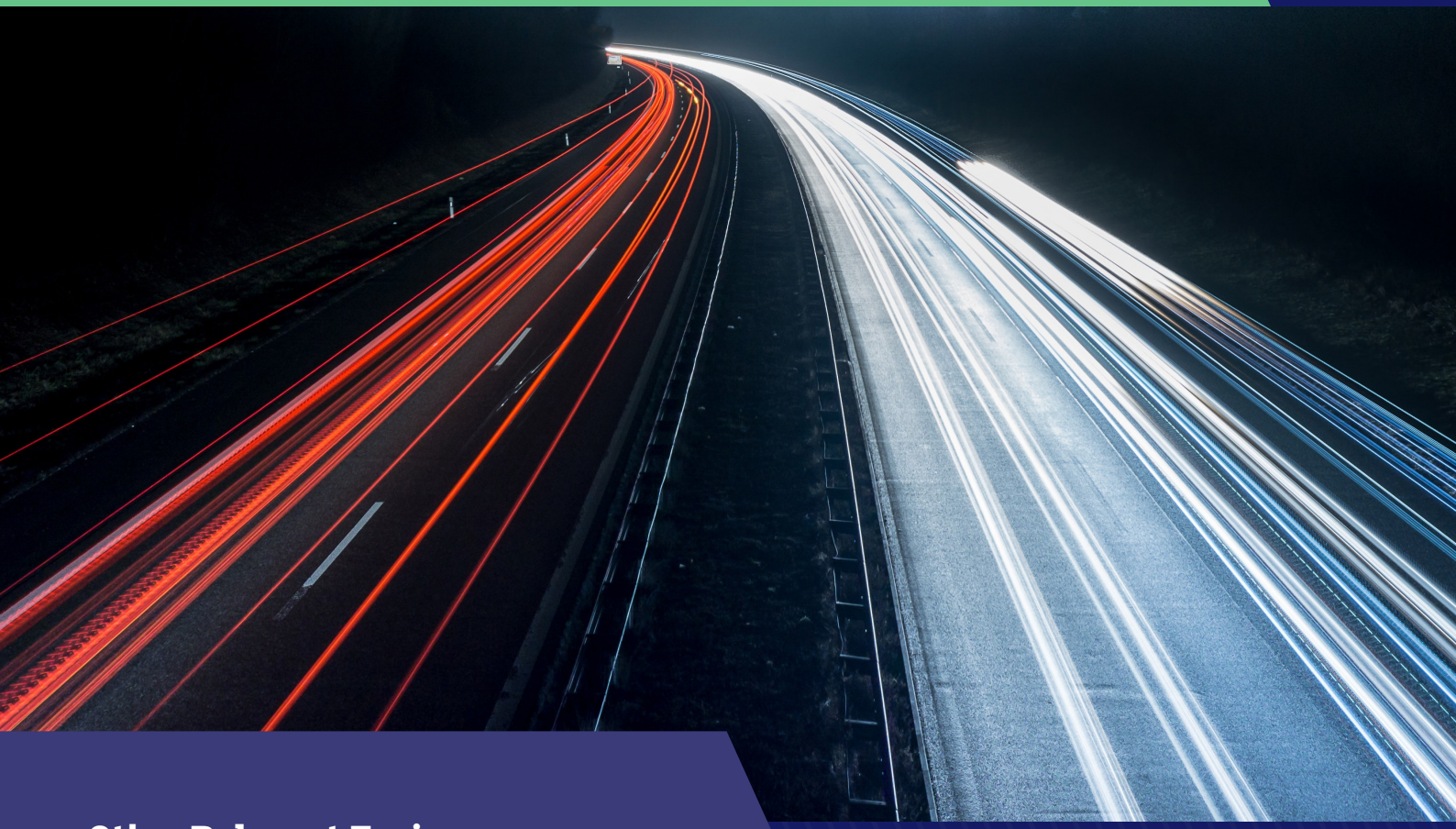
Synthesis title:

Traffic Calming

Category: Roads



Other Relevant Topics:

- Road Design (Drivers)
- Children (Pedestrian)
- Cycling Infrastructure (Roads)

Keywords:

Traffic Calming, Home Zones, Traffic Speed Reduction, Liveable streets

About the Road Safety Observatory

The Road Safety Observatory aims to provide free and easy access to independent road safety research and information for anyone working in road safety and for members of the public. It provides summaries and reviews of research on a wide range of road safety issues, along with links to original road safety research reports.

The Road Safety Observatory was created as consultations with relevant parties uncovered a strong demand for easier access to road safety research and information in a format that can be understood by both the public and professionals. This is important for identifying the casualty reduction benefits of different interventions, covering engineering programmes on infrastructure and vehicles, educational material, enforcement and the development of new policy measures.

The Road Safety Observatory was designed and developed by an Independent Programme Board consisting of key road safety organisations, including:

- Department for Transport
- The Royal Society for the Prevention of Accidents (RoSPA)
- Road Safety GB
- Parliamentary Advisory Council for Transport Safety (PACTS)
- RoadSafe
- RAC Foundation

By bringing together many of the key road safety governmental and non-governmental organisations, the Observatory hopes to provide one coherent view of key road safety evidence.

The Observatory originally existed as a standalone website, but is now an information hub on the RoSPA website which we hope makes it easy for anyone to access comprehensive reviews of road safety topics.

All of the research reviews produced for the original Road Safety Observatory were submitted to an Evidence Review Panel (which was independent of the programme Board), which reviewed and approved all the research material before it was published to ensure that the Key Facts, Summaries and Research Findings truly reflected the messages in underlying research, including where there may have been contradictions. The Panel also ensured that the papers were free from bias and independent of Government policies or the policies of the individual organisations on the Programme Board.

The Programme Board is not liable for the content of these reviews. The reviews are intended to be free from bias and independent of Government policies and the policies of the individual organisations on the Programme Board. Therefore, they may not always represent the views of all the individual organisations that comprise the Programme Board.

Please be aware that the Road Safety Observatory is not currently being updated; the research and information you will read throughout this paper has not been updated since 2017. If you have any enquiries about the Road Safety Observatory or road safety in general, please contact **help@rospa.com** or call **0121 248 2000**.

How do I use this paper?

This paper consists of an extensive evidence review of key research and information around a key road safety topic. The paper is split into sections to make it easy to find the level of detail you require. The sections are as follows:

Key Facts	A small number of bullet points providing the key facts about the topic, extracted from the findings of the full research review.
Summary	A short discussion of the key aspects of the topic to be aware of, research findings from the review, and how any pertinent issues can be tackled.
Methodology	A description of how the review was put together, including the dates during which the research was compiled, the search terms used to find relevant research papers, and the selection criteria used.
Key Statistics	A range of the most important figures surrounding the topic.
Research Findings	A large number of summaries of key research findings, split into relevant subtopics.
References	A list of all the research reports on which the review has been based. It includes the title, author(s), date, methodology, objectives and key findings of each report, plus a hyperlink to the report itself on its external website.

The programme board would like to extend its warm thanks and appreciation to the many people who contributed to the development of the project, including the individuals and organisations who participated in the initial consultations in 2010.

Key facts

- In 2016 a total of 23,550 pedestrian casualties occurred on UK roads. Of this total, 448 were killed (34 of which were children) and 5,140 were seriously injured (1,253 of which were children).

  (RRCGB, DfT, 2017)

- Traffic calming schemes reduce the severity of injury in the event of a RTI and make it easier for drivers to avoid RTIs.

  (National Children's Bureau, 2004)

- Compared to educationally based road safety interventions, area wide traffic calming appears to be a more promising intervention for reducing traffic injuries and fatalities.

  (F. Bunn *et al.*, 2009)

- Bunn *et al* (2004) performed a meta-analysis of area-wide traffic calming projects and estimated a reduction of 37 per cent in fatal RTIs, 11 per cent in injury RTIs and 5 per cent in all RTIs.

  (G. Yanis *et al.*, 2008)

- It has been shown that on average each 1 mph reduction in mean vehicle speed results in an average RTI reduction of 5 per cent.

  (DfT, 2007)

Summary

In 2016 a total of 23,550 pedestrian casualties occurred on UK roads. Of this total, 448 were killed (34 of which were children) and 5,140 were seriously injured (1,253 of which were children). (RRCGB, DfT, 2017)

Reducing vehicle speeds would help to reduce the frequency and severity of these RTIs. This is demonstrated by the well established relationship between speed reduction and RTI reduction – a 1 mph reduction in speed results in an average of 5 per cent reduction in RTIs.

Physical traffic calming measures were found to be most effective at reducing speeds when compared to other interventions, such as standard and variable message signs or education campaigns. Of the different types of physical traffic calming, those involving some form of vertical deflection (e.g. speed humps, bumps or cushions) were the most effective at achieving speed reductions. While the numbers can vary quite considerably, many traffic calming schemes have shown RTI reductions of between 60-80 per cent post implementation.

Studies which compare injury severity with vehicle speed show that RTIs at speeds above 20 mph are more likely to result in severe injuries, rather than slight injuries. Traffic calming schemes have been shown to reduce the severity of injury in the event of a RTI and make it easier for drivers to avoid RTIs.

Urban 20 mph zones have become more popular over the past few decades as evidence for their effectiveness has strengthened. These 20 mph zones have been successful in substantially reducing speeds and RTIs in the areas where they have been applied. In some cases they have reduced child pedestrian RTIs by 70 per cent and cyclist RTIs by 48 per cent.

The main issue associated with implementing traffic calming schemes is their cost, although cost benefit analysis does show that it is possible to achieve payback within a year. In addition to cost, some of the physical measures can also produce noise and/or vibration which make them unpopular with some residents.

Methodology

Traffic calming concerns a coordinated use of traffic engineering and control measures in a large area in order to improve traffic and environmental conditions (Elvik, Vaa 2004), by means of a reduction or ban of through-traffic, a reduction of travel speeds and a change of access and parking regulations in residential roads.

Traffic calming measures have evolved from the original concept as safety schemes on individual streets to wider area schemes often contributing to environmental and community objectives as well as safety benefits. More recently some areas have seen even further development in the form of 'liveable streets' which have even wider objectives and types of treatment such as removing signs and adding art works.

This synthesis was compiled during August– September 2012.

Note
This review includes statistics from Reported Road Casualties Great Britain 2011, which were the latest available data when the review was written. In December 2017, statistics from Reported Road Casualties Great Britain were updated to Reported Road Casualties Great Britain 2016.

A detailed description of the methodology used to produce this review is provided in the Methodology section of the Observatory website at http://www.roadsafetyobservatory.com/Introduction/Methods.

The steps taken to produce this synthesis are outlined below:

- **Identification of relevant research** – searches were carried out on pre-defined research (and data) repositories. However, some additional information sources were consulted at the suggestion of a subject matter expert. Search terms used to identify relevant papers included but was not limited to:
    - 'Traffic calming';
    - 'Home zones';
    - 'Traffic speed reduction'; and,
    - 'Liveable streets'.

  Approximately 100 pieces of relevant research were identified.
- **Initial review of research** – primarily involved the ranking of the research, based on key criteria, to ensure the most relevant and effective research went forward for inclusions in this synthesis. Key criteria included:
    - Relevance – whether the research makes a valuable contribution to this synthesis, for example robust findings from a various traffic calming measures.

- Provenance – whether the research is relevant to drivers, road safety policies or road safety professionals in the UK. If the research did not originate in the UK the author and expert reviewer have applied a sense check to ensure that findings are potentially relevant and transferable to the UK.
- Age – Newer research is likely to include newer technologies, techniques and materials which may be more effective in calming traffic. However, given that traffic calming is not as fast moving a topic as others e.g. telematics, older data sources were not excluded.
- Effectiveness – whether the research credibly proves (or disproves) the effectiveness of a particular traffic calming measure.

Following initial review 23 pieces of research were taken forward to form the basis for this synthesis.

- **Detailed review of research –** key facts, figures and findings were extracted from each piece of research to highlight the relevant topic issues.
- **Compilation of Synthesis** – the output of the detailed review was analysed for commonality and a synthesis written in the agreed format. Note that the entire process from identifying research to compiling the synthesis was a time-bound exercise.
- **Review** – the draft synthesis was subjected to extensive review by a subject matter expert, proof reader and the DfT's Evidence Review Panel.

Definitions

Traffic calming schemes can include a range of measures such as:

- Development of pedestrian streets;
- Development of residential zones;
- Introduction of speed humps;
- Reduction of speed limits;
- Implementation of one-way traffic in residential streets;
- Implementation of traffic and pedestrian signal control; and,
- Development of reserved parking areas for residents.

In the UK traffic calming does not include roundabouts, controlled junctions or cycle tracks. However, this synthesis may refer to these features as they are seen as traffic calming measures in some countries.

Key statistics

This section collates key statistics relating to traffic calming.

General

- In 2011 a total of 26,198 pedestrian casualties occurred on UK roads. Of this total, 453 were killed (33 of which were children) and 5,454 were seriously injured (1,569 of which were children).
- This represents an overall increase of 1 per cent in pedestrian casualties but a 12 per cent increase in pedestrian fatalities compared to 2010.
- Pedal cyclists are also a vulnerable group with 107 fatalities and a total of 19,215 casualties in 2011.
- Compared to 2010, pedal cyclist casualties increased overall by 12 per cent. In contrast, the number of pedal cyclist fatalities decreased by 4 per cent.

(DfT, 2012)

- Child pedestrian injury arising from road RTIs is the leading cause of child accidental fatality in the UK
- Children in poor neighbourhoods are five times more likely to be injured by a car than those in affluent areas.

(National Children's Bureau, 2004)

Research findings

Summaries of key findings from several research reports are given below. Further details of the studies reviewed, including methodology and findings, and links to the reports are given in the References section.

Speed reduction

Speed reduction is one of the most obvious goals of traffic calming as it is the reduction in speed which leads to other safety and environmental benefits. The following extracts give an indication of the impact that these various measures can have on vehicle speeds.

- Speed humps are the most widely-used form of traffic calming, especially in those countries where traffic calming has spread very quickly: Great Britain and Netherlands.
- The speed reduction effect – usually perceptible 50 metres before and after the humps – is largely dependent on the hump heights and gradients.
- Speed management through infrastructure changes has saved many lives. With the knowledge that has been accrued about best practices, as well as lessons learned from mistakes, traffic calming will continue to be a very important speed management measure in urban areas.

(OECD, 2006)

- The most effective forms of traffic calming usually involve some degree of vertical deflection.
- Road humps have been proven to be highly effective at reducing vehicle speeds but cause driver/passenger discomfort, particularly in larger vehicles.
- Speed cushions are effective at reducing speed, but not quite as effective as road humps.

(R.E. Layfield and D.I. Parry, 1998)

- Excessive speed is a major contributory factor in a large proportion of fatalities and serious injuries on British roads.
- Combinations of (traffic calming) measures can be used along a stretch of road to generate a desired set of outcomes in terms of speed and flow of traffic.
- Horizontal deflection measures, such as chicanes, also reduce speed, with traffic often being restricted to a single lane through the chicane on a two way road.
- Visual warnings comprise measures such as countdown signs to the speed limit, red surface treatments and speed camera signs. Some of these elements are only mildly successful at reducing road speeds.

- Estimations from responses to choice experiments for traffic calming on through routes revealed that local people had a positive willingness to pay (WTP) for a reduction in the negative impacts of road traffic and for more attractive, rather than basic designs of the traffic calming measures.
- This WTP could help when selecting traffic calming measures to maximise the ratio of social benefits to costs.

(G.D. Garrod *et al.*, 2002)

- A combination of measures tended to produce bigger estimated reductions in speeds.
- Continuous or repeated measures were required to sustain speed reductions.
- Uncertainty appeared to reduce speed; e.g. build outs were particularly effective where another vehicle was approaching.
- The most effective measures were ‘red brick narrowing’ or ‘tree build outs’.
- The most effective measures were those with physical as well as psychological elements.

(J. Kennedy *et al.*, 2005)

- An examination of the effects of different types of traffic calming measures on speeds showed differences by type of measure.
    - The greatest impact on speeds was produced by tables, followed by humps, chicanes and cushions.
    - This confirms the order of effectiveness seen by Layfield (1994).
    - However, some variation was seen between measures of the same type indicating that their location can impact their effectiveness.
    - This study also produced evidence that some chicanes are totally ineffective in reducing speeds.

(H.M. Barbosa *et al.*, 2000)

- Vehicle Activated Signs appear to reduce speeds by a few mph at the sign and some of the reduction can be maintained some distance downstream.
- The speed reductions appeared to be maintained over time.

(D.C. Webster, 1995a)

- The effectiveness of speed humps is well proven; however it should be noted that they generate higher levels of noise, which can be a nuisance for the people living nearby.

(OECD, 2006)

- An additional drawback of traffic calming measures is that they can cause increases in vehicles emissions due to the increase in acceleration and deceleration events.

(P. Boulter, 2001)

- It was proposed that on through routes, vehicle speeds should be reduced by average speed cameras; for residential streets full-width humps should be used.

(Southwark Living Streets, 2008)

RTI reduction

RTI reduction (both frequency and severity) is the main aim of traffic calming which is predominantly achieved by reductions in vehicle speed. All of the extracts below help to reinforce the safety benefits that can be achieved through the installation of traffic calming measures.

- The direct link between reduced speeds and reduced RTIs is well documented.

(J. Kennedy *et al.*, 2005)

- Traffic calming measures have been shown to reduce the frequency of RTIs involving pedestrians, cyclists and motorcyclists (as well as car occupants).
- Whilst some studies have shown dramatic reductions in RTIs in and around areas with calming measures, others have reported large increases in RTIs in surrounding areas.
- This suggests that an area wide view has to be taken and that smaller, localised schemes may not offer such significant benefits.

(DfT, 2007)

- Traffic calming measures in villages can yield reductions in speed, which is associated with substantial reductions in injury RTIs, particularly KSI RTIs.
- The most substantial measures (physical features and signing/marking measures with high visual impact) are the most effective in terms of speed and RTI reduction.

(DfT, 2000)

- Research shows that lower limits, when accompanied by traffic calming measures, are very effective at reducing RTIs and injuries, with reductions of up to two thirds having been demonstrated.

(OECD, 2006)

- Compared to educationally based road safety interventions, area wide traffic calming appears to be a more promising intervention for reducing traffic injuries and fatalities.
- An important effect of traffic calming schemes is to reduce the speed of traffic, in which case traffic calming might still reduce the likelihood of injury in the event of a RTI.

(F. Bunn *et al.*, 2009)

- A review of both UK and international studies noted that engineering measures to reduce traffic speed, generally do reduce RTIs and fatalities or injuries among children and young people.
- There is moderate evidence from two uncontrolled before and after studies (both UK) that area-wide traffic calming may reduce rates of KSI children casualty rates.
- Evidence from two uncontrolled before and after studies indicates that 20 mph zones reduce KSI child casualty rates.
- Two US studies of the Safe Routes to School (SRTS) programmes based predominantly on engineering measures show that they may reduce the rates of RTI-involved child pedestrians or cyclists, or the rate of child injury RTIs.

(NICE, 2010)

- Area-wide traffic calming is designed to control traffic in urban residential areas and has been shown to be effective in reducing child RTIs.
- Traffic calming has been compared with another popular intervention – road safety education. Whilst the effectiveness on reducing pedestrian injuries from traffic calming has been shown, the beneficial effects on injury reduction from education programmes are less clear.

(National Children's Bureau, 2004)

20 mph zones and home zones

As one of their main objectives is to reduce traffic speeds, 20 mph zones and home zones can have a significant impact on safety as the following summaries show.

- Speed significantly increases the chance of being injured in a RTI. Studies which compare injury severity with vehicle speed show that RTIs at speeds above 20 mph are more likely to result in severe injuries, rather than slight injuries.
- Speed management including the use and enforcement of speed limits is a practical and established way of reducing injuries, and therefore, urban 20 mph zones present a way of significantly reducing the likelihood of a serious injury.

(RoSPA, 2012)

- 20 mph zones have been successful in substantially reducing speeds and RTIs in the areas where they have been applied.
- Most zones in the UK have been predominantly implemented in residential areas, with about 10 per cent being in town or city centres.
- The average size of the zones was 0.28 sq.km.
- The most common traffic calming measures used in 20 mph zones were round topped and flat topped humps and speed tables. Speed cushions were used in some more recent schemes.
- RTI migration into surrounding areas was not found to be a problem but care should still be taken in design of schemes to prevent traffic transferring to unsuitable routes.

(D.C. Webster and A.M. Mackie, 1996)

- An analysis has shown that the reduction in road injuries in 20 mph zones occurred at a greater rate than the overall trend of reduction in casualties in London, that this was not attributable to any regression-to-the-mean effect, and that there was no displacement in RTI risk to roads close to the 20 mph zones. (C. Grundy *et al.*, 2009)
- Traffic calming schemes reduce the severity of injury in the event of a RTI and make it easier for drivers to avoid RTIs.

(National Children's Bureau, 2004)

- Pedestrian injuries were reduced in one centre (Sheffield) in particular and there was a general reduction in child cyclist casualties. Measures that protected two-wheel vehicles such as right turn prevention and right turn bays, were particularly successful.
- A longer term assessment in Reading showed that child pedestrians and cyclists particularly benefited from such schemes.
- No migration of RTIs was found to other areas as a result of the introduction of the zones.
- There is now good evidence that area-wide engineering schemes and traffic calming measures reduce RTIs. Area-wide engineering schemes were also found to be cost effective.

(NHS Health Development Agency, 2001)

- Physical measures such as speed humps are the most effective at enforcing 20 mph zones.
- The majority of sign only zones which were reviewed did not show any reduction in RTIs, although small speed reductions were recorded.

(A.M. Mackie, 1998)

- On average, from nine Home Zone schemes reviewed, 74 per cent of respondents thought the zones were 'very safe' or 'quite safe' for adults who were walking or cycling in the home zones.
- With regards to children walking and cycling in the home zone, 58 per cent thought they were 'very safe' or 'quite safe'.

(D. Webster *et al.*, 2006)

Signage – improving traffic calming measures

- Traffic calming features generally need supporting by traffic signs to ensure the features are clearly visible to approaching drivers at all times.
- Signs and markings are used to alter the drivers' perception of the road on which they are travelling and hence bring about a change in behaviour leading to slower speeds.
- Vehicle activated sign devices are particularly useful on the approaches to bends and junctions where motorists may be unable to judge a safe speed until they are in the bend, or are unaware of side road visibility restrictions.
- White lining can have a significant part to play in traffic calming schemes and can bring about driver behavioural change, although benefits are likely to be greatest when used in combination with other techniques.
- Experience has indicated that the clearer the road marking layout, the more positive drivers will be in their actions and general behaviour.
- However, clear markings can lead to more aggressive driving as drivers “claim” their priority, with a resulting increase in speeds. Wider, clearly defined lane widths, with their feeling of spaciousness, can promote a feeling of comfort and create a road environment considered suitable for higher speeds.

(IHT and the County Surveyors’ Society, 2005)

How effective?

The following sections present statistics that demonstrate how successful a variety of traffic calming interventions have been.

Speed reduction

- It has been shown that on average each 1 mph reduction in mean vehicle speed results in an average RTI reduction of 5 per cent.
- Hence a 10 mph speed reduction may give a 50 per cent RTI saving. This result has been confirmed by a number of studies.

(DfT, 2007)

- In one area of London, only full-width humps spaced less than 40 metres apart were able to reduce the 85th percentile speed of vehicles to below 20 mph.

(Southwark Living Streets, 2008)

- Gateway Speeds from nine UK village traffic calming schemes (over 12 months after installation) showed that:
    - Following implementation of the schemes there were reductions in inbound speeds at all the gateways.
    - Speed reductions ranged from 3 mph to 13 mph for mean speeds, and up to 15 mph for 85th percentile speeds.
    - The largest reduction in speed at the various gateways, relative to the magnitude of 'before' speeds, occurred at the narrowed entries (with speed cushions) to the 20 mph zone at Costessey.
    - Signing (including marking) measures giving a high visual impact can produce quite large speed reductions at village entries. However, these speeds are still likely to be above the speed limit.
- Speed data from within the same villages showed that:
    - Reductions in mean speed, over both directions, ranged from 2 mph to 12 mph, with 85th percentile reductions of up to 14 mph.
    - Individually, physical measures yielded speed reductions of between 7 mph and 12 mph.
    - It is important that features are visible at night, particularly as it has been shown that speeds tend to increase at this time. The use of reflective material is therefore imperative.

(DfT, March 2000)

- In one village based scheme, two way mean speeds fell by 7-8 mph to 31 mph and 85th percentile speeds fell by 8-10 mph to 37 mph.
- The proportion of vehicles exceeding 40 mph (in a new 30 mph zone) fell from 50 per cent to 10 per cent.

(J. Kennedy *et al.*, 2005)

- Schemes with physical measures in a village would be expected to reduce mean speeds by almost 8 mph and to reduce the proportion of drivers exceeding the speed limit by more than 30 percentage points.

(DfT, December 2000)

- Various types of horizontal deflections have been used in calming schemes to reduce traffic speed.
- Chicanes installed in a large number of schemes on local and trunk roads, resulted in average speed reductions for mean and 85th percentile speeds of 12 mph at the chicanes.
- Between chicanes, this reduction dropped to 7 mph.
- Two way chicanes appeared to achieve slightly smaller speed reductions than one way versions.

(I.A. Sayer *et al.*, 1998)

- In four schemes on urban distributor roads, the 85th percentile speeds were reduced to levels below or near the 30 mph limit. On average speeds were reduced by 11 mph from 38 mph to 27 mph.
- Mean speeds reduced by 10 mph from 34 mph to 24 mph.

(D.C. Webster, 1995b)

RTI reduction

- Bunn *et al* (2004) performed a meta-analysis of area-wide traffic calming projects and estimated a reduction of 37 per cent in fatal RTIs, 11 per cent in injury RTIs and 5 per cent in all RTIs.

(G. Yanis *et al.*, 2008)

- RTIs were reduced by 71 per cent at 34 sites and by 60 per cent in 20 mph zones, which comprised mainly humps.
- RTI data supplied by Fife (Fife Council, 2004) for their 'H' and 'S' hump scheme on South Parks Road, Glenrothes, shows that injury RTIs have been reduced from 10 in 5 years (2 per year) to only one in the five years (0.2 per year) after the scheme was installed.
- RTI reductions of 86 per cent have been reported for schemes containing speed cushions at sites in Huddersfield and Northampton.
- An average of 40 per cent reduction in RTIs was seen at 4 sites where thermoplastic 'thumps' were used.

(DfT, 2007)

- Looking at village traffic calming projects from 1992 to 1997, the project leaders found that when vehicle speeds dropped 2 to 7 mph, RTIs were reduced by 47 percent.
- Installation of village traffic calming greatly reduced injuries to children in the communities involved:
    - Child pedestrian injuries dropped by 40 percent;
    - Child pedestrians killed or seriously injured dropped by 77 percent;
    - Child cyclist injuries dropped by 51 percent; and,
    - Child cyclists killed or seriously injured dropped by 49 percent.

(NHTSA)

- Of 17 schemes where before and after RTI data was available, an overall reduction in RTI frequency of 54 per cent (41.2 -19.0 RTIs per annum) was seen following the introduction of traffic calming measures.

(I.A. Sayer *et al.*, 1998)

20 mph and home zones

- A review of six 20 mph zones found that child pedestrian and child cyclist RTIs fell by 70 and 48 per cent respectively after scheme installation giving an overall reduction of 67 per cent for all child RTIs.
- The reduction in RTIs for all cyclists was 29 per cent.
- Speed results show that the average speed at a calming measure was 13.2 mph, while between measures it rose to 17.8 mph.
- This indicates that the calming measures are effective at enforcing the 20 mph limit.
- There was a 6.2 per cent reduction in RTIs for every 1 mph reduction in vehicle speed.

(D.C. Webster and A.M. Mackie, 1996)

- In a series of pilot schemes for home zones, traffic calming reduced the mean speeds on average by about 5 mph to less than 15 mph. The 85th percentile speeds were reduced by about 6 mph to less than 19 mph.
- The percentage of vehicles exceeding 20 mph was reduced on average from 42 per cent to 12 per cent.
- RTIs were not a significant problem at any of the sites prior to changing to home zones, but the results indicated that a 0.3 reduction in RTIs per annum had resulted from the implementation of home zones.

(D. Webster *et al.*, 2006)

- From 1994, there was a widespread introduction of 20 mph zones in Hull, and by 2003, there were 120 zones covering 500 streets. The casualty statistics between 1994 and 2001 showed a drop of 14 per cent in Hull, compared to a rise of 1.5 per cent in the rest of Yorkshire and Humberside.
- In the 20 mph zones in Hull, there was a decrease in total RTIs of 56 per cent and in KSI casualties of 90 per cent. The biggest reductions were pedestrian casualties, which fell by 54 per cent, child casualties which dropped by 54 per cent and child pedestrian casualties fell by 74 per cent.
- A 2007 TRL review of half of the 20 mph zones which had been implemented in London (78 zones) found that they reduced injury RTIs by about 42 per cent and KSI RTIs by 53 per cent.

(RoSPA, 2012)

- The introduction of 20 mph zones was associated with a 41.9 per cent reduction in road casualties, after adjustment for underlying time trends.
- There was no evidence of casualty migration to areas adjacent to 20 mph zones, where casualties also fell slightly by an average of 8.0 per cent.

- Using the more conservative risk reduction estimates based on 2000-6, it was estimated that 20 mph zones prevent 203 casualties each year, of whom 27 would be killed and seriously injured and 51 would be pedestrians.
- The study concluded that 20 mph zones are effective measures for reducing road injuries and deaths..

(C Grundy, *et al*, 2009)

- When comparing data before and after implementation of a 20 mph zone, annual RTI frequency was found to drop by about 60 per cent.
- Child pedestrian RTIs fell by as much as 70 per cent and child cyclist RTIs by 48 per cent.

(National Children's Bureau, 2004)

- In the *Urban Safety Project*, overall RTIs were reduced by 13 per cent but there were great variations between schemes. Slight RTIs declined proportionately more than fatal and serious ones.

(NHS Health Development Agency, 2001)

Gaps in the research

- There appears to be some significant variation in the level of RTI reduction that traffic calming measures can achieve.
- Therefore, further research to identify the factors that may be causing these variations would be beneficial as it would help to ensure that future schemes are designed to achieve their maximum potential in RTI reduction.

References

Department for Transport research and statistics

Title: Reported casualties by road user type, age and severity, Great Britain, 2011
Author / organisation: DfT **Date:** 2012 **Format:** Pdf **Link:** http://www.dft.gov.uk/statistics/releases/reported-road-casualties-gb-main-results-2011 **Free / priced:** Free
Objectives: To present road casualties statistics for 2011
Methodology: Statistics collated from STATS19 data which is collected by police officers attending RTIs.
Key Findings: • In 2011 a total of 26,198 pedestrian casualties occurred on UK roads • Of this total, 453 were killed (33 of which were children) and 5,454 were seriously injured (1,569 of which were children). • This represents an overall increase of 1 per cent in pedestrian casualties but a 12 per cent increase in pedestrian fatalities, compared to 2010. • Pedal cyclists are also a vulnerable group with 107 fatalities and a total of 19,215 casualties of all severities. • Pedal cyclist casualties increased overall by 12 per cent, compared to 2010. In contrast, the number of pedal cyclist fatalities decreased by 4 per cent.
Themes: Road casualty statistics.
Comments: Essentially raw data with no analysis/narrative given, but the data is very useful to give an indication of how casualty numbers have changed year to year.

Title: Reported Road Casualties Great Britain, 2013
Author / organisation: Department for Transport **Date:** 2014 **Format:** Pdf **Link:** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/359311/rrcgb-2013.pdf **Free / priced:** Free
Objectives: To present reported road casualties statistics for 2013
Methodology: Statistics collated from STATS19 data which is collected by police officers attending RTIs.
Key Findings: • In 2013, a total of 24,033 pedestrian casualties occurred on GB roads • Of this total, 398 were killed (26 of which were children) and 4,998 were seriously injured (1,332 of which were children). • This represents a 5 decrease in pedestrian deaths and casualties in pedestrian fatalities, compared to 2012. • Pedal cyclists are also a vulnerable group with 109 fatalities and a total of 19,438 casualties of all severities. • Pedal cyclist casualties increased overall by 2 per cent, compared to 2012. In contrast, the number of pedal cyclist fatalities decreased by 8 per cent.
Themes: Road casualty statistics.
Comments: Essentially raw data with no analysis/narrative given, but the data is very useful to give an indication of how casualty numbers have changed year to year.

Title: Reported Road Casualties Great Britain, 2014

Author / organisation: Department for Transport
Date: 2015
Format: Pdf
Link:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/463797/rrcgb-2014.pdf
Free / priced: Free

Objectives: To present reported road casualties statistics for 2014

Methodology: Statistics collated from STATS19 data which is collected by police officers attending RTIs.

Key Findings:
In 2014:

- A total of 19,239 pedestrian casualties occurred on GB roads in reported road accidents
- Of this total, 446 were killed (29 of whom were children) and 5,063 were seriously injured (1,350 of whom were children).
- This represents a 12% increase in pedestrian deaths, a 1.3% in serious injuries and a 12% increase in pedestrian casualties overall, compared to 2013.
- Pedal cyclists are also a vulnerable group with 113 fatalities and a total of 21,287 casualties of all severities.
- Pedal cyclist casualties increased overall by 10%, compared to 2013, including a 4% increase in the number of pedal cyclist fatalities.

Themes: Road casualty statistics.

Comments: Essentially raw data with no analysis/narrative given, but the data is very useful to give an indication of how casualty numbers have changed year to year.

Title: Local Transport Note 01/07 Traffic Calming

Author / organisation: DfT
Date: 2007
Format: Pdf
Link: http://assets.dft.gov.uk/publications/local-transport-notes/ltn-1-07.pdf
Free / priced: Free

Objectives: To bring together a summary of the research commissioned by the Department for Transport, together with research from external sources, to provide advice on the use of traffic calming measures today.

Methodology: A review of traffic calming research commissioned by DfT was undertaken so that a comprehensive summary of types calming measures, their effectiveness, cost and environmental impact could be presented in one document.

Key Findings:

- Contains a very large amount of detailed information on the range of speed reductions which can be achieved by each traffic calming method as well as the variety of types of measure within a group (e.g speed cushions vs speed humps).
- It has been shown that on average each 1 mph reduction in mean vehicle speed results in an average RTI reduction of 5 per cent.
- Hence a 10 mph speed reduction may give a 50 per cent RTI saving. This result has been confirmed by two further studies.
- Traffic calming measures have been shown to reduce the frequency of RTIs involving pedestrians, cyclists and motorcyclists (as well as car occupants).
- While some studies have shown dramatic reductions in RTIs in and around areas with calming measures, others have reported large increases in RTIs in surrounding areas.
- This suggests that an area wide view has to be taken and that smaller, localised schemes may not offer such significant benefits.
- RTIs were reduced by 71 per cent at 34 sites and by 60 per cent in 20 mph zones, which comprised mainly humps.
- Sinusoidal humps installed in Edinburgh have reduced RTIs slightly. However, the numbers are small and further sites would be needed to confirm whether the expected effect could be similar to other humps for a given speed reduction.
- RTI data supplied by Fife (Fife Council, 2004) for their ‘H’ and ‘S’ hump scheme on South Parks Road, Glenrothes, shows that injury RTIs have been reduced from 10 in 5 years (2 per year) to only one in the five years (0.2 per year) after the scheme was installed.
- RTI reductions of 86 per cent have been reported for schemes containing speed cushions at sites in Huddersfield and Northampton.
- An average of 40 per cent reduction in RTIs was seen at 4 sites where thermoplastic ‘thumps’ were used.

Themes: Traffic calming, effectiveness, RTI reduction.

Comments: Very comprehensive report – far too much detail to be included here.

Title: Traffic Advisory Leaflet 11/00 Village traffic calming – reducing RTIs
Author / organisation: DfT **Date:** December 2000 **Format:** Pdf **Link:** http://assets.dft.gov.uk/publications/tal-11-00/tal-11-00.pdf **Free / priced:** Free
Objectives: To assess the effect on RTIs of traffic calming measures in a number of villages.
Methodology: In all, RTIs in 56 village traffic calming schemes were studied. Villages were classified into three groups depending on the level of measures in place. Injury RTI data covered an average of 7 years before and 5 years after the installation of the measures. RTIs were grouped in to slight, KSI and all RTIs. Over 1400 RTIs were analysed.
Key Findings: • Traffic calming measures in villages can yield reductions in speed, which are associated with substantial reductions in injury RTIs, particularly KSI RTIs. • From previously published results, firm estimates can be made of the reduction in mean speeds obtainable from proposed new schemes. It is now possible to predict the reduction in KSI and all-injury RTIs that are possible. • A 1 mph reduction in mean speed would result in a 4.3 per cent reduction in all-injury RTIs, and a 10 per cent reduction in KSIRTIs. • Schemes with physical measures in the village would be expected to reduce mean speeds by almost 8 mph and to reduce the proportion of drivers exceeding the speed limit by more than 30 percentage points. • The most substantial measures (physical features and signing/marking measures with high visual impact) are the most effective in terms of speed and RTI reduction. • For all types of measures a downward shift in the distribution of speeds would result in a reduction in mean speeds.
Themes: RTI reduction, Traffic calming.
Comments: A detailed analysis of village RTI data following installation of calming measures. Useful statistics.

Title: Traffic calming in villages on major roads Traffic Advisory Leaflet 1/00

Author / organisation: DfT
Date: March 2000
Format: Pdf
Link: http://assets.dft.gov.uk/publications/tal-1-00/tal-1-00.pdf
Free / priced: Free

Objectives: To summarise the results from nine of village speed control projects which aimed to assess the effectiveness of traffic calming measures in reducing the 85th percentile speed of traffic.

Methodology: A review of nine speed reduction projects throughout England focusing on speed reductions associated with different measures. Speed measurements were recorded for comparison before, 1 month after and 12 months after installation.

Key Findings:

Gateway Speeds

- Following implementation of the schemes there were reductions in inbound speeds at all the gateways.
- These ranged from 3 mph to 13 mph for mean speeds, and up to 15 mph for 85th percentile speeds.
- The largest reduction in speed at the various gateways, relative to the magnitude of 'before' speeds, occurred at the narrowed entries (with speed cushions) to the 20 mph zone at Costessey.
- Even though speed reductions were achieved at all of the gateways, only the mean speeds were close to (or in the case of West Wellow equal to or below) the speed limit. The 85th percentile speeds were all considerably above the speed limit.

Speeds within villages

- Reductions in mean speed, over both directions, ranged from 2 mph to 12 mph, with 85th percentile reductions of up to 14 mph.
- Individually, physical measures yielded speed reductions of between 7 mph and 12 mph.
- The use of the repeater roundels reduced speeds by about 3 mph to 5 mph.
- The target of obtaining 85th percentile speeds which did not exceed the speed limit, was seldom met.
- Signing (including marking) measures giving a high visual impact can produce quite large speed reductions at village entries. However, these speeds are still likely to be above the speed limit.
- It is important that features are visible at night, particularly as it has been shown that speeds tend to increase at this time. The use of reflective material is therefore imperative.

Themes: Traffic calming, Speed reductions, Villages.

Comments: A useful illustration of the reductions that rural traffic calming can achieve.

Other works

Title:20 mph Zones and Speed Limits
Author / organisation: Royal Society for the Prevention of Accidents **Date:** 2012 **Format:** Pdf **Link:** http://www.rospa.com/rospaweb/docs/advice-services/road-safety/drivers/20-mph-zone-factsheet.pdf **Free / priced:** Free
Objectives: To review and summarise the history, characteristics and effectiveness of 20 mph zones
Methodology: The report findings are based on a literature review of available publications
Key Findings: • In 2008, there were 771 fatalities and 92,714 injuries reported on built up roads in Great Britain. A large proportion of these RTIs occurred on residential roads, with 116 fatalities on B roads and 289 fatalities on other minor C and unclassified roads. • The majority of pedestrian casualties occur in built up areas: 24 child pedestrians and 278 adult pedestrians were killed in 2010 on such roads. In total there were 24,950 pedestrian injuries. • Pedal cyclists are also vulnerable in built up areas and there were 59 cyclist fatalities and 15,995 casualties of all severities. • Speed significantly increases the chance of being injured in a RTI. Studies which compare injury severity with vehicle speed show that RTIs at speeds above 20 mph are more likely to result in severe injuries, rather than slight injuries. • Speed management including the use and enforcement of speed limits is a practical and established way of reducing injuries, and therefore, urban 20 mph zones present a way of significantly reducing the likelihood of a serious injury. • The first widespread evaluation of 20 mph zones in the UK was carried out by TRL in 1996. It found that injury RTIs were reduced by 60 per cent, and child injury RTIs were reduced by 67 per cent. The evaluation did not find evidence that RTIs increased on surrounding roads due to drivers changing their route. • From 1994, there was a widespread introduction of 20 mph zones in Hull, and by 2003, there were 120 zones covering 500 streets. The casualty statistics between 1994 and 2001 showed a drop of 14 per cent in Hull, compared to a rise of 1.5 per cent in the rest of Yorkshire and Humberside. • In the 20 mph zones in Hull, there was a decrease in total RTIs of 56 per cent and in fatal and serious injuries of 90 per cent. The biggest reductions were pedestrian casualties, which fell by 54 per cent, child casualties which dropped by 54 per cent and child pedestrian casualties fell by 74 per cent. • A 2007 review of half of the 20 mph zones which had been implemented in London (78 zones) found that they reduced injury RTIs by about 42 per cent and fatal or serious RTIs by 53 per cent.

- A major review of road casualties in London between 1986 and 2006 was published in the BMJ in 2009. It demonstrated that 20 mph zones reduced the number of casualties by over 41.9 per cent. The 20 mph zones were slightly more effective in preventing fatal or serious injuries to children, which were reduced by 50.2 per cent.
- The BMJ analysis showed that the reduction in road injuries in 20 mph zones occurred at a greater rate than the overall trend of reduction in casualties in London, that this was not attributable to any regression-to-the-means effect, and that there was no displacement in RTI risk to roads close to the 20 mph zones.
- TRL carried out research on 20 mph limits in 1998 which examined the effectiveness of 20 mph limits without traffic calming measures. It found that traffic calming was a more effective way of reducing vehicle speeds than signs only, which only produced a small reduction in speed.

Themes: RTI reduction, 20 mph zones.

Comments: Very good summary of the effectiveness of 20 mph zones.

Title: Preventing unintentional injuries among children and young people aged under 15: road design and modification - NICE public health guidance 31

Author / organisation: National Institute of Clinical Excellence
Date: 2010 **Format:** Pdf.
Link: http://www.nice.org.uk/nicemedia/live/13273/51626/51626.pdf
Free / priced: Free

Objectives: The guidance is for local highway authorities, local strategic partnerships, directors of public health, health professionals who have a responsibility for preventing or treating unintentional injuries affecting children and young people aged under 15, and school travel planners.

Methodology: The evidence section of the report covers the data which was used to develop the report's recommendations. Five UK based studies evaluated area-wide traffic calming schemes. A number of international schemes were also reviewed.

Key Findings:

- The report noted that the evidence it reviewed consistently suggests that engineering measures to reduce traffic speed generally do reduce RTIs and fatalities or injuries among children and young people.
- There is moderate evidence from two uncontrolled before-and-after studies (both UK) that area-wide traffic calming may reduce rates of killed or seriously injured children.
- There is moderate evidence from one uncontrolled before-and-after study and one ecological study (both UK) that area-wide traffic calming may reduce child road casualty rates of any severity. There is moderate evidence from one controlled and two uncontrolled before-and-after studies (all UK) that area-wide traffic calming may reduce child injury RTI rates of any severity.
- Evidence from two uncontrolled before-and-after studies indicates that 20 mph zones reduce killed or seriously injured child casualty rates.
- Two US studies of the Safe Routes to School (SRTS) programmes based predominantly on engineering measures show that they may reduce the rates of RTI-involved child pedestrians or cyclists, or the rate of child injury RTIs.
- In 125 SRTS project areas across California, a mean reduction of 7% in the all-injury RTI rate with child pedestrians and cyclists was estimated.
- Three cost–benefit analyses of a variety of area-wide traffic calming schemes show that, even in the short term (after 1 year), benefits are likely to exceed costs in most circumstances.
- One cost–benefit analysis of advisory 20 mph speed limits shows that, in the short term, benefits are likely to exceed costs. Similarly, there is moderate evidence from one cost–benefit analysis of mandatory 20 mph zones that shows that, in the medium to long term, benefits are likely to exceed costs.

Themes: Traffic calming schemes, Injury reduction, RTI reduction.

Comments: A good review of calming measures undertaken by a non transport organisation with an extremely rigorous approach to evaluating research evidence. Includes reviews of UK and international studies.

Title: Area-wide traffic calming for preventing traffic related injuries
Author / organisation: F. Bunn, T. Collier, C. Frost, K. Ker, R. Steinbach, I. Roberts, and R. Wentz, - The Cochrane Collaboration **Date:** 2009 **Format:** Pdf **Link:** http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003110/pdf **Free / priced:** Free
Objectives: To assess the effects of area-wide traffic calming for preventing RTI, injuries, and fatalities.
Methodology: An extensive literature search was undertaken of online transport related databases, websites of road safety organisations, conference proceedings were hand searched, reference lists were checked for relevant papers and experts in the area were contacted. The search was not restricted by language or publication status. The searches were last updated in 2008. 22 controlled before and after studies were selected for detailed analysis – these schemes were in the UK, Europe and Australia and most were in residential areas.
Key Findings: • Road traffic RTIs are a major cause of fatality and injury in low and middle income countries. With increasing motorisation in these countries the problem is likely to get worse. • Compared to educationally based road safety interventions, area wide traffic calming appears to be a more promising intervention for reducing traffic injuries and fatalities. • The results from this review suggest that area-wide traffic calming in towns and cities may be a promising intervention for reducing the number of road traffic injuries and fatalities. However, further rigorous evaluations of such interventions are needed. • An important effect of traffic calming schemes is to reduce the speed of traffic, in which case traffic calming might still reduce the likelihood of injury in the event of a RTI. • A systematic analysis of good quality evidence, with comparative tables summarising the percentage reduction in fatalities, injuries and RTIs between vehicles and pedestrians, including confidence levels. Overall reductions in these indicators are estimated across the 22 studies synthesised. However further details of the outcomes of individual schemes are not provided.
Themes: Traffic calming, Injury reduction.
Comments: Very statistical review – outcomes from individual schemes reviewed not always clear.

Title: Effect of 20 mph traffic speed zones on road injuries in London, 1986-2006: controlled interrupted time series analysis

Author / organisation: C. Grundy, R. Steinbach, P. Edwards, J. Green, B. Armstrong, and P. Wilkinson.
Date: 2009
Format: Pdf
Link:
http://www.bmj.com/highwire/filestream/398316/field_highwire_article_pdf/0/bmj.b4469
Free / priced: Free

Objectives: To quantify the effect of the introduction of 20 mph (32 km an hour) traffic speed zones on RTIs, injuries, and fatalities in London.

Methodology: Observational study based on analysis of geographically coded police data on road casualties, 1986-2006.

Key Findings:

- The introduction of 20 mph zones was associated with a 41.9 per cent (95 per cent confidence interval 36.0 per cent to 47.8 per cent) reduction in road casualties, after adjustment for underlying time trends.
- The percentage reduction was greatest in younger children and greater for the category of killed or seriously injured casualties than for minor injuries.
- There was no evidence of casualty migration to areas adjacent to 20 mph zones, where casualties also fell slightly by an average of 8.0 per cent (4.4 per cent to 11.5 per cent).
- Using the more conservative risk reduction estimates based on 2000-6, we estimate that 20 mph zones prevent 203 casualties each year, of whom 27 would be killed and seriously injured and 51 would be pedestrians.
- The study concludes that 20 mph zones are effective measures for reducing road injuries and deaths.

Themes: Traffic calming, 20 mph zones, Injury reduction.

Comments: Good long term review of impact of 20 mph zones. Quoted by a number of other studies.

Title: Research Into The Effectiveness Of Different Forms Of Research Traffic Calming In The London Borough Of Southwark Traffic Southwark

Author / organisation: Southwark Living Streets
Date: 2008
Format: PowerPoint presentation
Link: http://southwarklivingstreets.files.wordpress.com/2008/11/traffic calming-effectiveness-report.pdf
Free / priced: Free

Objectives: To revisit DfT research on the effectiveness of various calming measures on maintaining a 20 mph zone.

Methodology: Three stages were undertaken in delivering the research:

- A literature review of existing DfT work in the Southwark District;
- A review of speed measurements at a newly installed 20 mph zone in East Walworth; and
- Speed data from calming schemes around the district.

Key Findings:

- Only full-width humps spaced less than 40 metres apart were able to reduce the 85th percentile speed of vehicles to below 20 mph.
- Certain types of calming that are currently being installed appear have very little effect in reducing vehicle speeds in the streets where they are being employed.
- It was proposed that on through routes vehicle speeds should be reduced by SPECS-type cameras; for residential streets full-width humps should be used.
- Research by the Department for Transport concludes that the wider the cushions & the closer they are together, the more vehicle speeds will be reduced.
- The review of speeds at East Walworth found:
    - Only 1.9 metre wide cushions and raised tables are able to reduce the proportion of vehicles moving at more than the speed limit to under 25 per cent;
    - The introduction of infrequent raised crossing on Thurlow St., Flint St and Rodney Road has had almost no effect on 85th per cent speeds; and
    - Even average vehicle speeds only fall to below 20 mph with the introduction of either cushions or raised tables.
- The review of the effect of different forms of calming around the borough allowed for the comparison of the effect of cushions/full width humps with locations where there is no calming.

Themes: Speed reduction, Traffic calming.

Comments: A presentation from a community group which reviews and summarises past studies.

Title: Best Practice for Cost Effective Road Safety Infrastructure Investments

Author / organisation: G. Yanis, P.Evgenikos. and E. Papdimitriou (Conference of European Directors of Roads)
Date: 2008
Format: Pdf
Link:
http://www.cedr.fr/home/fileadmin/user_upload/Publications/2008/e_Road_Safety_Investments_Report.pdf
Free / priced: Free

Objectives: Identification of best practice on cost-effective infrastructure related road safety investments, based on the international experience attained through extensive and selected literature review and additionally on information/data collected through a questionnaire based survey, launched by the Task O7 Group.

Methodology: Literature review and questionnaire based survey.

Key Findings:

- In general, an investment combining a high safety effect with a low implementation cost is considered to be the most preferred.
- The literature sources used in the study detailed projects using measures such as roadside treatments, speed limits, traffic control at junctions and traffic calming, which were all assessed for cost effectiveness.
- Elvik and Vaa (2004) summarise the results of several studies and report significant safety effects in terms of injury road RTIs, ranging from around 15 per cent in the entire selected area to around 25 per cent - 30 per cent on the residential roads of the selected area. On the main roads forming the boundaries for the selected area, RTIs reduction accounts for around 10 per cent.
- A meta-analysis of safety effects associated with area-wide traffic calming measures by Elvik (2001) found RTIs resulting in material damage only were reduced by nearly 20 per cent especially in local streets. Bunn et al. (2004) performed a meta-analysis of area-wide traffic calming projects, including only before-and-after studies that employed a comparison group and estimated a reduction of 37 per cent in fatal RTIs, 11 per cent in injury RTIs and 5 per cent in all RTIs.
- According to a study in three municipalities in Israel regarding the installation of speed-humps on 94 local roads, a 40 per cent reduction in all injury RTIs was achieved (Hakkert et al., 2002), whereas in a similar study in Greece, in which the implementation of residential zones (woonerfs) and the installation of speed-humps in one direction, one lane streets in a broad municipal area took place, the average safety effect was a 38 per cent reduction in the total number of injury RTIs.
- From the 17 sources of data used in the review, an average RTI reduction of 25 per cent was achieved.

Themes: Traffic calming.

Comments: The high level nature of the study and the cost benefit analysis provides an alternative angle for the synthesis.

Title: Pilot home zone schemes: summary of the schemes

Author / organisation: D. Webster, A.Tilly, A. Wheeler, D.Nicholls and S. Buttress (TRL)
Date: 2006
Format: Pdf
Link: https://trl.co.uk/reports/TRL654
Free / priced: Free

Objectives: The objective was to assess the effectiveness of the DfT's pilot home zone schemes. The aim of these schemes was to allow all road users to co-exist in a pleasant environment; to identify the need for additional legislation and to identify and disseminate good practice

Methodology: The study interrogated a variety of data sources in order to assess the effectiveness of the schemes. This included: Interviews with residents, traffic flows, video records, RTI data and noise and air quality measurements.

Key Findings:

- The schemes used a wide selection of calming measures. Each scheme used a multiple types of calming measures from gateways, build outs, vertical deflections and signage.
- The mean speeds were reduced on average by about 5 mph to less than 15 mph. The 85th percentile speeds were reduced by about 6 mph to less than 19 mph.
- The percentage of vehicles exceeding 20 mph was reduced on average from 42 per cent to 12 per cent
- On average 74 per cent of respondents thought it was 'very safe' or 'quite safe' for adults who were walking or cycling in the home zones
- With regards to children walking and cycling in the home zone 58 per cent thought it was 'very safe' or 'quite safe'.
- Road RTIs were not a serious problem at any of the sites prior to the implementation of the schemes. At the seven sites where data was available there was a total of 19 RTIs in the five years prior to the schemes.
- This gave an average of 0.54 RTIs a year
- Although five years of 'after' data was not available at the time of producing the report, the data which was available was equivalent to 0.24 RTIs per year.

Themes: Home zones, traffic calming, RTI reduction, Speed reduction.

Comments: Although data on RTI reduction was not very extensive the paper covers a number of quite large schemes and concludes that home zones can positively influence traffic speed and RTIs.

Title: **Speed Management**

Author / organisation: Organisation For Economic Co-Operation And Development
Date: 2006
Format: Pdf
Link:http://www.internationaltransportforum.org/Pub/pdf/06Speed.pdf
Free / priced: Free

Objectives: To assess the extent and impact of speeding in OECD member countries.

Methodology: The report draws on research results and experience to date and takes into account the responses from 23 OECD and ECMT countries to a survey conducted as part of the study. The report focuses on the key issues related to speeding including road safety fatalities and injuries and adverse environmental impacts, highlights the policy and operational improvements needed and outlines a policy framework for reducing the extent of speeding on the roads.

Key Findings:

- Research shows that lower limits, when accompanied by traffic calming measures, are very effective at reducing RTIs and injuries, with reductions of up to two thirds having been demonstrated.
- Speed humps are the most widely-used form of traffic calming, especially in those countries where traffic calming has spread very quickly: Great Britain and Netherlands.
- The effectiveness on desired speed is well proven; however it should be noted that speed humps generate higher levels of noise, which is a real nuisance for the people living nearby.
- The speed reduction effect – usually perceptible 50 meters before and after the humps – is largely dependent on the hump heights and gradients.
- The application of roundabouts is a very effective speed reduction measure for appropriate locations.
- Based on a meta-analysis, Elvik and Vaa (2004) report an injury RTI reduction of 10-40 per cent, depending on the number of arms and the previous form of traffic control.
- The effect on pedestrian RTIs is similar to that of other RTI types; the effects for cyclists are somewhat smaller (10-20 per cent).
- The meta-analysis showed an increase in the number of damage-only RTIs at roundabouts.
- Speed management through infrastructure changes has saved many lives. With the knowledge we have accrued about best practices, as well as lessons learned from mistakes, traffic calming will continue to be a very important speed management measure in urban areas.

Themes: Speed reduction, Traffic calming, RTI reduction.

Comments: A wider view of traffic calming and speed reduction throughout Europe – provides international evidence to support the findings from UK studies.

Title: Psychological traffic calming

Author / organisation: J. Kennedy, R. Gorell,L. Crinson, A. Wheeler and M. Elliott (TRL)
Date: 2005
Format: Pdf
Link: https://trl.co.uk/reports/TRL641
Free / priced: Free

Objectives: To develop and test traffic calming measures which make greater use of psychological (non-physical) measures which still have a significant speed reducing capability.

Methodology: An initial review of psychological measures was undertaken to understand the cognitive mechanisms involved in driver's responses to help develop appropriate measures. Focus groups and interviews were used as an initial assessment of the measures before the most successful ones were taken forward for a driving simulator study. Finally, one scheme was progressed to a site trial in Wiltshire where traffic speeds, flows and public attitudes were assessed.

Key Findings:

- The direct link between reduced speeds and reduced RTIs is well documented.
- The concept of psychological measures was welcomed by the focus group but concerns were raised about some of the costs as well as a potential reduction in effectiveness over time.
- A combination of measures tended to produce bigger estimated reductions in speeds.
- Continuous or repeated measures were required to sustain speed reductions.
- Uncertainty appeared to reduce speed; e.g. build outs were particularly effective where another vehicle was approaching.
- The most effective measures were 'red brick narrowing' or 'tree build outs'.
- The site trials used a range of measures such as stone gateways, build outs, surface colouring and the removal of the centre line.
- Inbound mean speeds fell by up to 8 mph at the gateways.
- In a village, two way mean speeds fell by 7-8 mph to 31 mph and 85th percentile speeds fell by 8-10 mph to 37 mph.
- The proportion of vehicles exceeding 40 mph (in a new 30 mph zone) fell from 50 per cent to 10 per cent.
- The most effective measures were hose with physical as well as psychological elements.
- While there will continue to be situations where physical measures are needed, psychological schemes can be effective, their effects can be lasting and they are highly acceptable to local people.

Themes: Non physical, Psychological, Traffic calming.

Comments: An alternative view on the methods by which traffic calming can be achieved. Concludes that psychological calming can be effective although other studies suggest that physical measures are most effective.

Title: Traffic calming techniques: Experience and practical advice with 80 case studies

Author / organisation: The Institution of Highways and Transportation and the County Surveyors' Society
Date: 2005 **Format:** Pdf
Link: http://www.ciht.org.uk/en/publications/index.cfm/traffic calming-techniques-2005
Free / priced: Priced £25

Objectives: To provide an update ten years after the publication of the County Surveyors' Society's publication entitled Traffic Calming in Practice. The report updates the work started in TCiP and extends it to demonstrate how traffic calming techniques have changed. The objectives of the report are to describe the context within which traffic calming measures should be considered and provide guidance on design and implementation and how traffic calming techniques may develop in the future.

Methodology: The report has been developed through a review of:

- Design and implementation of traffic calming measures;
- Public consultation and participation processes;
- Relevant legislation, standards, guidance and advice;
- National policy background, design procedures and quality; and,
- Case studies looking at a longer term view of some of the schemes introduced in the past.

Key Findings:

- Traffic calming features generally need supporting by traffic signs. Signing and lighting are subject to the requirements of the regulations and advice, which aim to ensure that traffic calming features are clearly visible to approaching drivers at all times.
- As well as using signing, markings and lighting to meet the requirements of regulations, they can also be used to provide information to ensure appropriate warning of traffic calming features is given to approaching drivers at all times. Traffic calming measures need to be visible both day and night and in adverse weather conditions.
- Traffic calming schemes, particularly when introduced in rural situations where the aim is to reduce speeds to 40, or perhaps 30 mph, sometimes result in a significant increase in the number of warning signs in advance of the traffic calmed area. Along with carriageway markings and other features, they are used to alter the drivers' perception of the road on which they are travelling and hence bring about a change in behaviour leading to slower speeds.
- White lining can have a very significant part to play in many traffic calming schemes and can in itself bring about significant benefits, although these are likely to be greatest when used in combination with other techniques.
- Vehicle activated sign devices are particularly useful on the approaches to bends and junctions where motorists may be unable to judge a safe speed until they are in the bend, or are unaware of side road visibility restrictions.

Themes: Signs and markings, safety, RTIs, Legislation, Policies and standards.

Comments: Robust document. However, it is slightly dated (7 years old) and signs and markings only form part of the analysis.

Title: Traffic calming and childhood injury on the road

Author / organisation: National Children's Bureau
Date: 2004
Format: Pdf
Link:
http://www.whatworksforchildren.org.uk/docs/Nuggets/pdfs/traffic_calming.pdf
Free / priced: Free

Objectives: To provide a brief summary of the benefits and costs which traffic calming can provide with regards to childhood injury.

Methodology: Literature review.

Key Findings:

- Child pedestrian injury arising from road RTIs is the leading cause of child accidental fatality in the UK.
- In 2001, 132 child pedestrians/cyclists under the age of 16 were killed on British roads, 3,818 were seriously injured and 17,322 suffered less severe injuries such as cuts and bruises.
- These figures come from police STATS19 data, so could be an underestimate as some RTIs are not reported or recorded correctly.
- Children in poor neighbourhoods are five times more likely to be injured by a car than those in affluent areas.
- Area-wide traffic calming is designed to control traffic in urban residential areas and has been shown to be effective in reducing child RTIs.
- When comparing data before and after implementation of a 20 mph zone, annual RTI frequency was found to drop by about 60 per cent.
- Child pedestrian RTIs fell by as much as 70 per cent and child cyclist RTIs by 48 per cent.
- Introducing an area-wide traffic calming scheme is likely to be an effective measure in reducing inequalities in child health.
- The schemes reduce the severity of injury in the event of a RTI and make it easier for drivers to avoid RTIs.
- Traffic calming has been compared with another popular intervention – road safety education. While the effectiveness on reducing pedestrian injuries from traffic calming has been shown, the beneficial effects on injury reduction from education programmes are less clear.

Themes: Traffic calming, Child RTI reduction.

Comments: Another good summary of benefits with particular reference to child injury RTIs.

Title: Estimating the Benefits of Traffic Calming on Through Routes

Author / organisation: G.D. Garrod, R.Scarpa, and K.G. Willis (Journal of Transport Economics and Policy)
Date: 2002
Format: Pdf
Link:
http://www.ingentaconnect.com/content/lse/jtep/2002/00000036/00000002/art00003
Free / priced: Free

Objectives: To evaluate the benefits and to investigate how they relate to the various outcomes of how they relate to the various outcomes of traffic calming, including reductions in speed noise and pedestrian waiting times.

Methodology: Choice experiments were used to estimate the attributes/benefits that local residents derive from the various outcomes of traffic calming. The choice experiment approach is essentially a structured method of data generation. It relies on carefully designed choice tasks that help reveal the factors influencing choice. The attributes which the paper investigates include (but is not limited to) safety improvements and reductions in noise and road crossing wait times.

Key Findings:

- Excessive speed is a major contributory factor in a large proportion of fatalities and serious injuries on British roads.
- One approach to tackling the speeding problem is the use of traffic calming as a means of enforcing speed restrictions along roads running through populated areas.
- Combinations of (traffic calming) measures can be used along a stretch of road to generate a desired set of outcomes in terms of speed and flow of traffic.
- Vertical deflection measures, such as road humps, are one of the most effective forms of reducing traffic speed.
- Horizontal deflection measures, such as chicanes, also reduce speed, with traffic often being restricted to a single lane working through the chicane on a two way road.
- Visual warnings comprise measures such as countdown signs to the speed limit, red surface treatments and speed camera signs. Some of these elements are only mildly successful at reducing road speeds.
- Estimations from the responses to choice experiments for traffic calming on through routes revealed that local people had a positive willingness to pay (WTP) for a reduction in the negative impacts of road traffic and for more attractive, rather than basic designs of the traffic calming measures.
- This WTP could help when selecting traffic calming measures to maximise the ratio of social benefits to costs.

Themes: Traffic calming, Speed reduction, Cost benefit.

Comments: While the overall purpose of the paper is to look at the wider considerations and benefits which traffic calming can offer, the paper provides additional evidence to support the safety improvements of traffic calming seen in other reports and documents.

Title: The Impacts of Traffic Calming Measures on Vehicle Exhaust Emissions

Author / organisation: P. Boulter, A. Hickman, S. Latham, R. Layfield, P. Davidson and P Whiteman (TRL)
Date: 2001
Format: Pdf
Link: https://trl.co.uk/reports/TRL482
Free / priced: Free

Objectives: The main objectives of the study were to investigate the effects of different traffic calming measures on the exhaust emissions from passenger cars, and to develop a system of performance indicators for the measures.

Methodology: Nine types of traffic calming measure were used in the trial along with twelve in service petrol and three in service diesel cars. A total of 542 individual emission tests were conducted with fuel consumption and exhaust emissions of four pollutants (CO, HC, NOx, and CO2) being recorded in each test.

Key Findings:

- The results of the study clearly indicate that traffic calming measures increase the emissions of some pollutants from passenger cars.
- For petrol non-catalyst, petrol catalyst, and diesel cars, mean emissions of CO per vehicle-km increased by 34 per cent, 59 per cent, and 39 per cent respectively.
- For all three vehicle categories the increase in mean HC emissions was close to 50 per cent.
- Emissions of NOx from petrol vehicles increased only slightly, but NOx emissions from diesel vehicles increased by around 30 per cent.
- Emissions of CO2 from each the three vehicle categories increased by between 20 per cent and 26 per cent.
- Emissions of particulate matter from the diesel vehicles increased by 30 per cent.
- Although weak, some trends were seen between increases in emissions (for specific vehicle types) and particular calming measures.
- Consequently, even though traffic calming generally increases emissions per vehicle it is very unlikely that it would result in poor local air quality.
- However, the increases in vehicle emissions associated with traffic calming would need to be given particular attention in Air Quality Management Areas.

Themes: Traffic calming, Emissions.

Comments: Although not a direct road safety issue, the impact of calming measures on the environment is an important consideration.

Title: What works in preventing unintentional injuries in children and young adolescents? An updated systematic review

Author / organisation: NHS Health Development Agency
Date: 2001
Format: Pdf
Link: http://www.nice.org.uk/niceMedia/documents/prevent_injuries.pdf
Free / priced: Free

Objectives: This is a systematic review of evidence which attempts to answer the question: 'How effective are health promotion interventions in preventing unintentional injuries in childhood and young adolescence?'

Methodology: A review of six studies along with consultation with 'key informants' was undertaken. Two studies were from the UK, two from Denmark and two from the Netherlands.

Key Findings:

- In the *Urban Safety Project*, overall road traffic RTIs were reduced by 13 per cent but there were great variations between schemes. Slight RTIs declined proportionately more than fatal and serious ones.
- Pedestrian injuries were reduced in one centre (Sheffield) in particular and there was a general reduction in child cyclist casualties. Measures that protected two-wheel vehicles such as right turn prevention and right turn bays, were particularly successful.
- A longer term assessment in Reading showed that child pedestrians and cyclists particularly benefited. Each scheme cost about £250,000 and first year rates of return indicated considerable cost savings. In the Netherlands, Vis et al estimated the cost of 30km/h zones as about $7,000 per 10,000$m_2$ but did not provide any data on cost savings from RTI reduction.
- The evaluation of 20 mph zones in the UK proved them to be effective both in reducing traffic speed and in reducing RTIs. In particular child pedestrian injuries were reduced by 70 per cent from 1.24 per year in each area before to 0.37 after the zones were introduced. Child cyclist injuries were reduced by 48 per cent, from 0.21 before to 0.11 per year after the intervention. No migration of RTIs was found to other areas as a result of the introduction of the zones.
- One finding of the evaluation of the impact of bicycle tracks was that although RTIs involving cyclists and car users decreased, RTIs involving cyclists and other road users (pedestrians and other cyclists) increased.
- There is now good evidence that area-wide engineering schemes and traffic calming measures reduce RTIs.
- Vulnerable road users such as child pedestrians and cyclists benefited from such schemes.
- Area-wide engineering schemes are cost effective.
- There is some evidence that cycle tracks reduce some cycle injuries but more research is needed in this area.

Themes: Traffic calming measures, RTI reduction.

Comments: A good summary of a selection of European schemes.

Title: A model of speed profiles for traffic calmed roads
Author / organisation: H.M. Barbosa, M.R. Tight and A.D. May (Transportation Research Part A) **Date:** 2000 **Format:** Pdf **Link:** Available through www.ingentaconnect.com **Free / priced:** Priced
Objectives: To assess the influence of traffic calming measures on the speed of unimpeded vehicles by evaluating differences in speed profiles obtained from various combinations of traffic calming measures.
Methodology: The study was undertaken by evaluating the differences in speed profiles obtained from the various combinations of traffic calming measures (humps, speed cushions, and chicanes implemented in sequence. The emphasis was on creating an empirical model which explains the variations in speed profiles according to the type and position of measures within the sequence.
Key Findings: • An examination of the effects of different types of traffic calming measures on speeds has showed differences by type of measure. • The greatest impact on speeds was produced by tables, followed by humps, chicanes and cushions. • This confirms the order of effectiveness seen by Layfield (1994). • However, some variation was seen between measures of the same type indicating that their location can impact their effectiveness. • This study has also produced evidence that some chicanes are totally ineffective in reducing speeds.
Themes: Traffic calming, Speed reduction.
Comments: The research was predominantly aimed at developing a model to predict the speed reductions achieved by proposed traffic calming measures but some of the information discussed is relevant to the synthesis.

Title: Traffic calming – Speed Cushion Schemes
Author / organisation: R.E. Layfield and D.I. Parry (TRL) **Date:** 1998 **Format:** Pdf **Link:** https://trl.co.uk/reports/TRL312 **Free / priced:** Free
Objectives: To carry out an assessment of speed cushion design and effectiveness.
Methodology: To review and assess 34 local highway authority traffic calming schemes using speed cushions. The study assesses the effect of cushions on vehicle speeds, traffic flows, RTIs, driver behaviours and passenger discomfort.
Key Findings: • The most effective forms of traffic calming usually involve some degree of vertical deflection. • Road humps have been proven to be highly effective at reducing vehicle speeds but cause driver/passenger discomfort, particularly in larger vehicles. • Speed cushions are effective at reducing speed, but not quite as effective as road humps. • While a comprehensive RTI survey was not undertaken before and after the traffic calming schemes were introduced, it is estimated from other studies that the reductions in speeds and flows is likely to achieve injury RTI savings of approximately 60 per cent.
Themes: Traffic calming, Speed cushions, Effectiveness.
Comments: An effectiveness study focussed on one particular calming measure. While not as effective as humps, cushions offer the benefit of not impairing the emergency services or affecting public transport passengers.

Title: Traffic calming – An assessment of selected on-road chicane schemes

Author / organisation: I.A. Sayer, D.I. Parry and J.K. Barker (TRL)
Date: 1998
Format: Pdf
Link: https://trl.co.uk/reports/TRL313

Free / priced: Free

Objectives: To draw together and study all the available data concerning the design and effectiveness of chicanes installed on local highway authority and trunk roads over the past decade.

Methodology: Data collected from 134 authorities and 49 chicane schemes representing the 7 most common types. Each scheme included between 1 and 10 chicanes, and in all 142 chicanes were studied. The schemes were analysed for vehicle speeds, traffic flows, RTIs, geometric design signing and costs.

Key Findings:

- In 1995 60 per cent of all RTI casualties occurred in built up areas and approximately a third of these were vulnerable (pedestrian and cyclist) road users.
- Various types of horizontal deflections have been used in calming schemes to reduce traffic speed.
- Chicanes installed in a large number of schemes on local and trunk roads, resulted in average speed reductions for mean and 85th percentile speeds were reduced of 12 mph at the chicanes.
- Between chicanes, this reduction dropped to 7 mph.
- Two way chicanes appeared to achieve slightly smaller speed reductions that one way versions (5-7 mph higher).
- Of the 17 schemes where before and after RTI data was available, an overall reduction in RTI frequency of 54 per cent (41.2 -19.0 RTIs per annum) was seen.

Themes: Traffic calming, Horizontal deflection, Speed reduction,

Comments: Another study of non physical measures by reviewing data from a reasonable number of schemes around the UK.

Title: Urban Speed Management Methods

Author / organisation: A.M. Mackie (TRL)
Date: 1998
Format: Pdf
Link: https://trl.co.uk/reports/TRL363
Free / priced: Free

Objectives: To review and evaluate the measures needed for successful 20 mph zones.

Methodology: The predominant methodology employed was an in depth literature review of UK and international research. Speed measurements were also gathered before and after the installation of speed signs to assess their effectiveness.

Key Findings:

- Of all the methods reviewed (including speed cameras, and various types of signs) traffic calming measures were clearly the most effective achieving reductions in mean speed of 9.3 mph and 85th percentile speed reductions of 10.4 mph.
- Physical measures such as speed humps are therefore the most effective at enforcing 20 mph zones.
- The majority of sign only zones which were reviewed did not show any reduction in RTIs, although small speed reductions were recorded.
- Effective public awareness campaigns and/or enforcement can slightly increase the effectiveness of all measures, in some cases achieving additional speed reductions of 3 mph.
- The use of flashing signs and speed cameras have a substantial effect on speed reduction and appear likely to have safety benefits at specific locations.
- However, their costs may preclude them from being used as a comprehensive method of speed control across a whole urban zone.

Themes: Traffic calming, Speed reductions, Effectiveness.

Comments: Reviewing traffic calming methods in 20 mph zones. Older research – some advancements will have been made (e.g. in cameras) but basic premise of the methods that are reviewed haven't changed significantly.

Title: Review of traffic calming schemes in 20 mph zones

Author / organisation: D.C. Webster and A.M. Mackie (TRL)
Date: 1996
Format: Pdf
Link: https://trl.co.uk/reports/TRL215

Free / priced: Free

Objectives: To review the effect of traffic calming using 20 mph zones

Methodology: A literature review was undertaken to assess the impact of six 20 mph zones around the UK.

Key Findings:

- The most quoted reason for applying for an authorisation of a 20 mph zone was RTI reduction indicating that safety is the main justification for implementing the schemes.
- Most zones were in predominantly residential areas, with about 10 per cent being in town or city centres.
- The average size of the zones was 0.28 sq.km.
- The most common traffic calming measures used in 20 mph zones were round topped and flat topped humps and speed tables. Speed cushions were used in some more recent schemes.
- The 20 mph zones have been successful in substantially reducing speeds and RTIs in the areas where they have been applied.
- Child pedestrian and child cyclist RTIs fell by 70 and 48 per cent respectively after scheme installation giving an overall reduction of 67 per cent for all child RTIs.
- The reduction in RTIs for all cyclists was 29 per cent.
- Speed results show that the average speed at a calming measure was 13.2 mph while between measures it rose to 17.8 mph.
- This indicates that the calming measures are effective at enforcing the 20 mph limit.
- There was a 6.2 per cent reduction in RTIs for every 1 mph reduction in vehicle speed.
- RTI migration into surrounding areas was not found to be a problem but care should still be taken in design of schemes to prevent traffic transferring to unsuitable routes.

Themes: Speed reduction, RTI reduction, 20 mph zones, traffic calming

Comments: Good example of reductions in RTIs numbers resulting from speed reductions.

Title: Traffic Calming – Vehicle Activated Speed (VAS) Limit Reminder Signs
Author / organisation: D.C. Webster (TRL) **Date:** 1995a. **Format:** Pdf **Link:** https://trl.co.uk/reports/TRL548 **Free / priced:** Free
Objectives: To review the published results from 13 of these 'secret' sign sites which have been used in the UK, other European countries and the USA. Single 'secret' signs were used at ten sites and a pair of 'secret' signs were used at three of the sites.
Methodology: Published data on vehicle speeds was reviewed to assess the impact of the 'secret' signs on mean and 85th percentile speeds.
Key Findings: • VAS appear to reduce speeds by a few mph at the sign and some of the reduction can be maintained some distance downstream in the village centre. • Changes in RTIs, while not statistically significant were still encouraging – when compared to control sites there was an overall reduction in RTIs of 42 per cent. • The speed reductions appeared to be maintained over time.
Themes: Speed reduction, Non-physical measures.

Title: Traffic calming – four schemes on distributor roads
Author / organisation: D.C. Webster (TRL) **Date:** 1995b **Format:** Pdf **Link:** https://trl.co.uk/reports/TRL182 **Free / priced:** Free
Objectives: To obtain information on suitable traffic calming measures for urban distributor roads.
Methodology: 200 radar readings or automatic equipment was used to record before and after speeds on four distributor road calming schemes.
Key Findings: • In four schemes on urban distributor roads, the 85th percentile speeds were reduced to levels below or near the 30 mph limit. On average speeds were reduced by 11 mph from 38 mph to 27 mph. • Mean speeds reduced by 10 mph from 34 mph to 24 mph. • Across the schemes an overall RTI reduction of 32 per cent (26 – 17.8) was seen. The researchers noted that based on the size of the data set, the change is not statistically significant but is consistent with other research which showed reductions in speed being directly related to reductions in RTIs.
Themes: Traffic calming, Distributor roads.

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