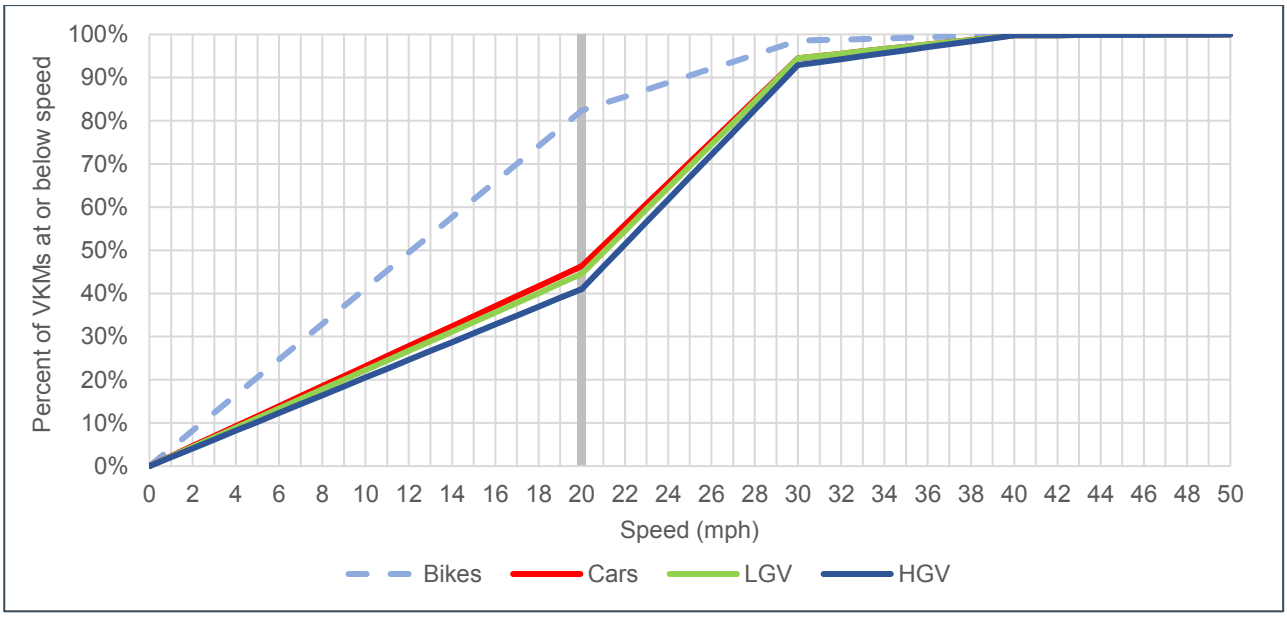
[34] *It is acknowledged that the approach is subject to error and some vehicles may be mis-categoriesd.*

As the number of monitoring days varies between sites, only those sites with 6, 7 and 8 days of data (and multiples of) have been used in the analysis – to ensure an appropriate representation of weekdays and weekends. Some sites had to be excluded, because the speed bin categories were not compatible with the majority of the sample. In total 26 sites were analysed, comprising data for 224,781 vehicles. All sites were located on 'minor local roads'.

The results presented below, suggest that 20mph compliance amongst HGV drivers (41%) is significantly lower than compliance amongst car (46%) and LGV (45%) drivers. However, those driving excessively (>30mph) are more likely to be car or LGV drivers.

Note - This data relates to 'problem sites', rather than a representative sample of monitoring sites.

Figure 6-1 Cumulative speed profile by vehicle type on 20mph roads (2013-2015)



The speed bin categories vary by site. In order to combine results across sites, it was necessary to aggregate the speed bins into broader groupings: 0-20mph, 20-30mph, 30-40mph.

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Table 6-2 Speed compliance by vehicle type

	Bikes / Motorcycles	Cars	Light Goods Vehicles (LGVs)	Heavy Goods Vehicles (HGVs)
% <=20 mph	82%+	46%	45%	**41%***
% <=30 mph	99%+	94%	93%	**98%***
Total no. of vehicles	22,545	194,475	6,852	909

+ *Significantly different to the corresponding figures for all other modes.*
* *Significantly different to the corresponding figures for cars and LGVs. No significant difference between the results for cars and LGVs.*

6.5. Speed displacement impacts (Brighton Phase 2 Case Study)

In the Brighton (Phase 2) area, a decision was made, post consultation, to retain a 30mph limit on a substantial number of 30mph roads. Spot speed surveys were undertaken at 28 sites on roads which remained 30mph, at the same time as monitoring took place on the new 20mph roads (48 sites).

Results for roads retaining a 30mph limit show a marginal increase in mean and 85th percentile speeds (+0.4mph and +0.8mph respectively), compared with the small decline recorded on new 20mph limits (-

1.1mph and -1.4mph respectively). The results are similar when broken down by road type. See Appendix G for further details.

This differs to the findings from the aggregated TomTom analysis (for all residential case study areas), which shows that speeds on surrounding 30mph declined following the implementation of nearby 20mph limits – but to a lesser extent than in the new 20mph areas.

7. Summary and conclusions

7.1. Introduction

A summary of the findings is presented below, structured around the research themes set out in Chapter 2.

7.2. General context

Existing evidence on speeds in 20mph zones and limits – Existing research suggests 20mph zones can achieve substantial reductions in average speed, of around 9-10mph. This evidence is largely based on schemes which are small scale (typically covering a few kms of road length), have a before speed well above 20mph (typically around 25mph), and were implemented in the 1990s and early 2000s primarily to address location-specific safety issues.

Evidence for 20mph limits, although more limited, suggests that signed only schemes deliver much smaller reductions in average speed (typically around 1-2mph), with variable accounting for background trends. The schemes involved tend to be large area-wide initiatives, with lower before speeds (closer to 20mph), and have been introduced to deliver an area-wide change rather than address location-specific issues.

This evidence provides a benchmark against which the results from this study can be compared.

Wider speed trends – DfT published statistics suggests that there has been a small downward trend in speeds in recent years, across a range of road types – locally managed A roads and 30mph roads. This trend is expected to have extended to 20mph roads, but potentially to a lesser extent as levels of enforcement are typically lower on 20mph roads. It is therefore possible that a small reduction in speeds would have occurred on these roads even if the new limit had not been introduced.

Evidence from three comparator areas selected as part of the analysis of GPS journey speed data supports this, and shows a small decline in median speed of up to 1mph over the period of analysis used for the main case study areas. This small downward trend in speeds on urban roads outside the case study areas needs to be taken into account when interpreting the findings presented in this report.

Detailed statistical analysis comparing the change in speed in case study and similar comparator areas has been undertaken as part of the analysis of GPS journey speed data[35], reported separately and in the main Technical Report. This estimates the extent to which the observed change in speed in the 20mph limit case study areas is likely to be due to the introduction of the 20mph limit, rather than part of a wider trend in speeds affecting both 20mph and 30mph roads.

The spot speed data presented below represents the actual change in speed observed in the case study areas. No statistical analysis has been undertaken here, to estimate the extent to which the changes are due to the introduction of 20mph limits, rather than background trends in speed. This report should therefore be read in conjunction with the main Technical Report.

7.3. Case study context

Site characteristics – The majority of spot speed monitoring sites in recently implemented case study areas are located on minor local roads (68% of sites) and / or roads with a before mean speed of <=24mph (59% of sites).

These findings exclude data for Portsmouth. The 20mph scheme here was one of the first to be implemented in the country, and pre-dated the other case study schemes by at least three years. A much higher proportion of monitoring sites (66%) already had a mean speed of <=20mph, compared with elsewhere; providing less scope for an overall reduction in speed.

[35] Atkins (2018) 20mph Research Study. Analysis of GPS journey speeds in case study areas. (Supporting Technical Appendix)

A number of case study authorities report a bias towards busier and more important roads, and those with known / expected speeding problems, when identifying spot speed monitoring sites. This suggests that the spot sped monitoring sites comprises an under-representation of minor local roads / roads with slower speeds generally, which may influence the outcomes observed.

Scheme differences – There is a substantial difference in the before speeds across the different case study schemes. For example, in Portsmouth, 63% of drivers at spot speed sites were already driving at or below 20mph, while in Walsall almost half of drivers surveyed (49%) were exceeding 30mph. This shows that 20mph limits have been implemented in a range of different speed environments, which is likely to affect the speed outcomes observed.

Spot speed vs TomTom data - Speed profiles, mean/median and 85th percentile changes are all similar to those found in the TomTom (GPS journey speed) analysis. However, spot speed surveys generally record higher speeds for all of these metrics due to the nature of how the data is collected (see Section 3.3).

7.4. Compliance

Overview - The level of scheme level compliance with the new 20mph limits varies from 14% in Walsall, to 71% in Portsmouth, based on evidence available for 5 scheme areas. This reflects the mean before speed. Across all the scheme areas with data, Walsall had the highest before mean speed, and Portsmouth had the lowest before mean speed.

7.5. Mean, 85th percentile speeds, and speed profile

Scheme level results – Spot speed data (based on unweighted and flow-weighted data) has been averaged across all monitoring sites within each area to identify changes in speed at a scheme level. Un-weighted metrics treat all sites equally, and reflect average speeds across the chosen sites; flow-weighted metrics place more emphasis on higher flow sites and are more representative of the behaviour of all drivers. Flow-weighted mean speeds are typically higher, reflecting higher speeds on busier roads.

Mean speeds – The average unweighted mean speeds for the scheme areas, prior to the introduction of the new 20mph limits, varied from 19.8mph in Portsmouth to 26.8 mph in Middlesbrough. This indicates a large variation in speeds across the scheme areas. In Portsmouth, a high proportion of drivers were already travelling at 20mph or less; while in Middlesbrough a substantial proportion were driving closer to 30mph prior to the introduction of the new limit.

Statistical analysis[36] shows a significant reduction in mean speed in four case study areas based on unweighted speed data:

- Middlesbrough: -2.3mph within the first year;
- Chichester: -1.7mph within the first year; and
- Brighton Phase 2: -0.9mph after 12 months, and -0.9mph after 24 months;
- Brighton Phase 1: -1.3mph after 13 months and -1.2mph after 26 months.

In the two Brighton case studies, flow-weighted differences were also found to be significant and show slightly bigger reductions in mean speed, reflecting a bigger reduction on busier roads:

- Brighton Phase 2: -1.1mph after 12 months, and -1.4mph after 24 months;
- Brighton Phase 1: -1.6mph after 13 months and -1.3mph after 26 months.

In addition, the flow weighted difference in Calderdale Phase 1 (-1.5mph) was significant, although the findings are based on 3 sites only.

[36] A paired t-test was used for the unweighted data, and a weighted least squares model for the weighted data.

No significant change in mean speed was found in: Walsall (Rushall), Winchester (Stanmore) and Winchester City Centre. It was not possible to calculate confidence intervals for Portsmouth as speed data is not readily available.

85th percentile speeds – The average unweighted 85th percentile speeds for scheme areas, prior to the introduction of the new 20mph limits, varied from 25.9mph in Winchester to 31.7 in Calderdale Phase 1. This data was only available for seven scheme areas, but again indicates a large variation in higher end speeds across the different locations.

Statistical analysis[37] shows a significant reduction in 85th percentile speeds in five case study areas based on unweighted speed data:

- Walsall: -2.1mph after 30 months;
- Calderdale: -2.2mph after 3 months (based on 3 sites only);
- Brighton Phase 2: -0.9mph after 12 months, and -0.9mph after 24 months;
- Brighton Phase 1: -2.0mph after 13 months and -1.9mph after 26 months;
- Chichester: -2.8mph within the first year.

Flow-weighted differences were also found to be significant in Walsall (-1.6mph), Brighton Phase 2 (-1.2mph, -1.4mph), and Brighton Phase 1 (-1.8mph, -1.3mph); but not in Calderdale.

No significant change in mean speed was found in: Winchester (Stanmore) and Winchester City Centre.

In general, the change in the 85th percentile speed is greater or equal to the change in mean speed.

There is relatively little variation in performance across the scheme areas, with all schemes recording either no change or a small change in speed, and relatively little variation in performance evident across schemes. No particularly schemes stand out as performing particularly strongly or weakly in terms of the change in speed recorded. This is despite the schemes being implemented in a range of different geographical and speed environments.

Site specific results – Data for individual sites shows more variability, with some more substantial reductions in speed and a small number of sites reporting increases.

Across the case study schemes with comprehensive data, the change in mean speed at individual sites varied from -7.2mph (decrease) to +4.3mph (increase), based on data from eight case studies; and the change in the 85th percentile speed varied from -9.0mph (decrease) to +7.6mph (increase), based on data from seven case studies.

Monitoring data shows a reduction in mean and 85th percentile speeds at the majority of sites[38]; and a general increase in the proportion of sites with a mean speed less than 24mph and an 85th percentile speed of <30mph[39].

7.6. Trends over time

Brighton case studies – Data for Brighton Phase 2 (residential) and Phase 1 (city centre focused) was collected one year and two years post implementation. In both cases, there is no evidence to suggest a statistically significant change in speeds between the two after periods[40].

[37] A paired t-test was used for the unweighted data, and a weighted least squares model for the weighted data.

[38] 62% of sites across eight case study areas reported a reduction in mean speed (or 77% if data from Portsmouth is excluded). 78% of sites across six case study areas with comprehensive data reported a reduction in the 85th percentile speed.

[39] The % of sites with a mean speed of <=24mph increased from 74% to 84% (or 59% to 75% if data from Portsmouth is excluded). The % of sites with an 85th percentile speed of <=30mph increased from 70% to 87%.

[40] A paired t-test was used for the unweighted data, and a weighted least squares model for the weighted data.

7.7. Relationship between change in speed and road type

Speed profile analysis - Data for Walsall (small-scale residential), Brighton Phase 2 (area-wide residential); and Winchester City Centre (city centre) has been used to compare the before and after results by road type.

The results for Walsall and Winchester City Centre reflect the findings of the aggregated TomTom analysis (for all scheme areas), which shows that the major factor relating to how drivers respond to speed limits of 30mph or 20mph is the character of the road itself. The difference in speed between the two road types is far larger than the changes brought about by lowering the speed limit.

In contrast, the results for Brighton Phase 2 show very similar results for the two different road types. This is likely to be a reflection of the characteristics of the specific monitoring sites. The TomTom data was undertaken at an aggregate level only, and it is likely that the results for each of the individual scheme areas show some variability around the overall trend.

7.8. Relationship between change in speed and before speed

Speed profile analysis - Data for Walsall (small-scale residential), Brighton Phase 2 (area-wide residential); and Winchester City Centre (city centre) has been used to compare the before and after results by before speed. The results support the findings of the aggregated TomTom analysis (reported separately[41]), which showed that the introduction of a 20mph limit has a bigger impact on roads with a higher pre-scheme speed. This is as expected, as these roads have more scope for speeds to reduce. However, even on the fastest roads the speed reduction is still small.

Site specific analysis – Plotting the before mean speed at individual sites against (i) the change in mean speed and (ii) the change in 85th percentile speed, shows a weak but significant relationship (reflecting the above findings).

Nevertheless, the result show that mean before speed, on its own, is a poor predictor of change in speed, suggesting other factors (such as the characteristics of the road environment, the types of drivers and vehicles using the road) are influencing the actual change in speed.

7.9. Impact of road environment on outcomes

Relationship between change in speed and before speed – Analysis of the characteristics of ten sites with the biggest reduction in mean speed shows no evidence to suggest that one particular type of road characteristic (e.g. length, width, straight / curved, housing style / size, openness / density of environment) is associated with bigger reductions in mean speed. However, the results do support the findings reported earlier in this report which show larger reductions in speed tend to be associated with more important local roads, and those which support a number of functions (i.e. likely to be used by local residents, other road users to access local amenities, and as a through route).

The findings suggest that the actual change in speed occurring at specific sites is driven by a complex set of factors, which may include a combination of road characteristics, publicity and community engagement, and the behaviour and attitudes of local drivers. The influence of these factors on self-reported and perceived changes in speeds, is examined further in various regression models based on the questionnaire results (reported separately[42]).

Characteristics of sites with the highest after speeds (poorest compliance) – Analysis of the characteristics of the seven sites with the highest after speeds shows that the poorest compliance is associated with wide roads, low levels of on-street parking, moderate-high distances from the middle of the road to the housing. Most roads have reasonably long sections of straight or slightly curved road. These environments create a perception of space and openness, and provide the driver with good visibility. This may encourage drivers to adopt higher speeds, because they do not need to slow down to allow vehicles to pass, and perceive there

[41] Atkins (2018) 20mph Research Study. Analysis of GPS journey speeds in case study areas. (Supporting Technical Appendix)

[42] Atkins (2018) 20mph Research Study. Residents and drivers questionnaires - logistic regression analysis. (Supporting Technical Appendix)

to be less risk of a collision. The roads are all at least 500m long, allowing drivers to progressively build up speed.

Furthermore, the roads concerned are likely to be used as a through route as well as by local residents. In many cases they could be used as shortcuts or rat runs, with drivers keen to maintain a higher speed to reach their destination. The highest speeds are on Barns Lane (Walsall), which can be used as a through route, and to provide access to the industrial estate to the east; alongside providing access to local residents driving to/from home.

Characteristics of sites with the lowest after speeds (highest compliance) – In general, the roads with the highest compliance are all located on 'minor local roads'. They are typically straight roads with few junctions. Importantly they are all short roads where there is less scope to achieve faster speeds. The road environment is typically narrow (in terms of carriageway, road and/or building to building width), with medium to high levels of on-street parking; which is also likely to encourage slower speeds. Most of the sites are on residential streets, which are located within a housing estate / area, such that the traffic is likely to comprise predominantly of local residents leaving or arriving home. Most drivers are likely to be either at the start or the end of their journey.

In general, the roads with the highest compliance are associated with environments which are likely to constrain speeds - because their length provides less opportunity to build-up speed, visibility may be limited, drivers feel that they need to 'squeeze' passed parked vehicles and do not feel that they have sufficient space to drive faster, and possibly because they are either starting or ending their journey and are in less of a hurry at this point.

7.10. Supplementary analysis

Impact of Vehicle Activated Speed Signs (VASS) and enforcement activity on speeds – Data collected by Walsall suggests that VASS units and police enforcement achieved an additional reduction in mean speed of at least 5mph, on top of the change associated with the 20mph limit signs only. However, there is no evidence to suggest that the additional enforcement had a lasting affect, with speeds increasing again the following year.

VASS data has been provided for the second of the two weeks only, when the Police were out on site. It has not been possible to compare speeds for the first and second weeks, with and without Police presence.

Public perceptions of speeds – Complaints about speeding are the most common complaint received by Portsmouth City Council, from the public. The Council therefore have an on-going programme to monitor speeds on roads where complaints have been received by the public. Public concerns about speeding are validated by the actual monitoring data in about 58% of cases[43], indicating a moderate match between public perceptions of speed and actual speeds. Elsewhere, complaints are likely to have been in response to a small number of isolated incidents of excessive driving speeds, rather than a common problem.

Compliance by mode – The data collected by PCC as part of the on-going programme to monitor speeds on roads where complaints have been received by the public, is categorised by vehicle type (bicycle / motorcycle, car, LGV, and HGV). The results presented below, suggest that 20mph compliance amongst HGV drivers (41%) is significantly lower than compliance amongst car (46%) and LGV (45%) drivers. However, those driving excessively (>30mph) are more likely to be car or LGV drivers.

Speed displacement impacts – In the Brighton (Phase 2) area, a decision was made, post consultation, to retain a 30mph limit on a substantial number of 30mph roads. Spot speed surveys were undertaken at 28 sites on roads which remained 30mph, at the same time as monitoring took place on the new 20mph roads.

Results for roads retaining a 30mph limit show a marginal increase in mean and 85th percentile speeds (+0.4mph and +0.8mph respectively), compared with the small decline recorded on new 20mph limits (-1.1mph and -1.4mph respectively).

[43] The results show that 58% of sites have an 85th percentile speed of >24mph. In these locations, 15% (or substantially more at some sites) are driving more than 24mph, and are categorised by the Council as 'speeding'.

This differs to the findings from the TomTom analysis, which shows that speeds on surrounding 30mph declined following the implementation of nearby 20mph limits – but to a lesser extent than in the new 20mph areas.

7.11. Lessons

In preparing this report, a detailed examination has been undertaken of the monitoring, analysis and reporting approaches adopted by the case study authorities. This has identified a number of lessons which are summarised below:

Siting of monitoring equipment – Spot speed surveys only capture speeds in one specific location, so monitoring equipment should be sited in a location where vehicles are likely to be driving at a typical speed for the road, generally in free flow conditions. Speed readings will be lower if the equipment needs to be placed near a junction, at a bend, near parked cars, etc.

Monitoring locations – The results will be influenced by the types of roads surveys are undertaken on. There may be policy reasons for focusing on roads where speeding has been reported as an issue or are expected to have low level of 20mph compliance; but these roads may not be representative of the wider 20mph implementation.

Duration - Extending the monitoring period to two weeks allows two sets of data to be collected for each day of the week, and reduces the impact of any unusual circumstances (e.g. inclement weather). DfT's Transport Analysis Guidance (WebTAG) advises two weeks for undertaking flow counts.

Resource requirements – Sufficient resources should be budgeted for at the outset, to undertake, analyse, and report on the surveys. *Data on typical monitoring costs is reported elsewhere.*

There may be a need for additional monitoring post-implementation, to respond to concerns from the public and Councillors. For example, in Portsmouth, complaints about speeding are still the most common complaint received by the Council from the public, eight years after implementation. The Council therefore have an on-going programme to monitor speeds on roads where complaints have been received by the public, and roads with the highest speeds are shortlisted for further treatment. Similarly, in Middlesbrough, the scheme attracted a lot of public and media interest, and additional post-implementation surveys were undertaken to address concerns raised.

Data quality – The data collected should be consistent across survey sites and both the before and after periods, and should be fit for purpose:

- Speed bin categories should be appropriate for 20mph roads, i.e. capable of monitoring percentage compliance, and the proportion travelling at speeds of interest in the context of 20mph implementation (e.g. 20-24mph, >24mph). These categories will be different to those typically used on higher speed limit roads.
- Before and after data should be collected during comparable months (to minimise for seasonality impacts on flow and speeds), and on the same days of the week.
- Ideally, before data should be collected a sufficient period of time before implementation, to ensure that driver behaviour is not affected by consultation activities, education and awareness initiatives, disruption due to installation of signing and lining, or implementation in nearby areas. After surveys should be delayed (e.g. for 6-12 months) to allow scheme outcomes to establish.
- The raw data should be quality checked to ensure that it is fit for purpose, and is not influenced by significant gaps which bias the overall results.

Use of historic data can reduce the cost of monitoring, but can also reduce the robustness of the evidence if the data is collected at different times of the year, or at different points in time when background trends may have differed. It may also bias the location of sampling points.

Analysis – All case study authorities reported mean speed data, but this only provides a partial picture of outcomes. Other useful metrics are the percentage travelling less than 20mph (to monitor compliance), 85th percentile speed (to monitor the change in the highest speeds), and potentially speed bin data (to monitor change in profile). Flow data is required to weight site data, and identify any substantial changes in flow

which may influence outcomes. The key analysis metrics should be identified at the outset, and software outputs tailored appropriately (where possible), to minimise the amount of data extraction required. As part of the analysis undertaken for this report, it was necessary to extract the above metrics from the individual raw data files. This proved to be an onerous and time-consuming task, even when the process was automated.

Reporting periods – Most data collection software presents the results as a 5-day or 7-day average, and for the following time periods: 07:00-19:00, 06:00-22:00, 06:00-00:00, and 00:00-00:00. However, from a policy perspective, it would be useful to be able to compare peak and non-peak periods[44]. The TomTom analysis showed very little difference in outcomes in peak (07:00-10:00 and 14:00-19:00, weekdays) and non-peak periods (all other times, including weekends). However, it has not been possible to test this conclusion with the spot speed data. While raw data is generally available for individual hours and days, extracting and compiling this data in the required format would be a very onerous task – beyond the budget available for this study.

Reporting – The findings of the analysis should be clearly reported, and available for scrutiny by policy makers in the authority concerned and elsewhere. In general, the case study authorities were unable to provide a formal report setting out the findings of the monitoring data. Some provided analysis spreadsheets, while others referred the study team to Cabinet papers, which provide a high-level summary of the results. In general, however, documentation of any analysis was poor. So, while the authorities generally collected a substantial amount of monitoring data, there is a question about whether the data has been used effectively.

7.12. Implications of data limitations

The analysis presented in this report has been constrained by the availability, consistency, and quality of the evidence provided by the relevant local authorities. Specific issues have included limited in-depth reporting of results by the authorities concerned, lack of availability of raw data for some areas, and different data formats in the before and after periods and across authorities. For three of the case study areas the authorities concerned were unable to provide any monitoring data, for various reasons.

These issues mean that it has not been possible to provide consistent, comprehensive results across all the case study areas; and makes it difficult to compare across schemes on a like for like basis. Nevertheless, the data has allowed us to identify the scale of change in the case study areas, confirm some of the broad themes identified in the analysis of TomTom GPS data (reported separately), and to examine the site-specific characteristics associated with speed changes and compliance levels.

[44] For example, to identify when 20mph limits are most effective, and which types of trips should be targeted in terms promoting walking and cycling in 20mph areas.

Appendices

Appendix A. Walsall (Rushall) (R-SM1)

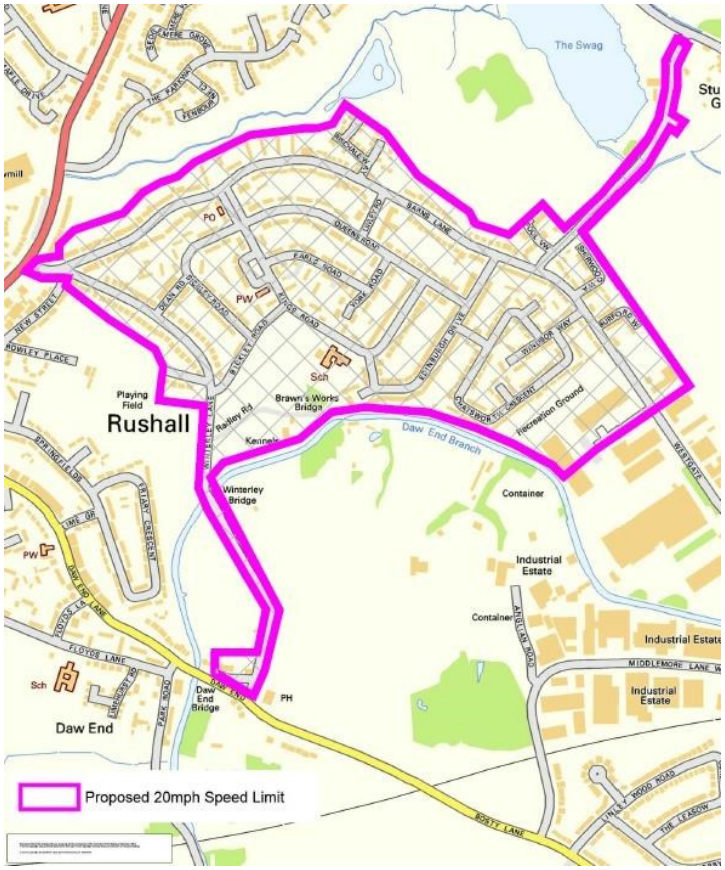
A.1. Scheme description (Predominantly residential and schools)

Rushall is one of five residential 'pilot' 20 mph speed limit schemes implemented in the borough since January 2014.

The Rushall scheme (**implemented March 2014**) covers a small area bounded by two classified roads, a local distributor road, and green space. There is an industrial area to the east of the scheme, and two routes through the estate are used as 'rat-runs'. Population within scheme area is estimated at a couple of thousand. The 20mph limit covers all residential areas within scheme boundary (all minor roads).

The limit operates 24 hours a day, 7 days a week.

Figure A1. Scheme location (Rushall)



The Rushall scheme was implemented to address speed related issues identified following a Speed Limit Review of roads in the borough; and complaints from residents regarding general vehicle speeds through the estate, particularly following a number of high profile collisions on Barns Lane. The route is heavily used by HGVs, which were seen as presenting a particular safety risk, due to excessive and inappropriate speeds. Consideration was given to other types of traffic calming on Barns Lane, such as weight restrictions and rerouting of HGVs, but these were considered inappropriate. There was strong support for the scheme from the local Councillor.

Speed limits and presence of pre-existing traffic calming measures in study area

Winterley Lane was already subject to a 20mph speed limit, with traffic calming (speed humps) under a previous local safety scheme; and there were speed cushions on Kings Road to resolve issues outside The Radley's School. No other pre-existing traffic calming was in place.

The majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (84%). No additional traffic calming measures have been installed as part of this scheme.

Signing approach (Moderate frequency and visibility of signing)

20mph road signs and coloured paving installed at the 'gateways' to the scheme area. Smaller repeater signs are placed at regular intervals along Barns Lane (the main through- and access-route) and 'SLOW' markings have been painted on the carriageway (some markings pre-date the 20mph limit). Elsewhere, '20' roundel markings are used to indicate the speed limit, generally located at junctions.

Area characteristics

The area comprises a mix of inter-war semi-detached housing, and some new areas with terraced housing and flats/apartments.

Roads are typically long and reasonably wide (approx. 6m wide). Many houses have large frontages, and are set back from the road. There is a mix of on and off-street parking.

The level of deprivation / affluence across the area is 'moderate' (category 3). Approximately a fifth of the population is aged under 16.

See 20mph Case Study Descriptions Report for more information.

A.2. Monitoring approach

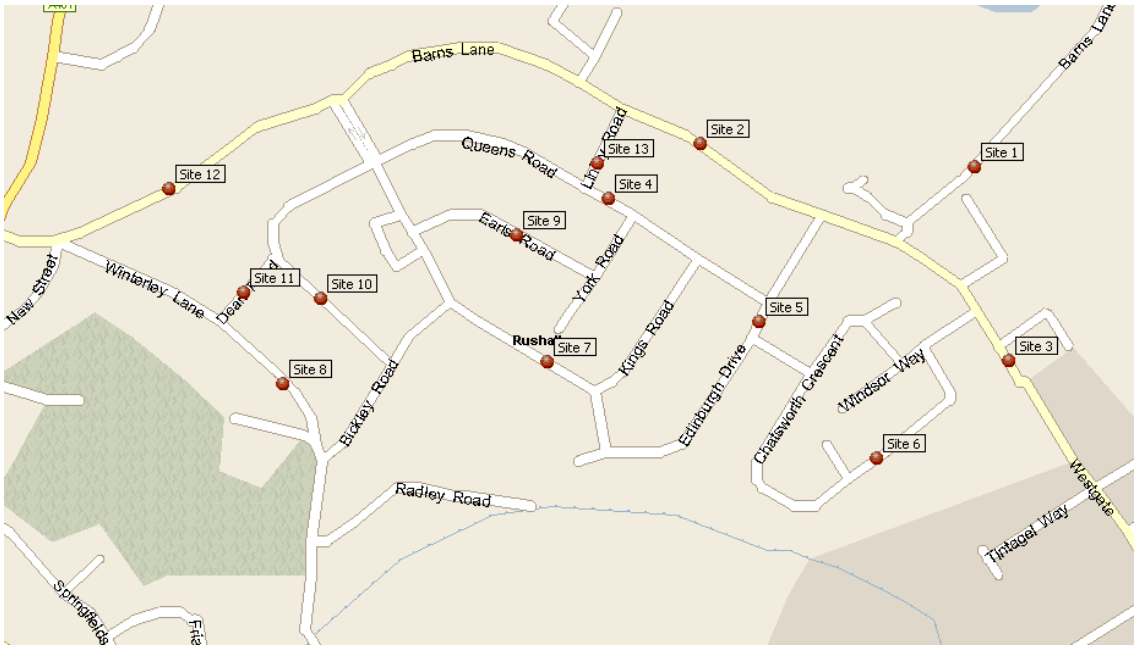
Speed and flow data has been collected at 13 representative sites across the scheme area.

Before data was collected 6 months pre-implementation of the 20mph signs (in Sep 2013). After data was collected 4 months post (Jul 2014), and again, 30 months post-implementation (Sep 2016). No further monitoring is planned.

Summary of monitoring approach in Walsall (Rushall) – Scheme impl. March 2014	
Number of monitoring sites	13 (10 used in analysis)
Location of sites	Representative locations across scheme area
Before and after timescales	Before = 6 months pre-impl (Sep 2013) After 1 = 4 months post (Jul 2014) After 2 = 30 months post (Sep 2016)
Data source	Automatic traffic counters (tubes)
Duration	7 days, 24 hrs/day during each timescale
Data available	Total vehicles (5 day and 7 day average) Mean speed and 85th percentile speed, % exceeding limit 5mph speed bins (+ above metrics) by hour of day and day of week No formal monitoring report provided.
Quality of evidence available for this study	**Moderate** Representative sample of locations across scheme area. 7 days of data, covering Monday to Sunday. Before and After2 data collected at same time of year, in neutral month. Tubes more visible than radar, and may influence driving speeds.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1g. Walsall\Task 3.1d Follow-up Info 2016\Data Provided_File Request_ Re_ Atkins - 20 mph Stakeholder Engagement Documents

Similar data was collected for the four other pilot schemes.

Figure A2. Location of monitoring sites



Data quality

Sites 6 and 9 are excluded from the analysis, as no 85th percentile data is available for 2016. Site 7 is excluded due to missing 85th percentile data for 2016.

In a small minority of cases, the reported 85th percentile speed is less than the reported mean speed, which is not a logical outcome. Further investigation showed that this is because the overall site mean and 85th percentile speed is calculated as the average of the mean and 85th percentile speeds for each 15 or 60 minute periods, weighted by flow. Mean speeds are reported for all 15 or 60 minute periods where at least one vehicle is detected, but 85th percentile data is only reported if the 15 or 60 minute flow exceeds 10 vehicles. As a result, the average 85th percentile speed for the site was based on data for part of the day only, and was not directly comparable with the average mean speed for the site (based on data for the whole day).

In most cases, the missing data occurs in the early morning / late evening when there is little flow, but for the rest of the day the flow is much higher and both mean speeds and 85th percentile speeds are reported. In these circumstances the reported average 85th percentile is expected to be close to the true 85th percentile speed (based on all vehicles).

However, where the flow is relatively low throughout the day, the number of 15 or 60 minute periods with missing data can be much higher, and the reported average 85th percentile may be substantially different to the true mean. In some cases, the reported 85th percentile can actually be less than mean speed, due to substantially differences in the time periods contributing to the mean and 85th percentile calculations.

This issue is more common where the raw data is presented for 15 minute, rather than 60 minute, time periods, as the number of vehicles recorded per time period is more likely to be less than 10.

Table A1. Example raw data file showing different time periods used to calculate average mean and 85th percentile speeds for the whole site

Time Period	Vehicles	Average Speed	85th %ile Speed
Etc.			-
13:45	4	16.3	-
14:00	2	19.6	-
14:15	3	19.0	-

14:30	2	16.9	-
14:45	4	16.3	-
15:00	5	15.2	-
15:15	10	13.0	15.6
15:30	13	12.9	13.3
15:45	5	15.5	17.9
16:00	4	18.8	-
16:15	6	15.1	18.4
16:30	6	14.2	13.9
16:45	5	18.9	-
17:00	4	17.8	-
17:15	5	16.6	-
17:30	3	17.0	-
17:45	4	17.2	15.9
18:00	3	18.4	-
18:15	4	18.2	-
18:30	4	19.5	17.4
18:45	3	17.9	-
19:00	3	18.0	-
Etc			
Total	**279.0**	**16.6**	**15.9**

A.3. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	3
	20-24mph	3
	>24mph	4
	>30mph	3
Number of sites on:	Major strategic road	0
	Important local road	3
	Minor local road	7
Before mode share	Motorcycles	2%
	Cars	87%
	LGVs	9%
	Buses	0%
	HGVs	2%
Before sample size	-	121,012 vehicles

The majority of sites are located on ‘minor local roads’, with low flow (7-day average flow varied from 202 to 1345 vehicles in the before period) and a mean before speed typically below 24mph. These are generally internal estate roads, likely to be used mainly by local residents to drive to and from their houses.

However, three of the sites (Sites 2, 3 and 12) are located on Barns Lane / Westgate, an ‘important local road’ through the estate, which provides access to the industrial sites to the east. The flow on these roads is much higher (7 day average flow varied from 3745 to 4550 vehicles in the before period), and many vehicles exceeded the 30 speed limit (38 to 74% across the three sites).

The majority of vehicles (in the before period) were cars (87%). However, there were a notable number of LGVs (9%) and HGVs (2%); mainly on Barns Lane / Westgate.

All sites are located on 20mph roads, and none had pre-existing traffic calming in place.

A.4. Results[45]

A.4.1. Headline results

Context:

- Speeds were high in the before survey, with a mean speed of 29.3mph, and 49% of vehicles monitored were exceeding the 30mph limit. The overall results are skewed by the number of fast vehicles on Barns Lane / Westgate, the main route through the estate carrying around 4,000 vehicles a day.
- The majority of vehicles were cars, but 9% in the before surveys were LGVs – reflecting the proximity of the area to an industrial estate. The mode share was broadly the same in the after surveys.
- The sample of vehicles monitored increased from 17,287 in the before period, to 18,590 in the after period, suggesting an 8% difference in flow (1303 vehicles) between the two survey periods.

Overall speed outcomes:

- Overall, speeds have declined across the 10 sites used in this analysis (Figure A3).
- Across all vehicles monitored, the mean speed changed by just +0.1mph, 2.5 years post implementation. The percentage driving at <=20mph remained the same at 14%, representing very poor compliance.
- However, there was more change amongst the fastest drivers, with the 85th percentile speed falling by -1.4mph, and the proportion exceeding 30mph falling from 49% to 42%.
- However, there was substantial variation across the different sites, as indicated by the results in the following sections. In particular, mean speed on Barns Lane / Westgate fell by only -0.2 to -0.9mph, and remained above 30mph post implementation.

[45] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1g. Walsall\Task 3.6 Spot Speed Analysis\Walsall SPEED DATA ANALYSISv1.0.xls

Figure A3. Cumulative speed distribution, across all vehicles monitored

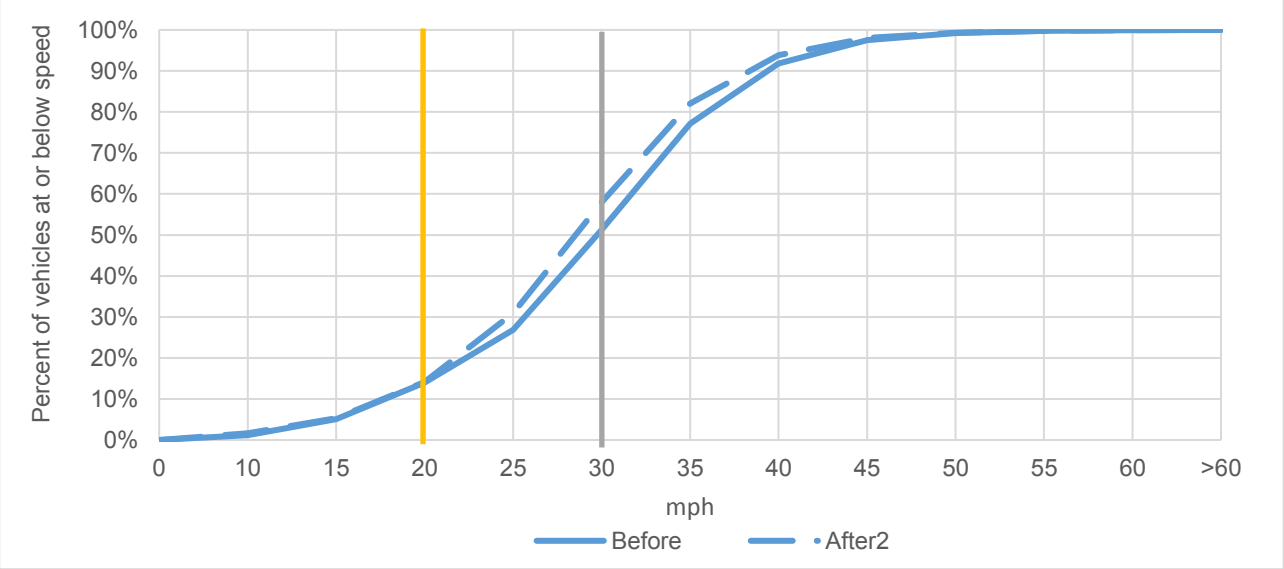


Table A2. Overall change, across monitored sites

7 day, 24hr average	Before (6 months pre impl.)	After2 (18-30 months post impl.)	Diff2
Speed limit	30mph	20mph	-
Flow	17287	18590	1303 (+8%)
Average Mean speed (mph)	29.3	29.5	+0.1 (+0%)
Average 85th percentile speed (mph)	35.1	33.7	-1.4 (-4%)
% <=20mph	14%	14%	0%
% >24mph	76%	72%	-3%
% >30mph	*49%*	*42%*	*-7%*

The above metrics are all flow weighted.

Table A3. Mode share, across monitored sites

7 day, 24hr average	Before (6 months pre impl.)	After2 (18-30 months post impl.)	Diff2
Speed limit	30mph	20mph	-
Flow	17287	18590	1303 (+8%)
Motorcycles	2%	2%	0%
Cars	87%	89%	+2%
LGVs	9%	8%	-1%
Buses	0%	1%	0%
HGVs	2%	1%	-1%
Total	100%	100%	0%

A.4.2. By road type

In general:

- Road type / function appears to be a more important determinant of speed than whether the road is signed 20mph or 30mph. Speeds on 'important local roads' are faster than those on 'minor local roads' in both the before and after scenarios, and the difference between road types is much greater than the before and after difference.
- Speeds have changed (declined) more on 'important local roads' than on minor local roads', as indicated by the size of the before and after gap in Figure A4.
- On 'important local roads', the biggest reduction occurs amongst those travelling >30mph (-10%).
- On 'minor local roads', there is very little difference between the before and after speeds, **although speeds were actually slightly faster in the after period**.

Figure A4. Cumulative speed distribution, by road type

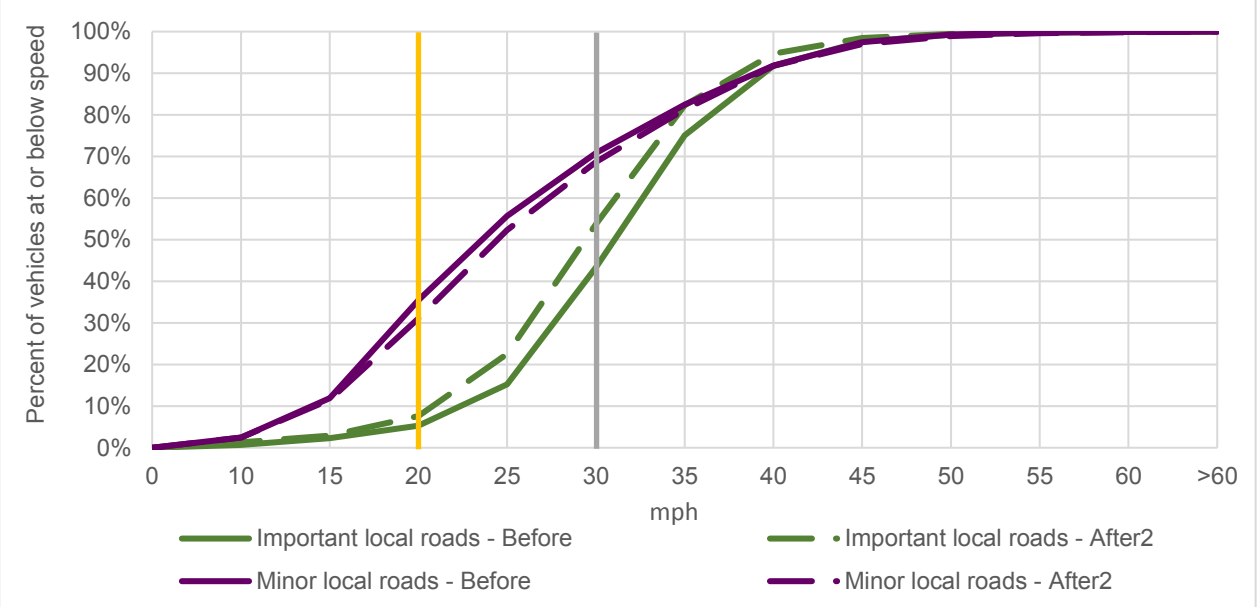


Table A4. Overall change, by road type

7 day, 24hr average	Important local roads			Minor local roads		
	Before, After2, Difference			Before, After2, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Flow	12322	13374	1052	4955	5215	260
% <=20mph	5%	8%	+2%	35%	31%	-4%
% >24mph	87%	80%	-6%	48%	52%	+4%
% >30mph	57%	46%	-10%	29%	31%	+2%

The above metrics are all flow weighted.

A.4.3. By before mean speed

In general:

- The 20mph limit has had a bigger impact on roads with higher pre-scheme speeds, although even on the fastest roads the speed reduction is still small.

Figure A5. Cumulative speed distribution, by mean before speed

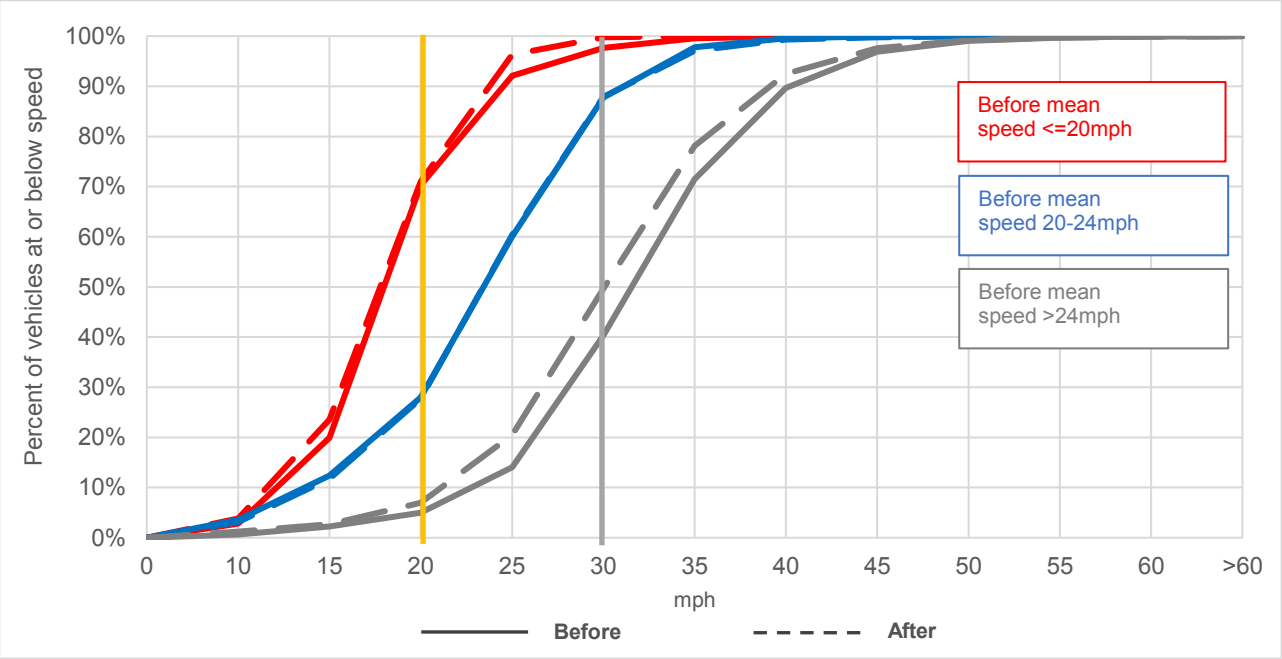


Table A5. Overall change, by mean before speed

7 day, 24hr average	Mean before speed <=20mph			Mean before speed 20-24mph			Mean before speed >24mph		
	Before, After, Difference			Before, After, Difference			Before, After, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-	30mph	20mph	-
Flow	1702	1377	-325	1910	2224	314	13665	14990	1325
% <=20mph	70%	71%	1%	28%	28%	0%	5%	7%	2%
% >24mph	12%	9%	-3%	46%	46%	0%	88%	82%	-6%
% >30mph	2%	0%	-2%	12%	12%	0%	60%	50%	-9%

The above metrics are all flow weighted.

A.4.4. Comparison with TomTom results

Speeds recorded in spot speed surveys are typically higher than those recorded by TomTom devices. However:

- the shape of the profile curves are similar; and
- the gap between the before and after curves (representing the scale of change) is also similar.

The specific shape of the spot speed curve will be influenced by the specific characteristics of the sample of monitoring sites. In contrast the TomTom curve captures speeds in all 20mph roads in the scheme area.

Figure A6. Cumulative speed distribution – spot speed vs TomTom data

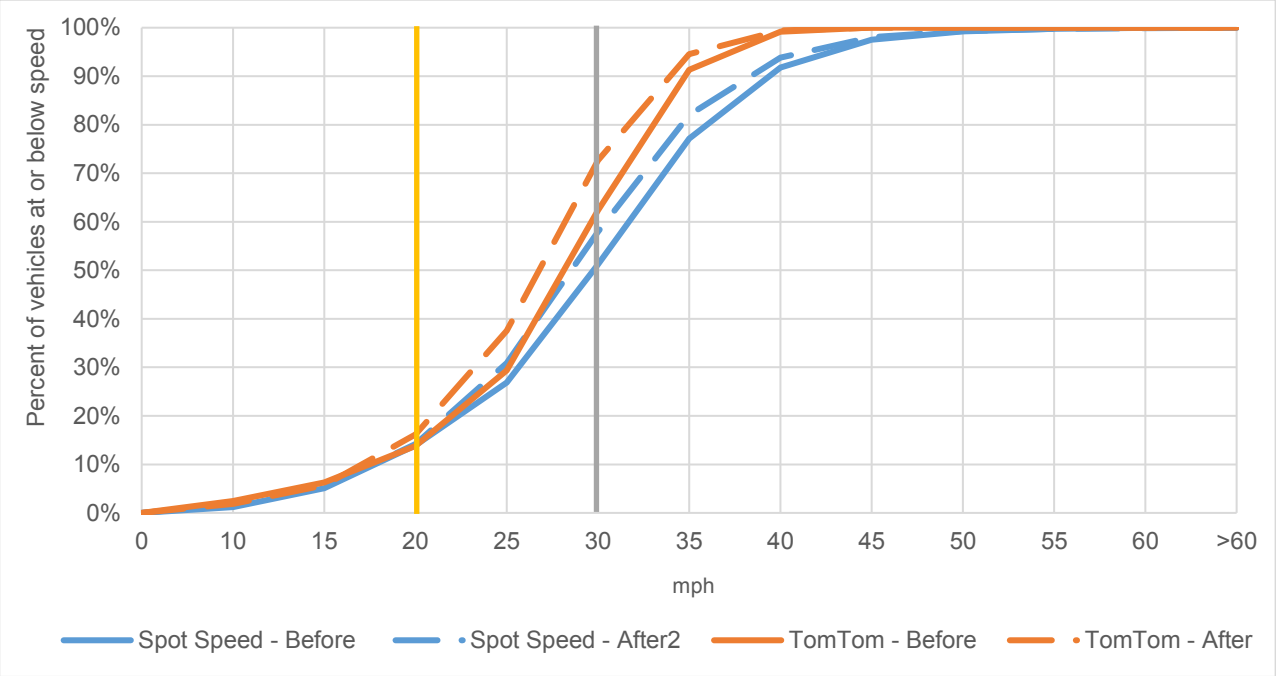


Table A6. Overall change – spot speed vs TomTom data

	Spot Speed Data			TomTom Data		
	Before, After2, Difference			Before, After, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Sample	121012 vehicles	130129 vehicles	+7%	6267 veh-kms	6755 veh-kms	+8%
% <=20mph	14%	14%	0%	14%	16%	+2%
% >24mph	76%	72%	-3%	74%	38%	-7%
% >30mph	49%	42%	-7%	38%	27%	-10%

The above metrics are all flow weighted.

A.5. Site specific analysis[46]

Overall - Across the 10 sites, the change in mean speed varied from +1.6mph to -3.1mph. Six of the 10 sites recorded a reduction.

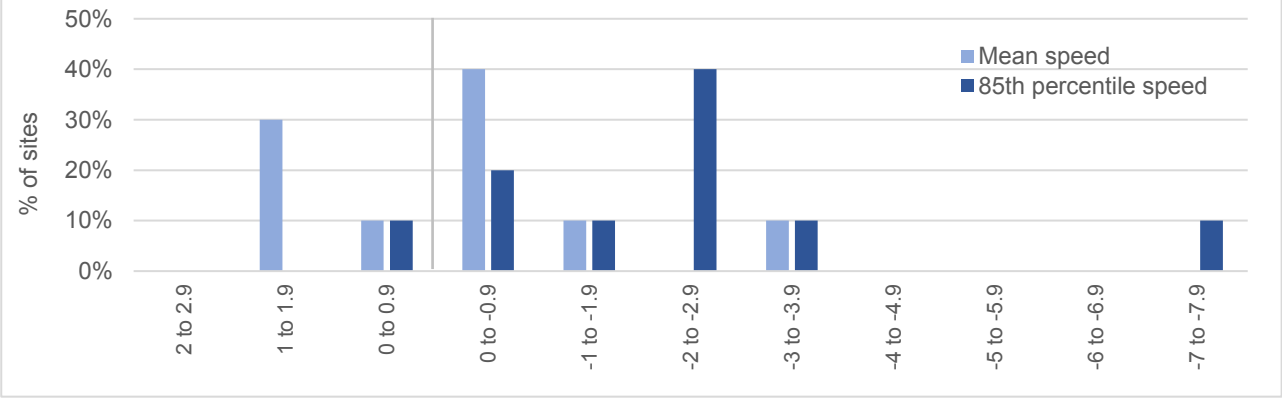
The change in 85th percentile speeds varied from +0.9mph to -7.1mph. Nine of the 10 sites recorded a reduction.

Table A7. Site specific analysis - overview

Description	Mean speed results	85th percentile speed results
Biggest increase / decrease	+1.6 mph (increase) -3.1 mph (decrease)	+0.9 mph (increase) -7.1 mph (decrease)
No. of sites reporting a reduction	6 out of 10 sites (60%)	6 out of 10 sites (60%)
No. of sites with: - mean speed <=24mph - 85th percentile speed <=30mph	Before = 6, After = 6	Before = 2, After = 4

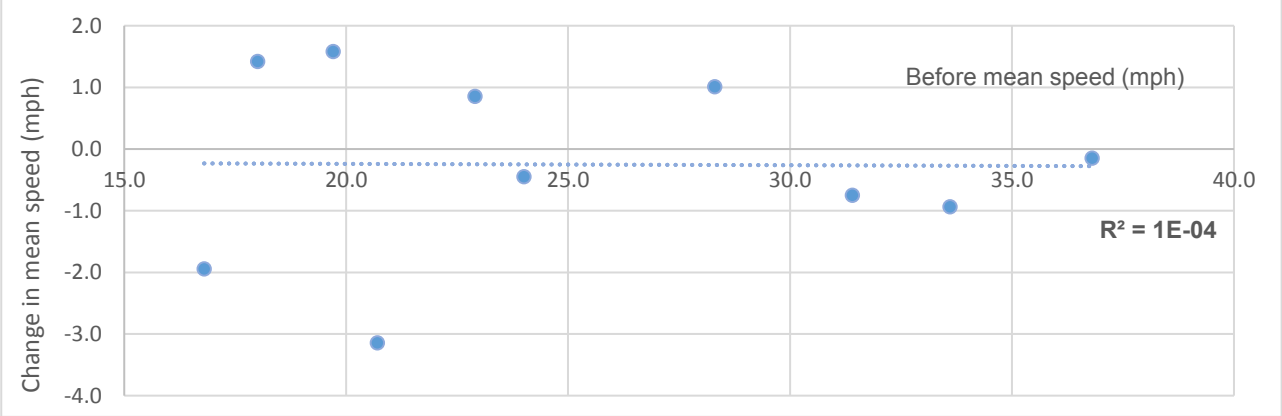
The most common change in mean speed was a reduction of 0 to -0.9mph; and -2 to -2.9mph for change in 85th percentile speed.

Figure A7. Change in average mean and 85th percentile speeds - % of sites in each change band



Change by before mean speed – Comparison of 'change in average mean speed, against 'before mean speed' shows no significant relationship.

Figure A.8. Change in mean speed by before speed



[46] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1g. Walsall\Task 3.6 Spot Speed Analysis\Walsall SPEED DATA ANALYSISv1.0.xls

A.6. Impact of Vehicle Activated Signs and enforcement activity on speeds

In November / December 2015, Vehicle Activated Speed Signs (VASS) were used to monitor speeds in each of the 20mph pilot areas, as part of a Restorative Justice Enforcement Programme.

In Rushall, VASS were located on Barns Lane / Westgate for a two week period (2-15 Nov). Monitoring undertaken 4 months post implementation showed that speeds on this road were still substantially above 20mph.

During the first week, the VASS units were used to monitor speeds 18 months after implementation; but during the second week, the Police were also out on site, using Prolaser hand-held devices to capture speeding drivers. Low level offenders were invited to attend a 'Speed in the Community Course', while higher level offenders were prosecuted. Four courses were run in February and March 2016, attended by 65 motorists across four pilot areas. The threshold for low and high level offenders was kept confidential by the Police.

The VASS was located on Barns Lane, near Rischale Way, and monitored speeds in the northbound direction only. The nearest ATC comparable to this is Barns Lane (near Linley Road) which is the staggered junction opposite Rischale Way.

Prior to implementation of the 20mph limit, the mean speed on Barns Lane (northbound, near Linley Road) was 31.4mph (Sep 2013). Surveys undertaken 4 months post implementation (July 2014), using pneumatic loops, showed a reduction of -2.2mph on the northbound carriageway at this site. Further surveys were undertaken 30 months post implementation (Sep 2016). These showed that speeds had risen again, and the reduction compared with the before survey was now only -1.2mph.

The mean speed monitored by the VASS in 2015 was 24.4mph, a reduction of 7.0mph when compared with the before data for Barns Road (near Linley Road), which estimated the mean speed as 31.4mph. The results suggest that VASS units and police enforcement achieved an additional reduction in mean speed of at least 5mph, on top of the change associated with the 20mph limit signs only (estimated as -2.2mph). However, there is no evidence to suggest that the additional enforcement had a lasting affect, with speeds increasing again the following year (the mean speed near Linley Road was estimated as 30.2mph in Sep 2016).

VASS data has been provided for the second of the two weeks only, when the Police were out on site. It has not been possible to compare speeds for the first and second weeks, with and without Police presence.

A.7. Lessons, barriers and enablers

Measuring change in attitudes and behaviour – Monitoring change in speeds and flow is relatively straight-forward, as there are well established methodologies in place. However, measuring changes in attitudes and behaviours is more challenging, requiring specialist expertise not readily available within the authority. Advice and guidance on this area of monitoring would be useful.

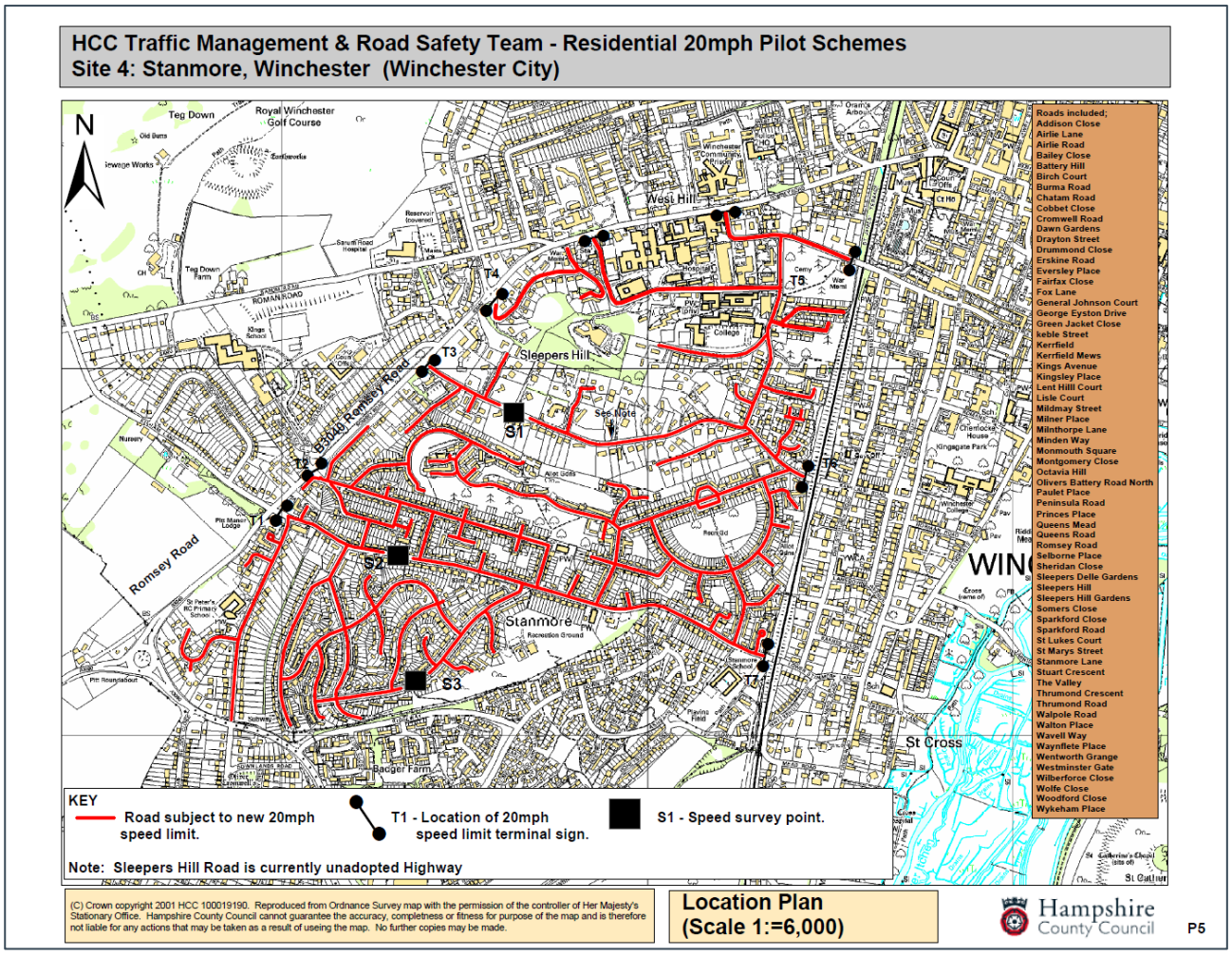
Appendix B. Winchester - Stanmore (R-SM2)

B.1. Scheme description (Predominantly residential and schools)

Stanmore is one of a number of 20mph pilot schemes being implemented across the County. It was **implemented in July 2014**, and is the largest of the pilot schemes.

The 20mph limit covers all roads within the scheme boundary (except for a short section of 10mph limit outside the hospital). All roads are unclassified. The limit operates 24 hours a day, 7 days a week.

Figure B1. Stanmore 20mph scheme



Speed limits and presence of pre-existing traffic calming measures in study area

All roads in the area had a 30mph limit prior to the introduction of the 20mph scheme (except for a short section of 10mph limit outside the hospital). However, there was substantial traffic calming in place (speed humps, chicanes) on three sections of road: Stanmore Lane, The Valley, and Airlie/Sparkford/Erskine Rd.

However, the majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (92%). No additional traffic calming measures were installed as part of this scheme.

Signing approach (Moderate frequency and visibility of signing)

The entrances to the scheme area are clearly marked with post-mounted 20 mph signs and '20' roundels on the carriageway. The interior of the area contains no (or few) post-mounted repeater signs but there are frequent '20' roundels marked on the carriageway.

Area characteristics

The area is located approximately 1km to the south of the City Centre. It is a self-contained area bound by the railway line to the east, and Romsey Road to the West. It comprises predominantly residential streets, but also includes the University of Winchester and the Royal Hampshire County Hospital, and a primary school in the south-west corner. Population within scheme area is estimated at a couple of thousand.

The area is one of the less affluent parts of the City and includes some Council-owned housing. There are a large number of students living in the area.

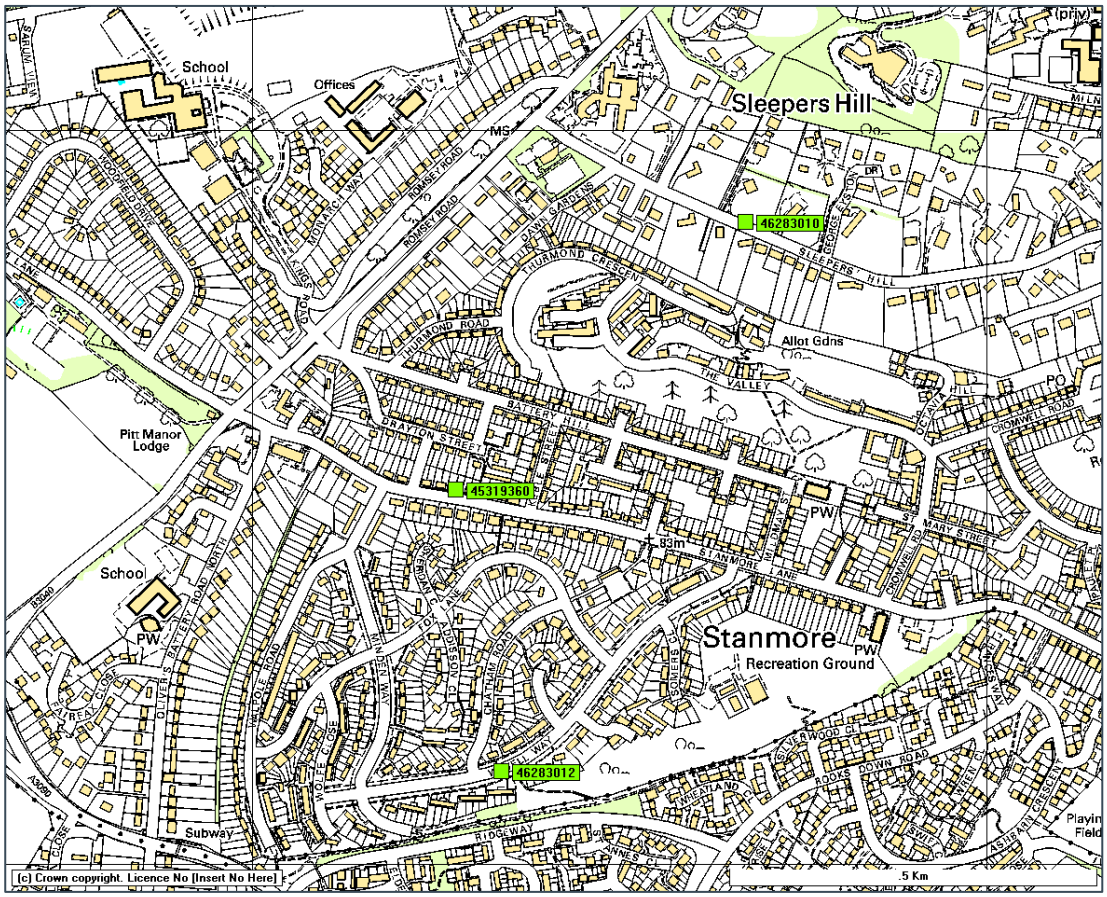
See 20mph Case Study Descriptions Report for more information.

B.2. Monitoring approach

Speed and flow data has been collected at 3 representative sites across the scheme area.

Summary of monitoring approach in Stanmore (Winchester) – Scheme impl. July 2014	
Number of monitoring sites	3
Location of sites	Representative locations across scheme area
Before and after timescales	Before = 15+ months pre-impl: - Stanmore Lane (Aug 2009) - Wavell Way (March 2013) - Sleepers Hill (March 2013) After 2 = 17 - 21 months post: - Stanmore Lane (March 2016) - Wavell Way (March 2016) - Sleepers Hill (Nov 2015)
Data source	Speed detection radar
Duration	Before and after data collected over a 7 day period.
Data available	Total vehicles, mean and 85th percentile speed, and speed bins by hour of day. Traffic flow data also collected, allowing the speed data to be weighted. Raw data has been provided in spreadsheet format, for each of the 9 sites. The data output is disaggregated by site, day, hour period, and direction. Also summarised for AM and PM Peak periods. No mode split data provided. No monitoring report provided.
Quality of evidence available for this study	**Moderate** The before and after data was collected in different months, which means that the data is not directly comparable for all sites. Radar less visible than tubes – less likely to influence driving speeds.
File location for data	Before data taken from: P:\GBBMA\HandT\CS\projects\5133131-Provision of 20mph Research\40 Technical\Case Studies\1c. Winchester\1. Information Recieved\Data from HCC and WCC\Data from HCC\Stanmore_Before_and_After_Comparison.xlsx

Figure B2. Location of monitoring sites



Data quality

See above.

B.3. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	0
	20-24mph	1
	>24mph	2
	>30mph	*0*
Number of sites on:	Major strategic road	0
	Important local road	1
	Minor local road	2
Before sample size		25,102 vehicles

B.4. Results[47]

B.4.1. Headline results

Context:

- Speeds across the three sites were moderate to high in the before period, and the 85th percentile speed was just over 30mph.
- The sample of vehicles monitored increased from 3668 to 4476 vehicles, suggesting a 22% increase in sample size between the two survey periods.
- The before flow at individual sites varied from 174 (Wavell Way) to 1625 (Stanmore Lane). The flow weighted average for Siddal is therefore, heavily influenced by the speeds on Stanmore Lane.

Overall speed outcomes:

- Overall, speeds across the 3 sites showed very little change, at an aggregate level.

Table B1. Overall change, across monitored sites (unweighted) – Phase 1 (Siddal)

7 day, 24hr average	Before (15+ months pre impl.)	After2 (17-21 months post impl.)	Diff2
Speed Limit	30mph	20mph	-
Flow	3668	4476	+808 (22%)
Average Mean speed (mph)	25.9	25.8	-0.1 (-1%)
Average 85th Percentile speed (mph)	31.8	31.8	0.0 (0%)
%<=20mph	19%	20%	+1%
%>24mph	58%	56%	-2%
%>30mph	18%	17%	0%

The above metrics are flow weighted.

B.5. Site specific analysis[48]

Overall – Across the 3 sites (6 directions):

- The change in mean speed varied from -1.8mph to +2.5mph; and the change in 85th speed varied from -2.2mph to +3.5mph.
- Three of the 6 direction-based sites (50%) recorded a reduction in mean speed.
- Both sites on Wavell Way recorded in increase in speed.

[47] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1h. Calderdale\Calderdale SPEED DATA ANALYSISv1.0.xls

[48] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1c. Winchester\Task 3.6 Spot Speed Analysis\ Winchester Stanmore SPEED DATA ANALYSISv1.1.xls

Table B2. Overall change – site specific summary

7 day, 24hr average	Before Flow	Mean Speed			85th Percentile Speed		
		Before, After2, Diff2			Before, After2, Diff2		
Speed Limit	30mph	30mph	20mph	-	30mph	20mph	-
Stanmore Lane – EB (Important local road)	850	26.2	26.1	-0.1	31.9	31.9	0.0
Stanmore Lane – WB (Important local road)	1186	26.7	24.9	-1.8	32.7	30.5	-2.2
Wavell Way – WB (Minor local road)	174	23.6	24.2	0.6	28.9	29.9	1.0
Wavell Way – EB (Minor local road)	355	20.5	23.0	2.5	25.4	29.0	3.6
Sleepers Hill – EB (Minor local road)	612	26.8	26.6	-0.2	32.3	32.8	0.5
Sleepers Hill – WB (Minor local road)	491	27.4	28.5	1.1	34.2	35.5	1.3

Appendix C. Liverpool (R-AW1a and 1b)

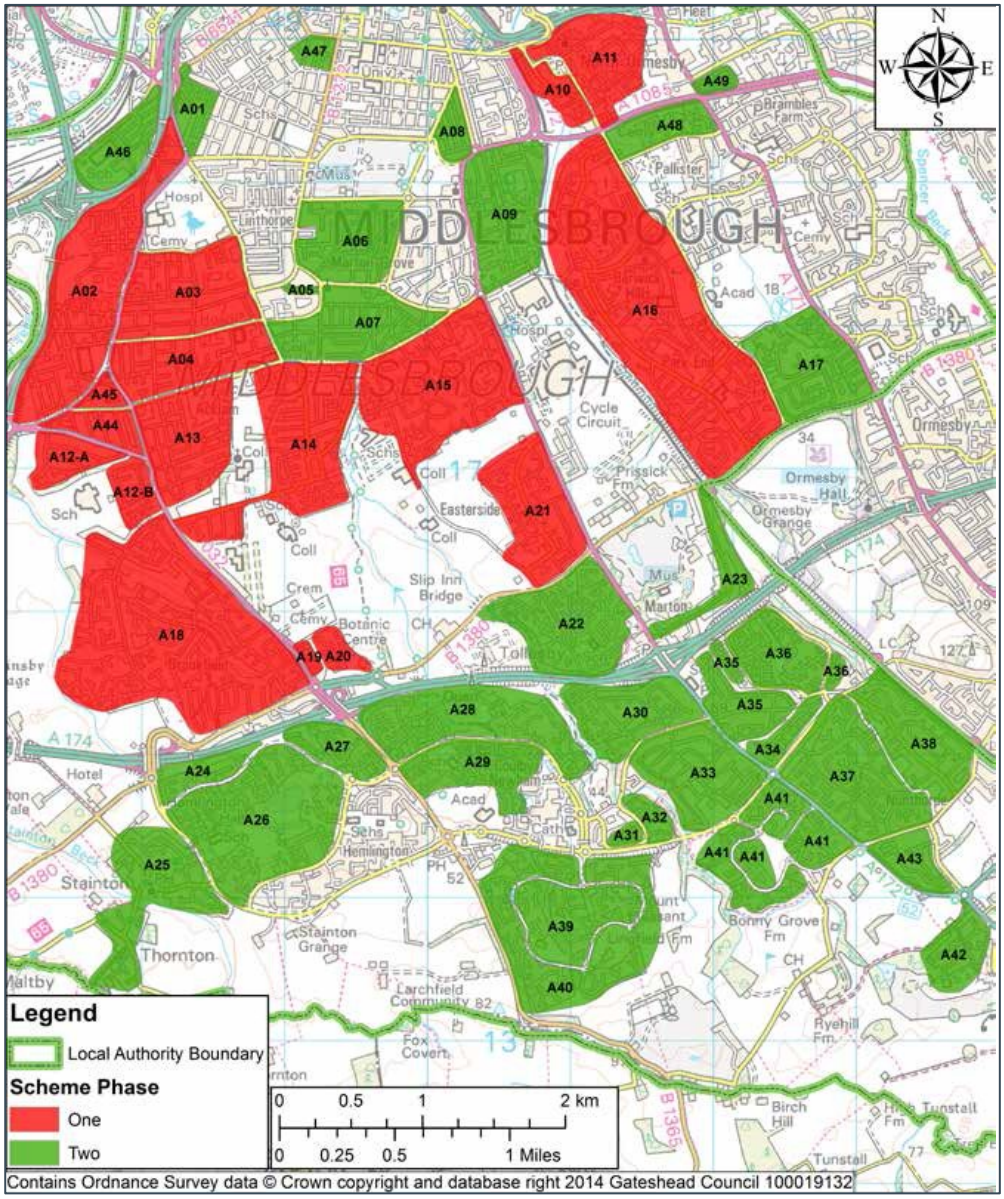
No monitoring data provided.

Appendix D. Middlesbrough (R-AW2)

D.1. Scheme description (Predominantly residential and schools)

The Council has established 20mph speed limits on 44% of the total road network in the town, mainly focused on residential areas, over two phases (comprising 49 discrete areas) between March 2012 and June 2013. Phase one of the implementation of these schemes ran from **March to June 2012**, while phase two was implemented a year later between **March and June 2013**.

Figure D1. Location of 20mph Speed Limit areas in Middlesbrough



The above areas comprise residential streets:

- with on-street frontage that do not serve a strategic function i.e. do not have the primary function of aiding movement between neighbouring districts;
- were previously subject to a 30mph speed limit;
- had an average 'before' traffic speed of 24mph or less (although some roads with higher speeds were included where they were part of a cluster of compliant streets, in or to avoid inconsistencies in signing).

All main roads were excluded from the speed limits to limit disruption. In addition, streets fronted by non-residential uses, residential streets with no direct frontage, wide roads that encourage high speeds, and streets with speeding problems were excluded.

The scheme operates on all days across all hours. Outside the main scheme, 20mph flashing lights operate during school hours only outside three schools which are located on roads which are still 30mph. Other schools in the borough are located within the core 20 mph speed limit areas.

Speed limits and presence of pre-existing traffic calming measures in study area

A number of roads within the scheme were covered by existing 20mph Zones or had pre-existing traffic calming measures in place, mainly in older residential areas around the town centre.

However, the majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (82%).

No additional traffic calming measures have been installed as part of this scheme.

Signing approach (Low to moderate frequency and visibility of signing)

Post-mounted 20 mph signs have been located at every entrance to the area, along with '20' roundels on the carriageway. There are occasional smaller lamppost-mounted repeater signs within the limit area, but no '20' roundels on the carriageway.

Area characteristics

The area covered by the limit is primarily residential.

- Southern area (Phase 2, south of A174) - The area to the south comprises newer properties in self-contained estates comprising a large number of crescents and cul-de-sacs, with predominantly off-street parking, gardens, and wide roads. Most of this area is categorised as 'affluent' or 'moderately affluent' (categories 4 and 5), but contains a pocket of deprivation in the south-west corner. The proportion of the population under 16 varies from 11-23%.

- Central area (mainly Phase 1) - The central section across the Borough comprises mixed housing. Levels of deprivation vary from 'deprived', through to 'affluent'. The proportion of the population under 16 varies from 12-24%.

- Northern area (Phase 1 and 2) - The area to the north (closest to the city centre) is predominantly semi-detached/terraced housing with small front gardens. Generally narrow streets with some or limited green spaces; but some wider roads in the east. A mix of on and off-street parking. These areas are categorised as 'deprived' or 'moderately affluent'. The proportion of the population aged under 16 varies from 20-23%.

See 20mph Case Study Descriptions Report for more information.

D.2. Monitoring approach

Middlesbrough Council undertook monitoring surveys at 16 sites in the Phase 1 area and 10 sites in the Phase 2 area. Before data was collected up to 4 years before implementation. After data was collected 9-12 months post implementation for Phase 1, but was generally undertaken within 3 months of implementation for Phase 2.

In addition, 'after only' data was collected at a further 16 locations in the Phase 1 area, and 13 locations in the Phase 2 area, where speeding was identified as a problem post implementation.

The scheme attracted a lot of public and media interest, and the data was collected to provide evidence for any issues arising following scheme delivery.

Summary of monitoring approach in Middlesbrough – Scheme impl. 2012 and 2013	
Number of monitoring sites	Phase 1 = 15 sites; Phase 2 = 10 sites
Location of sites	The sites chosen were generally located on the more important routes throughout the 20mph areas.
Before and after timescales	Phase 1 Before = up to 4 years pre-impl (Aug 2008 – Feb 2012). Three sites surveyed in 2008, three sites in 2009, seven sites in 2010, and two sites in 2012. Phase 1 After = generally 9-12 months post-impl (Mar – Jun 2013), with two sites monitored 4 months post-impl (Oct 12) Phase 2 Before = 2.5 - 3.5 years before impl (Oct 2009 – Jan 2011). One site surveyed in 2009, seven sites in 2010, one site in 2011, and one site in 2012. Phase 2 After = generally within 3 months of impl (Jul 2013), with two sites monitored in early 2014.
Data source	Early (before) monitoring was completed using tubes on the carriageway; however, the after monitoring was largely undertaken using radar devices.
Duration	Radar surveys were typically undertaken for 14-21 days, 24 hrs/day. It is unclear how long the tubes were in place.
Data available	Mean speed data provided only. The Council has raw data, including 85th percentile speeds, speed bins and flow. However, this is stored in the Council's internet system, and could not be easily made available for further analysis.
Quality of evidence available for this study	**Limited** Only mean speed and 85th percentile speed data provided. No flow data, speed bin data made available. Before data collected using tubes, after data collected using radar. Tubes more visible than radar, and may influence driving speeds. Note - The sites chosen were generally located on the more important routes through the 20mph areas.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1d. Middlesbrough\Task 3.1d Follow-up Info 2016\Write Up\ Middlesbrough_ Follow-up Information_v1.0.doc

Data quality

See above. Raw data files not provided, so not possible to check the robustness of data for individual sites.

D.3. Site characteristics

Characteristics			
Number of sites with mean before speed:		**Phase 1**	**Phase 2**
	<=20mph	0	0
	20-24mph	3	2
	>24mph	12	8
	>30mph	*2*	*2*
Number of sites on:	Major strategic road	0	0
	Important local road	5	2
	Minor local road	10	8
Before sample size		Not available	Not available

The majority of monitoring sites were located on minor local roads, and had a mean speed >24mph before the scheme was implemented. **All sites are located on 20mph roads, but some sites may have had pre-existing traffic calming in place.**

D.4. Results[49]

D.4.1. Headline results

Context:

- Speeds were high in the before period, averaging 26.5mph in the Phase 1 area and 27.4mph in the Phase 2 area. ***No flow data has been provided so these results are not flow weighted.***

Overall speed outcomes:

- Overall, speeds have declined across the both the Phase 1 area (-1.9mph) and Phase 2 area (-2.8mph), based on data for the 25 sites used in this analysis.
- No other data has been provided by the Council.

Table D1. Overall change, across monitored sites (unweighted)

7 day, 24hr average	Before (up to 4 years pre impl.)	After1 (3-12 months post impl.)	Diff1
Speed Limit	30mph	20mph	-
Phase 1 Average Mean speed (mph)	26.5	24.6	-1.9 (-7%)
Phase 2 Average Mean speed (mph)	27.4	24.6	-2.8 (-10%)
Phase 1 & 2 Average Mean speed (mph)	26.8	24.6	-2.3 (-8%)

The above metrics are not flow weighted.

[49] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1d. Middlesbrough\Task 3.6 Spot Speed Analysis\Middlesbrough SPEED DATA ANALYSISv1.0.xls

D.5. Site specific analysis[50]

Overall change - Across the 25 Phase 1 and Phase 2 monitoring sites, the change in mean speed varies from +0.3mph (increase) to -5.9mph (decrease). Overall, 23 of the 25 sites (92%) recorded a reduction in average speed.

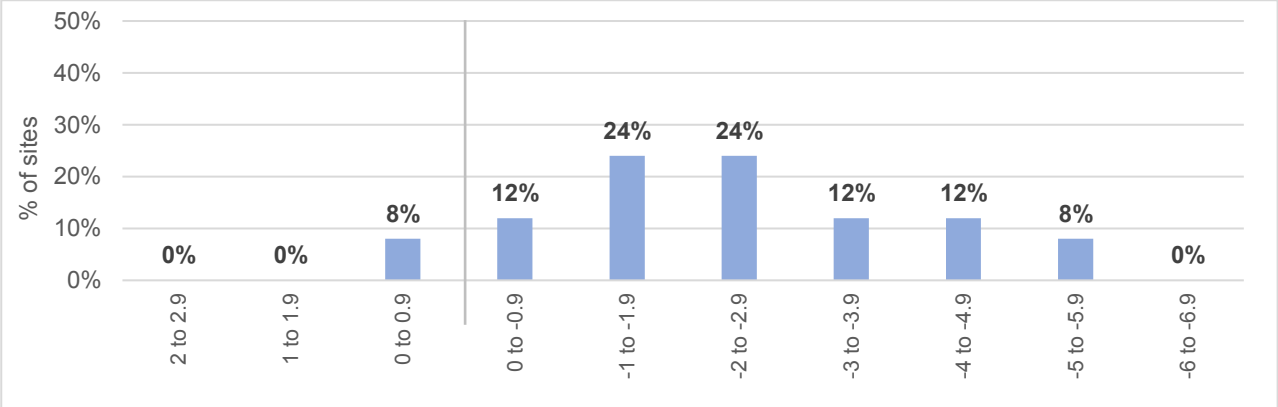
The number of sites with a mean speed of <=24mph increased from 5 sites before, to 10 sites after. However, at the majority of sites, the majority of drivers were still driving at higher speeds.

Table D2. Site specific analysis – overview

Description	Mean speed results	85th percentile speed results
Biggest increase / decrease	+0.3 mph (increase) -5.9 mph (decrease)	N/A
No. of sites reporting a reduction	23 out of 25 sites (92%)	N/A
No. of sites with: - mean speed <=24mph - 85th percentile speed <=30mph	Before = 5, After = 10	N/A

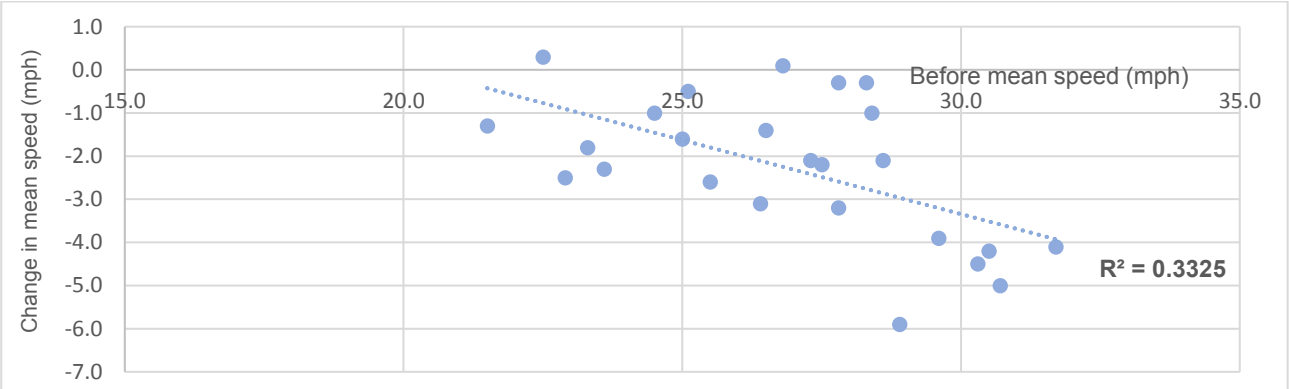
Around half of sites (48%) recorded a reduction of between -1.0 and -2.9mph.

Figure D1. Change in average mean - % of sites in each change band



Change by before mean speed - Comparison of 'change in mean speed' against 'before mean speed' shows a downward trend.

Figure D2. Change in mean speed by before speed



[50] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1d. Middlesbrough\Task 3.6 Spot Speed Analysis\Middlesbrough SPEED DATA ANALYSISv1.0.xls

Those sites with a before mean speed close to 30mph, typically show the largest reduction in mean speed. The four sites with a mean speed of more than 30mph prior to the introduction of the 20mph limit, all report a reduction in mean speed of 4 to 5mph.

D.6. On-going monitoring to address reports of speeding from the public

The Council also undertook additional monitoring at sites where complaints about speeding were received from the Council; and at sites identified by the Council as having a mean speed >25mph.

In locations where speeding problems were identified, additional signs and markings (e.g. roundels) were implemented, and further monitoring was undertaken. In cases where the additional signs and markings did not bring down speeds sufficiently, the Council installed Vehicle Activated Speed Signs (VASS) for temporary periods to remind drivers of the speed limit.

The Council note that complaints about speeds by the public have reduced over time, and subsequently the level of monitoring required has reduced.

Results

Post implementation monitoring was undertaken at 16 sites in the Phase 1 area, between March and July 2013, one year post implementation; and at 12 sites in the Phase 2 area, between July 2013 and March 2014 (1 to 9 months post implementation).

Table D3. Mean speeds for the 28 sites identified by the public as having speeding problems

	Mean speed	
<=20 mph	6 sites	21%
20-24 mph	13 sites	46%
>24 mph	9 sites	32%
Total	28 sites	100%

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The results show that 32% of sites have a mean speed >24mph. In these locations, a substantial proportion are driving more than 24mph, and speeding is a problem.

However, some of the roads identified by the public were found to have much lower speeds, and in 21% of cases, the mean speed was found to be <=20mph. In these locations, the complaints are likely to have been in response to a small number of isolated incidents of excessive driving speeds, rather than a common problem.

D.7. Lessons, barriers and enablers

The level of monitoring required was greater than anticipated. The Council noted that they should have envisaged the levels of monitoring given the interest in the scheme at the consultation stage.

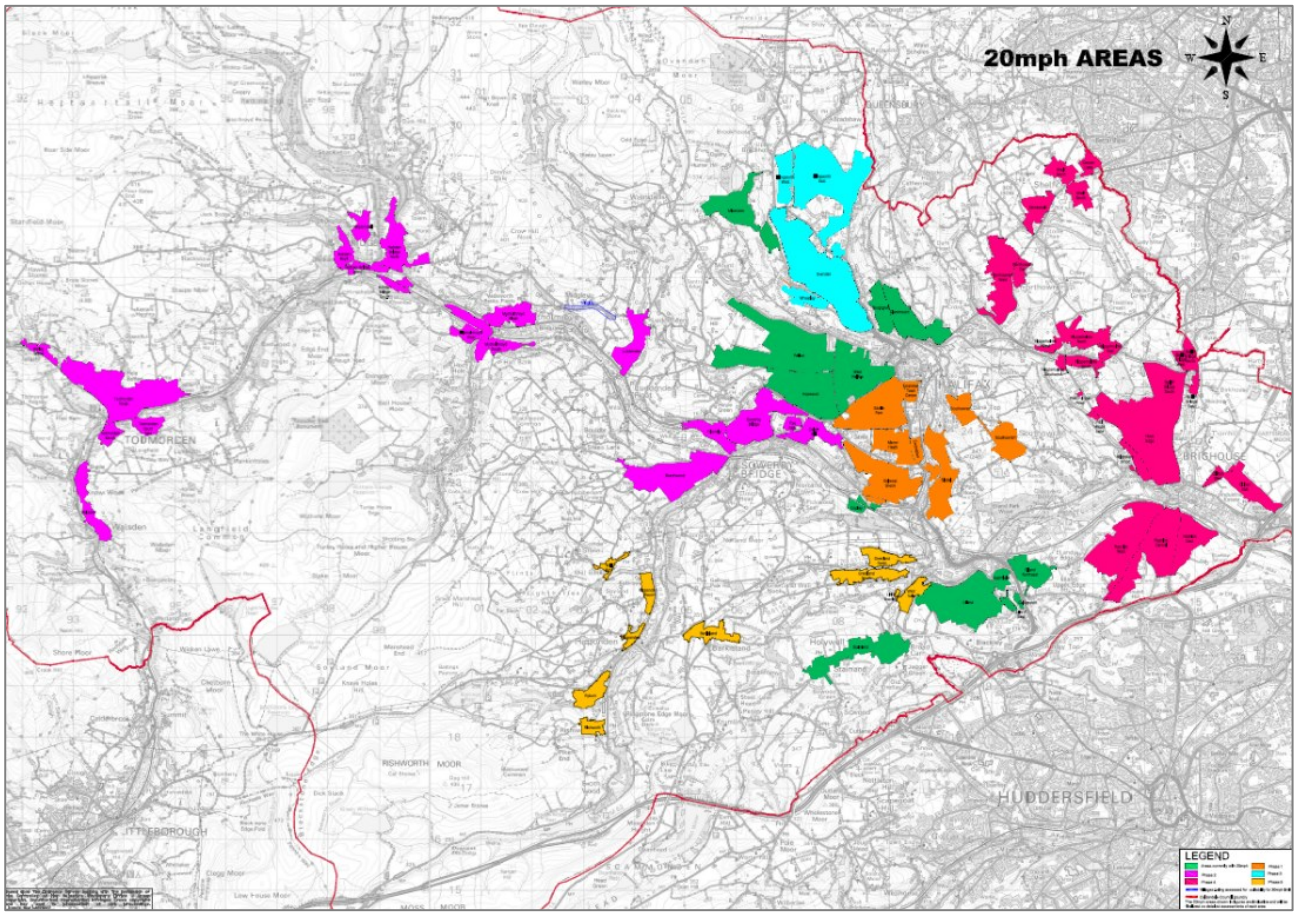
There is currently very little revenue available to allow continued monitoring of the scheme.

Appendix E. Calderdale (R-AW3)

E.1. Scheme description (Predominantly residential and schools)

The Council has introduced 20mph speeds limits across a wide area between 2015 and 2017.

Figure E1. Location of 20mph Speed Limit areas in Calderdale



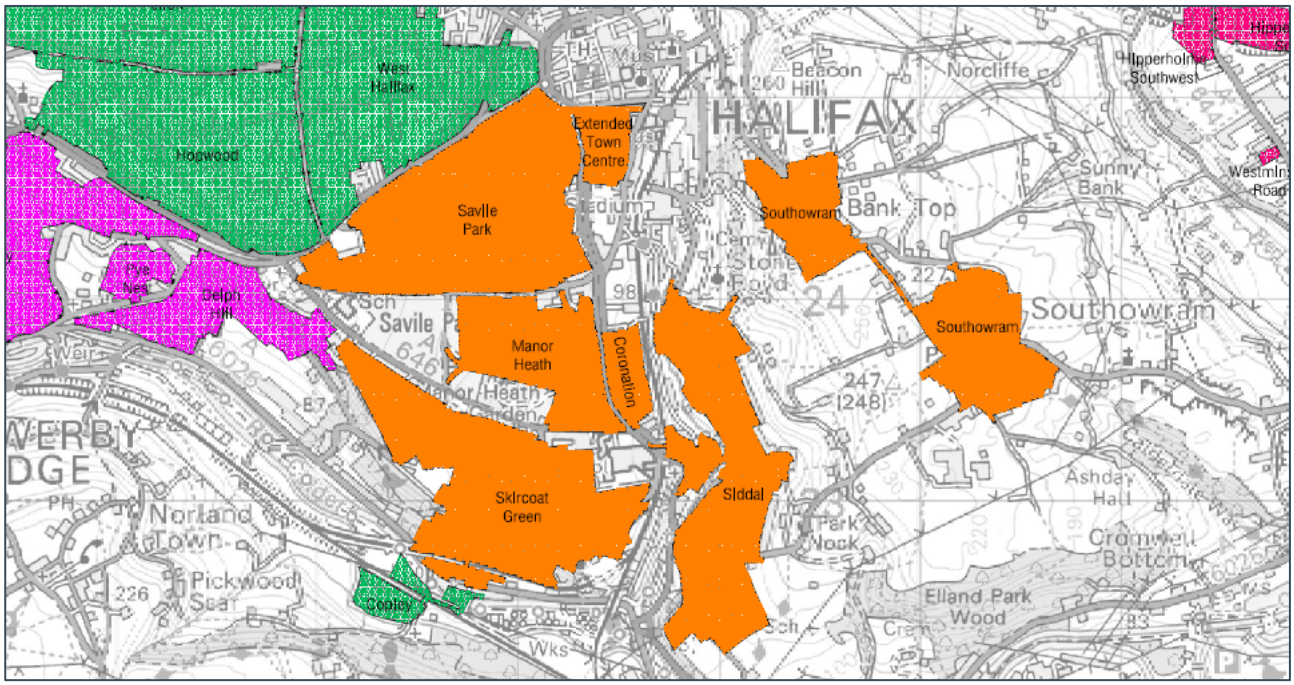
Source: http://www.calderdale.gov.uk/v2/sites/default/files/overview-20mph.pdf

All residential roads (approximately 510km) are included in the scheme. The scheme was phased in, with those area with higher numbers of casualties (killed and seriously injured) and near existing 20mph areas being delivered first.

Phase 1 (orange) focused on the areas to the south of Halifax, and form the focus for this case study. Siddal and Southowram were i**mplemented in June 2015**; followed by Skircoat Green, Saville Park, Manor Heath, Coronation and the Extended Town Centre in **July 2015**. The scheme took approximately 9 months to complete (October 2014 – June 2015). **Phase 1 forms the core case study area for this study, with the main focus on Siddal and Southowram.**

The scheme operates on all days across all hours.

Figure E2. Phase 1 areas (implemented June and July 2015)



Speed limits and presence of pre-existing traffic calming measures in study area

There are a small number of pre-existing 20mph Zones in the case study area; and a small number of roads also have pre-existing traffic calming in place, but previously had a 30mph limit

However, the majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (98%).

No additional traffic calming measures have been installed as part of this scheme.

Signing approach (Low to moderate frequency and visibility of signing)

Post-mounted 20 mph signs have been located at entrances to the area, with smaller lamppost-mounted repeater signs within the limit area. There are no '20' roundels on the carriageway.

Area characteristics

Siddall is part of the built up area of Halifax. It comprises a combination of older style terraced housing on narrow streets (some time cobbled), and newer areas, but generally with limited off-street parking.

Southowram is a small settlement / village, just over 2kms from the centre of Halifax, but not part of the continuous built up area. It comprises a range of different housing and environment types.

Saville Park, Manor Heath, and Skircoat Green are all suburbs to the south-west of the town centre. They comprises a range of different housing and environment types.

See 20mph Case Study Descriptions Report for more information.

E.2. Monitoring approach

Calderdale Council has undertaken before and after monitoring at 3 sites in the Siddal area of Phase 1. Before data was collected at least one month prior to implementation (pre-May 2015). After data was collected 12 months post implementation (in June 2016). No other Phase 1 areas were monitored.

Summary of monitoring approach in Calderdale (Phase 1)	
Number of monitoring sites	3 sites
Location of sites	Sites mainly on busier through routes.
Before and after timescales	Before = at least 1 month pre-impl (May 2015). After = 3 months post-impl (Oct 2015).
Data source	Tubes (automatic traffic counters) on carriageway.
Duration	7 days, 24 hrs/day.
Data available	Flow, mean and 85th percentile speed data provided, in aggregated format only, for each site. No raw data available for this study. The data was recorded by Leeds Council and provided back to Calderdale Council via their C2 system in the form of a web report. The report contains information on the total number of vehicles that data has been recorded for and also the average (mean) speed at the location. Data on individual vehicles is not stored.
Quality of evidence available for this study	**Limited** Aggregated data provided only. No speed bin data available for this study. Before data collected using tubes. Tubes more visible than radar, and may influence driving speeds. The monitoring sites represent a mix of road types in the 20mph limit areas, but tended to be located on busier through routes. Locations with traffic calming were avoided.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1h. Calderdale\Information Received\Speed Data Stage 3d\ Siddal - new before & after speed survey.xls

Similar data was collected and provided for Phase 0 (48 sites, across 5 locations) which was implemented between 2012 and 2014; and for Phase 2 Todmorden (6 sites) which was implemented between September 2015 and April 2016.

Data quality

See above. Raw data files not available, so not possible to check the robustness of the data for individual sites.

E.3. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	0
	20-24mph	2
	>24mph	1
	>30mph	*0*
Number of sites on:	Major strategic road	0
	Important local road	2
	Minor local road	1
Before sample size		59,828 vehicles

E.4. Results[51]

E.4.1. Headline results

Context:

- Speeds were moderate in the before period, and the 85th percentile speed was below 30mph.
- The sample of vehicles monitored decreased from 8547 to 7395 vehicles, suggesting a 13% decrease in flow between the two survey periods.
- The before flow at individual sites varied from 892 (Site 2), 1602 (Site 3), to 6053 (Site 1). The flow weighted average for Siddal is therefore, heavily influenced by the speeds at Site 1 (Whitegate Road).

Overall speed outcomes:

- Overall, speeds declined across the 3 sites used in this analysis, from 22.8mph to 21.5mph, a reduction of -1.4mph.
- The 85th percentile speed reduced by a similar amount, from 29.9mph to 28.3mph, a reduction of -1.6mph.

Table E1. Overall change, across monitored sites – Phase 1 (Siddal)

7 day, 24hr average	Before (up to 4 years pre impl.)	After1 (1-12 months post impl.)	Diff1
Speed Limit	30mph	20mph	-
Flow	8547	7395	-1152 (13%)
Average Mean speed (mph)	22.8	21.5	-1.4 (-6%)
Average 85th Percentile speed (mph)	29.9	28.3	-1.6 (-5%)

The above metrics are flow weighted.

E.5. Site specific analysis[52]

Outcomes varied across the three sites, although all three recorded a reduction in both the mean and 85th percentile speed. The biggest reduction in change occurred at Siddal Lane, which had the lowest flow and highest before speeds.

Table E2. Overall change – site specific summary – Phase 1 (Siddal)

7 day, 24hr average	Before Flow	Mean Speed			85th Percentile Speed		
		Before, After, Diff1			Before, After, Diff1		
Speed Limit	30mph	30mph	20mph	-	30mph	20mph	-
Whitegate Road	6053	22.1	20.7	-1.4	28.8	27.5	-1.3
Siddal Lane	892	28.9	26.1	-2.8	34.9	32.5	-2.4
Park Lane	1602	22.3	21.2	-1.1	31.4	28.7	-2.8

[51] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1h. Calderdale\Calderdale SPEED DATA ANALYSISv1.0.xls

[52] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1h. Calderdale\Calderdale SPEED DATA ANALYSISv1.0.xls

E.6. Lessons, barriers and enablers

The Council reported that speed and collisions were the most cost-effective outcomes to measure. However, monitoring other outcomes was viewed as requiring substantial resources, and was only likely to provide a snapshot of the situation.

One particular outcome where the Council had not been able to identify a cost-effective and robust monitoring approach was mode shift.

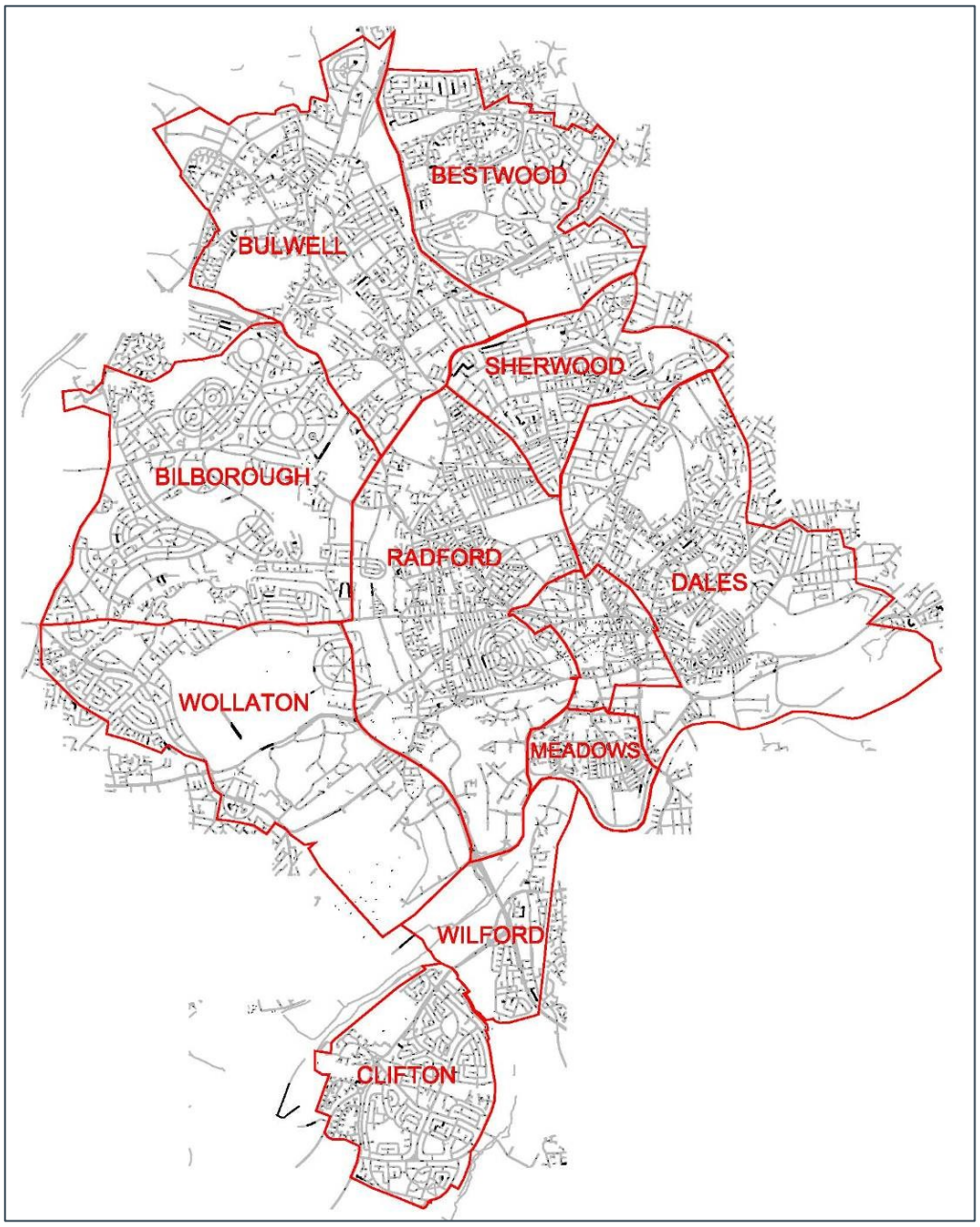
Appendix F. Nottingham (Bestwood) (R-AW4)

F.1. Scheme description (Predominantly residential and schools)

In 2006 Nottingham started implementing 20mph limits outside schools, as part of the School Safety Initiative. They began with a roll out of 5 schools a year (as part of the Local Transport Plan programme), which then accelerated to 10 a year. Following the change in Government guidelines for signed only 20mph limits, the Council decided to roll this out to a city wide level. A programme to undertake this work was approved by the Executive Board in April 2013.

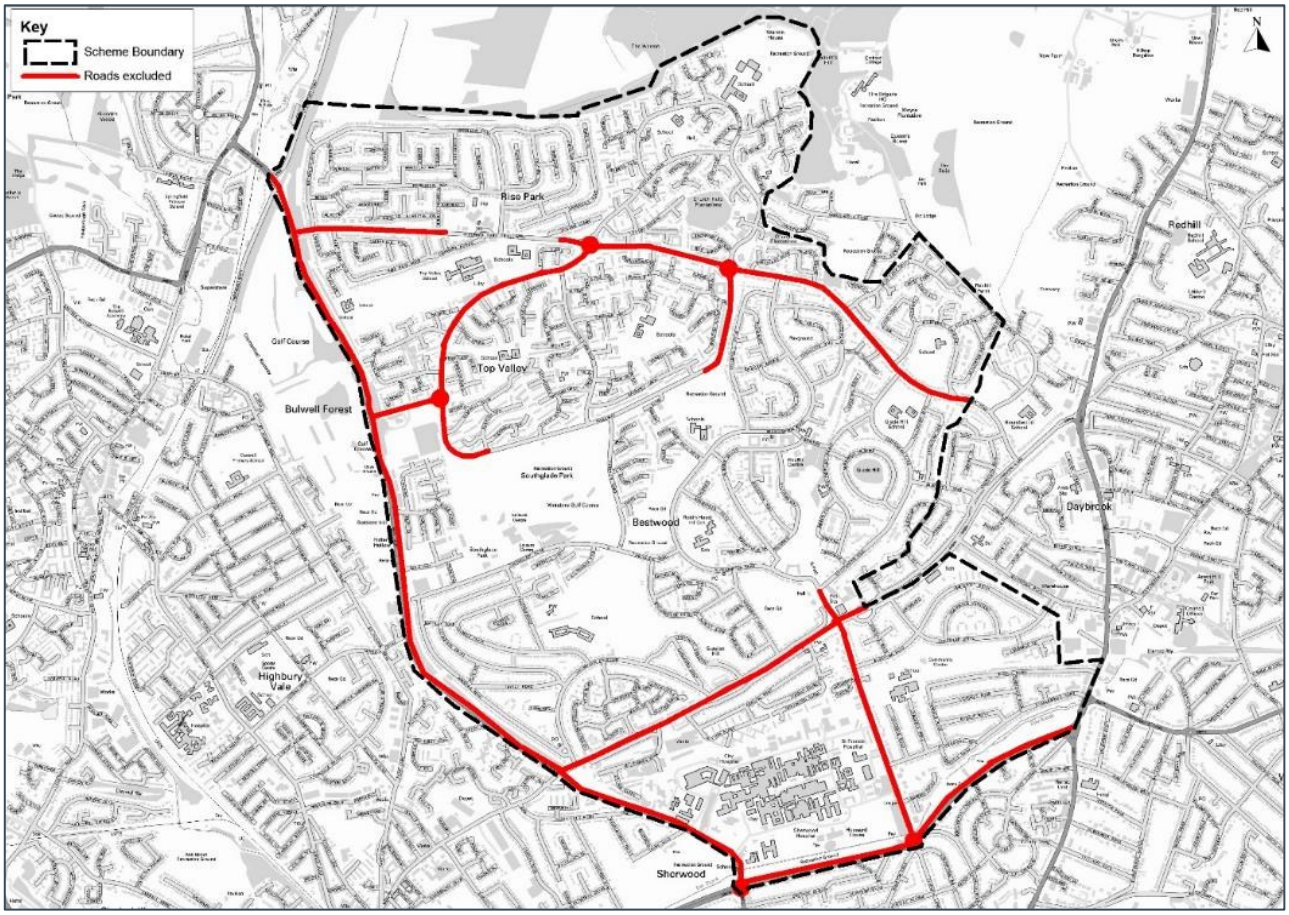
The programme has been rolled out as 11 schemes, 10 of which are phased across the city's residential areas, and one covering the city centre. The pilot 20mph scheme (Sherwood) was implemented in April 2013, with the remaining areas implemented between January 2014 and March 2015. The City Centre was last to be implemented.

Figure F1. Nottingham 20mph Scheme Areas



The case study area for this study focuses on Bestwood, an area north of Nottingham City Centre - the third area to be implemented, **in April 2014**.

Figure F2. Bestwood 20mph Scheme, Nottingham



Speed limits and presence of pre-existing traffic calming measures in study area

There are small sections of pre-existing 20mph Zones in the case study area (comprising signs, road humps and chicanes, *'SLOW'* markings and '20' roundels on the carriageway.

The majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (78%). No additional traffic calming measures have been installed as part of this scheme.

Signing approach (Moderate frequency and visibility of signing)

Post-mounted 20 mph signs have been located at entrances to the area, with smaller lamppost-mounted repeater signs within the limit area. No roundels were marked on the carriageway as part of this scheme (although there are some pre-existing ones).

Area characteristics

This area is predominantly residential, with a number of schools, recreational areas, and small clusters of retail. Housing comprises largely of semi-detached properties with gardens, town houses with three or four residences each, or terraced housing built in1930s and 50s (+ some newer). Housing is arranged in self-contained estates and cul-de-sacs, linked by wide distributor roads. Roads generally wide, with some on-street parking. There are a number of recreational parks and open spaces. The area includes a large council estate, with high levels of crime.

The area contains a number of pockets of deprivation, but other areas are more affluent. The proportion of the population under 16 varies from 12 to 28%.

Elsewhere in the city, housing types and environments vary considerably. However, there are a large number of areas where on-street parking causes narrowing of streets.

See 20mph Case Study Descriptions Report for more information.

F.2. Monitoring approach

Speed and flow data was collected at 5 sites on new 20mph roads, 4 sites on roads which remained at 30mph, and 3 control sites.

Before data was collected 12 months pre-implementation of the 20mph signs. **However, due to limited resources (both funding and staffing), after monitoring was not undertaken. No further monitoring is planned.**

Summary of monitoring approach in Bestwood – Scheme impl. April 2014	
Number of monitoring sites	5 sites on new 20mph roads, 4 sites on roads which remained at 30mph, and 3 control sites.
Location of sites	Sites were chosen to represent a mix of road types, including smaller residential streets with larger flows and streets with higher speeds (based on anecdotal evidence) where the 20mph limit may have been more contentious.
Before and after timescales	Before = 12 months pre-impl (March 2013). No after monitoring undertaken.
Data source	Tubes (automatic traffic counters) or radar.
Duration	7 days, 24 hrs/day.
Data available	Flow, mean and 85th percentile speed data provided, in aggregated format only, for each site. Speed bin data was also collected, based on 0-15mph, 15-30mph, and then 5mph bands. These were the standard bands historically used by the Council when monitoring speeds on 30, 40 and 60mph roads, but were found to be unsuitable for monitoring 20mph compliance.
Quality of evidence available for this study	**Very limited** Before data available only.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1f. Nottingham\1. Information Recieved\Bestwood\data recieved Feb 2016

F.3. Results

No after data available.

The ‘before’ data shows that the four roads with the highest flow (Bestwood Park Drive, Queens Bower Road, Arnold Road and Top Valley Drive) all remained 30mph when the 20mph scheme was implemented. These roads also had the highest mean and 85th percentile speeds.

Table F1. Bestwood before data

	Street Name	Speed limit post imple-mentation	Before Implementation - Feb/March 13			After Implementation		
			24hr flow	Mean *-mph*	85th% *-mph*	24hr flow	Mean *-mph*	85th% *-mph*
Core Monitoring Sites	Arndale Rd	20	1,239	14.1	27.2			
	Arnold Rd	**30**	11,580	22.4	29.5			
	Beckhampton Rd	20	3,976	21.2	30.7			
	Bestwood Park Dr	**30**	14,876	24.5	33.8			
	Birkdale Way	20	518	16.6	27.3			
	Chippenham Rd	20	2,450	21.8	29.3			
	Queens Bower Rd	**30**	14,873	23.1	32.2			
	Southglade Rd	20	2,395	21.5	27.9			
	Top Valley Dr	**30**	6,739	27.7	34.8			
Control Sites	Belleville Dr	20	673	11.7	26.5			
	Brownlow	20	945	24.6	33.4			
	Gainsford Cres	20	1,135	20.8	27.6			

F.4. Sherwood pilot results

While 'after' data was not collected for Bestwood, or any of the other areas implemented subsequently, the Council did collect before and after data for the pilot area of Sherwood (implemented April 2012).

Speed and flow data was collected at 6 sites on new 20mph roads, 2 sites on roads which remained at 30mph, and 4 control sites. Before data (June 2012) was collected 10 months pre-implementation of the 20mph signs, with after data collected 12 months post implementation (in April 2014).

The key findings, as reported by Nottingham City Council, are:

- The mean speed across all 20mph sites fell by 1.2mph, 22.3mph to 21.1mph.
- There was a bigger reduction amongst those driving at higher speeds, with the 85th percentile falling by 3.6mph, from 31.6mph to 27.9mph.
- Where the 30mph speed limit was retained in Sherwood there was no significant change in mean speeds. However 85th percentile speeds decreased by 3.6mph to 30.6mph.
- Data for control sites across the city shows that mean speeds increased marginally and 85th percentile speeds showed a small decrease – but around half of that witnessed in the Sherwood area as shown in the table below.

Table F2. Sherwood pilot before and after data

	Speed limit post imple-mentation	Before Implementation - June/July 12			After Implementation - April/May 2014			Change		
		24hr flow	Mean *-mph*	85th% *-mph*	24hr flow	Mean *-mph*	85th% *-mph*	24hr flow	Mean *-mph*	85th% *-mph*
20mph sites	20mph	17487	22.3	31.6	17167	21.1	27.9	-320	-1.2	-3.6
30mph sites	30mph	32102	25.0	34.2	32599	25.1	30.6	+497	+0.1	-3.6
Control sites	Mix	31225	22.3	30.8	32735	22.9	29.1	+1510	+0.5	-1.7

Source: Sherwood 20mph Speed Limit: 12 Month Monitoring Report.

Data for individual sites was also provided by NCC, but it is not clear which sites were used to calculate the above results.

Appendix G. Brighton Area 2 (R-AW5)

G.1. Scheme description (Predominantly residential and schools)

In 2010 a Scrutiny Committee recommended the implementation of 20mph limits across Brighton and Hove. Due to the size of the project, and availability of funds, the implementation of the scheme was staggered and was delivered in three separate phases:

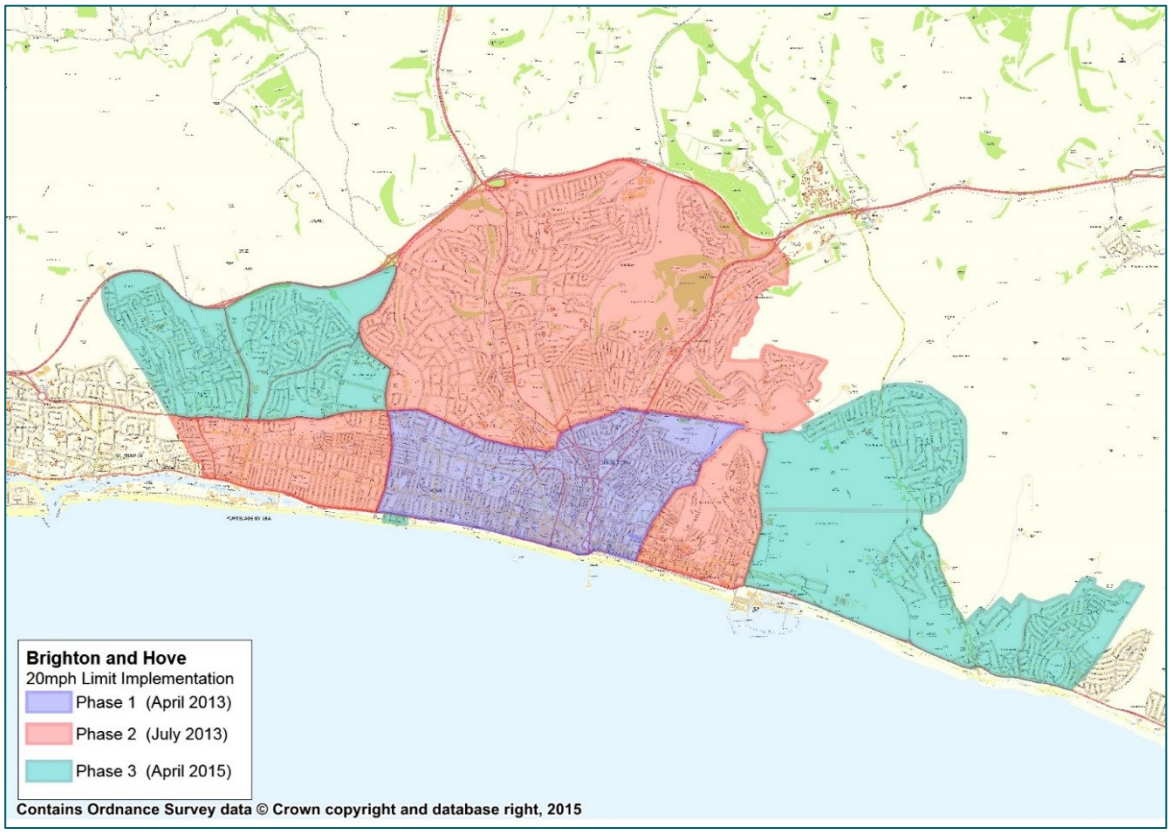
- Phase 1, comprising the city centre of Brighton and Hove was implemented in April 2013;
- Phase 2, consisting of the surrounding areas of Phase 1 was implemented in **June 2014**;
- Phase 3, which contains the remaining areas of Brighton and Hove was implemented in June 2015.

Phases 1 and 2 both form separate case studies for this research. This chapter focuses on Phase 2, which is a predominantly residential area.

The scheme covers the entirety of the administrative boundary of Brighton and Hove. Notable exceptions are main roads and key arterial routes, where, due to their strategic nature, 30mph limits remain in place. However, some A and B roads were included on the basis of flow, speeds, casualties, and layout; particularly in the city centre area. All limits operate 24 hours a day, seven days a week.

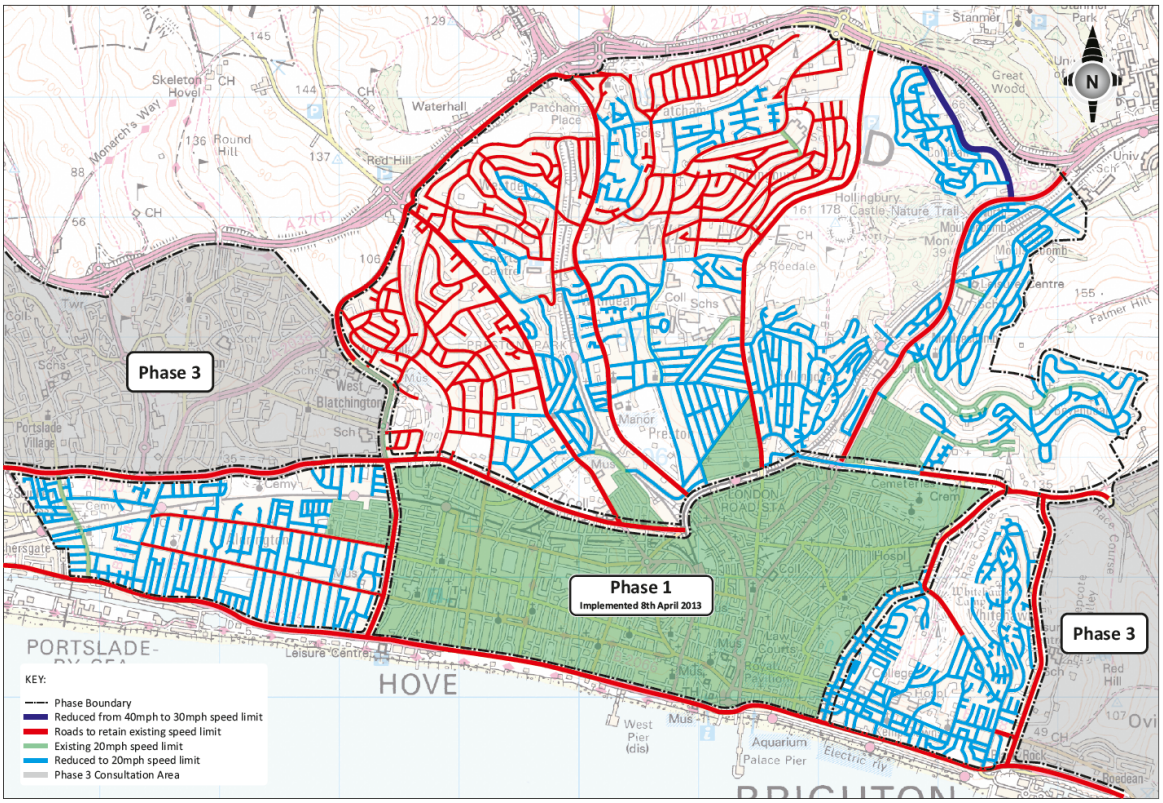
No additional traffic calming measures have been installed as part of this scheme.

Figure G1. Brighton 20mph Speed Limit Scheme (Phases 1 to 3)



Phase 2 covers suburban areas of the City, to the north, west, and east of the city centre. Residents were consulted on whether they wanted their street to be included in the scheme or not. Where there was a clear lack of interest, the limit was not changed.

Figure G2. Phase 2 implementation (roads included / excluded)



Source: https://www.brighton-hove.gov.uk/content/parking-and-travel/travel-transport-and-road-safety/safer-streets-better-places

Speed limits and presence of pre-existing traffic calming measures in study area

Prior to the implementation of the city-wide scheme, the city already had some 20mph Zones in place, and had already started to look at introducing small clusters of 20mph limits around schools.

However, the majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (85%).

Signing approach (Low-Moderate frequency and visibility of signing)

Post-mounted 20mph signs are located at all entrances to the limit area and are sometimes accompanied by roundels on the carriageway. Inside the limit there are occasional smaller lamppost-mounted 20 mph signs and roundels on the carriageway – generally one feature per road only, but some roads contain neither. The signs are relatively small and not always clearly visible, particularly where there are lots of parked vehicles on the street, potentially creating some uncertainty about the limit in some areas.

Area characteristics

Phase 2 contains newer housing in more suburban areas, comprising a mix of ages and styles.

G.2. Monitoring approach

Brighton Council has undertaken extensive monitoring across all three phases of implementation. For Phase 2, automatic traffic counts (by vehicle classification) and spot speed surveys were undertaken at 100+ 20mph and 30mph sites before implementation (in Jun 2013) and after implementation (in Sep 2014, Jun 2015, and Jun 2016).

In addition, moving observer surveys have been undertaken on 4 routes to examine change in journey times. These are discussed further in Section G.7 below.

Summary of monitoring approach in Brighton – Scheme impl. June 2014	
Number of monitoring sites	Analysis based on 46 sites on new 20mph roads, and 28 sites on roads which remained at 30mph.
Location of sites	Representative locations across the city, reflecting a range of locations and road types. Sample also includes some sites where complaints about speeding have been received from the public. Sample includes a mix of 20mph and 30mph roads.
Before and after timescales	Before = 12 months pre-impl (Jun 2013) – 195 sites After 0 = 2 months post-impl (Sep 2014) – 184 sites After 1 = 12 months post-impl (Jun 2015) – 190 sites After 2 = 24 months post-impl (Jun 2016) – 104 sites *The analysis below is based on sites with complete data for 2013, 2015, and 2016; on new 20mph and existing 30mph roads. The data from Sep 2014 has not been presented below, due to the short timescale, post implementation.*
Monitoring approach	Automatic traffic counters (two rubber tubes laid across the carriageway, linked to a side road recorder box)
Monitoring duration	7 days per site, 24 hrs/day
Data available	Total vehicles (5 day and 7 day average) Mean speed and 85th percentile speed, % exceeding limit 5mph speed bins (+ above metrics) by hour of day and day of week A number of cabinet reports and internal monitoring reports present findings from the data, but no formal monitoring report has been produced to date.
Quality of evidence	**Moderate** Large sample of representative locations across scheme area. But, sample also includes some sites where complaints about speeding have been received from the public. 7 days of data, covering Monday to Sunday. Before and After1 / After1 data collected at same time of year, in neutral month. Tubes more visible than radar, and may influence driving speeds.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\1. Info Received\2017 - Peter Brett info\2017 Data Issue

Similar data is also available for Phases 1 and 3.

Data quality

See above.

G.3. Site characteristics

Characteristics		New 20mph roads	Roads remaining at 30mph
Number of sites with mean before speed:	<=20mph	8	0
	20-24mph	25	12
	>24mph	13	16
	>30mph	*0*	*3*
Number of sites on:	Major strategic road	1	2
	Important local road	8	9

	Minor local road	37	17
Before mode share	Motorcycles	3%	2%
	Cars	88%	92%
	LGVs	0%	0%
	Buses	7%	5%
	HGVs	1%	1%
Before sample flow	7 day average	115,226	140,431

Sites on new 20mph roads

The majority of sites on new 20mph roads are located on 'minor local roads', with an average 7 day flow varying from 152 to 4,755 vehicles. Most sites had a mean before speed of 20-24mph.

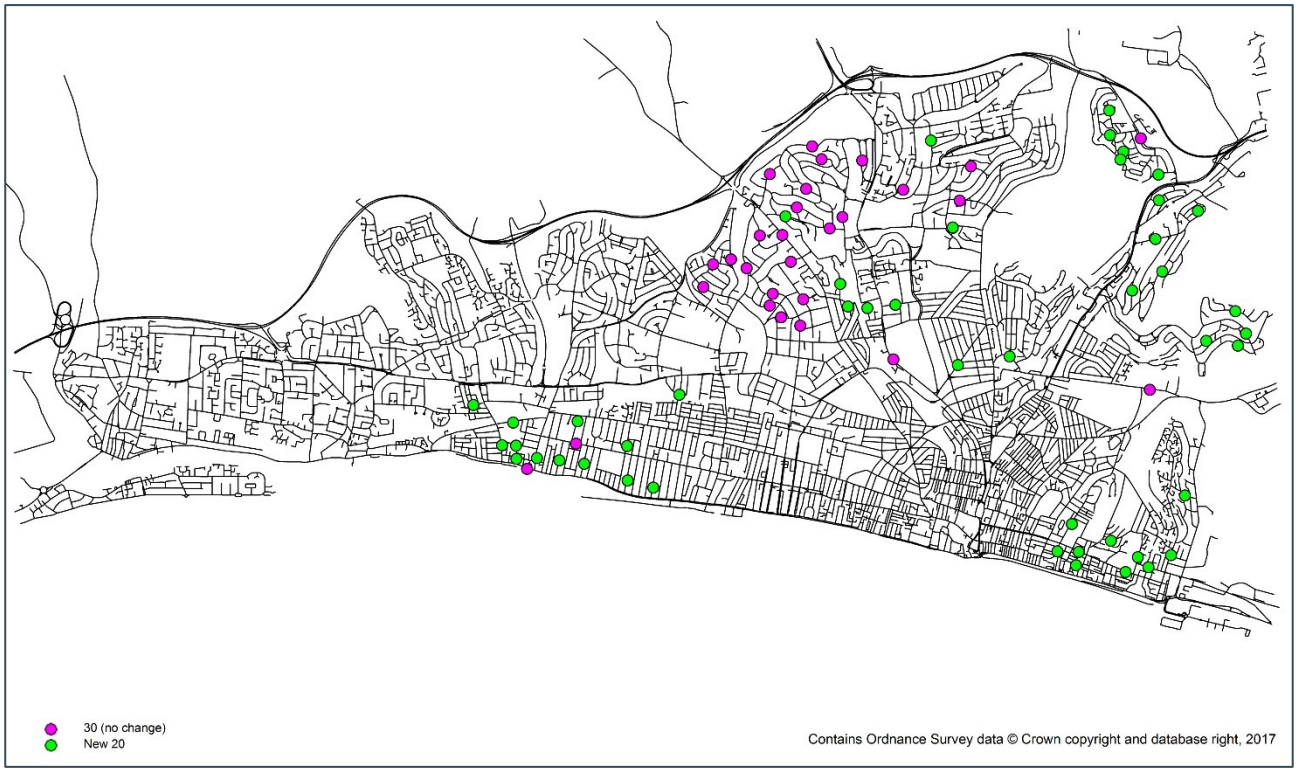
One monitoring site was located on a major strategic road, with a much higher flow of 12,602 veh/day, and a before mean speed of 24mph. Two other sites (on important local roads) were located on busy roads, with an average flow exceeding 10,000 veh/day.

Sites on roads remaining at 30mph

The majority of sites on roads are located on 'minor local roads', with an average 7 day flow varying from 211 to 3,443 vehicles. Most sites had a mean before speed of >24mph.

Two monitoring sites were located on major strategic roads, with a much higher flow of around 20,000 veh/day.

Figure G3. Location of monitoring sites



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G.4. Results for sites on new 20mph roads[53]

G.4.1. Headline results

Context:

- Speeds were moderate in the before survey – the mean speed across the Phase 2 area was 23.7mph. Only 12% of vehicles were exceeding 30mph (the speed limit at the time), and 85% were travelling below 28.6mph.
- The majority of vehicles were cars (88%), but 7% were buses – reflecting the inclusion of more strategic roads in the scheme area.
- The sample of vehicles monitored (representing flow), showed little change between the Before and After1 period (0% change), but was slightly lower in the After2 surveys (-2%).

Overall speed outcomes:

- Overall, speeds declined across the 46 sites used in the analysis (Figure G4).
- Mean speeds fell by -1.1mph after 12 months, and by -1.4mph after 24 months.
- The 85th percentile speed fell by the same amount - by -1.1mph after 12 months, and by -1.4mph after 24 months. **This suggests that, in general, faster drivers did not reduce their speed more than slower drivers.**
- The results were similar at 12 months and 24 months post implementation.

[53] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\Task 3.6a Spot Speed Analysis (Phase 2)\ Brighton SPEED DATA ANALYSIS_20mph.xls

Figure G4. Cumulative speed distribution, across all vehicles monitored

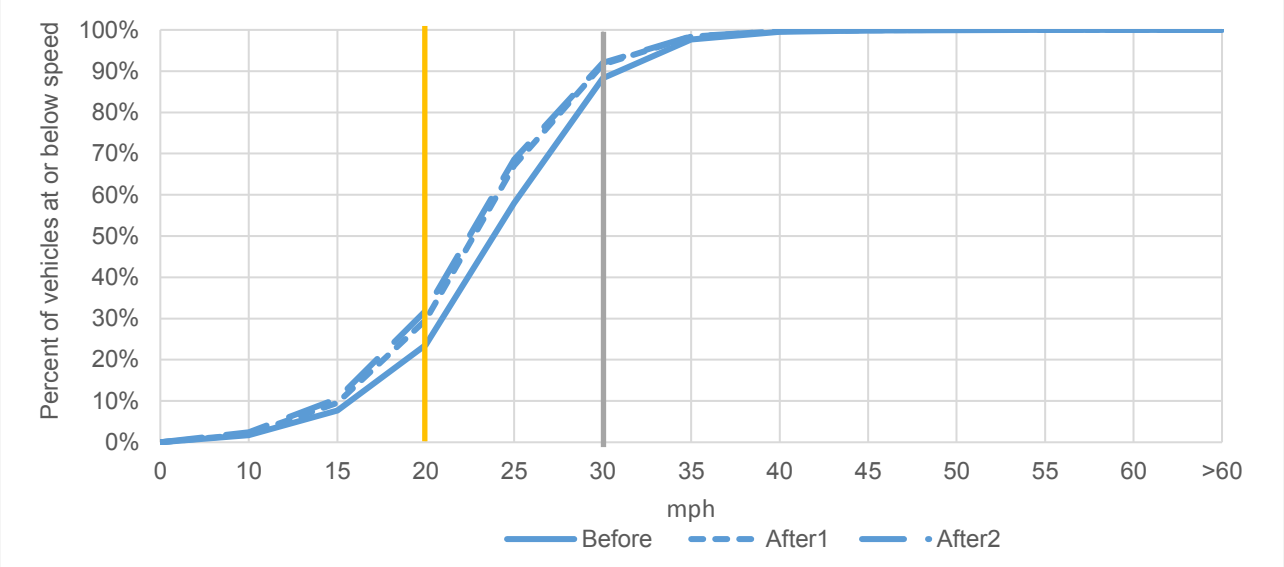


Table G1. Overall change, across monitored sites

7 day, 24hr average	Before (12 months pre impl.)	After1 (6-18 months post impl.)	Diff1	After2 (18-30 months post impl.)	Diff2
Speed limit	30mph	20mph	-	20mph	-
Flow (vehicles)	115226	114906	-320 (0%)	113156	-2070 (-2%)
Average Mean speed (mph)	23.7	22.6	-1.1 (-5%)	22.3	-1.4 (-6%)
Average 85th percentile speed (mph)	28.6	27.4	-1.1 (-4%)	27.2	-1.4 (-5%)
% <=20mph	24%	30%	+6%	32%	+8%
% >24mph	49%	40%	-8%	39%	-10%
% >30mph	*12%*	*8%*	*-3%*	*8%*	*-4%*

The above metrics are all flow weighted.

Table G2. Mode share, across monitored sites

7 day, 24hr average	Before (6 months pre impl.)	After1 (6-18 months post impl.)	After2 (18-30 months post impl.)
Speed limit	30mph	20mph	20mph
Flow (vehicles)	115226	114906	113156
Motorcycles	3%	3%	3%
Cars	88%	88%	88%
LGVs	0%	0%	0%
Buses	7%	8%	7%
HGVs	1%	1%	1%
Total	100%	100%	0%

G.4.2. By road type

In general:

- 'Important local roads' and 'minor local roads' had similar speed profiles in the before period – unlike in other scheme areas.
- Speeds declined more on 'important local roads' than on 'minor local roads'; but in both cases the reduction was small.
- One site was located on a 'major strategic road'. The proportion driving <=20mph increased from 15% in the Before period to 23% in the After2 period.

Figure G5. Cumulative speed distribution, by road type: Before v After2 (18-30 months post impl.)

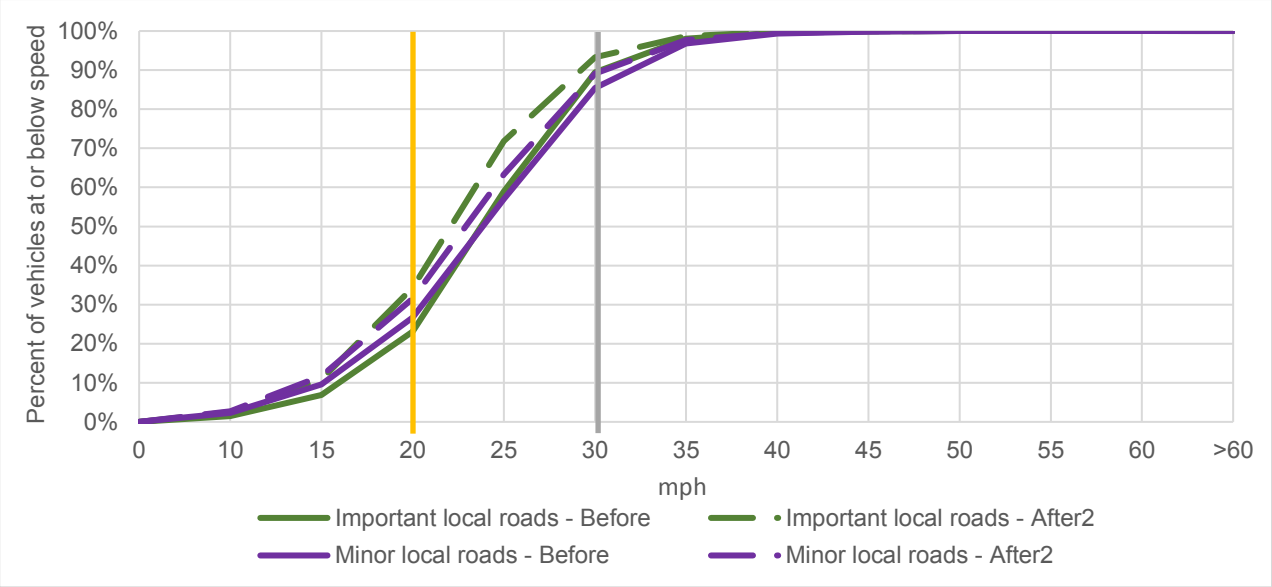


Table G3. Overall change, by road type: Before v After1 (6-18 months post impl.)

	Important local roads			Minor local roads		
	Before, After1, Difference			Before, After1, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Flow (vehicles)	55511	54519	-992	47084	48386	1302
% <=20mph	23%	30%	+7%	27%	30%	+4%
% >24mph	48%	40%	-8%	49%	43%	-6%
% >30mph	*11%*	*8%*	*-3%*	*15%*	*11%*	*-4%*

The above metrics are all flow weighted.

Table G4. Overall change, by road type: Before v After2 (18-30 months post impl.)

	Important local roads			Minor local roads		
	Before, After2, Difference			Before, After2, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Flow (vehicles)	55511	52293	-3218	47084	48423	1339
% <=20mph	23%	34%	+11%	27%	32%	+5%
% >24mph	48%	36%	-12%	49%	43%	-6%
% >30mph	*11%*	*7%*	*-4%*	*15%*	*11%*	*-4%*

The above metrics are all flow weighted.

G.4.3. By before mean speed

In general:

- The 20mph limit has had a bigger impact on roads with higher pre-scheme speeds, although even on the fastest roads the speed reduction is still small.

Figure G6. Cumulative speed distribution, by mean before speed: Before v After2 (18-30 months post impl.)

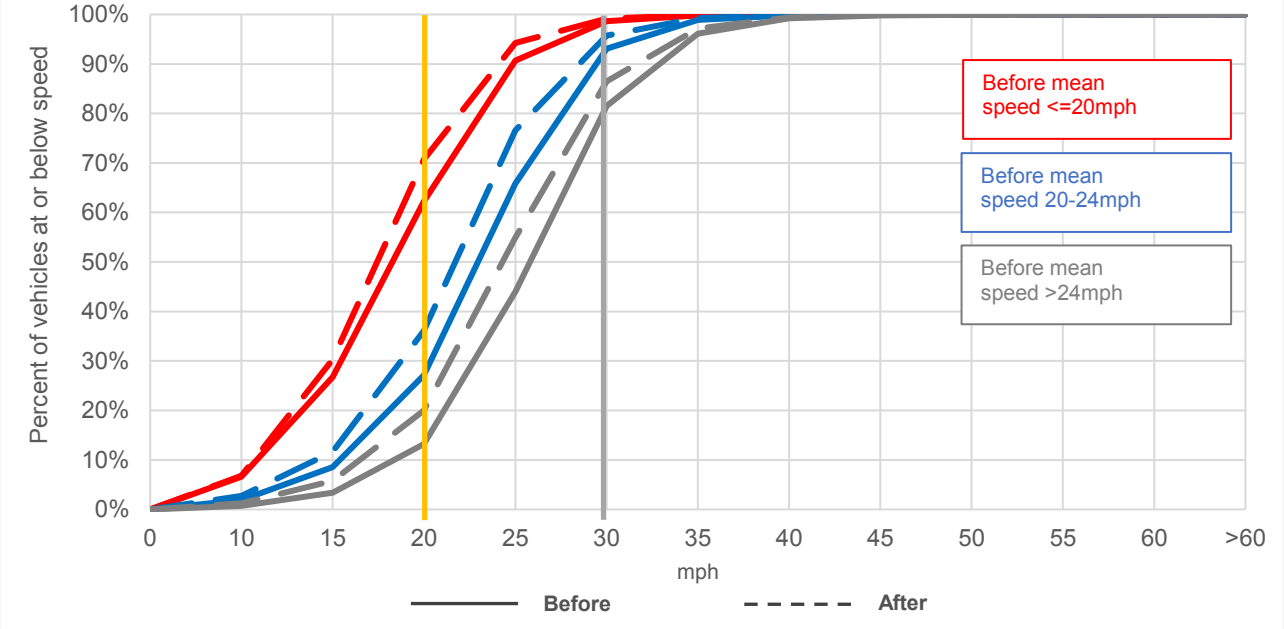


Table G5. Overall change, by mean before speed: Before v After1 (6-18 months post impl.)

	Mean before speed <=20mph			Mean before speed 20-24mph			Mean before speed >24mph		
	Before, After1, Difference			Before, After1, Difference			Before, After1, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-	30mph	20mph	-
Flow (vehicles)	9114	8946	-168	54363	52902	-1461	51719	53049	1330
% <=20mph	62%	65%	3%	27%	35%	8%	13%	18%	5%
% >24mph	15%	14%	-1%	42%	32%	-10%	62%	53%	-9%
% >30mph	*1%*	*1%*	*0%*	*7%*	*4%*	*-2%*	*18%*	*13%*	*-5%*

The above metrics are all flow weighted.

Table G6. Overall change, by mean before speed: Before v After2 (18-30 months post impl.)

	Mean before speed <=20mph			Mean before speed 20-24mph			Mean before speed >24mph		
	Before, After2, Difference			Before, After2, Difference			Before, After2, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-	30mph	20mph	-
Flow (vehicles)	9114	9033	-81	54363	55021	658	51719	49095	-2624
% <=20mph	62%	71%	9%	27%	36%	9%	13%	20%	7%
% >24mph	15%	10%	-5%	42%	32%	-10%	62%	52%	-10%
% >30mph	*1%*	*1%*	*-1%*	*7%*	*4%*	*-3%*	*18%*	*14%*	*-5%*

The above metrics are all flow weighted.

G.4.4. Comparison with TomTom results

Speeds recorded in spot speed surveys are typically higher than those recorded by TomTom devices.

The gap between the before and after curves (representing the scale of change) is of a similar order of magnitude for both datasets. However, the spot speed data shows a slightly bigger change.

The specific shape of the spot speed curve will be influenced by the specific characteristics of the sample of monitoring sites. In contrast the TomTom curve captures speeds in all 20mph roads in the scheme area.

Figure G7. Cumulative speed distribution – spot speed vs TomTom data

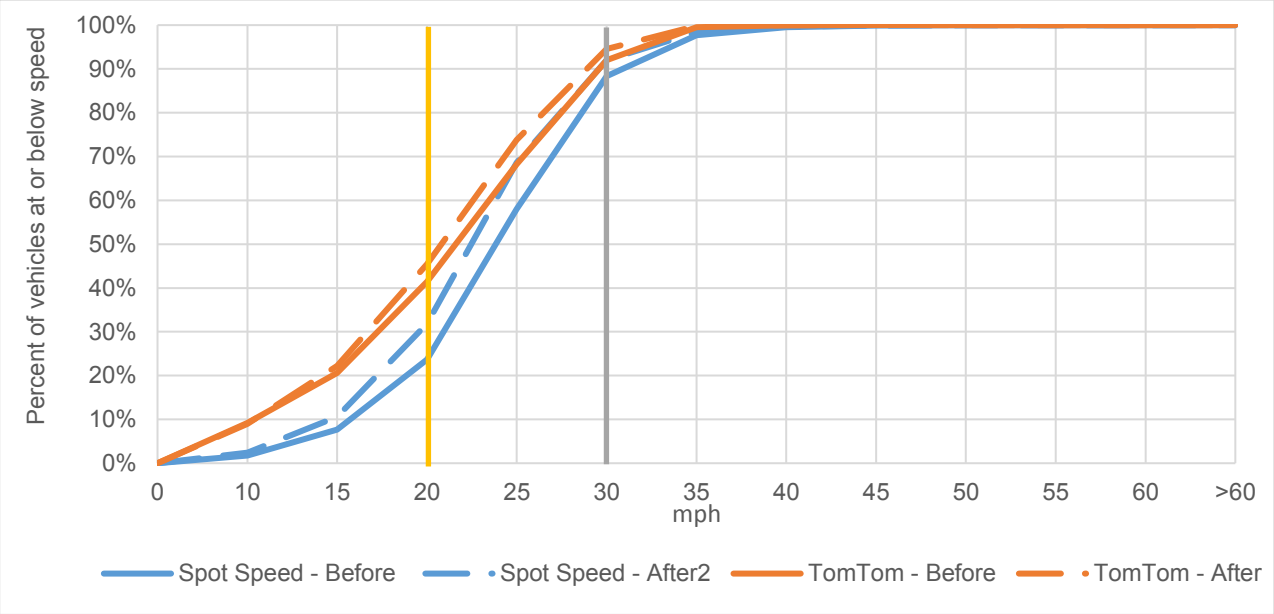


Table G7. Overall change – spot speed vs TomTom data

	Spot Speed Data			TomTom Data		
	Before, After2, Difference			Before, After, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Sample	806,567 vehicles	792,108 vehicles	-2%	278035 veh-kms	332180 veh-kms	+19%
% <=20mph	24%	32%	+8%	41%	45%	+4%
% >24mph	49%	39%	-10%	37%	31%	-5%
% >30mph	12%	8%	-4%	8%	5%	-3%

The above metrics are all flow weighted.

G.5. Site specific analysis (new 20mph roads)[54]

Overall change - Across the 46 monitoring sites on new 20mph roads, the change in mean speed varies from +2.1mph (increase) to -3.8mph (decrease). Overall, 33 of the 46 sites (72%) recorded a reduction in average speed, 10 (22%) recorded an increase, and 3 (7%) recorded no change.

The number of sites with a mean speed of <=24mph increased from 33 sites before, to 40 sites after.

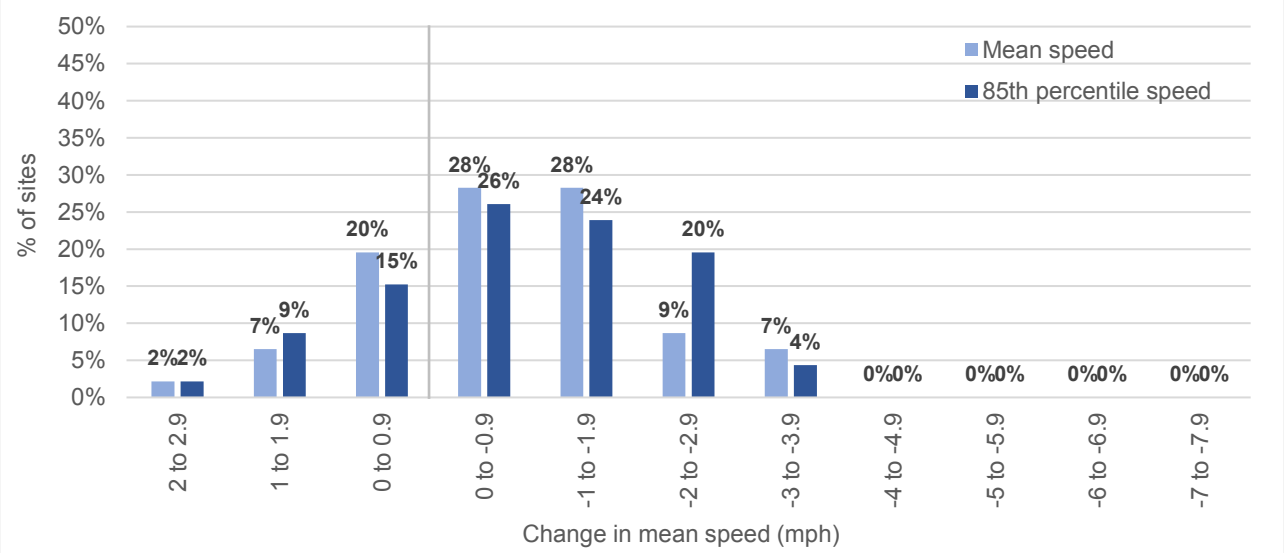
Similar changes were recorded for 85th percentile speeds.

Table G8. Site specific analysis – overview (Before vs After2)

Description	Mean speed results	85th percentile speed results
Biggest increase / decrease	+2.1 mph (increase) -3.8 mph (decrease)	+2.2 mph (increase) -3.8 mph (decrease)
No. of sites reporting a reduction	33 out of 46 sites (72%)	34 out of 46 sites (74%)
No. of sites with: - mean speed <=24mph - 85th percentile speed <=30mph	Before = 33, After = 40	Before = 38, After = 42

Over half of sites (57%) recorded a reduction in mean speed of between 0 and 2mph.

Figure G8. Change in average mean (Before vs After2) - % of sites in each change band



Change by before mean speed - Comparison of 'change in mean speed' against 'before mean speed' shows a slight downward trend.

Similarly, comparison of 'change in 85th percentile speed' against 'before mean speed' also shows a slight downward trend.

[54] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\Task 3.6a Spot Speed Analysis (Phase 2)\ Brighton SPEED DATA ANALYSIS_20mph.xls

Figure G9. Change in mean speed (Before vs After2) by 'before' mean speed

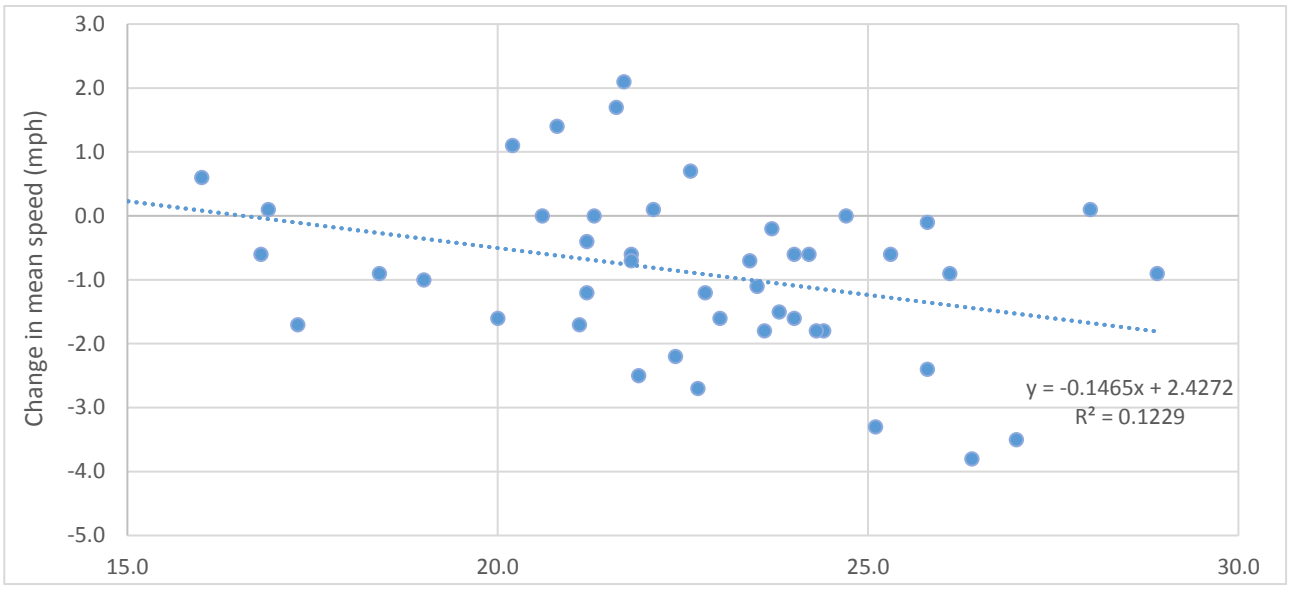
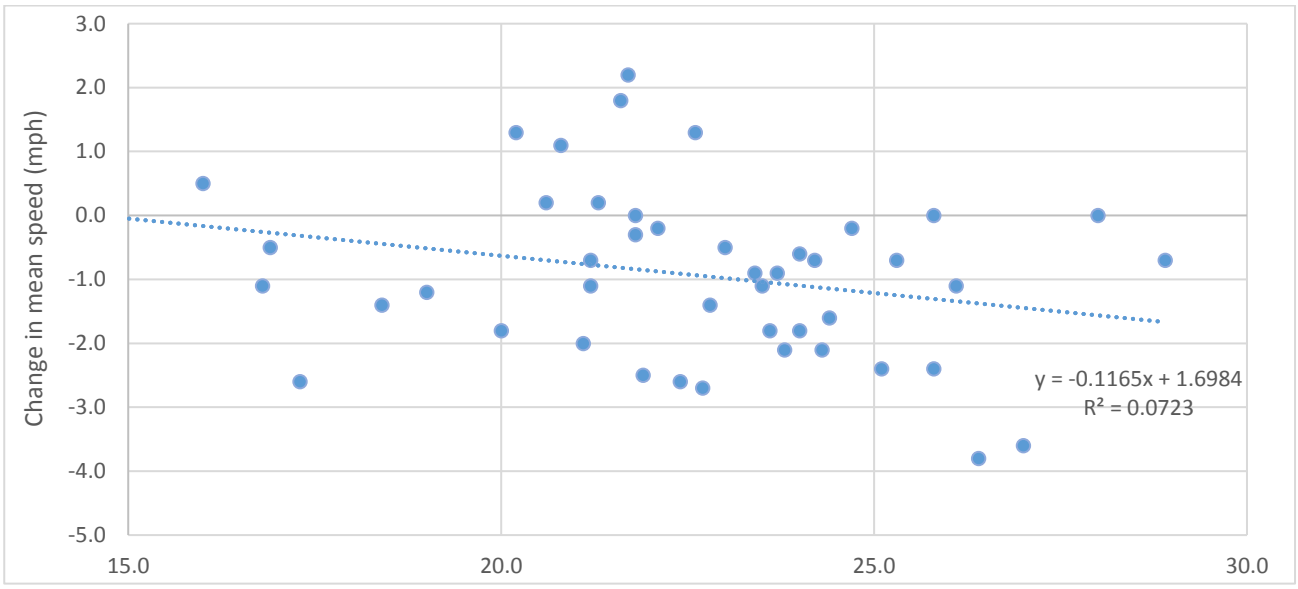


Figure G10. Change in 85th percentile speed (Before vs After2) by 'before' mean speed



G.6. Comparison with sites on 30mph roads[55]

In general:

- Results for roads retaining a 30mph limit show a marginal increase in speeds, compared with the small decline recorded on new 20mph limits.
- The results are similar when broken down by road type.

Table G9. Overall change – All roads: Before v After2 (18-30 months post impl.)

	New 20mph roads			Roads retaining 30mph limit		
	Before, After2, Difference			Before, After2, Difference		
Speed limit	30mph	20mph	-	30mph	30mph	-
Sample (flow)	115,226	113,156	-2070	140,431	136,903	-3528
Average Mean speed (mph)	23.7	22.3	-1.1	27.4	27.8	+0.4
Average 85th percentile sp (mph)	28.6	27.2	-1.4	31.8	32.6	+0.8
% <=20mph	24%	32%	+8%	10%	11%	0%
% >24mph	49%	39%	-10%	74%	76%	+2%
% >30mph	*12%*	*8%*	*-4%*	*31%*	*37%*	*+5%*

The above metrics are all flow weighted.

Table G10. Overall change – Important local roads: Before v After2 (18-30 months post impl.)

	New 20mph roads			Roads retaining 30mph limit		
	Before, After2, Difference			Before, After2, Difference		
Speed limit	30mph	20mph	-	30mph	30mph	-
Sample (flow)	55511	52293	-3218	77,832	73,280	-4552
% <=20mph	23%	34%	+11%	5%	5%	0%
% >24mph	48%	36%	-12%	84%	86%	+2%
% >30mph	*11%*	*7%*	*-4%*	*45%*	*48%*	*+4%*

Table G10. Overall change – Minor local roads: Before v After2 (18-30 months post impl.)

	New 20mph roads			Roads retaining 30mph limit		
	Before, After2, Difference			Before, After2, Difference		
Speed limit	30mph	20mph	-	30mph	30mph	-
Sample (flow)	47084	48423	1339	21,248	22,572	-1324
% <=20mph	27%	32%	+5%	21%	20%	-1%
% >24mph	49%	43%	-6%	54%	55%	+2%
% >30mph	*15%*	*11%*	*-4%*	*14%*	*15%*	*0%*

[55] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\Task 3.6a Spot Speed Analysis (Phase 2)\ Brighton SPEED DATA ANALYSIS_20mph.xls

G.7. Journey time analysis

In addition to the speed data collected at each of the ATC sites, the Council have also collected journey time data, via a moving observer method. All information was collected using Garmin GPS60 GPS units which were configured to record the vehicle's speed and position every three seconds. The resulting GPS files were analysed using Nationwide Data collection's in-house software and tabulated in Microsoft Excel.

Within the Phase 2 area, 4 different routes were driven approximately 10 times each during the AM Peak (0700 to 1000), Inter Peak (1100 to 1300), and PM Peak (1600 to 1900).

Data has been collected for 3 after periods only (Sep 2014, Jun 2015, and Jun 2016).

The table below shows that average speeds along the routes (representative of the ambient driving speeds) are below 20mph in most instances. However, in 20% of cases, the average speed is between 20 and 22mph. In these cases, a substantial proportion of vehicles are travelling more than 20mph.

Table G?. Average speed of traffic on journey time routes

	2014			2015			2016		
	AM Pk	IP	PM Pk	AM Pk	IP	PM Pk	AM Pk	IP	PM Pk
Route 1A	18.7	18.2	17.3	16.4	17.5	17.4	19.2	17.8	17.7
Route 1B	16.3	17.6	16.4	14.3	15.7	14.6	17.3	16.4	16.7
Route 1C	15.4	10.7	13.1	11.4	12.2	11.1	12.5	13.5	14.7
Route 2A	21.1	20.5	20.3	20.3	18.9	18.9	21.3	20.5	19.9
Route 2B	20.6	20.8	20.5	20.0	18.9	19.4	20.3	19.7	19.9
Route 3A	18.3	19.1	18.8	21.6	21.5	21.8	18.2	19.4	19.0
Route 3B	17.1	18.4	16.7	20.5	21.1	19.6	17.7	18.5	17.3
Route 4A	16.4	19.0	14.8	17.1	17.5	17.5	16.0	17.2	14.6
Route 4B	17.0	18.4	17.2	17.8	16.4	15.0	17.6	16.9	16.7

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Appendix H. Portsmouth (R-AW6)

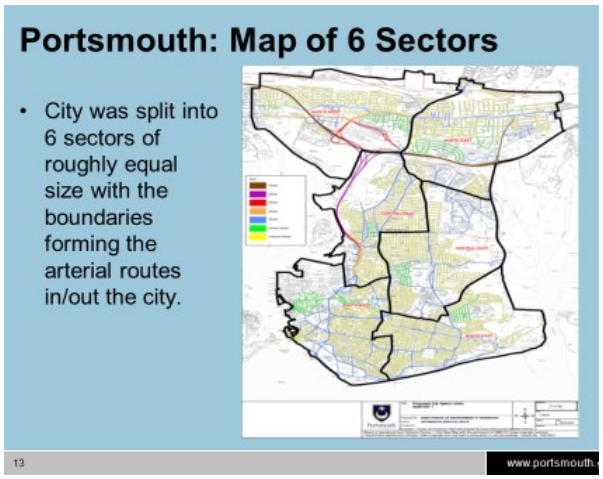
H.1. Scheme description (Predominantly residential and schools)

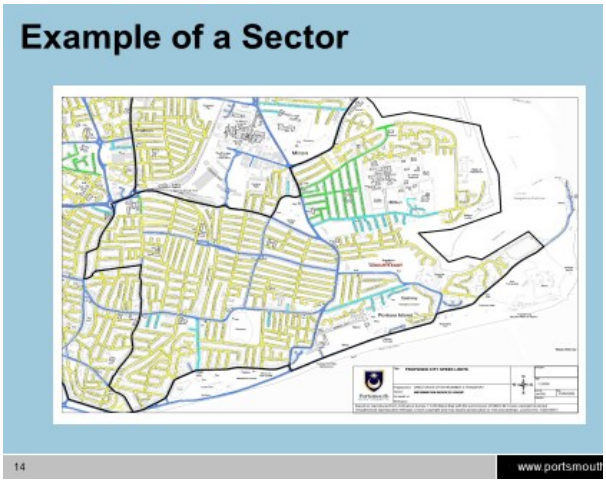
Portsmouth City Council was the first local authority in England to implement an extensive area-wide 20mph Speed Limit Scheme, covering most of its residential roads, and minor roads with schools and shops.

The scheme was implemented during 2006-2008 - The first sector (South East) went live in **June 2007** and the last sector South West) went live in **March 2008**. It covers 94% of roads on the PCC road network (410km of the 438km of road length) that previously had a 30mph limit. Strategic routes have been excluded.

The limit operates 24 hours a day, seven days a week.

Figure H1. Scheme coverage





Speed limits and presence of pre-existing traffic calming measures in study area

In 2005/06 an experimental 20mph Speed Limit Scheme was implemented on one of the city's roads, following a triple road fatality. Some surrounding roads were also included in the Traffic Order.

A small number of 20mph zones were subsequently implemented on other roads, to address specific speeding or safety issues.

However, the majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (96%).

Signing approach (Moderate frequency and visibility of signing)

Entrances to the 20mph limit areas, from the strategic network, are clearly marked by post-mounted 20mph signs and '20' roundels on the carriageway. Within the limit itself, smaller lamppost-mounted repeater signs are situated approximately halfway along the road. In the case of limited visibility, occasional roundels are also provided adjacent to the repeater signs (the high density of parked vehicles can make some signs difficult to see).

Area characteristics

The city has three strategic entry and exit routes and a number of primary roads, interlinked by a network of primary and secondary distributor roads, many of which pass through residential areas. The city has one of the highest densities of population within Europe. A great number of the city's residential streets form a closely packed network of terraced housing, developed in the 19th Century or earlier, with little or no off-street parking. As a consequence of high volume of on-street parking, the available carriageway space is often narrowed to a point where the roads operate as informal one-way streets. Standoff situations often arise when drivers fail to give way to each other.

Thus the layout of Portsmouth's roads was considered to lend itself well to the provision of speed limit signs alone without the need for complementary, additional physical traffic calming measures.

Levels of deprivation / affluence vary substantially across the city, but there are pockets of very high deprivation near the city centre (which are amongst the most deprived areas in the south-east of England).

The proportion of the population under 16 also varies substantially across the city, from 9 to 24%.

See 20mph Case Study Descriptions Report for more information.

H.2. Monitoring approach

PCC undertook extensive 'before' (Jun 2004 – Feb 2007) and 'after' (Jun 2007 – Nov 2009) monitoring of the scheme, in partnership with the DfT.

Average 'Before' and 'After' spot speed data was collected at 223 sites across the six sectors. Data was collected from 0600 to 2200 hours, on the same day of the week in the 'before' and 'after' periods, on one day only.

Summary of monitoring approach in Portsmouth – Scheme impl. 2007-2008	
Number of monitoring sites	223
Location of sites	Representative locations across the city
Before and after timescales	Before = 4 months to 4 years pre-impl (Jun 2004 – Feb 2007) After1 = generally 6-18 after implementation (Jun 2007 – Nov 2009)
Data source	Automatic traffic counters (two rubber tubes laid across the carriageway, linked to a side road recorder box)
Duration	1 day per site, 16 hrs/day (06:00-22:00)
Data available	Mean before and after speeds – aggregated by area sector and before speed. Same day before and after. No data available for individual sites. No speed profile data collected.
Quality of evidence available for this study	**Moderate** Speeds collected on one day only at each site, but the large no. of sites improves the robustness of the data if analysed at an aggregate level. No flow data provided, so not possible to calculate a flow weighted average. Some before data collected several years before implementation.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1e. Portsmouth\Portsmouth 20mph Evaluation Report

H.3. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	141 (63%)
	20-24mph	50 (22%)
	>24mph	32 (14%)

The majority of sites (63%) were located on roads with a mean before speed <=20mph.

It has not been possible to identify the functional road classification of the site locations, but it is believed that the majority of sites were on 'minor local roads'.

No information is available about the mode share of the before and after samples.

H.4. Results

Context:

- The majority of sites (63%) already had mean speeds below 20mph. It is unlikely that speeds would have fallen substantially at these sites.

Trend across all sites:

- Across all 223 sites:
  - 111 sites (50%) recorded a decrease in average speed – *mostly by 1-5mph, but 26 sites by 6-10mph, and 8 sites by >10mph*;
  - 30 sites (11%) recorded no change;
  - 82 sites (37%) recorded an increase in average speed – *mostly on roads where the before mean speed was already <=20mph*.
- While the majority of sites saw a reduction in speed, some sites on roads where speeds were already low experienced an increase. This may have been due to drivers treating the new 20mph limit as a target, and increasing their speed accordingly.

Change in mean speed (no flow weighting):

- The average overall speed for the six sectors before the scheme implementation was 19.8 mph. This reduced to an average of 18.5 mph after implementation of the scheme; a reduction of 1.3 mph. The average reduction across the six sectors varied from -0.6 to -1.8mph.
- These results represent the 'typical' change in speed across all sites, unweighted by flow.

Change by before mean speed (no flow weighting):

- In general, the biggest reductions in mean speed occurred at sites with higher 'before' speeds:
  - <=20mph = -0.7mph;
  - 21-24mph = -2.3mph;
  - >=24mph = -7.4mph.

20mph compliance:

- The data does not specifically identify the number of drivers complying with the limit, but his can be estimated from the number of sites with a mean speed of <=20mph.
- Following implementation, 159 sites (71%) were found to have a mean after speed of <=20mph. This suggests that **well over half of drivers were complying with the new limit**. This compares with 141 sites (63%) with an average before speed of <=20mph in the before period.
- Compliance with the new 20mph limit was highest at sites where speeds were already close to 20mph. Some 88% of sites with a before mean speed <=20mph were found to have an after mean speed <=20mph, compared with 46% of sites with a before mean speed 20-24mph, and 38% of sites with a before mean speed >24mph.

Change in mean speed

Table H1. Change in mean speed (unweighted)

	Before	After1	Diff1
Speed limit	30mph	20mph	-
Flow	-	-	-
Mean speed (mph) – averaged across sites then by sector (no flow weighting)	19.8	18.5	-1.3
Central West	*20.2*	*19.1*	*-1.1*
South East	*19.6*	*18.6*	*-1.0*
Central East	*18.5*	*17.9*	*-0.6*
North East	*18.2*	*16.4*	*-1.8*
South West	*18.4*	*16.9*	*-1.5*
North West	*23.9*	*22.0*	*-1.7*

Site summary

Table H2. Scale of change in speed at individual sites

	<=20mph	21-24mph	>24mph	Total	Summary
Decrease >15mph	2	0	0	2 sites	111 sites
Decrease 11-15mph	6	0	0	6 sites	
Decrease 6-10mph	21	2	3	26 sites	
Decrease 1-5mph	59	14	4	77 sites	
No change	23	6	1	30 sites	30 sites
Increase 1-5mph	45	18	8	71 sites	82 sites
Increase >5mph	3	5	3	11 sites	
Total	159 sites	45 sites	19 sites	223 sites	223 sites
% Decrease	55%	36%	37%	50%	50%
% No change	14%	13%	5%	13%	13%
% Increase	30%	51%	58%	37%	37%

Compliance

Table H3. Number of sites with mean speeds <=20mph, 20-24mph, >24mph

	After mean speed				% sites <=20mph
Before mean speed	<=20mph	21-24mph	>24mph	Total	
<=20mph	124	15	2	141 sites	88%
21-24mph	23	21	6	50 sites	46%
>24mph	12	9	11	32 sites	38%
Total	159 sites	45 sites	19 sites	223 sites	71%

Impact on excessive (high) driving speeds:

- Following implementation, there were fewer sites with an average mean speed >24mph (32 before, 19 after), and on average the mean speed at sites with a 'before' mean speed >24mph is reported to have fallen by -7.4mph – suggesting a notable reduction in incidents of excessive driving.

Conclusion:

- Roads with a before mean speed >24mph are reported to have benefitted from substantial speed reductions, but not to the extent that the 20mph speed limit is self-enforcing.

Source: Interim Evaluation of the Implementation of 20 mph Speed Limits in Portsmouth (PCC and Atkins, Sep 2010).

Analysis file: P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1g. Walsall\Task 3.1d Follow-up Info 2016\SPEED DATA ANALYSIS FOR REPORT.xls

H.5. On-going monitoring to address reports of speeding from the public

Complaints about speeding are the most common complaint received by the Council from the public. PCC therefore have an on-going programme to monitor speeds on roads where complaints have been received by the public.

Since July 2013, three Speed Detection Radar units have been in operation 24hrs a day, for up to 4 week periods (but generally less than 2 weeks) within the 20 mph areas. These are attached to lampposts and used to collect traffic volume and speed data, classified by mode.

Three streets are monitored at a time. Locations chosen are primarily driven by complaints / queries from the public about levels of speeding; however, some surveys are undertaken to inform engineering schemes.

Where speeds are found to be high, Vehicle Activated Signs are introduced for a temporary period, and Community Speedwatch enforcement is undertaken. Over the last couple of years, the annual speed reduction budget has been used to traffic calm the sites with the highest 85th percentile speeds.

Data has been collected for about 80 roads since July 2013; and there is currently a backlog of more than 20 requests for speed monitoring. Some data was collected before July 2013, using older, less reliable units. The extent of monitoring undertaken has been scaled back recently due to resource constraints.

Results

High level results, based on mean speed and 85th percentile speed for each site, are summarised below.

Figure H1. Cumulative profile of mean and 85th percentile speeds across the 79 sites identified by the public as having speeding problems

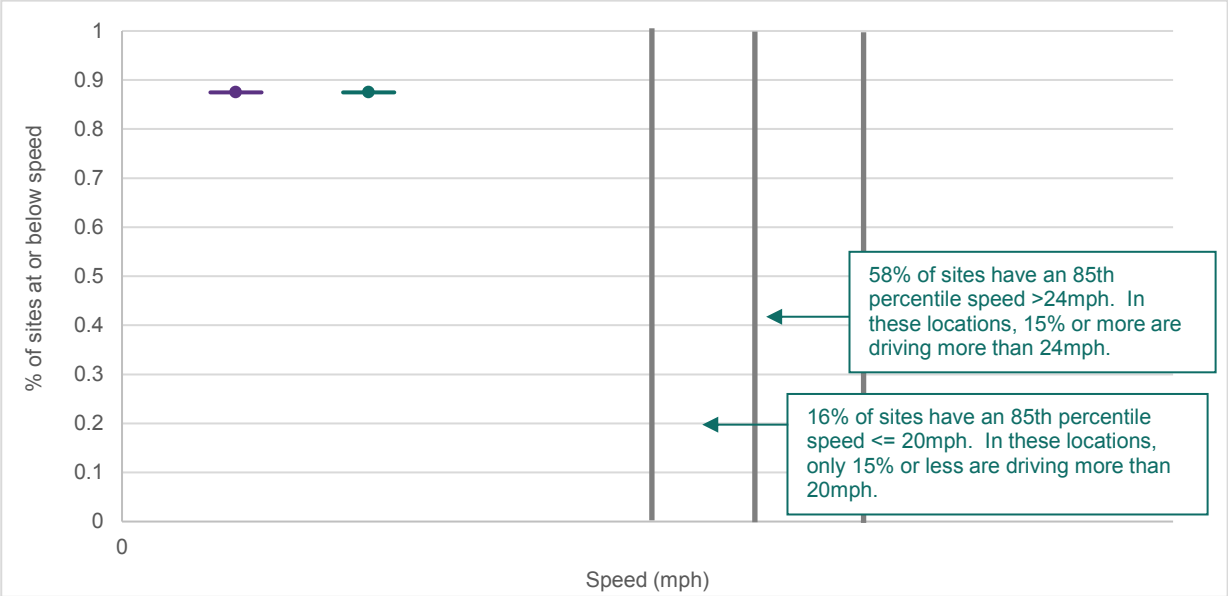


Table H4. Mean and 85th percentile speeds for the 79 sites identified by the public as having speeding problems

	Mean speed		85th percentile speed	
<=20 mph	49 sites	62%	13 sites	16%
20-24 mph	27 sites	24%	20 sites	25%
>24 mph	3 sites	4%	46 sites	58%
Total	79 sites	100%	79 sites	100%

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The results show that 58% of sites have an 85th percentile speed of >24mph. In these locations, 15% (or substantially more at some sites) are driving more than 24mph, and are categorised by the Council as 'speeding'. This shows that speeding remains a problem on some roads.

However, some of the roads identified by the public were found to have much lower speeds. On 16% of the identified sites, the 85th percentile speed is <=20mph, suggesting that incidents of speeding (e.g. driving more than 24mph) are relatively low. In these locations, the complaints are likely to have been in response to a small number of isolated incidents of excessive driving speeds, rather than a common problem.

H.6. Compliance by mode

Data collected by the Speed Detection Radar is categorised by vehicle type (bicycle, car, LGV, and HGV). Vehicle type is estimated from the length / size of the vehicle, but is subject to error. Nevertheless it gives an indication of how compliance varied by vehicle type.

As the number of monitoring days varies between sites, only those sites with 6, 7 and 8 days of data (and multiples of) have been used in the analysis – to ensure an appropriate representation of weekdays and weekends. Some sites had to be excluded, because the speed bin categories were not compatible with the majority of the sample. In total 26 sites were analysed, comprising data for 224,781 vehicles. All sites were located on 'minor local roads'.

The results presented below, suggest that compliance amongst HGV drivers is slightly lower than that amongst car / LGV drivers.

However, those driving excessively (>30mph) are more likely to be car or LGV drivers.

Note - This data relates to 'problem sites', rather than a representative sample of monitoring sites.

Figure H2. Cumulative speed profile by vehicle type

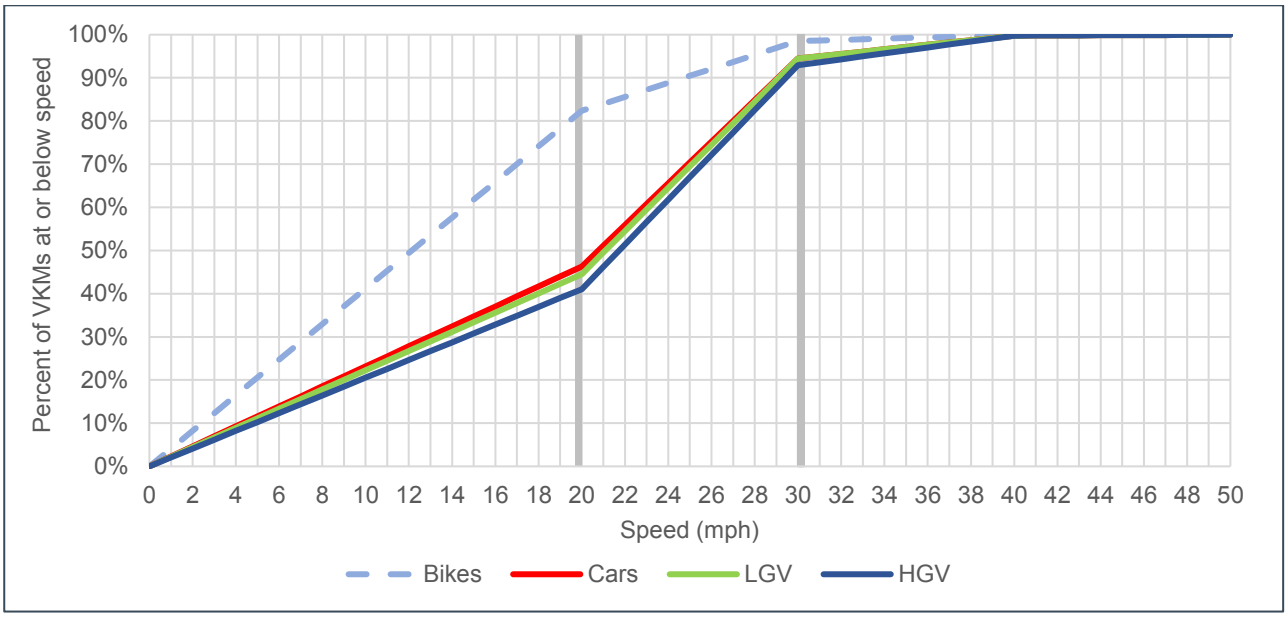

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Table H5. Speed compliance by vehicle type

	Bikes	Cars	Light Goods Vehicles (LGVs)	Heavy Goods Vehicles (HGVs)
% <=20 mph	82%+	46%	45%	**41%***
% <=30 mph	99%+	94%	93%	**98%***
Total no. of vehicles	22545	194475	6852	909

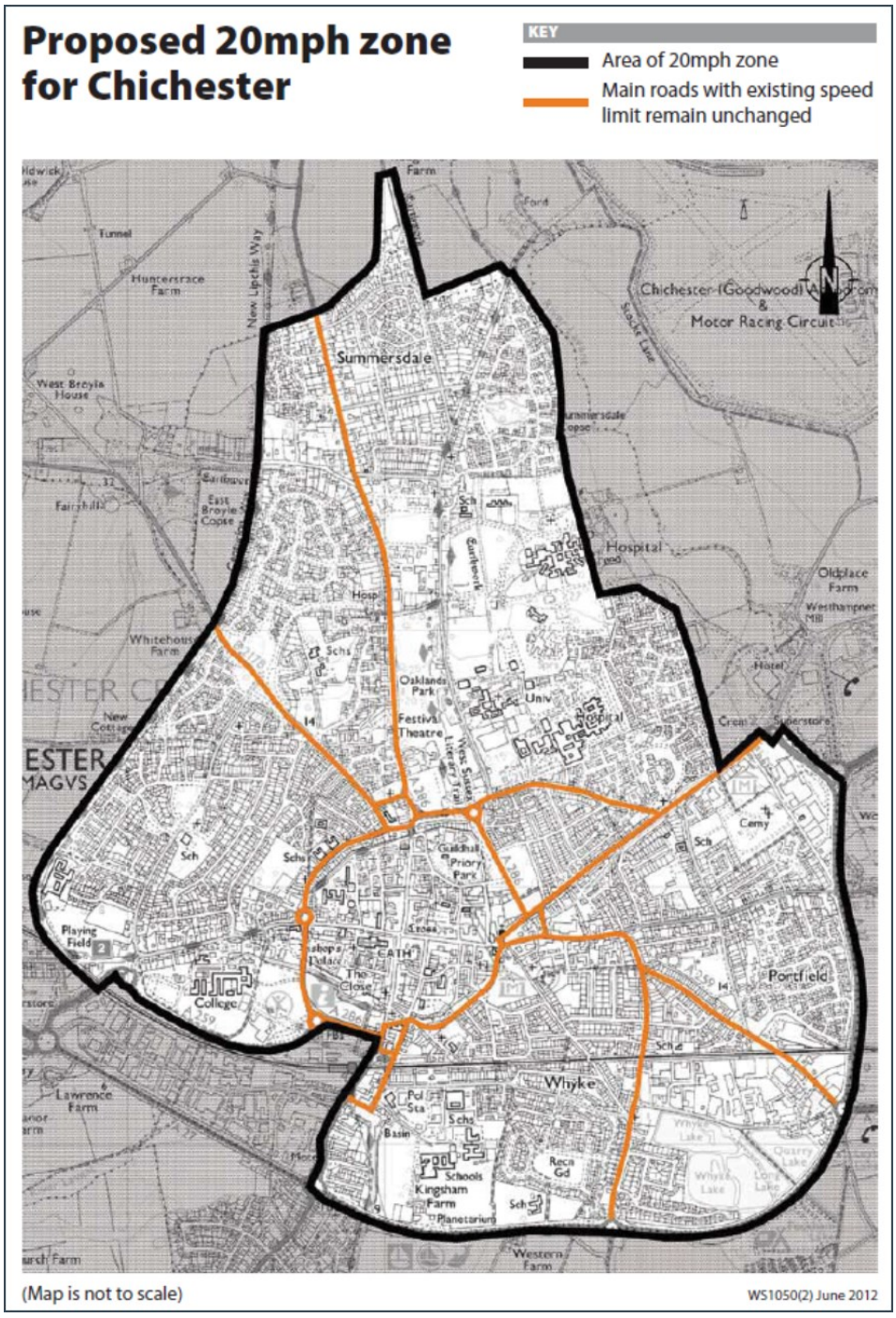
+ Significantly different to the corresponding figures for all other modes.
** Significantly different to the corresponding figures for cars and LGVs. No significant difference between the results for cars and LGVs.*

Appendix I. Chichester (R-AW7)

I.1. Scheme description (Predominantly residential and schools)

The Chichester scheme was proposed in 2010 and implemented in **July 2013**. It covers all residential streets in the City. The main strategic routes into the city have been excluded due to their strategic function.

Figure I1. Chichester 20mph scheme



The scheme operates on a 24 hour a day basis.

Supporting measures – Working in partnership with Sustrans, the Council ran a 12 month awareness and education campaign. Following implementation, a dedicated 20mph Officer was taken on (3 days/wk) to

increase awareness of the new limit, ensure compliance, and encourage take-up of active travel modes. Engagement activities were focused around various pop-up events, on-street interventions, and doorstep conversations in known 'hotspots' in the city for speed-related issues.

Speed limits and presence of pre-existing traffic calming measures in study area

The city centre area was already covered by a 20mph Limit (with occasional traffic calming), prior to the role out of the main scheme. However, in most of the residential areas, there was no pre-existing traffic calming measures in place, except on a few particular roads.

The majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (87%). No additional traffic calming measures have been installed as part of this scheme.

Signing approach (High frequency and visibility of signing)

Entrances to the new 20 mph limit are marked by post-mounted signs, occasionally accompanied by '20' roundels marked on the carriageway on red backgrounds. Within the 20mph limit area, most roads are very clearly marked with '20' roundels at frequent intervals. These are used as substitutes for repeater posts/plates, to reduce street clutter (and reduce costs).

Area characteristics

Many of the roads are older character with high levels of on-street parking. City Centre streets are narrow, reflecting the City's roman origins, and there is a clear distinction between residential and non-residential roads. Elsewhere, the street layout comprises self-contained communities and cul-de-sacs, which are generally not conducive to rat running.

The majority of the city is categorised as 'affluent', although there are a few pockets of less affluent areas. The proportion of the population aged under 16 varies from 9% and 19%.

See 20mph Case Study Descriptions Report for more information.

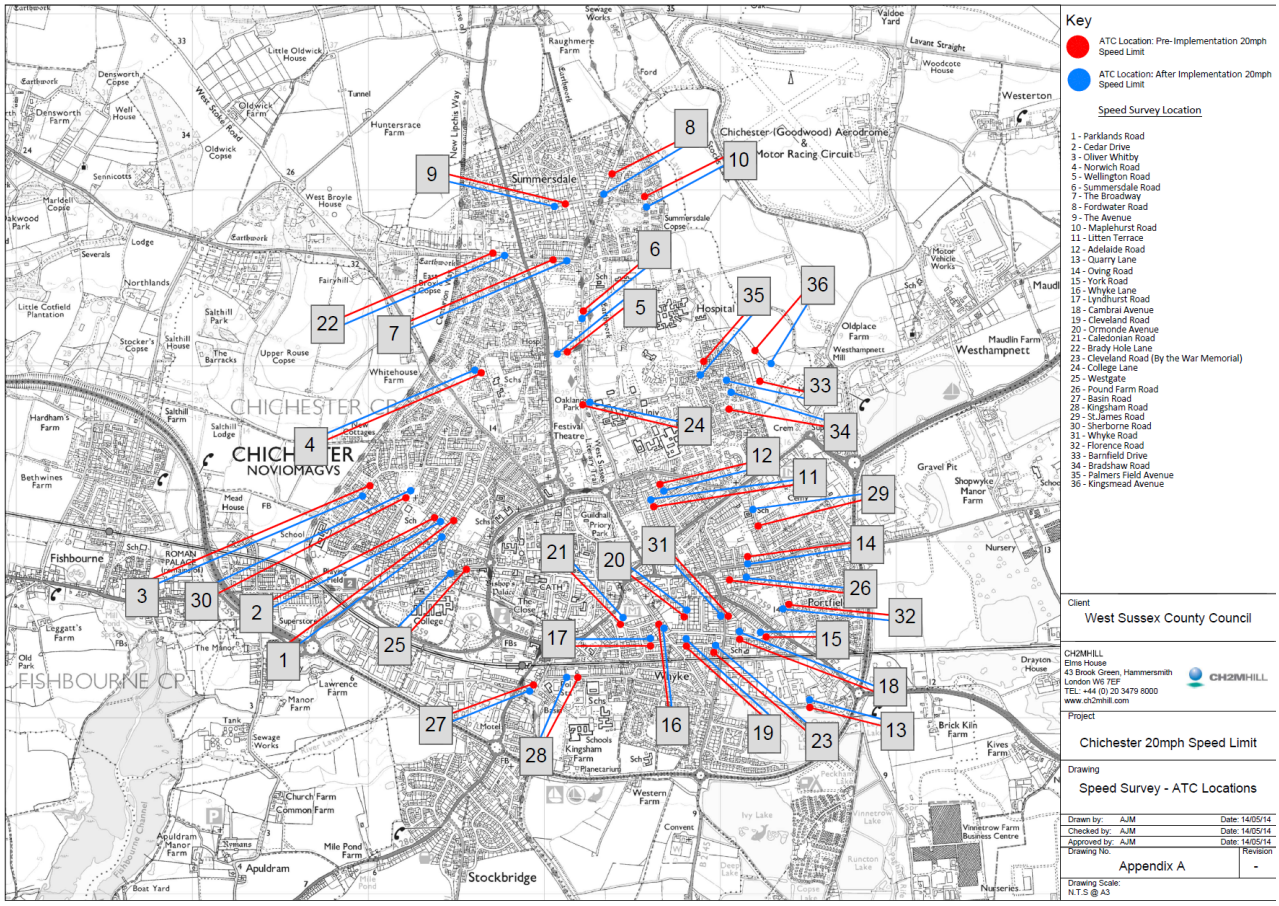
I.2. Monitoring approach

Speed and flow data was collected at 35 sites across the City.

Summary of monitoring approach in Chichester (20mph limit implemented July 2013)	
Number of monitoring sites	35
Location of sites	Sites chosen across the city, to cover typical areas and locations where higher speeds were likely (e.g. long, straight, wide roads).
Before and after timescales	Before = 16 sites monitored in March 2012 (15 months pre-impl); 4 sites in Jan 2011; 2 sites in Feb/Nov 2010; 3 sites in May/Jun 2009; 1 site in Jun 2008; 1 site in Jan 2007; 4 sites in Feb/May/Jun 2006; 5 sites in May 2005 (8 years pre-impl). After = 8 months post implementation (March 2014).
Data source	Automatic traffic counters (two rubber tubes laid across the carriageway, linked to a side road recorder box)
Duration	Before data generally collected over a 7-10 day period. Data collected in 2012 is based on weekdays only; data collected earlier tends to be collected on all days (including weekends). After data collected over a two week period, covering both weekdays and weekends.
Data available	Total vehicles, mean and 85th percentile speed, and speed bins by hour of day. No breakdown by day for before data.

	Speed bin categories used differ in the before and after datasets, limiting the scope for direct comparison. Raw data provided for before sites, but raw after data only provided for 23 of the 35 sites. Monitoring report produced in July 2014, *"Traffic Speed Assessment - Chichester 20mph Speed Limits Scheme"*.
Quality of data available for this study	**Limited-Moderate** Where possible, monitoring equipment was positioned at the same location in the before and after surveys to ensure direct comparison. However, due to on-street parking, there were a small number of sites where it was necessary to locate the equipment in a slightly different position on the street. Furthermore, the equipment used for the after surveys required one metre of clear road adjacent to a secure fixing point, which meant that some sample locations had to be moved. Before results are based on all survey days. For sites monitored in March 2012, this is limited to weekdays only, but for older sites, this sometimes includes weekends. After results are presented based on both a 5 day and 7 day average; but the figures reported are all based on a 7 day average. The before and after data is not, therefore, directly comparable. A small number of sites had existing traffic calming in place. Tubes more visible than radar and may influence driving speeds.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1i. West Sussex\1. Information Received\follow up data

Figure I2. Location of monitoring sites



I.3. Data quality

See above.

I.4. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	5
	20-24mph	19
	>24mph	11
	>30mph	0
Number of sites on:	Major strategic road	0
	Important local road	14
	Minor local road	21
Before sample size		Not available

The majority of monitoring sites were located no 'minor local roads', and the majority had a before mean speed of 20-24mph. Overall:

- 15 sites (43%) were on 'minor local roads' and had a before mean speed of 20-24mph; and,
- 9 sites (26%) were on 'important local roads' and a before mean speed of >24mph.

In total, 11 sites (31%) had a mean before speed exceeding 24mph.

I.5. Results[56]

I.5.1. Headline results

Context:

- Speeds were moderate in the before period, with a mean speed of 23.0mph, and an 85th percentile speed of 28.7mph; indicating that most vehicles were travelling below the speed limit. ***No flow data has been provided so these results are not flow weighted.***

Overall speed outcomes:

- Overall, the mean speed declined by -1.7mph. Faster drivers reduced their speed more, with the 85th percentile falling by 2.8mph, but the change was still small.

Table I1. Overall change, across monitored sites (unweighted)

Mix of 5 day and 7 day averages, 24hr	Before (1 to 4 years pre impl.)	After1 (8 months post impl.)	Diff1
Speed Limit	30mph	20mph	-
Average Mean speed (mph)	23.0	21.3	-1.7 (-7%)
Average 85th percentile speed (mph)	28.7	25.9	-2.8 (-10%)

The above metrics are not flow weighted.

[56] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1i. West Sussex\Task 3.6 Spot Speed Analysis\Chichester SPEED DATA ANALYSISv1.0.xls

I.6. Site specific analysis[57]

Change in mean speed - Across the 35 monitoring sites, the change in mean speed varied from +2.1mph (increase) to -5.4mph (decrease). Overall, 30 of the 35 sites (86%) recorded a reduction in average speed.

The number of sites with a mean speed of <=20mph increased from 5 before, to 15 sites after. However, the average remained above 20 at the majority of sites, indicating that a high proportion of drivers were not complying with the limit.

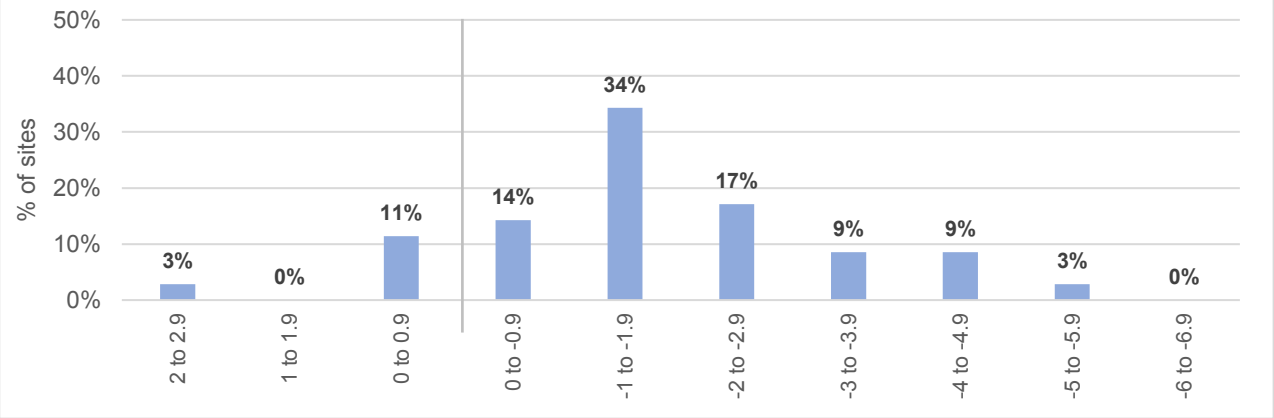
The number of sites with a mean speed of <=24mph increased from 24 before, to 27 sites after.

Table I2. Site specific analysis – overview

Description	Mean speed results	85th percentile speed results
Biggest increase / decrease	+2.1 mph (increase) -5.4 mph (decrease)	+0.4 mph (increase) -7.8 mph (decrease)
No. of sites reporting a reduction	30 out of 35 sites (86%)	32 out of 35 sites (91%)
No. of sites with a mean speed a) <=20mph b) <=24mph	a) Before = 5, After = 15 b) Before = 24, After = 27	N/A
No. of sites with an 85th percentile speed a) <=24mph b) <=30mph	N/A	a) Before = 2, After = 12 b) Before = 25, After = 31

Around half of sites (51%) recorded a reduction of between -1.0 and -2.9mph.

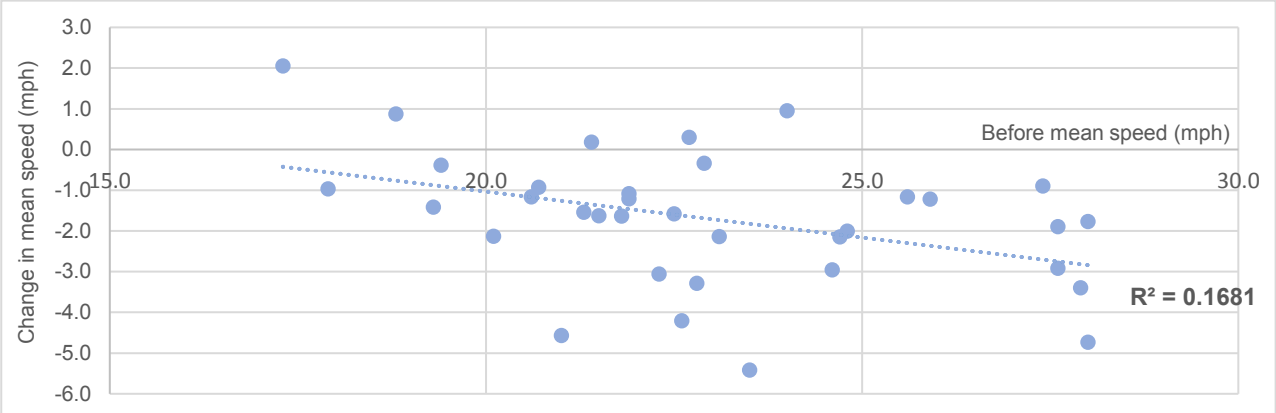
Figure I3. Change in mean speed - % of sites in each change band



[57] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1i. West Sussex\Task 3.6 Spot Speed Analysis\Chichester SPEED DATA ANALYSISv1.0.xls

Change in mean speed by before speed - Comparison of 'change in mean speed, against 'before mean speed' shows a downward trend.

Figure I4. Change in mean speed by before speed

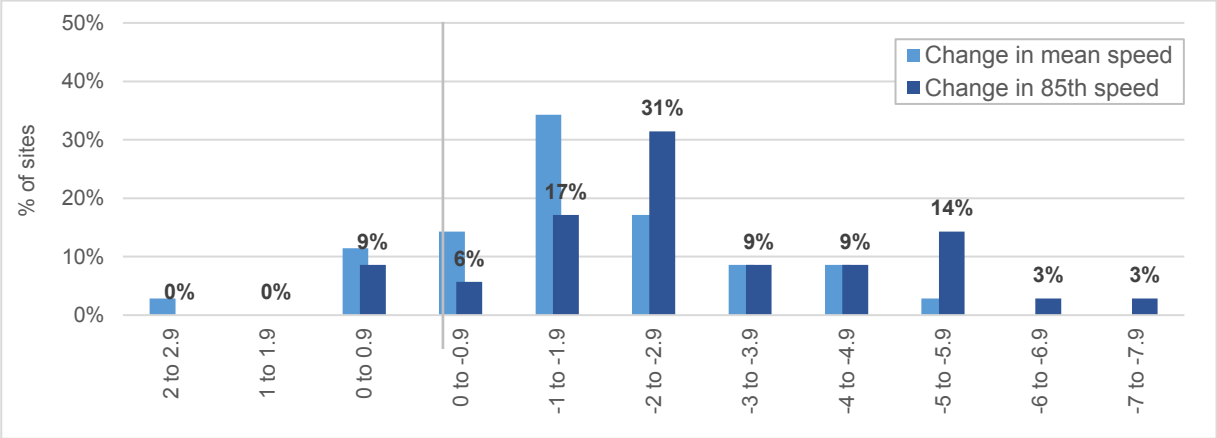


Change in 85th percentile speed – Overall, the change in 85th speed varied from +0.4mph (increase) to -7.8mph (decrease). Overall, 32 of the 35 sites (91%) recorded a reduction in average speed.

The number of sites with an 85th percentile speed of <=30mph increased from 25 to 31, suggesting fewer incidents of excessive speeds.

Around half of sites (49%) recorded a reduction of between -1.0 and -2.9mph, in the 85th percentile speed.

Figure I3. Change in 85th percentile speed- % of sites in each change band



Appendix J. Brighton (City Centre)

J.1. Scheme description (City centre and adjacent residential roads)

In 2010 a Scrutiny Committee recommended the implementation of 20mph limits across Brighton and Hove. Due to the size of the project, and availability of funds, the implementation of the scheme was staggered and was delivered in three separate phases:

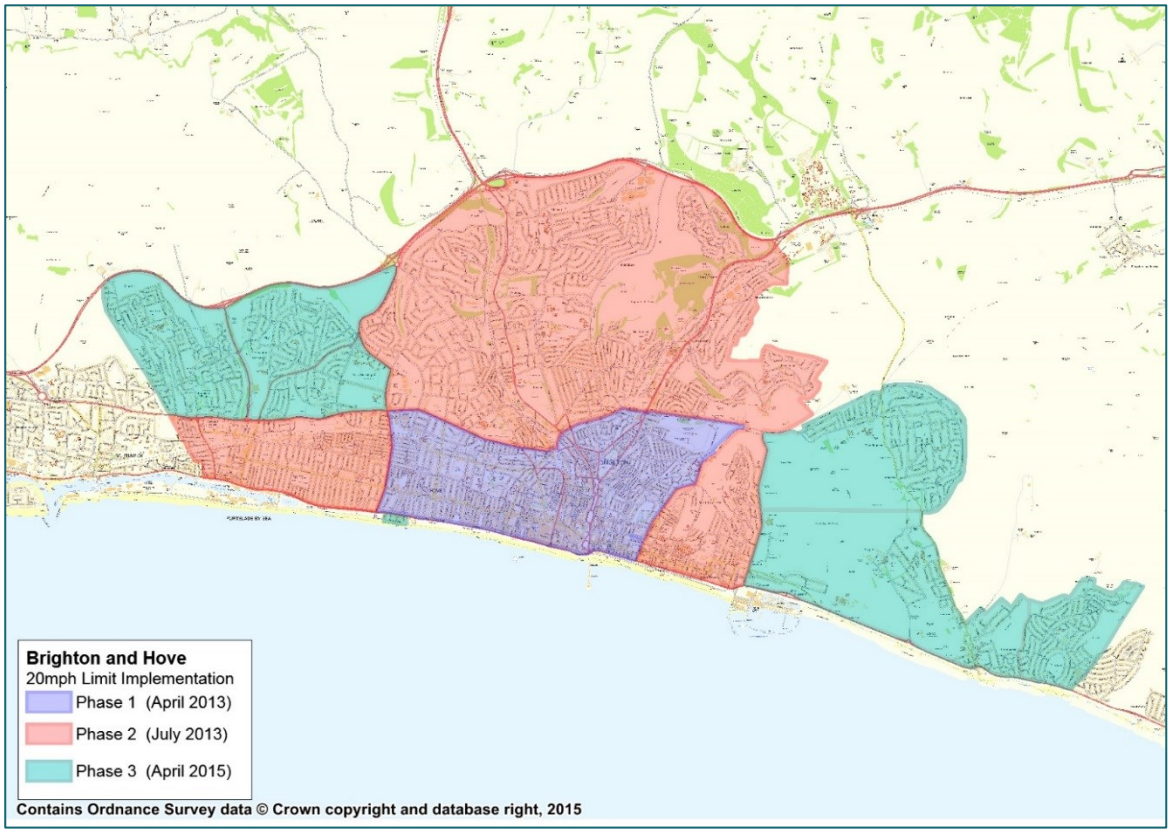
- Phase 1, comprising the city centre of Brighton and Hove was implemented in **April 2013**;
- Phase 2, consisting of the surrounding areas of Phase 1 was implemented in June 2014;
- Phase 3, which contains the remaining areas of Brighton and Hove was implemented in June 2015.

Phases 1 and 2 both form separate case studies for this research. This chapter focuses on Phase 2, which is a predominantly residential area.

The scheme covers the entirety of the administrative boundary of Brighton and Hove. Notable exceptions are main roads and key arterial routes, where, due to their strategic nature, 30mph limits remain in place. However, some A and B roads were included on the basis of flow, speeds, casualties, and layout; particularly in the city centre area. All limits operate 24 hours a day, seven days a week.

No additional traffic calming measures have been installed as part of this scheme.

Figure J1. Brighton 20mph Speed Limit Scheme (Phases 1 to 3)



Phase 1 covers the historic Brighton City Centre and adjacent residential areas, including parts of Hove. A number of A and B roads have been included in the scheme, including the A23, A270, A2010, and the B2066 and B2120.

Speed limits and presence of pre-existing traffic calming measures in study area

Prior to the implementation of the city-wide scheme, the area already had six pre-existing 20mph Zones or Limits in place, with a variety of physical traffic calming measures. This included the retail area between the Brighton Pavilion and Train Station.

Signing approach (Low-Moderate frequency and visibility of signing)

Entrances to the limit area are clearly marked with post-mounted 20mph signs. Most 'A' roads with a 20mph limit contain '20' roundels, which are occasionally accompanied by smaller lamppost-mounted repeater signs. On minor roads there are occasional '20' roundels on the carriageway or lamppost-mounted signs repeater signs, but these are rather sporadic.

Area characteristics

Phase 1 contains the historic city centre, comprising predominantly retail uses and narrow, straight roads. Much of the city centre was covered by an old pre-existing 20mph Limit. The current scheme has extended the coverage and included most of the strategically important A-roads.

The adjacent residential areas comprise predominantly straight roads of varying widths, with terraced housing or appartments, and substantial on-street parking.

J.2. Monitoring approach

Brighton Council has undertaken extensive monitoring across all three phases of implementation. For Phase 1, automatic traffic counts (by vehicle classification) and spot speed surveys were undertaken at 50 20mph sites before implementation (in Jun 2012) and after implementation (in Sep 2013, May 2014, and Jun 2015).

Summary of monitoring approach in Brighton – Scheme impl. April 2013	
Number of monitoring sites	47 sites, on 20mph roads, with before and after data in all monitoring years.
Location of sites	Representative locations across the city, reflecting a range of locations and road types. Sample also includes some sites where complaints about speeding have been received from the public.
Before and after timescales	Before = 10 months pre-impl (Jun 2012) – 50 sites After 0 = 5 months post-impl (Sep 2013) – 97 sites After 1 = 13 months post-impl (May 2014) – 93 sites After 2 = 26 months post-impl (Jun 2015) – 100 sites
Monitoring approach	Automatic traffic counters (two rubber tubes laid across the carriageway, linked to a side road recorder box)
Monitoring duration	7 days per site, 24 hrs/day
Data available	Total vehicles (5 day and 7 day average) Mean speed and 85th percentile speed, % exceeding limit 5mph speed bins (+ above metrics) by hour of day and day of week A number of cabinet reports and internal monitoring reports present findings from the data, but no formal monitoring report has been produced to date.
Quality of evidence	**Moderate** Large sample of representative locations across scheme area. But, sample also includes some sites where complaints about speeding have been received from the public; and some with existing traffic calming. 7 days of data, covering Monday to Sunday. Before and After1 / After2 data collected at same time of year, in neutral month.

	Tubes more visible than radar, and may influence driving speeds.
File location for data	P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\1. Info Received\2017 - Peter Brett info\2017 Data Issue

Similar data is also available for Phases 2 and 3.

J.3. Data quality

See above.

J.4. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	16
	20-24mph	14
	>24mph	17
	>30mph	*0*
Number of sites on:	Major strategic road	1
	Important local road	11
	Minor local road	35
Before mode share	Motorcycles	-
	Cars	-
	LGVs	-
	Buses	-
	HGVs	-
Before sample flow	7 day average	1,281,151

J.5. Results[58]

J.5.1. Headline results

Context:

- Speeds were moderate in the before period, with a mean speed of 23mph and an 85th percentile speed of 28.2mph; but most people were travelling below 30mph.
- There was little change in flow between the two monitoring periods.
- The before flow at individual sites varied from 261 veh/day (site 52) to 16,725 veh/day (site 14).

Overall speed outcomes:

- Mean speeds fell by -1.7mph in the first 18 months, and by -1.3mph in the following period.
- The 85th percentile speeds fell by a similar amount, by -1.9mph in the first 18 months, and by -1.3mph in the following period.

Table J1. Overall change, across monitored sites – Phase 1

7 day, 24hr average	Before (10 months pre impl.)	After1 (6-18 months post impl.)	Diff1	After2 (18-30 months post impl.)	Diff2
Speed limit	30mph	20mph	-	20mph	-
Flow (vehicles)	183,022	186,562	+3540 (2%)	183,354	+332 (0%)
Average Mean speed (mph)	23.0	21.3	-1.7 (-7%)	21.7	-1.3 (-6%)
Average 85th percentile speed (mph)	28.2	26.2	-1.9 (-7%)	26.9	-1.3 (-5%)

The above metrics are all flow weighted.

J.6. Site specific analysis (new 20mph roads)[59]

Overall change - Across the 47 monitoring sites on new 20mph roads, the change in mean speed varies from +7.6mph (increase) to -9.0mph (decrease) - based on the After2 period. Overall, 36 of the 47 sites (77%) recorded a reduction in average speed, 11 (23%) recorded an increase, and 0 (0%) recorded no change. The number of sites with a mean speed of <=24mph increased from 30 sites before, to 41 sites after.

The range of speed changes was slightly bigger for 85th percentile speeds; but a similar proportion experienced a reduction.

Table J2. Site specific analysis – overview (Before vs After2)

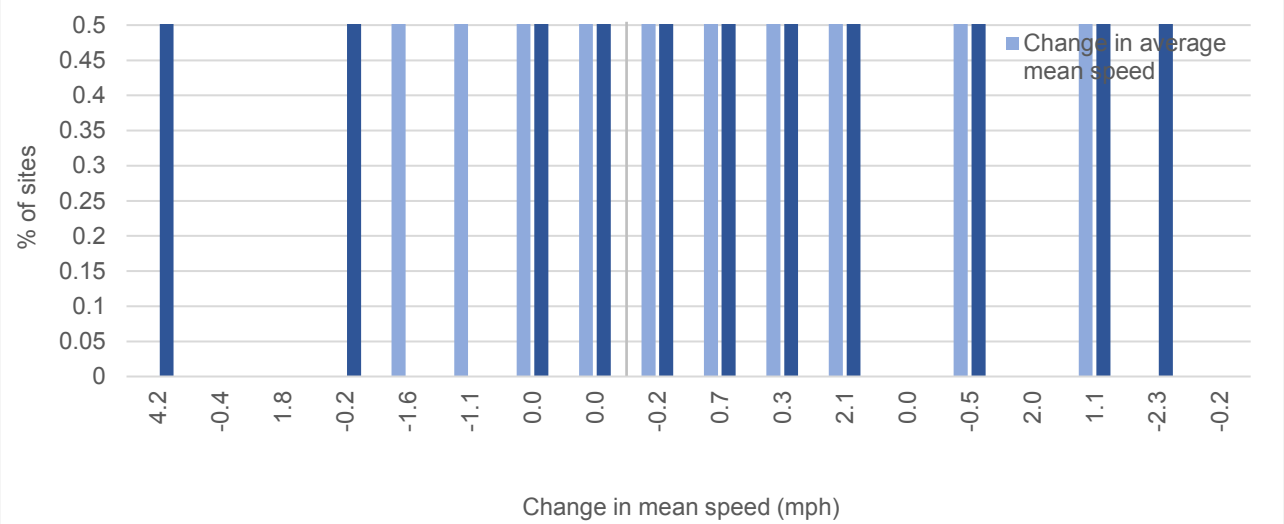
Description	Mean speed results	85th percentile speed results
Biggest increase / decrease	+3.9 mph (increase) -7.2 mph (decrease)	+7.6 mph (increase) -9.0 mph (decrease)
No. of sites reporting a reduction	36 out of 47 sites (77%)	38 out of 47 sites (81%)
No. of sites with: - mean speed <=24mph - 85th percentile speed <=30mph	Before = 30, After = 41	Before = 35, After = 45

[58] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\Task 3.6a Spot Speed Analysis (Phase 1)\ Brighton Ph1 SPEED DATA ANALYSIS_20mph.xls

[59] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1a. Brighton and Hove\Task 3.6a Spot Speed Analysis (Phase 1)\ Brighton Ph1 SPEED DATA ANALYSIS_20mph.xls

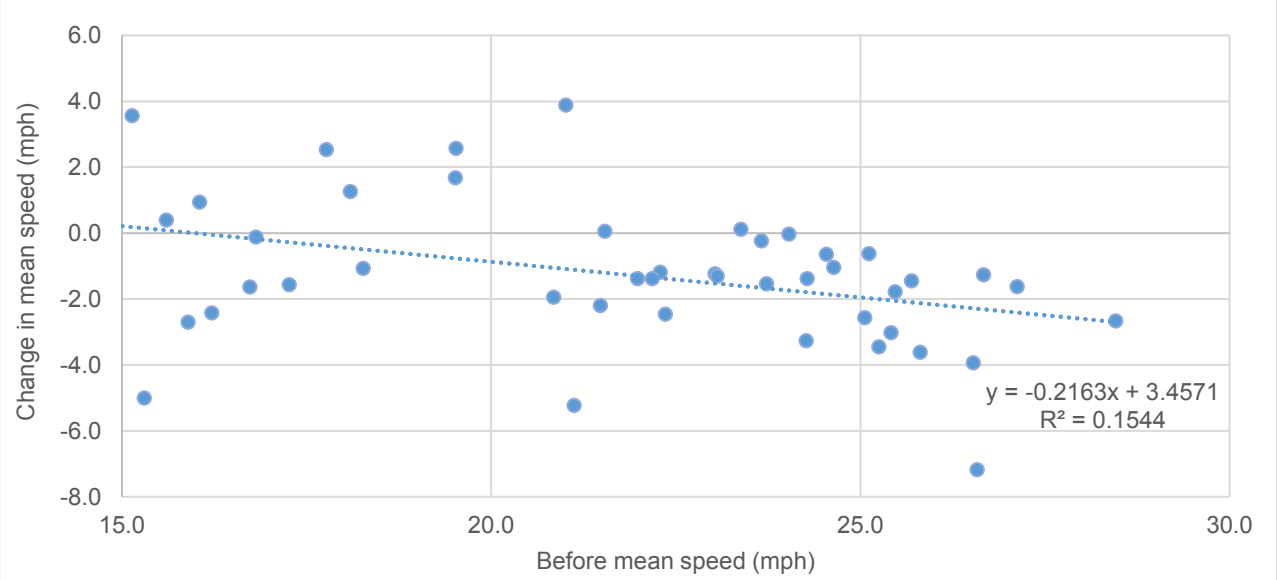
Some 49% of sites experienced a reduction in mean speed of between 1 and 3mph; and 70% of sites experienced a reduction in mean speed of between 0 and 4mph.

Figure J2. Change in average mean (Before vs After2) - % of sites in each change band



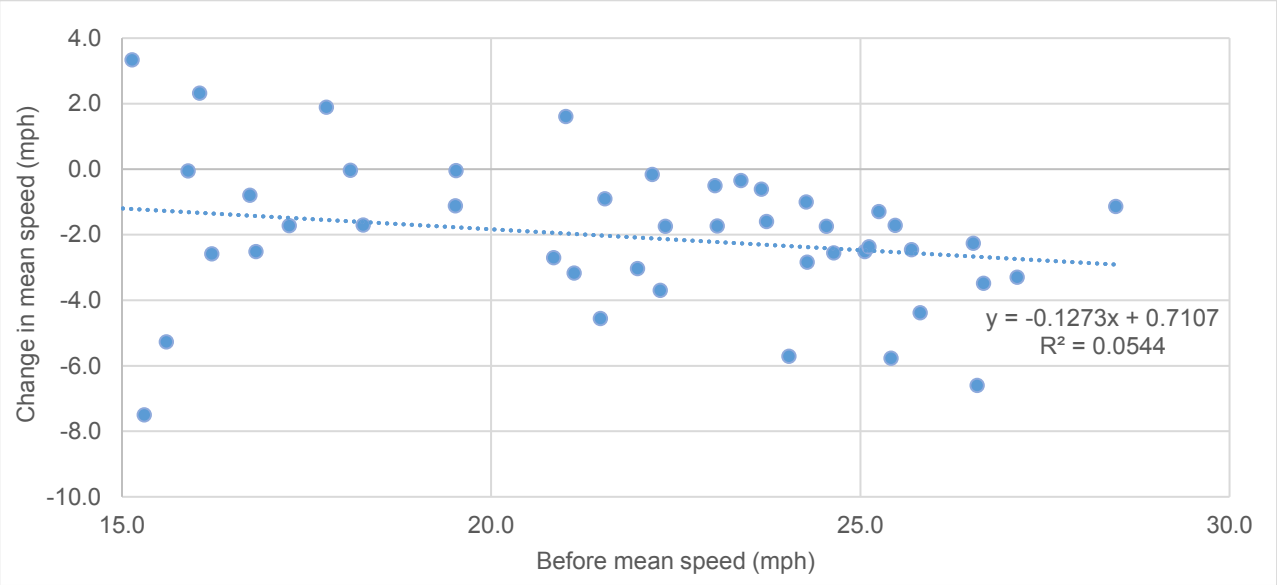
Change by before mean speed - Comparison of 'change in mean speed' against 'before mean speed' shows a slight downward trend.

Figure J3. Change in mean speed (Before vs After2) by 'before' mean speed



Similarly, comparison of 'change in 85th percentile speed' against 'before mean speed' also shows a slight downward trend.

Figure J4. Change in 85th percentile speed (Before vs After2) by 'before' mean speed



Appendix K. Winchester (City Centre)

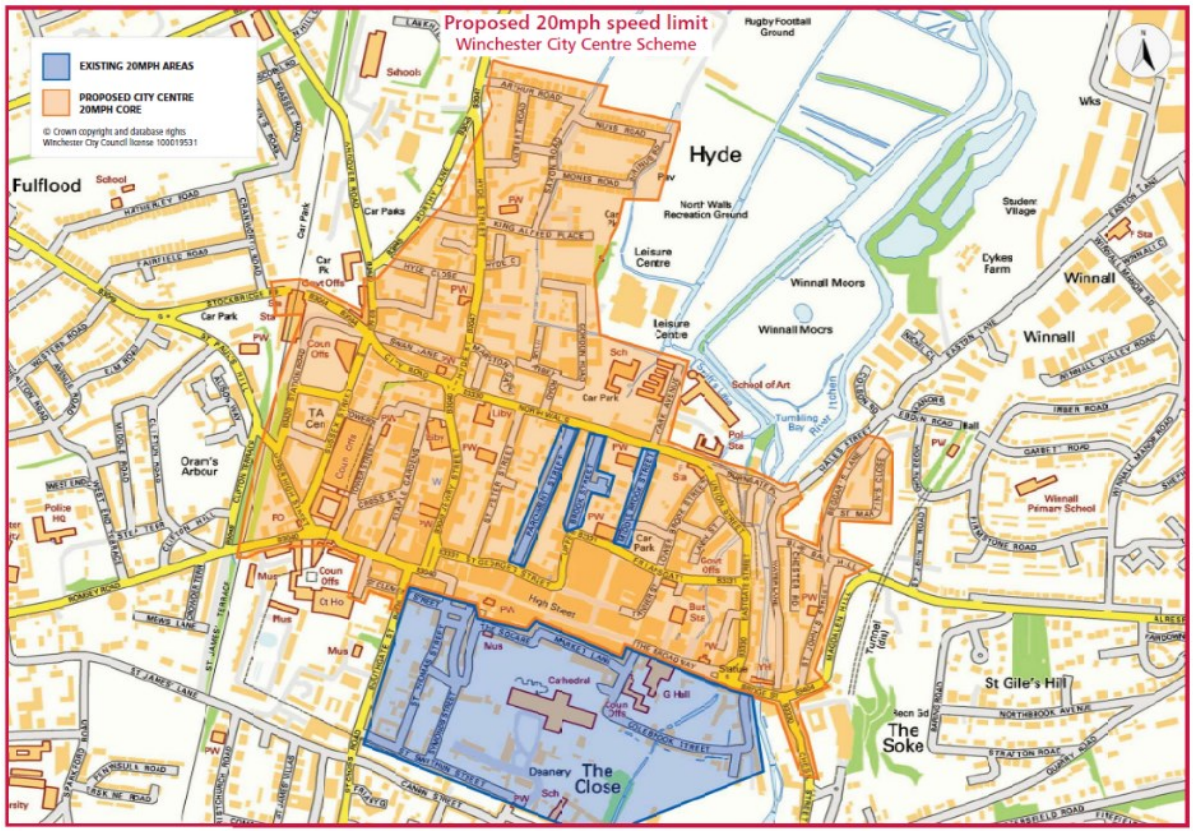
K.1. Scheme description (Predominantly residential and schools)

The scheme includes the historic city centre, including a number of B roads which circulate the pedestrianised centre; and residential areas in the city centre and small area to the north. The scheme was implemented in **September 2014**, as part of the Local Sustainable Transport Fund (LSTF) package delivered by Hampshire County Council.

The area is well defined as it matches the location of the old city walls. The City Centre is designated as a conservation area and an important tourist destination; and as such appropriate measures have been taken to make sure that the signage associated to the scheme don't cause "eye sores" within the historic city centre. Residential roads typically comprise historic terraced housing, very narrow streets, and some on-street parking where the road has sufficient width.

The scheme operates on all days, and across all hours.

Figure J1. Winchester City Centre 20mph Scheme



Speed limits and presence of pre-existing traffic calming measures in study area

The scheme includes some existing 20mph limits around the historic Cathedral area, and there are also some 20mph zones (with road humps and chicanes) on a small number of historic residential streets very close to the City Centre. Many of the roads in the area are narrow lanes with historic builds lying close to the road.

The majority of 20mph roads within the study area are 'New 20mph (signed only)' roads (95%). No additional traffic calming measures were installed as part of this scheme.

Signing approach (High frequency and visibility of signing)

Entrances to the 20 mph scheme are clearly marked with post-mounted signs on both sides of the road. Much of the retail area inside the limit is pedestrianised, however non-pedestrianised streets have '20' roundels markings on the carriageway.

The north of the area is primarily residential and streets are often narrow with parking on both sides of the carriageway. Entrances to the area are clearly marked by post-mounted 20 mph signs, and roads inside the limit contain many '20' roundels on the road, often more than once on a carriageway.

Area characteristics

Residential roads typically comprise historic terraced housing, straight and very narrow streets, often one-way, and some on-street parking where the road has sufficient width.

The area is categorised as 'affluent'. The proportion of the population under 16 varies from 10% to 26%.

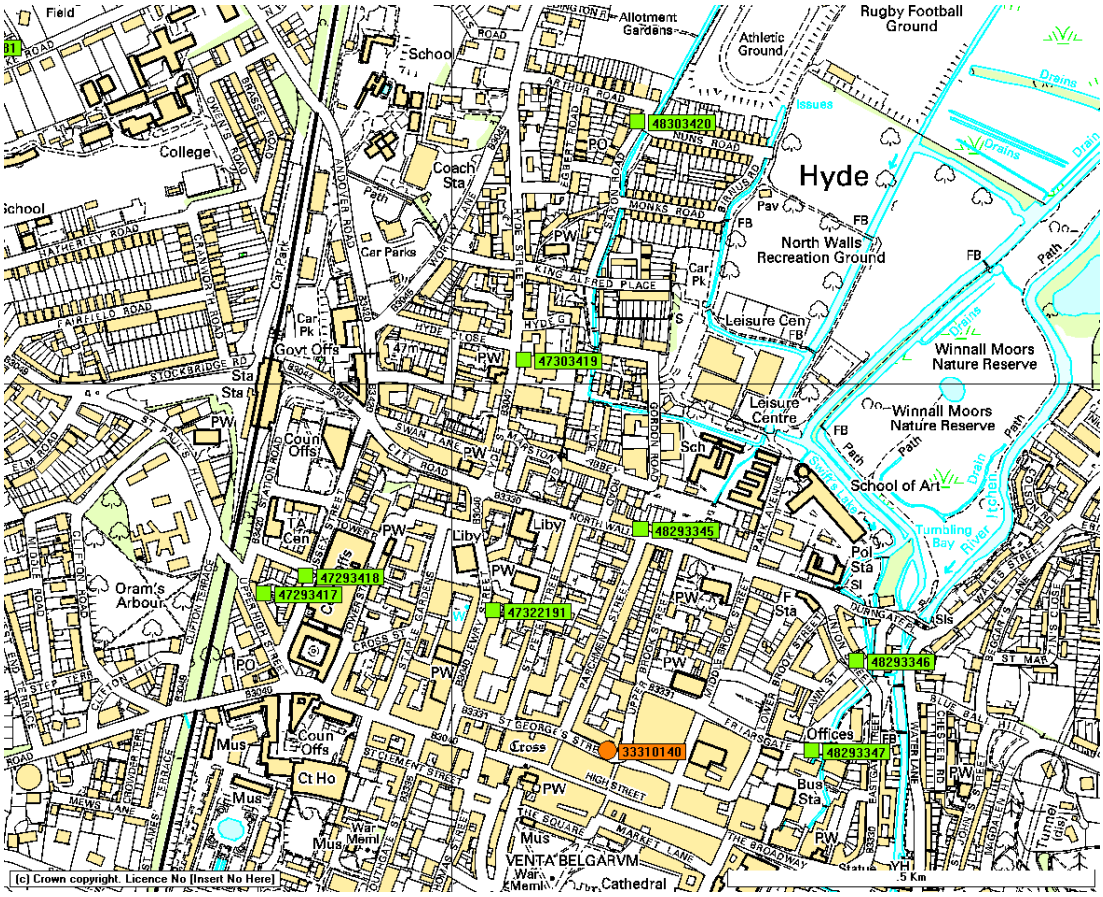
See 20mph Case Study Descriptions Report for more information.

K.2. Monitoring approach

Speed and flow data was collected at 11 sites within the City Centre, before and after implementation.

Summary of monitoring approach in Chichester (20mph limit implemented Sep 2014)	
Number of monitoring sites	11 (on 9 20mph roads)
Location of sites	Sites chosen across the city, to cover typical areas and locations.
Before and after timescales	Before = 12-30 months pre-impl. Surveys undertaken between April 2012 and September 2013. 1 site in Apr 2012, 1 in Apr 2013, 3 in Jul 2013, 6 in Sep 2013. After = 7-8 months post impl. Surveys undertaken in April – May 2015.
Data source	Speed detection radar.
Duration	Before and after data collected over a 7 day period.
Data available	Total vehicles, mean and 85th percentile speed, and speed bins by hour of day. Traffic flow data also collected, allowing the speed data to be weighted. Raw data has been provided in spreadsheet format, for each of the 9 sites. The data output is disaggregated by site, day, hour period, and direction. No mode split data provided. No monitoring report provided.
Quality of data available for this study	**Moderate** The before and after data was collected in different months, which means that the data is not directly comparable for all sites. Radar less visible than tubes – less likely to influence driving speeds.
File location for data	P:\GBBMA\HandT\CS\projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1c. Winchester\1. Information Recieved\Data from HCC and WCC\Data from WCC\Speed, Flow Data\ - 130730 North Walls, Union Street, Friarsgate.xls - 130909_ Upper High St, Sussex St, Hyde St, Saxon Road.xlsx - 130429.xls

Figure J2. Location of monitoring sites



Site ID	Location	Direction	Before survey	After survey
33310140	B3331 St George's Street	Westbound	22-29/04/2013	22-29/04/2015
47293417	B3420 Upper High Street	Northbound	06-13/09/2013	22-29/04/2015
47293418	Sussex Street	Southbound	06-13/09/2013	22-29/04/2015
47303419	Hyde Street (nr Hyde Close)	Southbound / Northbound	06-13/09/2013	22-29/04/2015
48293345	North Walls (nr j/w Parchment St)	Eastbound	19-26/07/2013	22-29/04/2015
48293346	Union Street(adj to Lawn St)	Southbound	19-26/07/2013	22-29/04/2015
48293347	Friarsgate	Westbound	19-26/07/2013	22-29/04/2015
48303420	Saxon Rd (btwn Monks Rd & Nuns Rd)	Southbound / Northbound	06-13/09/2013	22-29/04/2015
47322191	Jewry Street	Oneway	16-23/04/2012	07-15/05/2015

K.3. Data quality

See above.

K.4. Site characteristics

Characteristics		
Number of sites with mean before speed:	<=20mph	4
	20-24mph	2
	>24mph	5
Number of sites on:	Major strategic road	0
	Important local road	9
	Minor local road	2
Before flow (7 day average)	-	85,731

The majority of monitoring sites were located no 'important local roads'. There was a range of before mean speeds.

K.5. Results[60]

K.5.1. Headline results

Context:

- Speeds were moderate in the before survey, with a mean speed of 22.2mph, and 85th percentile speed of 26.8mph.
- The flow (7 day average) was slightly lower in the after survey period, 83716 vehicles compared with 85731 vehicles in the after period.

Overall speed outcomes:

- Overall, the mean speed declined by just -0.7mph.
- The 85th percentile speed showed very little change, falling by just -0.2mph after 7-8 months. **This suggests that, in general, faster drivers did not reduce their speed more than slower drivers.**

Figure J3. Cumulative speed distribution, across all vehicles monitored

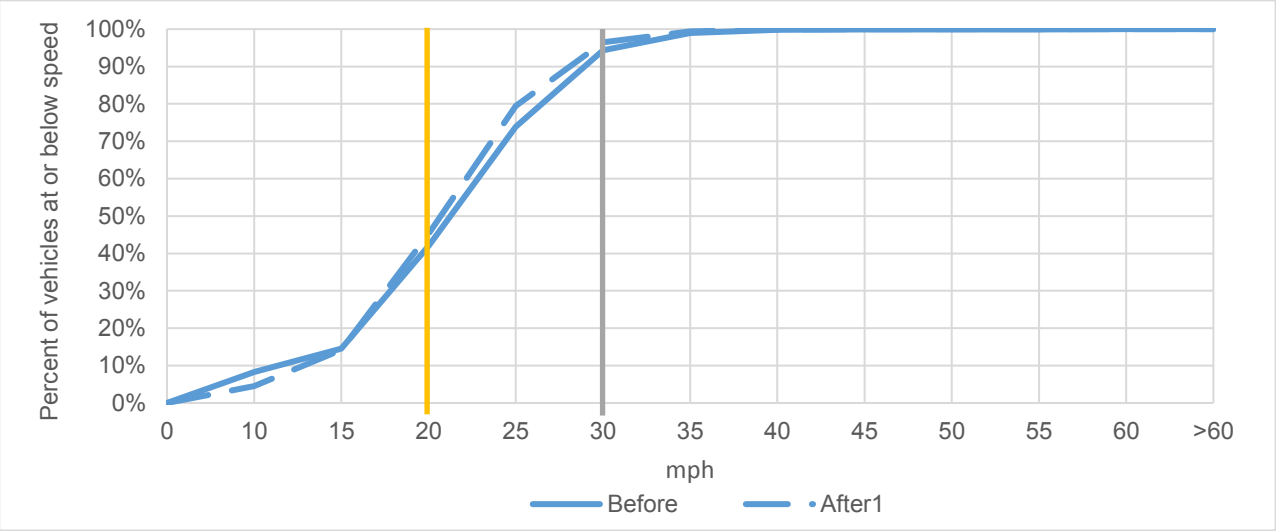


Table J1. Overall change, across monitored sites

7 day, 24hr average	Before (12-30 months pre impl.)	After1 (6-18 months post impl.)	Diff1
Speed limit	30mph	20mph	-
Flow (vehicles)	85,731	83,716	-2015 (-2%)
Average Mean speed (mph)	22.2	21.5	-0.7 (-3%)
Average 85th percentile speed (mph)	26.8	26.6	-0.2 (-1%)
% <=20mph	42%	45%	+3%
% >24mph	33%	27%	-5%
% >30mph	*6%*	*4%*	*-2%*

The above metrics are all flow weighted.

[60] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1c. Winchester\Task 3.6 Spot Speed Analysis\Winchester City Centre SPEED DATA ANALYSISv1.1.xls

K.5.2. By road type

In general:

- Road type / function appears to be a more important determinant of speed than whether the road is signed 20mph or 30mph. Speeds on 'important local roads' are faster than those on 'minor local roads' in both the before and after scenarios, and the difference between road types is much greater than the before and after difference.
- The majority of monitoring sites were on ‘important local roads’, and the results are broadly comparable with those presented above.
- Only two of the monitoring sites (Saxon Road – north and southbound) were on a ‘minor local road’. These sites actually show an increase in speed before and after implementation. In both cases, the before mean speed was very low (just 14.0 and 11.3mph), and the 7 day average flow was below 250 vehicles in both periods.

Figure J4. Cumulative speed distribution, by road type

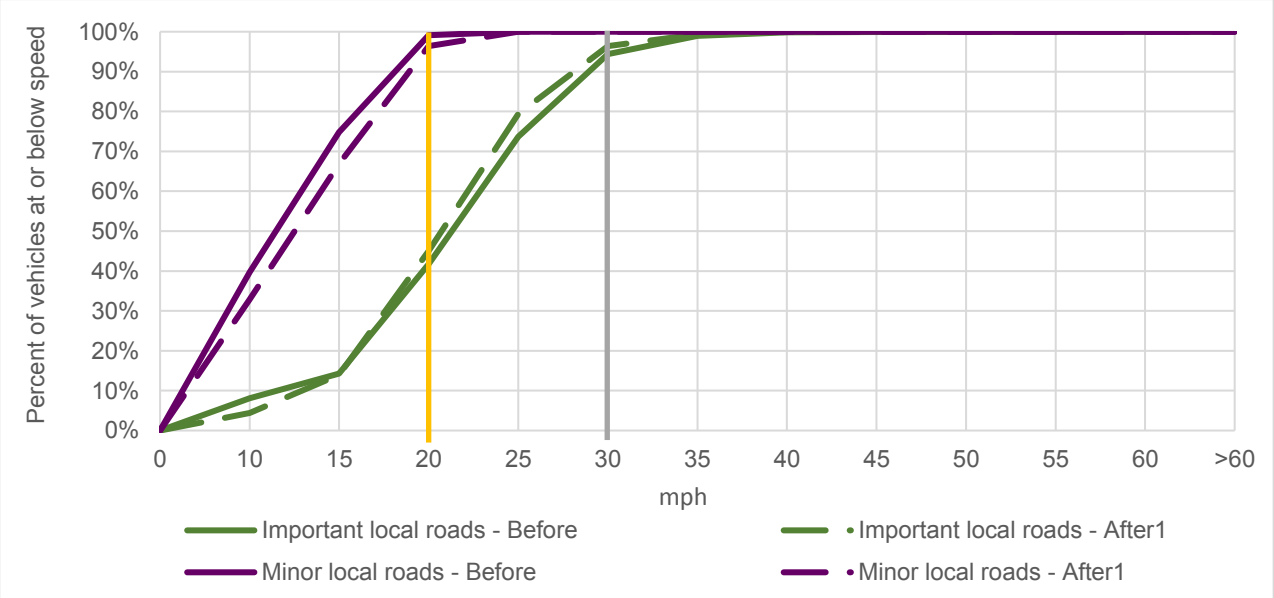


Table J2. Overall change, by road type

	Important local roads			Minor local roads		
	Before, After1, Difference			Before, After1, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Flow (vehicles)	85140	83294	-1846	468	359	-109
% <=20mph	42%	45%	+3%	99%	96%	-3%
% >24mph	33%	27%	-5%	0%	3%	+3%
% >30mph	6%	4%	-2%	0%	0%	0%

The above metrics are all flow weighted.

K.5.3. By before mean speed

In general:

- The biggest reduction in speed occurred on roads with a mean before speed of >24mph.
- There was very little change on roads with a lower mean before speed.

Figure J5. Cumulative speed distribution, by mean before speed

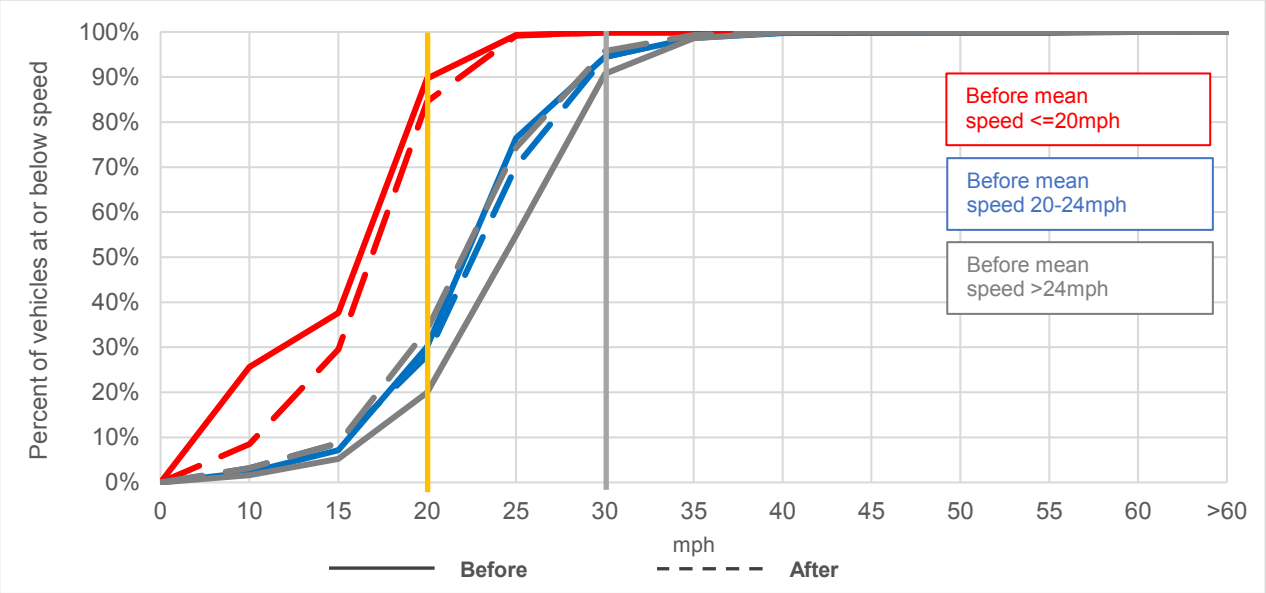


Table J3. Overall change, by mean before speed

	Mean before speed <=20mph			Mean before speed 20-24mph			Mean before speed >24mph		
	Before, After, Difference			Before, After, Difference			Before, After, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-	30mph	20mph	-
Flow (vehicles)	23017	21885	-1132	27976	27479	-497	34615	34289	-326
% <=20mph	90%	85%	-5%	30%	28%	-2%	20%	34%	+14%
% >24mph	3%	4%	1%	33%	38%	5%	52%	34%	-18%
% >30mph	0%	0%	0%	6%	6%	0%	9%	4%	-5%

The above metrics are all flow weighted.

K.5.4. Comparison with TomTom results

Speeds recorded in spot speed surveys are typically higher than those recorded by TomTom devices.

However:

- the shape of the profile curves are similar; and
- both sets of data show a small reduction in vehicles speeds (slightly higher in the TomTom data than the spot speed data).

The specific shape of the spot speed curve will be influenced by the specific characteristics of the sample of monitoring sites. In contrast the TomTom curve captures speeds in all 20mph roads in the scheme area.

Figure J5. Cumulative speed distribution – spot speed vs TomTom data

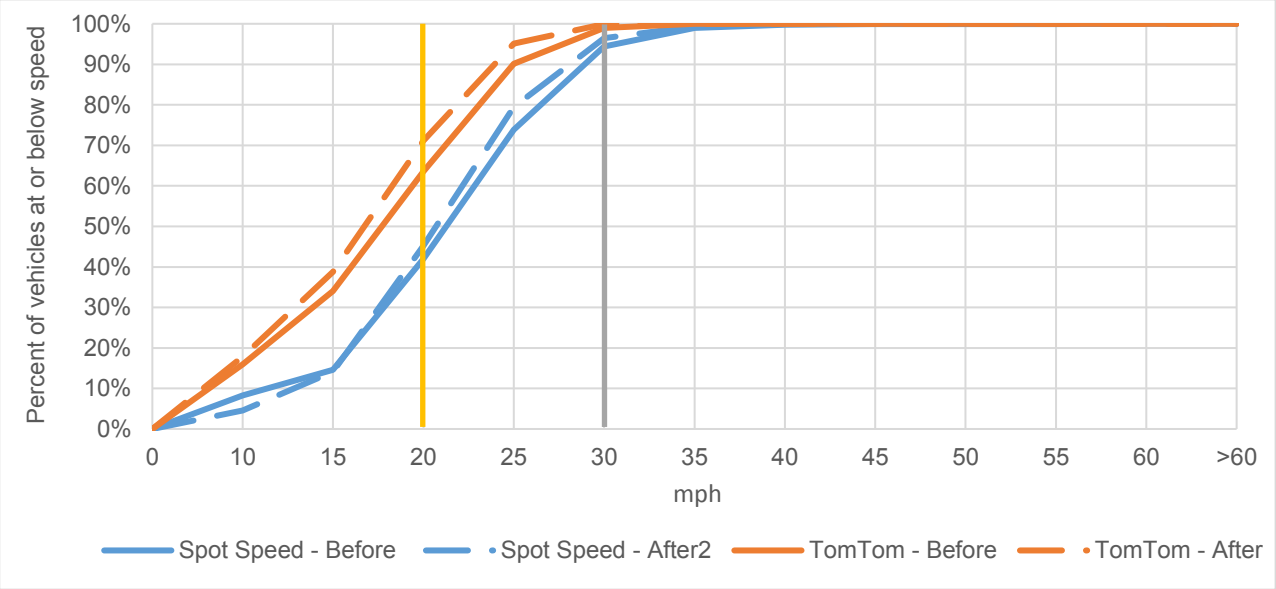


Table J4. Overall change – spot speed vs TomTom data

	Spot Speed Data			TomTom Data		
	Before, After2, Difference			Before, After, Difference		
Speed limit	30mph	20mph	-	30mph	20mph	-
Sample	600,113 vehicles	585,998 vehicles	-2%	63944 veh-kms	79548 veh-kms	+24%
% <=20mph	42%	45%	+3%	64%	71%	+8%
% >24mph	33%	27%	-5%	13%	7%	-6%
% >30mph	6%	4%	-2%	1%	0%	-1%

The above metrics are all flow weighted.

K.6. Site specific analysis[61]

Overall - Across the 11 sites, the change in mean speed varied from +1.9mph to -3.6mph. Six of the 11 sites recorded a reduction.

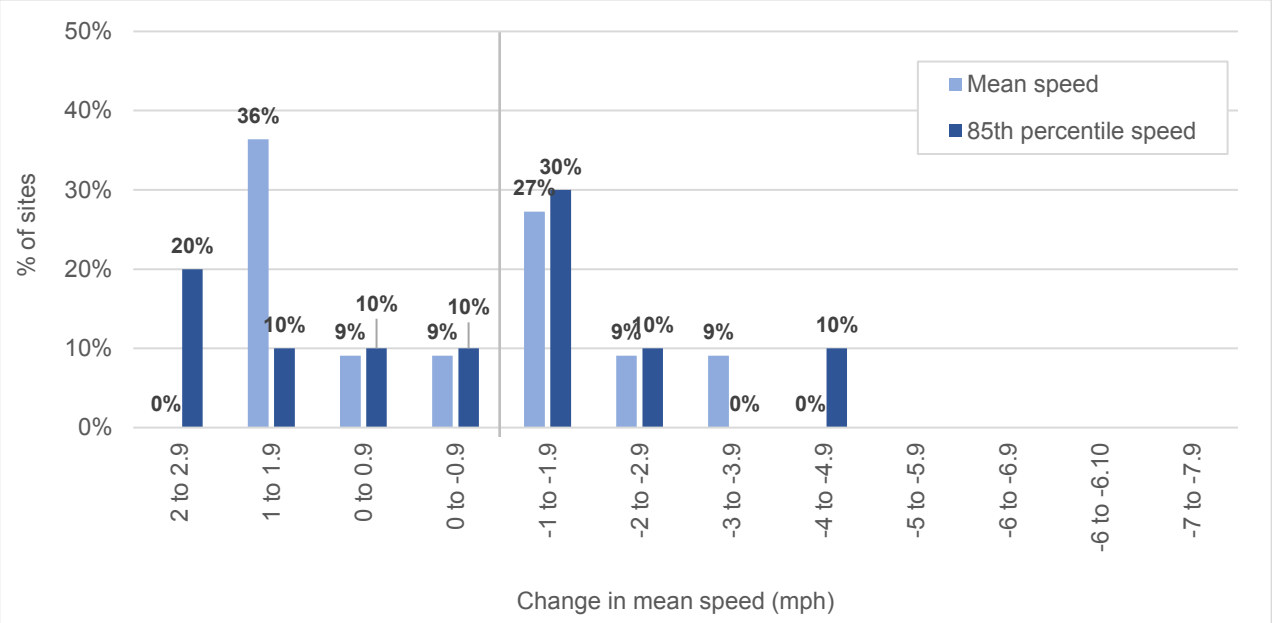
The change in 85th percentile speeds varied from +3.3mph to -4.3mph. Six of the 11 sites (the same sites as above) recorded a reduction.

Table J5. Site specific analysis - overview

Description	Mean speed results	85th percentile speed results
Biggest increase / decrease	+1.9 mph (increase) -3.6 mph (decrease)	+3.3 mph (increase) -4.3 mph (decrease)
No. of sites reporting a reduction	6 out of 11 sites (55%)	6 out of 11 sites (55%)
No. of sites with: - mean speed <=24mph - 85th percentile speed <=30mph	Before = 6, After = 8	Before = 6, After = 9

The most common change in mean speed was actually an increase of 1 to 1.9mph; a -1 to -1.9mph decrease for change in 85th percentile speed.

Figure J6. Change in average mean and 85th percentile speeds - % of sites in each change band



[61] P:\GBBMA\HandT\CS\Projects\5133131- Provision of 20mph Research\40 Technical\Case Studies\1c. Winchester\Task 3.6 Spot Speed Analysis\Winchester City Centre SPEED DATA ANALYSISv1.1.xls

Change by before mean speed - Comparison of 'change in mean speed' against 'before mean speed' shows a slight downward trend. Sites with a higher before speed generally recorded a larger decline in mean speeds

Similarly, comparison of 'change in 85th percentile speed' against 'before mean speed' also shows a slight downward trend.

Figure J7. Change in mean speed (Before vs After1) by 'before' mean speed

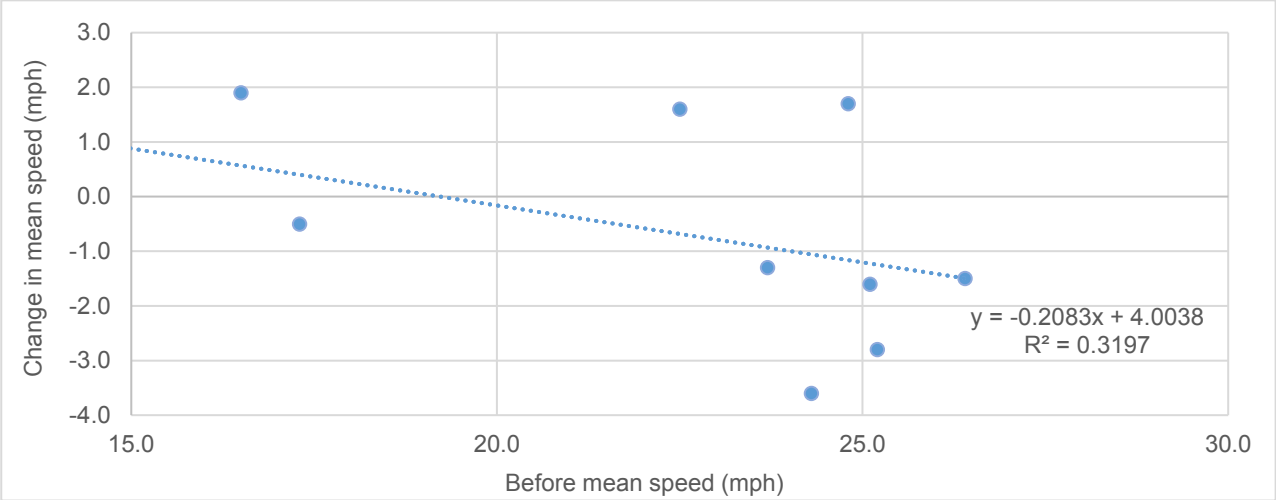
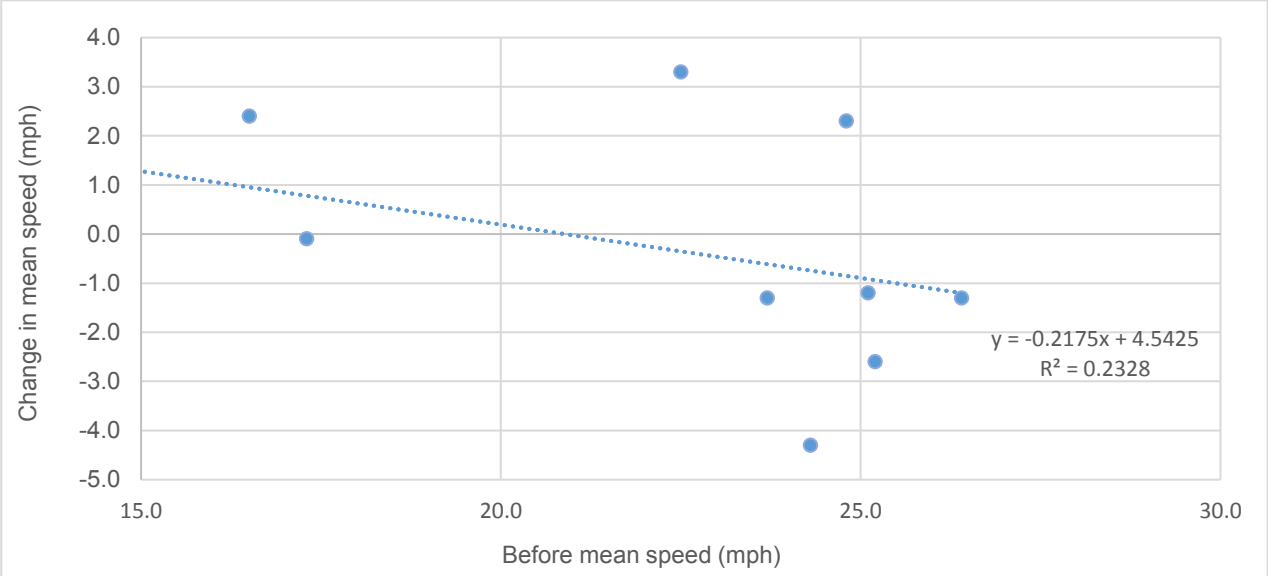


Figure J8. Change in 85th percentile speed (Before vs After1) by 'before' mean speed



Appendix L. Site specific characteristics

Images are taken from Google StreetView.

L.1. Images and maps of sites with the biggest reduction in mean speed

Gunnergate Lane, South of Tollesby Lane (Middlesbrough)

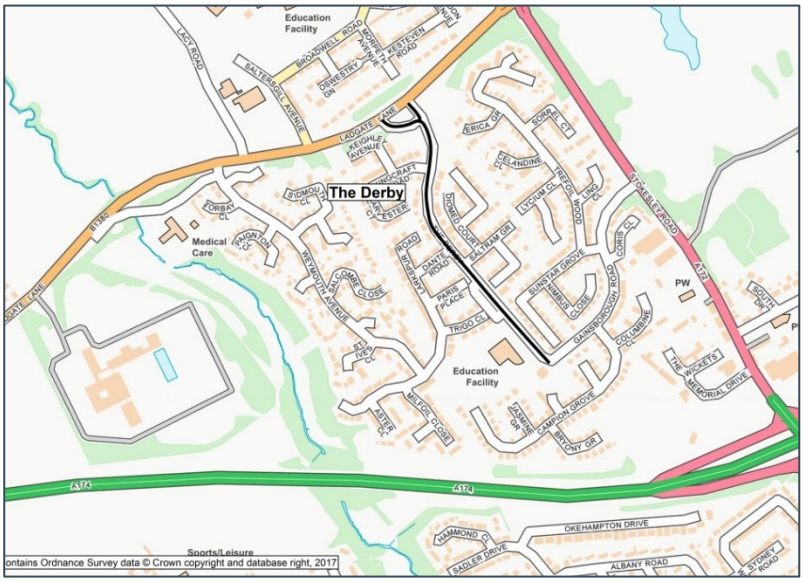
Before mean speed = 28.9mph (~2.5 years before); After mean speed = 23.0mph (<3 months after); Diff = 5.9mph

York Road, mid-way (Chichester)

*Before mean speed = 23.5mph (**~8 years before**); After mean speed = 18.1mph (10 months after); Diff = 5.4mph*

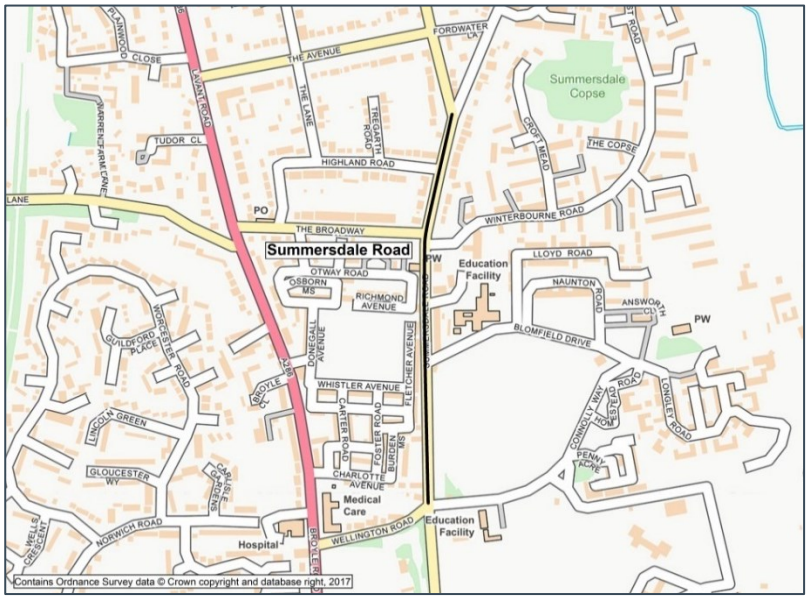
The Derby, near Dante Rd (Middlesbrough)

Before mean speed = 30.7mph (~3 years before); After mean speed = 25.7mph (<3 months after); Diff = 5.0mph



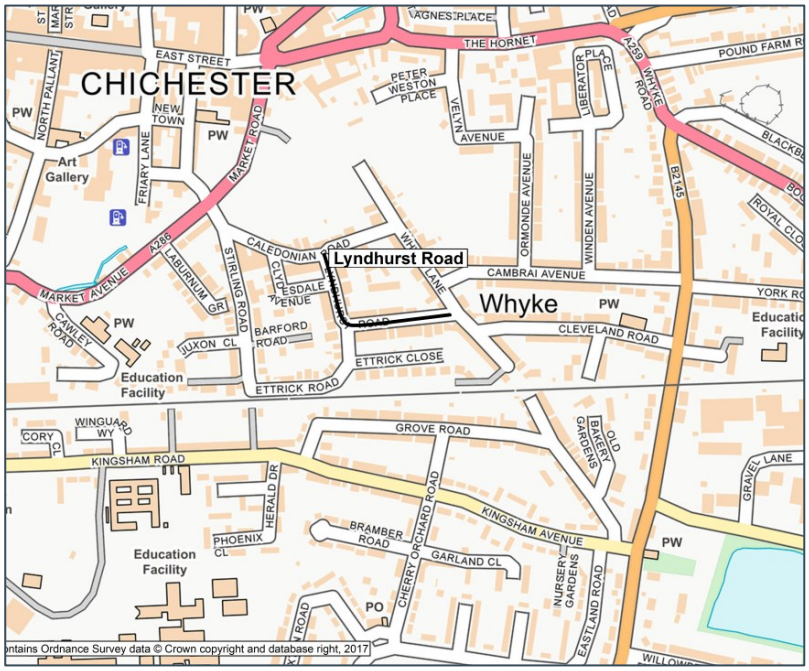
Summersdale Road, near Blomfield Drive (Chichester)

Before mean speed = 28.0mph (~3 years before); After mean speed = 23.3mph (<3 months after); Diff = 4.7mph



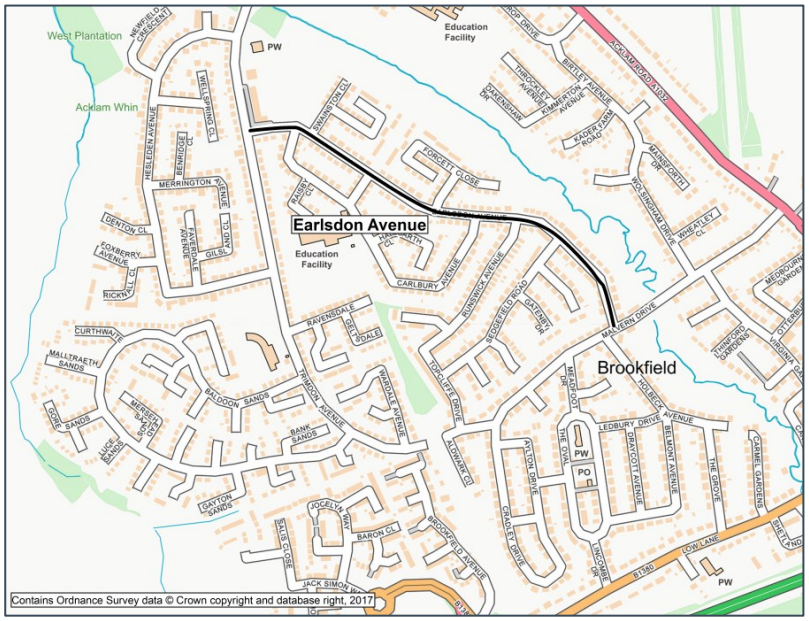
Lyndhurst Road, by No.54 (Chichester)

*Before mean speed = 21.0mph (**~8 years before**); After mean speed = 16.4mph (<3 months after); Diff = 4.6mph*



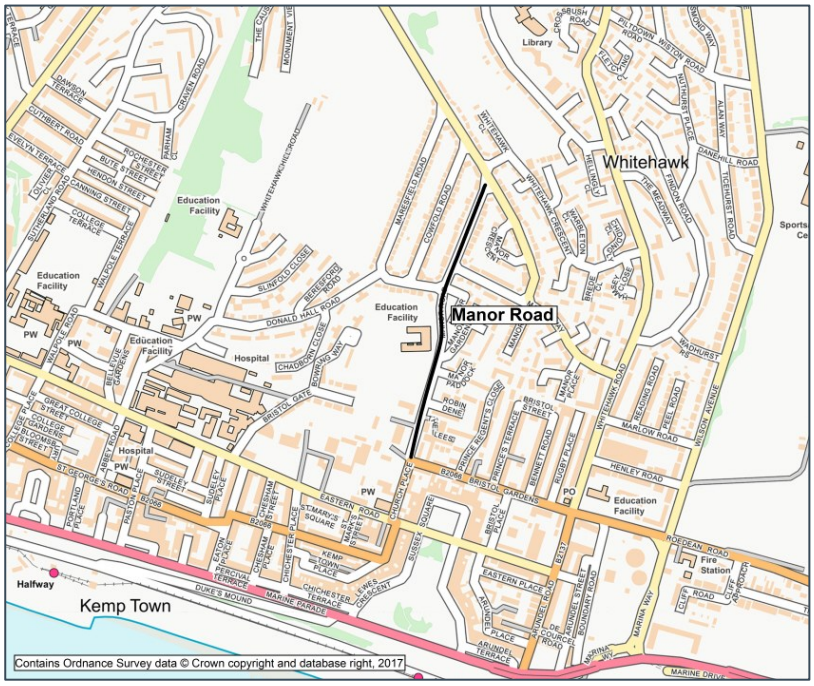
Earlsdon Avenue (Middlesbrough)

Before mean speed = 30.5mph (~2 years before); After mean speed = 26.0mph (12 months after); Diff = 4.5mph



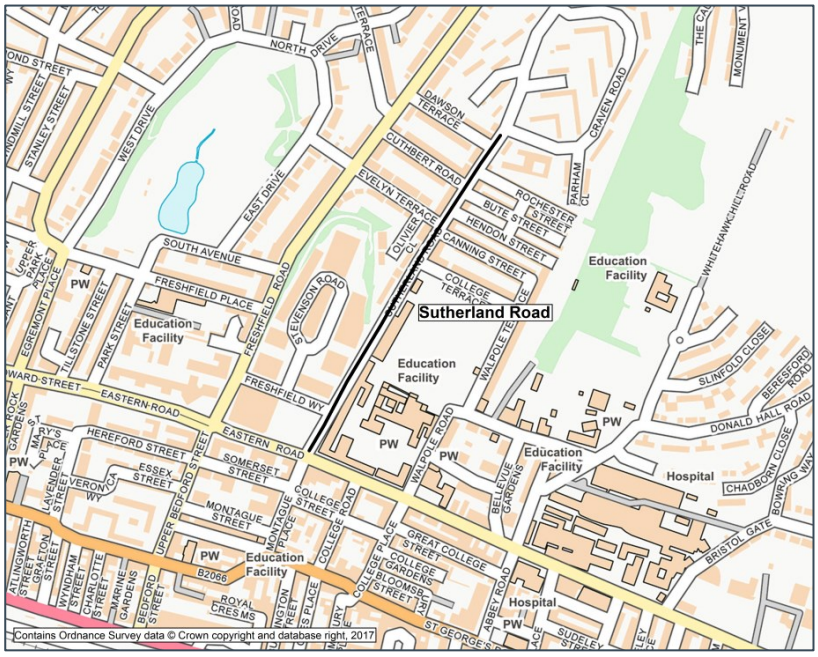
Manor Road, near lane to Bristol Gate (Brighton Phase 2)

Before mean speed = 26.4mph (12 months before); After mean speed = 22.6mph (2 years after); Diff = 3.8mph



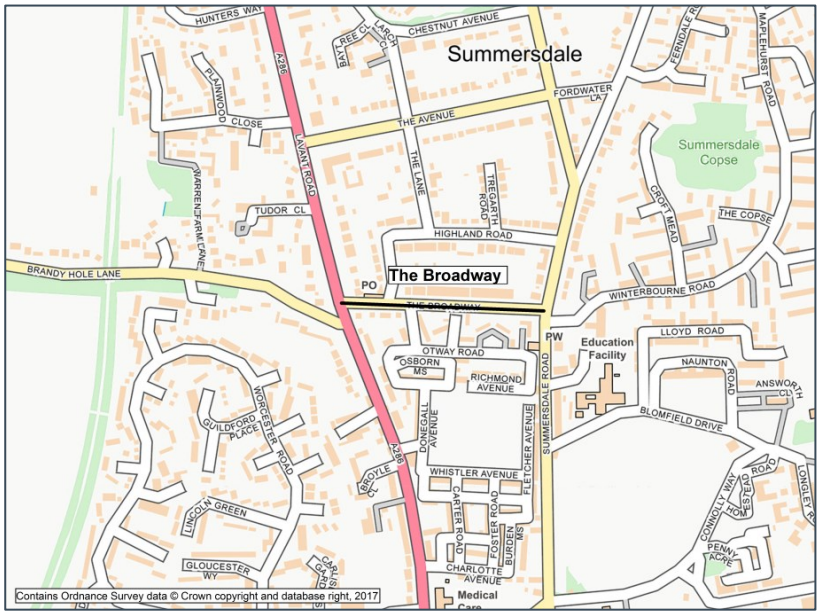
Sutherland Road, south of College Terrace (Brighton Phase 2)

Before mean speed = 27.0mph (12 months before); After mean speed = 23.5mph (12 months after); Diff = 3.5mph



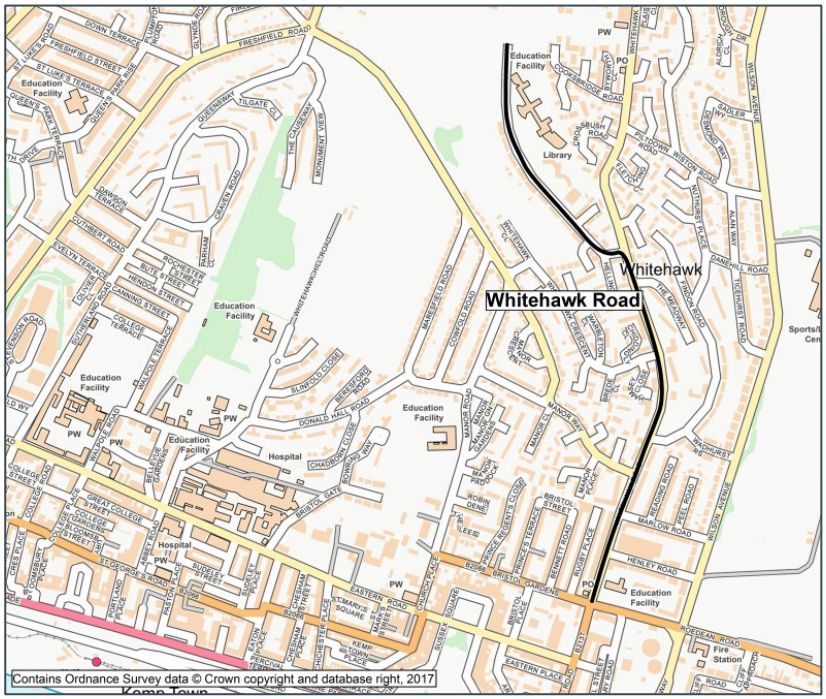
The Broadway, mid-way, by No. 25 (Chichester)

Before mean speed = 27.9mph (15 months before); After mean speed = 24.5mph (12 months after); Diff = 3.4mph



Whitehawk Road, near Marlow Road (Brighton Phase 2)

Before mean speed = 25.1mph (12 months before); After mean speed = 21.8mph (2 years after); Diff = 3.3mph



L.2. Images and maps of sites with the highest after speeds (poorest compliance)

Barns Lane (Walsall)

a) North of Pool View, leading to Stubbers Green Lane

After mean speed = 36.6mph (30 months after)

b) East of Linley Road

After mean speed = 30.6mph (30 months after)

c) East of Winterley Lane

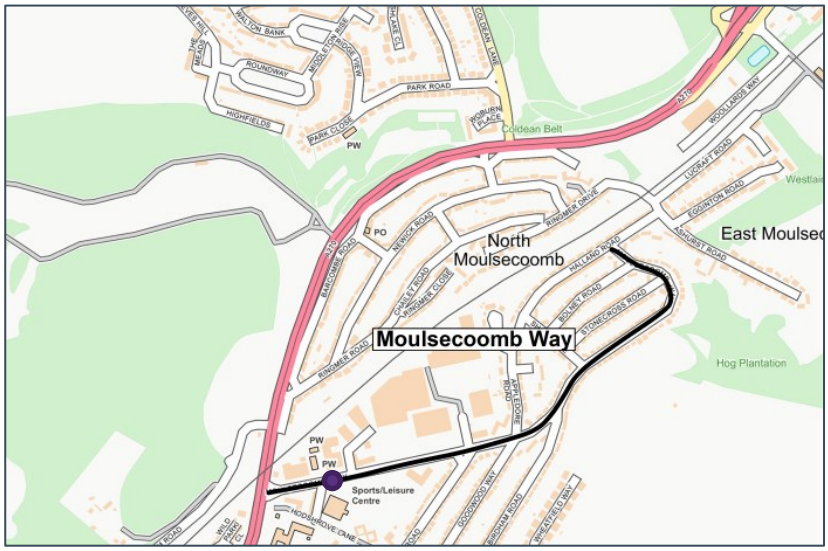
After mean speed = 29.3mph (30 months after)

d) Westgate

After mean speed = 32.7mph (30 months after)

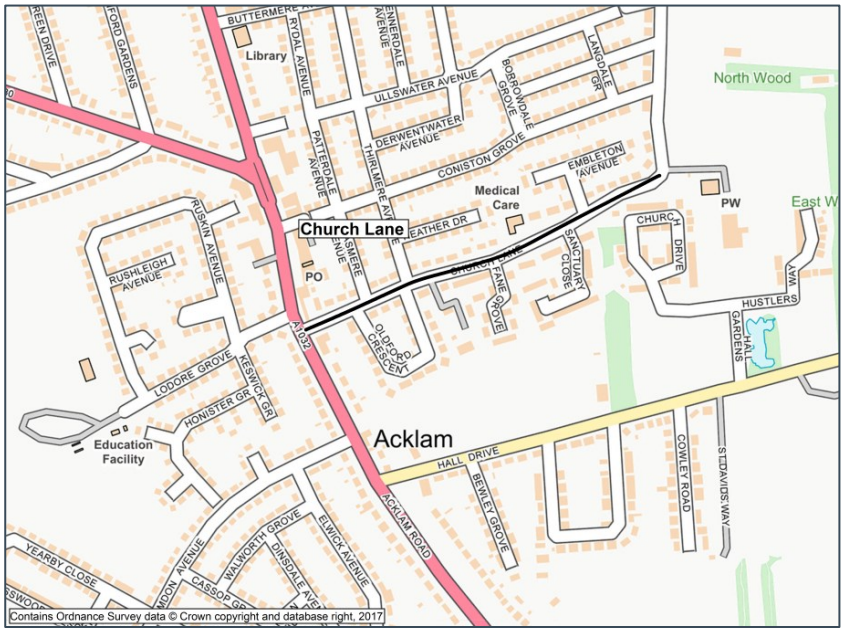
Moulescoomb Way, west of Westergate Road (Brighton)

After mean speed = 28.1mph (24 months after)



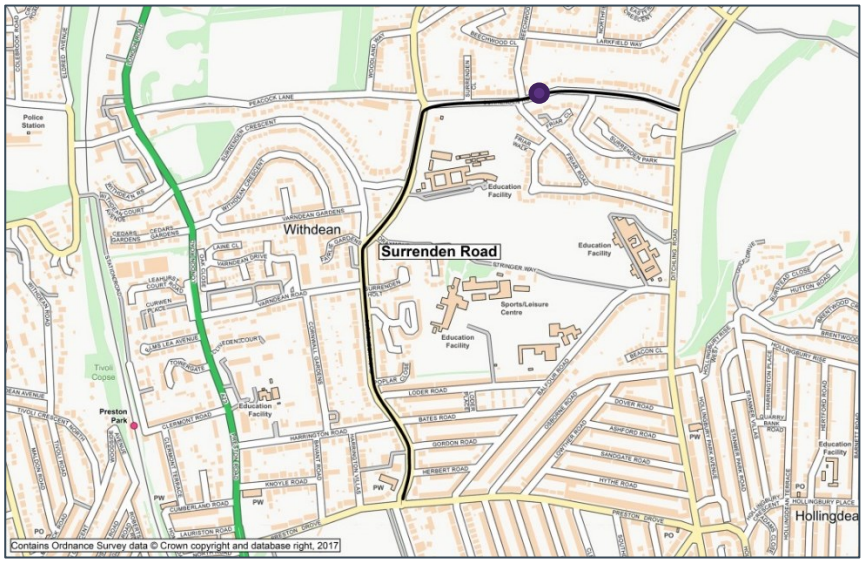
Church Lane (Middlesbrough)

After mean speed = 28.0mph (10 months after)



Surrenden Road, near Friar Road (Brighton)

After mean speed = 27.6mph (24 months after)

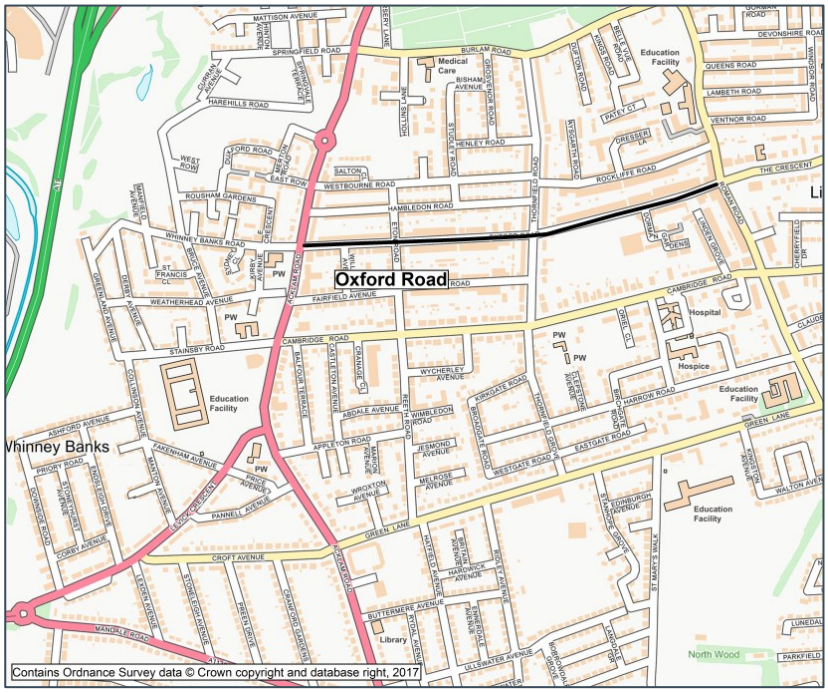


Mallowdale (Middlesbrough)

After mean speed = 27.6mph (<3 months after)

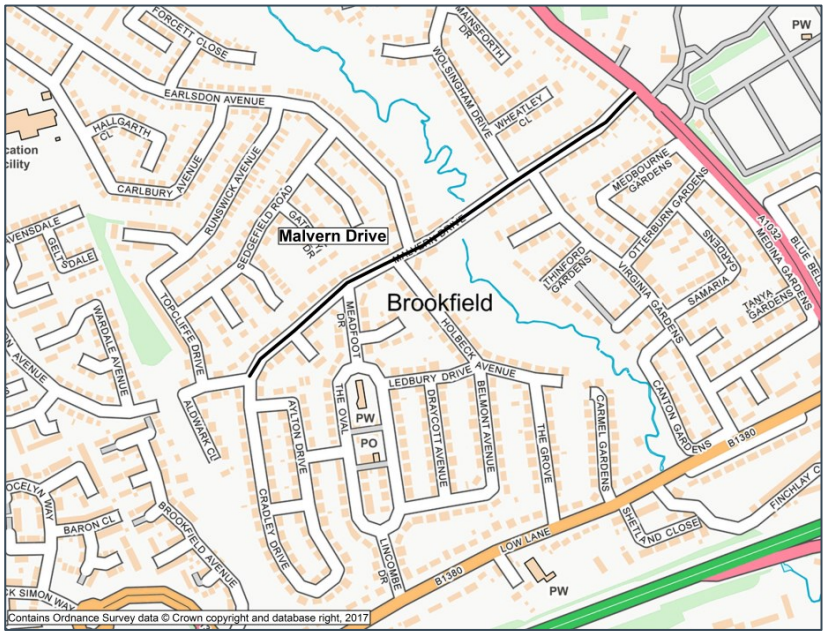
Oxford Road (Middlesbrough)

After mean speed = 27.5mph (~4 months after)



Malvern Road (Middlesbrough) – Precise location not specified

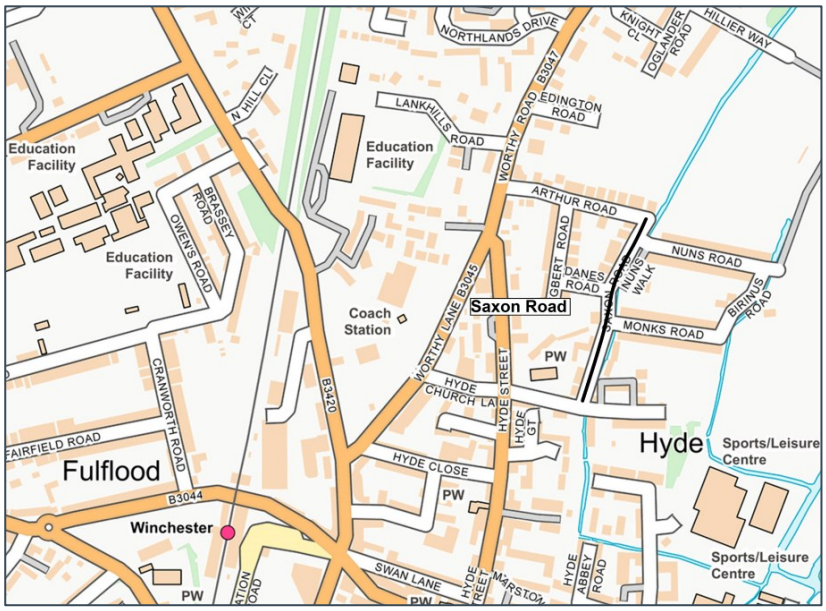
After mean speed = 27.4mph (12 months after)



L.3. Characteristics of sites with the lowest after speeds (highest compliance)

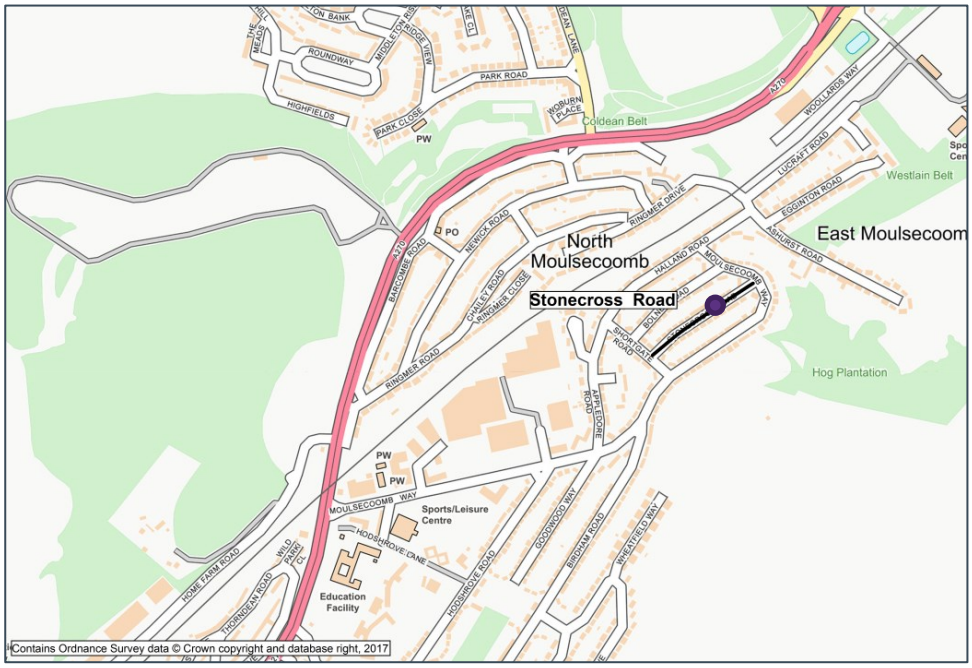
Saxon Road, between Monks Rd and Nuns Rd (Winchester City Centre)

After mean speed = 13.7 mph (7 months after)



Stonecross Road, mid-way along road (Brighton Phase 2)

After mean speed = 14.8 mph (12 months after)

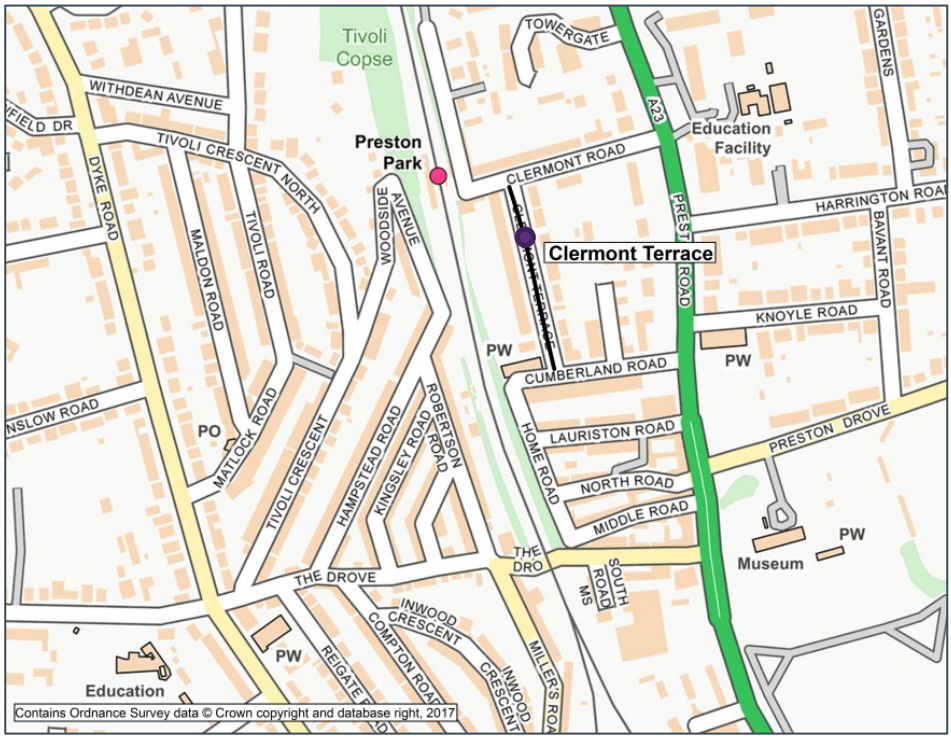


Linley Road (Walsall)

After mean speed = 14.9 mph (30 months after)

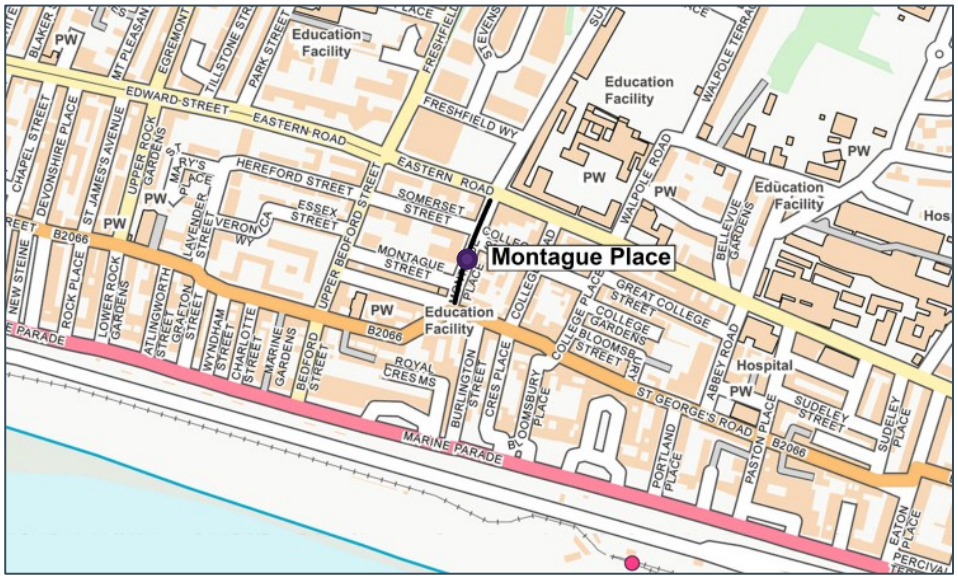
Clermont Terrace, Clermont Road (Brighton Phase 2)

After mean speed = 15.6 mph (24 months after)



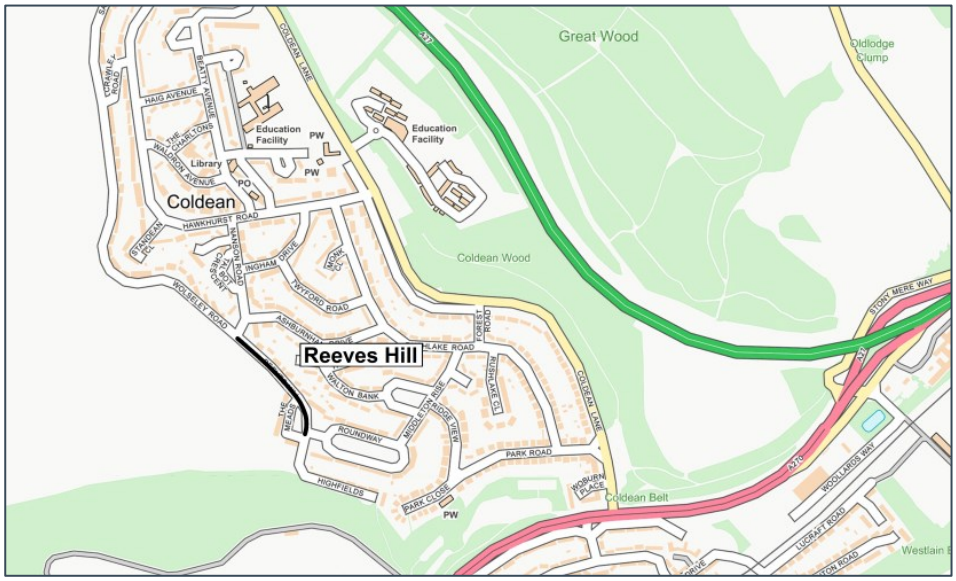
Montague Place, north of Montague Street (Brighton Phase 2)

After mean speed = 16.2 mph (24 months after)



Reeves Hill (Brighton Phase 2)

After mean speed = 16.2 mph (12 months after)



Appendix M. Quality assurance

M.1. Introduction

The findings presented in this report are based on raw data files provided by local authorities. A separate analysis spreadsheet has been developed for each case study area, which:

- collates before and after headline, mode share, and speed bin profile data (where available) for each site;
- calculates the metrics required to inform the findings set out in Chapter 5 (Speed outcomes in case study areas); and
- compares the spot speed profile with the profile calculated as part of the TomTom analysis (reported separately).

The following checking processes have been undertaken to ensure that the results presented are robust and consistent.

M.2. Checking of raw data files

A number of the authorities provided raw data files for each of the monitoring sites.

A small sample of files for each case study area were checked for completeness. In particular, the following checks were undertaken:

- Check complete data for all survey days.
- Check speed bin totals add up to total flow.
- Check for missing mean and 85th percentile data, and whether this affects totals.
- Check missing means co-incide with low flow.
- Check the 85th percentile is bigger than mean.

Some of the issues identified are reported in Chapter 3 (Availability and quality of evidence for this study).

M.3. Checking case study analysis spreadsheets

The analysis spreadsheets all followed the same structure and format.

The three most detailed ones (covering Walsall, Brighton Phase 2, and Winchester City Centre) have been independently checked to ensure the formulas are correct and pick up the correct data, and the logic behind the calculations is sound.

In addition, the results presented in Chapter 5 have been independently checked to ensure that the spreadsheet outputs have been correctly transcribed in the report.

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