Slow zones: their impact on mode choices and travel behaviour

March 2011

Carolyn O'Fallon, Pinnacle Research & Policy Ltd, Wellington

Charles Sullivan, Capital Research, Wellington

NZ Transport Agency research report 438

ISBN 978-0-478-37171-0 (print)
ISBN 978-0-478-37172-7 (electronic)
ISSN 1173-3756 (print)
ISSN 1173-3764 (electronic)

NZ Transport Agency
Private Bag 6995, Wellington 6141, New Zealand
Telephone 64-4 894 5400; Facsimile 64-4 894 6100
Email: research@nzta.govt.nz
Website: www.nzta.govt.nz

O'Fallon, C[1] and C Sullivan[2] (2011) Slow zones: their impact on mode choices and travel behaviour. *NZ Transport Agency research report no.438*. 110pp.

[1] Pinnacle Research & Policy Ltd, PO Box 12-483, Thorndon, Wellington. Carolyn@pinnacleresearch.co.nz
[2] Capital Research, 31 Gloucester St, Wilton, Wellington. Charles@capitalresearch.co.nz

Keywords: active transport, assessment, cycling, evaluation, evidence, home zone, impacts, mode shift, safety, slow zones, speed, speed limits, sustainable transport, traffic calming, traffic modes, urban design, walking

An important note for the reader

The NZ Transport Agency is a Crown entity established under the Land Transport Management Act 2003. The objective of the Agency is to undertake its functions in a way that contributes to an affordable, integrated, safe, responsive and sustainable land transport system. Each year, the NZ Transport Agency funds innovative and relevant research that contributes to this objective.

The views expressed in research reports are the outcomes of the independent research, and should not be regarded as being the opinion or responsibility of the NZ Transport Agency. The material contained in the reports should not be construed in any way as policy adopted by the NZ Transport Agency or indeed any agency of the NZ Government. The reports may, however, be used by NZ Government agencies as a reference in the development of policy.

While research reports are believed to be correct at the time of their publication, the NZ Transport Agency and agents involved in their preparation and publication do not accept any liability for use of the research. People using the research, whether directly or indirectly, should apply and rely on their own skill and judgement. They should not rely on the contents of the research reports in isolation from other sources of advice and information. If necessary, they should seek appropriate legal or other expert advice.

Acknowledgements

The authors gratefully acknowledge the funding provided by the NZ Transport Agency, without which this research project could not have been undertaken.

We would also like to recognise the individuals in our steering group whose input and comments helped us to focus the output from this project into the areas of greatest interest and usefulness to them: Iain McAuley (Ministry of Transport); Evelyn Légaré (Senior Corporate Policy Officer, VicRoads); Celia Wade-Brown (Living Streets Aotearoa and Mayor, Wellington City); Anna Sunter-Daniels (NZTA) and Andrew Edgar (formerly of NZTA). We also appreciate the assistance from our peer reviewers: Dr Ray Brindle (Eldamar Research Associates, Victoria, Australia) and Associate Professor Geoff Rose (Institute of Transport Studies, Monash University) and expert advisor: Phil Jones (Phil Jones Associates, Birmingham, UK).

Abbreviations and acronyms

DFT	Department for Transport, UK
HZ	home zones
IPPR	Institute for Public Policy Research, UK
ITE	Institute of Transportation Engineers
km/h	kilometres per hour
KT	kilometres travelled
mph	miles per hour
MPR	mixed priority routes
NAP	neighbourhood accessibility plan(ning)
NZHTS	NZ Household Travel Survey
NZTA	NZ Transport Agency
RCR	road capacity reduction
SZ	slow zones
TC	traffic calming
TCRP	Transit Cooperative Research Program

Contents

Executive summary

Overview

We created the term ‘slow zone’ treatment or programme to generically describe the aim of any programme that modified the physical road environment in such a way it would moderate driver behaviour, slow vehicle traffic, and/or improve the environment of the neighbourhood. Within this definition, slow zone treatments included: traffic calming (local area traffic management), 30km/h zones and limits, home zones, mixed priority routes, neighbourhood accessibility planning, road capacity reduction, shared space and complete streets.

In 2004, legislative changes enabled New Zealand local authorities to implement a wider range of speed limits. For example, Wellington City Council's Safer Roads project planned suburb-wide 40km/h speed restrictions as part of a major programme of changes costing $21 million (over seven years). Over the same period, UK local authorities implemented 30km/h zones and speed limits which, in some cases affected almost all the residential streets and roads in a city (eg Portsmouth, Oxford and Islington).

Safety was, of course, a primary objective of these changes. Overseas evidence suggested the safety impact could be substantial. Recent UK research showed a significant reduction in all casualties (42%) when compared with areas that did not have 30km/h zones and there were even significant benefits to physical health and health-related behaviours.

Given that the safety impacts of traffic management measures, including their effect on traffic speed, were reasonably well-established, we wanted to explore the potential impact of slow zone treatments on mode choice and travel behaviour, other than reductions in driving speed.

Purpose

We hypothesised that the often dramatic and clearly visible changes to streets created by establishing slow zones could also have substantial impacts on aspects of travel behaviour, in particular mode choice and travel patterns.

Hence, we proposed to examine international experience in the development, implementation and monitoring of slow zones to identify what types (if any) of slow zone treatments contributed to changes in mode use and/or travel behaviour, other than reducing driving speed. We wanted to take the ‘best practice’ slow zone treatment(s) and compare them with slow zone treatments in New Zealand, with a view to providing a sound method to test their cause-and-effect on a broader range of impacts, particularly mode use and travel behaviour. That is, we proposed to lay the foundations for progressing the evaluation of slow zones in New Zealand by completing a comprehensive ‘evaluability assessment’.

Methodology

We adopted an evaluability assessment framework as the methodological approach for this research project. Evaluability assessment is a systematic process that helps identify whether a planned programme evaluation is justified, feasible and likely to provide useful information. In the first stage of an assessment, one output is a logic model.

In order to develop the logic model, our investigation followed a predefined process by:

- clarifying the purpose of our investigation (ie, whether or not it was justifiable and/or feasible to evaluate the impact of slow zones on mode choice and travel behaviour, other than reducing driving speeds)
- defining the slow zone programme boundaries
- identifying and analysing the available international and New Zealand evidence.

Our aim was to develop an evidence-based logic model by identifying the 'best practice' slow zone treatment programmes, wherein the programme's components had been demonstrated to lead to specified outputs, outcomes and impacts, particularly those associated with mode shift and/or changes in overall mode use. We expected the review would enable us to identify appropriate performance measures and indicators together with some methods already shown to be successful in collecting the data needed. It was anticipated that, once completed, the logic model would form the basis of the evaluation design, by ensuring the evaluation focused on appropriate performance measures.

However, the evidence review did not allow us to clearly identify slow zone programme 'best practice(s)' for facilitating mode shifts or changes in transport mode use. Hence, instead of describing and verifying a comprehensive logic model, we developed less detailed guidance for a monitoring framework to assist in the collection of appropriate outcome and impact data.

Findings from review of international and New Zealand experience

None of the studies (some of which covered several or many cases) we reviewed specifically documented evidence of mode use or travel behaviour change. Rather, we had to focus on changes in walking, cycling and vehicle traffic flow, which may or may not be indicative of a change in mode use. Overall the evidence was mixed: 16 studies showed increases in walking while 11 had decreases or no change in pedestrian activity; six studies showed increased cycling activity and seven decreased or had no change. Where traffic flow was measured, it more consistently showed reductions, but there were many studies where no traffic flow was monitored and/or reported. Overall, while some types of slow zone treatments were found to be effective in reducing vehicle traffic speed and vehicle and pedestrian crash rates, the results of our review are inconclusive with respect to whether or not slow zone treatments:

- increase walking and cycling activity
- decrease vehicle traffic flow
- cause people to alter their mode use.

Proposed framework for evaluating impact on mode use

Our proposed evaluation framework focuses on collecting evidence of the impacts of slow zone treatments on modal shift, whereas the most common reasons for implementing slow zone treatments are to improve safety, reduce vehicle speeds and/or improve liveability in an area. The methodology and considerations for measurement of changes in safety and vehicle speeds, in particular, were outside the purview of this research project. However, given the lack of consistent evaluation of slow zone treatments to date, whether implemented for safety or other reasons, we recommend any evaluation addresses all relevant objectives.

In broad terms, the design for evaluating mode use and/or travel behaviour changes associated with slow zone treatments is quite straightforward and requires the consistent measurement of pedestrian, cycling, public transport and vehicle activity within the area to be treated and in the surrounding environs (to take account of possible diversion of users). This should be done before carrying out a slow zone treatment and after its implementation.

Ideally, data would be collected for both the treatment and also a control area where no treatments had been undertaken; however, this may not be feasible or practicable. To ascertain the characteristics effective in encouraging alternative mode use, we recommend different types of treatments should be evaluated.

Recommendations

We recommend careful consideration of whether or not an evaluation is required in the early stages of designing a slow zone treatment (ie well before it will be implemented). This is to ensure, as far as is feasible, the collection of 'before' data suitable for establishing the effect of the treatment in terms of its stated objective(s) and outcome(s).

However, we also caution that our review of the overseas evidence suggests implementing an evaluation framework in New Zealand to reliably estimate effects on mode choice on its own may not deliver good value for money. Many New Zealand-based slow zone treatments target smaller areas than those overseas (ie they are not 'area-wide') and/or design speeds or speed limits are commonly 50km/h or 40 km/h, as opposed to 30km/h, which is more widespread in international examples. As a result of these differences, the overall expected effects on vehicle traffic flow and speed, and safety, let alone mode choice, within a New Zealand-based slow zone would be smaller and, therefore, more difficult (and costly) to detect.

We recommend including the findings of the review of international and New Zealand experience in the NZTA integrated planning toolkit as appropriate.

Abstract

Given that the safety impacts of traffic management measures, including their effect on traffic speed, have been reasonably well-established, we wanted to explore the potential impact of such treatments on mode choice and travel behaviour such as travel patterns. We created the term ‘slow zone’ treatment or programme to generically describe the aim of any programme that modified the physical road environment in such a way it would moderate driver behaviour, slow vehicle traffic, and/or improve the environment of the neighbourhood.

We adopted an evaluability assessment framework as the methodological approach for this research project. Evaluability assessment is a systematic process that helps identify whether a planned programme evaluation is justified, feasible and likely to provide useful information. In the first stage of an assessment, one output is an evidence-based logic model. In completing the tasks for this stage, we found the evidence review did not allow us to develop a comprehensive logic model as planned, because we could not clearly identify slow zone programme ‘best practice(s)’ for facilitating mode shifts or changes in transport mode use. Hence, we developed less detailed guidance for a monitoring framework to help collect appropriate outcome and impact data.

1 Introduction

1.1 Project context

In 2004, legislative changes enabled local authorities to implement a wider range of speed limits. For example, Wellington City Council's Safer Roads project planned suburb-wide 40km/h speed restrictions as part of a major programme of changes costing $21 million (over seven years). However, at the start of this research project, many of the traffic management measures (some of which would encourage traffic speeds as low as or lower than 40km/h) had been implemented in the seven treated areas – incorporating 12 suburbs, while speed limit changes had only been implemented in two suburbs (40km/h in Newtown and 30km/h in part of the Lambton area). Christchurch City Council had several streets where speed limits had been set at 40km/h after a significant amount of traffic calming infrastructure was put in place. More recently, Wellington City Council began a four-year plan to implement 30km/h zones in the 21 suburban shopping areas[1], some of which will be less than 200m in length.

The wide application of 30km/h zones and other slow zone treatments in some UK cities contrasts sharply with the relatively timid application in New Zealand. For example, Webster and Layfield's (2003) report noted 137 installed 20mph (equivalent to 30km/h) zones in London by 2002. By 2007/08, 399 zones covering 2216km of (mostly minor) roads had been installed in London and its boroughs (Grundy et al 2008). The 30km/h zones ranged from 0.07km to 37km in length. In 2002, Hull had 120 such 30km/h zones covering 191km (26%) of the city's roads (IPPR 2002). More recently, several councils and boroughs in Britain have implemented signed 20mph (30km/h) speed limits (without traffic management measures) on almost all of their residential streets and roads (Portsmouth, Oxford and Islington) or on significant portions of them (eg Bristol – one-third of the city; Warrington piloting on 197 roads in the town; Southwark and Wirral are in the process of establishing 20mph limits for all residential roads).

Safety was, of course, a primary objective of these changes. Overseas evidence suggested the safety impact could be substantial. For example, a 1996 study of the introduction of 30km/h zones in the UK found a 60% reduction in crash frequency overall (Webster and Mackie 1996). Some displacement to non-treated streets nearby occurred and there was also a 27% reduction in traffic flows within the slow zones. More recent UK research showed a significantly large reduction in all casualties (42%) when compared with areas that did not have 30km/h zones (Grundy et al 2008) and even significant benefits to physical health and health-related behaviours (Morrison et al 2004).

Given that the safety impacts of traffic management measures, including their effect on traffic speed, have been reasonably well-established, we wanted to explore the potential impact of slow zone treatments on mode choice and travel behaviour, other than driving speeds, with a view to understanding the potential for slow zone treatments to contribute to wider New Zealand transport objectives such as more effective and efficient use of transport network capacity and transport modes, improved community and individual health and well-being outcomes, and reduced transport costs. We hypothesised that the often dramatic and clearly visible changes to streets created by establishing slow zones could also have substantial impacts on aspects of travel behaviour, in particular mode choice and travel patterns. It is often stated that lower speeds across many streets in a single community and greater perceived safety will encourage increased walking and cycling, particularly by children. For example, the UK Department for Transport (DFT 2009) in its consultation on making the UK's roads 'the safest in the world', stated the following:

[1] The Wellingtonian, 4 March 2010, p1

> *We believe that these road safety measures will have the effect of enhancing both public safety and public perception of safety, so encouraging more walking and cycling. They are particularly popular around schools, with both children and adults.* (p53)

Hence, we proposed to examine international experience in the development, implementation and monitoring of slow zones to identify what types (if any) of slow zone treatments contributed to changes in mode use and/or travel behaviour. We wanted to take the 'best practice' slow zone treatment(s) and compare them with slow zone treatments in New Zealand, with a view to providing a sound method to test their cause-and-effect on a broader range of impacts here, particularly on mode use and travel patterns. That is, we proposed to lay the foundations for progressing the evaluation of slow zones in New Zealand later by completing a comprehensive 'evaluability assessment' in the first instance.

1.2 Report structure

This paper is structured as follows:

- Chapter 2 defines and describes the range of slow zone treatments investigated as part of this research project.
- Chapter 3 outlines the research methodology, which was based on evaluability assessment and a literature review.
- Chapter 4 presents the findings from our review of international and New Zealand experience with slow zone treatments and their effect on transport use.
- Chapter 5 delineates a possible framework for evaluating impacts of slow zone treatments on changes in mode use.
- Chapter 6 summarises our conclusions and recommendations.

2 Defining slow zone treatments

2.1 Overview

In undertaking this research project, we wanted to investigate a broad range of physical and/or environmental measures that could contribute to slowing down vehicle traffic and improving the liveability and safety of an area. In the early stages, we used the term 'traffic calming' to describe the treatments or measures we were considering, but on further investigation, we realised that 1) the perceptions/ definitions of traffic calming varied among practitioners and researchers; and 2) we wanted to expand the parameters of the study to include some treatments not typically considered as part of the traffic calming rubric. This led us to invent the term 'slow zone' treatment or programme to generically describe the aim of any programme that modified the physical road environment in such a way it would moderate driver behaviour, slow vehicle traffic, and/or improve the environment of the neighbourhood. The specific treatments we investigated as part of this research project included:

- traffic calming (including local area traffic management)
- 30km/h zones
- 30km/h limits
- home zones
- mixed priority routes (UK)/Sharing the Main Street (Australia)
- neighbourhood access planning (New Zealand)
- road capacity reduction (also known as road diet)
- shared space
- complete streets.

The slow zone treatments are described in the following sections.

We specifically excluded reviewing speed change management approaches, including self-explaining roads,[2] whose particular focus is to encourage drivers either to change speed or maintain an appropriate speed within a particular area (Charlton and Bass 2006) and speed-reducing measures which are used to manage driver speed in urban and rural environments (Jamson et al 2008). While there are clearly overlaps between speed management and slow zones, in terms of the physical measures applied, the narrow focus of the former has generally precluded any examination of their effect on travel behaviour (other than vehicle speeds) and mode use. Readers particularly interested in the effectiveness of different speed treatments on changing drivers' mean speeds and the proportions of drivers exceeding the speed limit are referred to Charlton and Bass (2006), Jamson et al (2008) and Austroads (2009b).

[2] According to Charlton and Bass (2006), self-explaining roads (SER) use road designs that evoke correct expectations and driving behaviours from road users. The SER approach recognises that drivers' speed selection in particular appears to depend on explicit attention in some situations, and on implicit perceptual cues associated with road and traffic characteristics in others and facilitates road designs that assist drivers in forming appropriate schemata for various categories of road (including the desired speed), hence promoting correct behaviour for that road.

2.2 Traffic calming

The term 'traffic calming' was introduced into Australia by community lobbyists who argued neighbourhood or local area traffic management had failed and they advocated traffic calming in its place (Brindle 1997). There was, however, some ambiguity as to what traffic calming was supposed to look like in practice. Hence, a group of Australian practitioners met during an Australian Road Research Board conference in 1990 to 'reconcile the many apparently divergent definitions of traffic calming' (Brindle 1997). Three levels of traffic calming were identified, each involving physical/environmental techniques or actions and social/cultural changes or ethos. The physical and environmental management techniques include all actions available to the responsible governments to control the level, speed and route of vehicle traffic. The social/cultural changes refer to both actions taken to deliberately provoke change in community attitude and behaviour, as well as societal, cultural or attitudinal changes that may not be directly related to transport matters. The levels have come to be represented in what was originally called the 'Darwin matrix' (as it was developed at a Darwin-based conference), but what we have labelled the 'traffic calming matrix' (see table 2.1 below).

Table 2.1 The traffic calming matrix (adapted from Brindle 1997 and Arup Services 2003)

Level	Focus	Scope of measure	Physical/environmental (techniques)	Social/cultural/attitudinal (ethos)
1	Local (street or neighbourhood	Results of actions to restrain traffic speed and lessen traffic impacts at the local level where traffic volumes, levels of service and network capacity are not an issue.	Local area traffic; management/residential street management; speed control devices; most reported speed and accident physical countermeasures	Neighbourhood speed watch; VicRoads 'Speed and volume' study; community action; attitudinal change
2	Intermediate (zone, traffic corridor, regional road)	Results of actions to restrain traffic speed and lessen traffic impacts on traffic routes (district or sub-arterial roads), where traffic volumes, levels of service and network capacity are or may become an issue.	Environmentally adapted through roads (Denmark); shared zones, lower-speed zones; pedestrianised shopping precinct; retail corridors (main or high street of town or suburb); road pricing (precinct); parking policies	Voluntary behaviour change: mode choice, speed
3	City wide	Results of actions at the broader scale, to lessen traffic levels and impacts city wide.	Travel demand management (TDM); transportation systems management (TSM); total system measures (fares policy, city-wide road pricing); manipulation of urban form and structure; parking policies	Cultural change; loss of choice (eg energy constraints, significant drop in living standard); population decline; alternative futures

The stated goal of traffic calming is calmed traffic, and there are various means to achieve this end. No specific traffic speed is identified, and in some cases traffic calming has been applied to calm the traffic speed from 60km/h (the sign-posted speed – the actual speed of the traffic may be greater) to 50km/h; in others it may be to reduce the speed from 50km/h to 30km/h. Local area traffic management –

sometimes referred to as neighbourhood traffic management – is thus one of the tools of level 1 traffic calming. The desired outputs of local area traffic management are to reduce traffic volumes and speeds in the local streets, while the outcomes are increased community amenity or liveability, and improved safety and access for residents, especially pedestrians and cyclists.

While the overall objectives may not be dissimilar, the Australian specification of traffic calming activities contrasts with that of the international transportation organisation, the Institute of Transportation Engineers (ITE) in *Traffic calming state of the practice* (as presented by Ewing 1999):

> *Traffic calming involves changes in street alignment, installation of barriers, and other physical measures to reduce traffic speeds and/or cut-through volumes in the interest of street safety, liveability, and other public purposes.*

It was noted that traffic calming excluded educational and enforcement activities, and streetscape or roadside environment improvements; speed limits; all-way stops and markings to narrow the width of road lanes. Only the *self-enforcing* engineered measures of local area traffic management (level 1 of the traffic calming matrix) are included. Ewing (1999) observed the ITE definition of traffic calming incorporated a mixture of means (included changes in street alignment; excluded speed limits) and 'immediate ends' (reduced traffic speeds and volumes) as well as 'ultimate ends' (safety and liveability).

2.3 30km/h limit and 30km/h zone

The 30km/h limit and 30km/h zone are two distinct approaches used in the UK to encourage drivers to slow down and create safer environments for other road users. Recently, Oxfordshire County Council, which implemented 20mph limits on almost all residential roads, unnumbered through roads and some main roads in its networks in September 2009, had the added outcomes 'to encourage more people to walk and cycle to reduce congestion and pollution, and to improve health'[3].

In the case of the 20mph (approximately 30km/h) *limit*, the speed limit is lowered, through the use of signage, to calm traffic but no physical engineering measures are put in place to assist in enforcing the lower speed. Repeater signs are used throughout the 20mph area to remind drivers of the limit. The UK Department for Transport (DFT) (2009) has stated that 'signed-only 20mph speed limits are therefore most appropriate for areas where vehicle speeds are already low', and indicated that if average vehicle speeds in an area are around 24mph (38km/h), then signing alone should lead to compliance with the new speed limit.

By contrast, 30km/h *zones* involve the use of physical measures to slow vehicle traffic to the desired speed limit of 30km/h. Road engineering measures have been classified into three categories (Ewing 1999; Charlton and Baas 2006):

- Vertical measures – textured pavements, raised intersections, speed tables, speed humps
- Horizontal measures – traffic circles (mini-roundabouts) and roundabouts, curb extensions (chicanes, lateral or axial shifts) and realigned or modified intersections
- Road narrowing – gateways, neckdowns, bulbouts, reduced pavement or lane width, intersection and centre island narrowing. Road narrowing is often accompanied by plantings or street furniture to create a further vertical visual boundary of the road space, thus encouraging maintenance of a lower speed.

[3] Accessed August 2010 from www.oxfordshire.gov.uk/20limits

Essentially, 30km/h zones are created using local area traffic management or traffic calming techniques with the specific aim of reducing traffic speed to 30km/h or lower.

In the UK, the 20mph limits initiative has been applied to whole council areas and towns (eg Portsmouth, Oxford and Islington, a borough of London), and as such could be considered a level 3 traffic calming initiative. 20mph zones have been used in areas of varying sizes (involving between 1km and 25km of road network) and areas (town centres, residential neighbourhoods, near schools and markets). According to the DFT (2009), neither 20mph limits nor zones should include major through roads. 20mph zones are thus either a level 1 or level 2 traffic calming treatment.

2.4 Home zones

Home zones are developed in residential streets so the road space is shared between vehicles and people 'safely and on equal terms' (Barrell and Groll 2005) with the aim being to 'promote quality of life and neighbourliness' (DFT 2001a). Creating a home zone (woonerf or 'living backyard' in the Netherlands where the concept originated) aims to allow cyclists, pedestrians and children playing to use all of the road space because vehicles are required to travel slowly (or in some cases are banned altogether) and the demarcations between footpaths and roadways are removed (Jones and Baulch 2001).

Figure 2.1 Home zone in Hull, UK (Photo: Carolyn O'Fallon)

Home zones have been developed in neighbourhoods of varying sizes: in the UK pilot programme, home zones include areas such as The Methleys, Leeds comprising 14 streets, 300 homes and 700 residents; Northmoor, Manchester, incorporating 1400 dwellings; and Magor, Monmouthshire, with about 60 dwellings and 20 small shops. A range of treatments were used based on the neighbourhood characteristics and resident consultation (refer figure 2.1 and table 2.2). Common to all was the establishment of gateways, with gateway treatments (varying combinations of home zone signage, plantings, road narrowing or buildouts, and raised or otherwise differentiated road surfaces), so that non-resident drivers were made aware they were entering a home zone (Webster et al 2006).

Table 2.2 UK home zone pilot programme – treatments used (Data source: Webster et al 2006)

HZ location	Gateway treatments (including HZ	20mph signs/ zone	Shared road surface on some roads	TC	Street lighting	Streetscaping (eg planting, playgrounds)	Road narrowing/ closure
Leeds	√	√	√	√			
Manchester	√		√		√	√	
Sittingbourne	√			√		√	√
Magor	√	√		√		√	
Plymouth	√	√	√				
Nottingham	√	√		√		√	
Ealing	√	√	√	√	√		
Lambeth	√		√		√	√	√
Peterborough	√		√	√	√	√	√

If referring to the traffic calming matrix, a home zone would be a level 1 traffic calming initiative.

2.5 Mixed priority routes

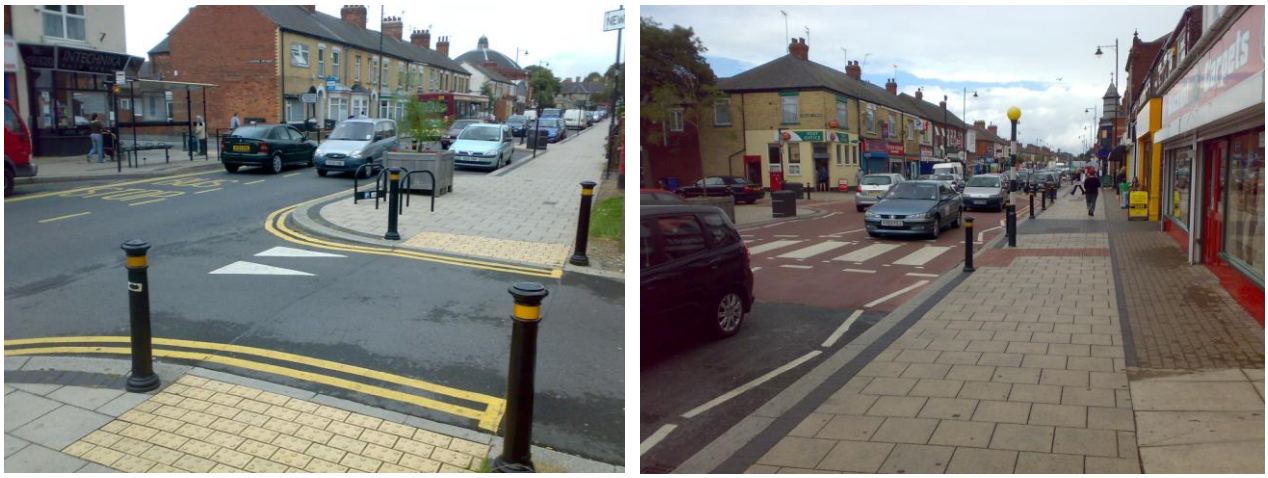
The Department for Transport devised the mixed priority routes demonstration project to address the 'unique combination of road safety problems' (DFT 2008a, p6) caused by the diverse traffic and mixed uses on many high streets and shopping streets in the UK. Mixed priority routes (MPR) are thus defined as:

> *streets that carry high levels of traffic and also have:*
>
> - *A mix of residential use and commercial frontages;*
> - *A mix of road users, ie shoppers, cyclists, bus passengers, schoolchildren;*
> - *A mix of parking and deliveries* (DFT 2008a).

The primary purpose of implementing an MPR is to reduce the number of casualties and create a more pleasant environment by making better use of the road space – without unnecessarily displacing traffic onto other roads – and providing 'high quality streetscapes' (see figure 2.2 for an example). A mixture of measures may be used to achieve the outcomes:

- Shared-space junctions, and diagonal and informal crossings created for pedestrians, depending on the setting
- reduced vehicle speeds through vertical and horizontal traffic calming measures and road narrowing (reduced lane widths)
- improvements to parking and loading arrangements
- reducing street clutter (combining lighting and traffic signal poles, removing unnecessary signs, replacing bollards with street furniture, etc)
- creating shared use roadways for cyclists and motor vehicles (including buses)
- improving streetscapes and public open spaces with planting, benches and lighting.

Figure 2.2 Mixed priority route in Newland Avenue, Kingston Upon Hull, UK (Photos Carolyn O'Fallon)



In New South Wales, the broader functions of urban streets passing through commercial centres was highlighted through its 'Sharing the main streets' programme (Roads and Traffic Authority NSW 2000), which guided practitioners to manage the main streets or sub-arterial road environments to improve the safety and quality for all of its users (including pedestrians, motorists, cyclists, businesses, transport operators, people with impairments, and visitors).

In terms of the traffic calming matrix, an MPR project would be similar to a level 2 traffic calming initiative, insofar as it applies to high street precincts where capacity and traffic volume may be an issue. Note that it does not go as far as re-allocating road space to one type of user (eg pedestrianised zone) or implementing road pricing for particular users.

2.6 Neighbourhood accessibility planning

Neighbourhood accessibility planning (formerly called 'Safer routes') is an initiative of the NZ Transport Agency (NZTA). According to the handbook *Neighbourhood accessibility plans: guidelines for coordinators* (NZTA 2009), a neighbourhood accessibility plan (NAP) is a tool for use by local authorities and other relevant agencies to help communities to improve the quality and safety of neighbourhood walking and cycling networks. The terms of reference templates (available from www.nzta.govt.nz/resources/neighbourhood-accessibility-plans/template/) set out the overall objectives of NAPs as:

- To improve connectivity and mobility in the area
- To improve safety for pedestrians, cyclists, and shared mode (public transport and car pooling) users
- To contribute to the health and vibrancy of the community/neighbourhood
- To contribute to increasing the number of pedestrians, cyclists and shared mode users in the project area
- To contribute to a reduction in environmental emissions by reducing the number of short-distance car trips
- To contribute to an improved transport environment in the neighbourhood, which may assist economic development in the area.

Neighbourhoods for NAPs are 'typically' no more than four square kilometres in land area, hence a key focus is on improving access by foot and cycle (NZTA 2009). Public transport interchanges could be one of the key destinations for residents, but public transport services themselves are not generally considered as part of a NAP, because such services are usually used for longer trips.

NAPs may incorporate a mixture of engineering or physical measures, as well as educational and promotional initiatives, such as workplace and school travel planning and speed enforcement measures.

2.7 Road diet or road capacity reduction

A road diet involves the narrowing or elimination of lanes on a roadway, usually to make more room for buses, cyclists or pedestrians (HSIS 2010). In the USA, the conversion is typically of a four-lane road to two lanes with the third (central) lane used as a turning lane. The fourth lane may become a cycle lane, footpath, or on-street parking (Rosales 2009). The capacity of the intersection is apparently not reduced, meaning the throughput of vehicles is unlikely to be affected (Ourston 1993). Discussions about road capacity reductions may include such permanent lane reallocation (to bus lanes, pedestrianisation, or cycle lanes) as well as temporary road or lane closures as a result of natural disasters (eg earthquakes) and maintenance or structural repairs (see for example, Kane and Behrens 2000; and Sharples 2009). In the latter cases, vehicle throughput may be affected due to changes to (or complete removal of) intersections.

Road diets in the USA are typically undertaken with a view to reducing crash frequency and incidents with little or no effect on traffic volume (HSIS 2010), while other road capacity reduction researchers discuss the possibility of reducing traffic demand and/or modifying travel behaviour (Kane and Behrens 2000; and Sharples 2009).

In addition to removal or narrowing of road lanes, a road diet project may incorporate traffic calming measures, streetscape improvements, pedestrian crossing features and cycle lanes (Rosales 2009).

2.8 Shared-space schemes

The shared-space concept was conceived in the Netherlands by Hans Monderman in the late 1970s (Hamilton-Baillie 2008a). Much of the available literature appears to be from advocates for the concept (eg Hamilton-Baillie 2008a and 2008b; Shared Space 2005) who state that creating shared spaces will slow down traffic, improve safety and encourage walking and cycling.

A review of shared-space schemes for the UK Department of Transport (MVA Consultancy 2009) noted several other terms used in connection with the shared-space concept: simplified streets, naked streets, shared streets, de-cluttering, and level or single surface. In the USA, shared-space schemes are known as 'shared-use streets' (see for example Gilman and Gilman 2007). MVA Consultancy (2009) defines shared space as:

> *a street or place accessible to both pedestrians and vehicles that is designed to enable pedestrians to move more freely by reducing traffic management features that tend to encourage users of vehicles to assume priority.*

Level surfaces, where the street surface is 'not physically divided by kerb or level differences into areas for particular uses' (MVA Consultancy 2009, p7), are a feature of some shared-space schemes. Shared spaces encourage integration of different users and uses (pedestrians, cyclists, buses and other vehicles all using the same space) rather than the segregation of the road into different spaces for each type of user, as is the case for complete streets or road diets. Shared-space streets typically have all street signage, footways, line-marking and intersection controls removed, relying on the built environment (eg level or

shared surfaces and streetscaping), level of activity, and the reduction in risk compensation to guide road user interactions and behaviour (Austroads 2009a). Austroads (2009a) suggests shared-space streets are considered most appropriate for areas with traffic volumes of less than 5000 vehicles per day (although one has been implemented in the Netherlands at an intersection carrying about 20,000 vehicles per day – Hamilton-Baillie 2008a) and where speeds are lower than 40km/h.

In appraising shared-space schemes for their impacts, MVA Consultancy (2009) included other UK schemes, such as home zones, high street, mixed priority routes, as well as continental European shared-space examples. It appears, as with traffic calming, there are some mixed views among practitioners and researchers as to what shared space is, and indeed whether or not it is a stand-alone concept, or an umbrella for a group of slow zone programmes. We assumed that as a 'zero-management street' (Austroads 2009a) with minimal regulation and traffic control, level surfaces and a principle of user-integration, the shared-space street is a stand-alone concept.

2.9 Complete streets

LaPlante and McCann (2008) define a complete street as 'a road that is designed to be safe for drivers; bicyclists; transit vehicles and users; and pedestrians of all ages and abilities'. In other words, street planning and construction is to take a multimodal approach, rather than focus on the movement of private motor vehicles and freight. In this respect, complete streets are similar to the UK's mixed priority routes. The distinction of the complete street concept is that the primary focus is on urban thoroughfares or arterial streets, rather than local shopping (known as high streets in the UK) or residential streets (which are the focus of home zones). But it can be applied to 'just about every thoroughfare' (McCann 2005). As is the case with home zones and mixed priority routes, 'context sensitive solutions', developed through extensive consultation with the community and other interest groups, are advocated to take account of different wants and needs of all users in each urban area. Characteristics of complete streets include:

- the allocation of road space so all types of users are accommodated safely
- the reduction of vehicle speeds and managing mobility of vehicle traffic (which in some cases will improve traffic flow and in others, may hinder it)
- a greater number of pedestrian crossings.

Rather than shared space, complete streets are more likely to have distinct or separate footpaths, cycle lanes, bus lanes, refuge medians and other formal crossing opportunities (footpath bulbouts, raised crossings, audible pedestrian signals).

According to LaPlante and McCann (2008), policies for complete streets are being adopted by some 50 towns and states in the USA, and there is a strong advocacy movement (National Complete Streets Coalition) to support their wider adoption and application.

3 Project methodology

3.1 Evaluability assessment: overview

We adopted an evaluability assessment framework as the methodological approach for this research project.

Evaluability assessment is a systematic process that helps identify whether a planned programme evaluation is justified, feasible and likely to provide useful information. Dunn (2008) suggests that an evaluability assessment addresses three critical questions:

- Is it plausible to expect impacts?
- Is it feasible to measure impacts?
- Would an impact assessment be useful?

From the beginning of this project, we planned pre-evaluative activity like an evaluability assessment rather than expecting to be able to plan or do an impact evaluation in detail. This was because we judged that it might be premature to attempt impact evaluations of slow zones on mode choice in New Zealand. Nevertheless, advance preparation for possible evaluation seemed desirable and useful because the evaluation need for baseline measurement before slow zone implementation could well require swift planning of evaluation.

Evaluability assessment typically includes the development, or where one is already available, the verification of a comprehensive logic model, also known as causal model (Dunn 2008), programme theory (Trevisan and Huang 2003), or intervention logic (SSC 2003). The logic model provides the conceptual framework for an impact assessment. It identifies the logical relationship or interactions of a programme's components and activities to its outputs, outcomes and impacts, and includes performance measures or indicators for the outputs and outcomes. In some cases, the logic model may already be well established at the onset of the evaluability assessment; in others, there may not be a clear logic model or the model may be incomplete. This was the case for slow zone programmes.

Part of our evaluability assessment was thus to develop and verify a model that was *comprehensive* (including all of the programme's major activities, outputs, outcomes and impacts) and *plausible* (the model should be logically developed so that it would be reasonable to expect it depicted how the programme's activities and outputs led to the specified outcomes and impacts) (Dunn 2008). Once completed, the logic model could drive the evaluation design, in the sense that the logic model was a 'precondition' to ensuring that the evaluation asked the correct questions and used the appropriate performance measures to answer them (Woller and Downing 2007).

According to Dunn (2008), verifying the logic model functions as a preliminary evaluation of the programme, by addressing whether the programme can be reasonably expected to produce its intended outcomes and impacts. Dunn suggested if it was not possible to 'establish a plausible link from programme activities to intended outcomes and impacts, then no further evaluation was warranted, and the resources available for the evaluation should be diverted to a more useful purpose'.

Trevisan and Huang (2003) outlined the following steps for evaluability assessment:

- determine the purpose of the assessment (programme justification, modification, process or outcome evaluation, etc)
- define the boundaries of the programme being studied

- identify and analyse available documentation
- develop/clarify the logic model or programme theory
- identify and interview key stakeholders to ascertain their perceptions, needs and concerns about the programme
- determine the plausibility or validity of the programme compared with the logic model – assessing how likely its implementation and activities will produce the desired outcomes
- draw conclusions and make recommendations, including how to utilise the information in the evaluability assessment.

Our investigation followed this process up to a point, as described below.

3.2 Purpose of assessment

The overall purpose of our project was to investigate, through an evaluability assessment, whether or not it was justifiable and/or feasible to evaluate the impact of slow zones on mode choice and travel behaviour, other than driving speeds. If there was a good platform for such an evaluation, we intended to outline an appropriate design. If a good platform for impact or outcome evaluation was lacking, we intended to specify the key factors missing so that it would be clear later when the conditions could be right for such an evaluation.

3.3 Defining slow zone programme boundaries

The parameters of slow zone treatment programmes included in our evaluability assessment are discussed in chapter 2.

3.4 Identifying and analysing available evidence

We reviewed international and New Zealand experience with slow zone programmes, specifically seeking reference to the effect on travel behaviour and mode choice. The purpose of the review was to develop the logic model (as discussed in section 3.1) for the evaluability assessment.

Early discussions with our peer reviewers/expert advisors indicated we were unlikely to uncover much evidence of changes in mode use (eg people choosing to walk, cycle, or use public transport rather than drive), although some studies did collect some data on the amount of walking and cycling before and after the implementation of slow zone treatments. Hence, our approach to developing the logic model was to keep the review of international experience as open as possible, in terms of examining and documenting.

In addition to internet searches, we contacted known experts in the field for access to unpublished research, clarification of their methodology and findings, etc. We also visited sites in the UK to see Hull's home zone and mixed priority route demonstration projects and to speak with their developers about the development process and perceived impacts of the slow zone treatment.

For the most part, we only included reports/documents which provided at least some evidence to support the claimed impacts of the slow zone treatments. Studies which made unsubstantiated claims were

generally excluded[4], unless they were used to provide background information for defining slow zone treatments in chapter 2.

Information about the range and quality of slow zone programme documentation collected and our analysis of the evidence provided are reported in chapter 4.

3.5 Next steps to developing a logic model

As indicated above, we analysed the available information on slow zone programmes that we had collected from our review of international and New Zealand experience. Our aim was to develop a logic model by identifying the 'best practice' slow zone treatment programmes, wherein the programme's components had been demonstrated to lead to specified outputs, outcomes and impacts, particularly those associated with mode shift and/or changes in overall mode use. We expected the review would enable us to identify appropriate performance measures and indicators. It was anticipated that, once completed, the logic model would form the basis of the evaluation design, by ensuring the evaluation focused on appropriate performance measures.

However, as reported in chapter 4, the review did not allow us to clearly identify slow zone programme 'best practice(s)' for facilitating mode shifts or changes in transport mode use as originally hoped. Hence, instead of describing and verifying a comprehensive logic model including (ideally) 'tried and true' evaluation measures, we developed less detailed guidance for a monitoring framework to assist in the collection of appropriate outcome and impact data (refer chapter 5).

[4] Most notably most of the studies on 'shared space' and 'complete streets' were excluded, as being primarily advocacy oriented, with little or no evidence of their effects on mode use, travel behaviour, safety or otherwise.

4 International and New Zealand experience with slow zones

4.1 Recording the content of the review

As noted in chapter 3, we reviewed international and New Zealand experience with slow zone programmes, specifically seeking reference to the effect on travel patterns and mode choice, but also noting their effects on accidents/crashes, vehicle speeds, and any community liveability measures. The purpose of the review was to develop the logic model for the evaluability assessment of slow zone programmes in New Zealand. We kept the review of international experience broad ranging to ensure we gathered any available evidence on mode use or mode shifts.

We created an Excel spreadsheet to document the material we collected. A worksheet was created for each slow zone treatment type identified in chapter 2. For the most part, we only recorded information from reports/documents that provided at least some evidence to support the claimed impacts of the slow zone treatments. In some instances (eg for mixed priority routes and home zones in the UK; local area traffic management in Australia), we obtained further information through meetings and correspondence with the project coordinators. Our documentation included:

- a brief description of the intervention/slow zone programme
- the location (country and city or town), study population, sample size used for any monitoring work
- a description of the methodology (eg surveys and/or counts; the length of follow up – time elapsed between the 'before' and 'after' monitoring or evaluation)
- outcome variables used to measure success (from a transport perspective)
- impacts on:
  - mode use in the short term (one year or less)
  - mode use/shift in the longer term
  - accidents or crashes
  - speed of vehicles
- potential confounders or sources of bias in the reported evaluation or monitoring (where acknowledged).

Studies which made unsubstantiated claims were generally excluded (although some of these were subsequently used to provide background information for defining slow zone treatments in chapter 2).

The Excel spreadsheet is included as appendix A.

4.2 Findings

4.2.1 Quality of materials reviewed

The quality of the evidence provided/data collected varied greatly. The evaluation methodology employed for each study was rated[5] as:

- 'good' (reasonably sound methodology, explained in text, daily and seasonal travel variability allowed for in data collection; sufficient sample; before and after data provided, ideally any possible confounders identified, conclusions of study thought unlikely to alter with more detailed data collection or deeper analysis)
- 'fair' (some description of methodology; some before and after data provided, no confounders identified, some risk that study conclusions could alter)
- 'poor' (no or very limited description of methodology; some or all before and after data either incomplete or missing, high risk that study conclusions could alter if shortcomings in data and/or analysis were addressed).

In an ideal world, the evaluation would include comparisons between treated area and an untreated 'control' area where the conditions are equivalent to the treated area before implementation of any changes, which in practice is nearly-impossible. Hence, we did not require this in establishing the rating system.

As can be seen from table 4.1 only 13 of the studies we reviewed were given a 'good' rating (and in some cases this was a fairly generous assessment).

The predominant focus of the reporting on slow zone treatments was on improvements to safety and traffic speed – mode use (vehicles, walking, cycling) monitoring or data collection only occurred in about half of the studies we reviewed. In terms of being in a position to identify the elements of slow zone treatments that contribute to changes in mode use, we found that, in many cases, there was little detail about the design elements of the projects being evaluated. There were few attempts to provide any demographic information about the population affected by slow zone treatments: in some cases there was a distinction between adult and children's behaviours; in others, a gender split was provided.

4.2.2 Documented impacts of slow zone treatments on mode use

The findings of our review of international and NZ experience are summarised in tables 4.1 and 4.2. The spreadsheet in appendix A includes expanded versions of these summary tables as well as the full details of the studies we reviewed.

As noted above, the main focus in implementing slow zone treatments has been on the potential for improving the safety outcomes for vehicles, pedestrians and cyclists, generally by reducing the speed of the vehicle traffic in the areas where the measures were being implemented. Traffic volume reductions were the specific focus of some interventions (eg home zones).

[5] We created the categories based on the quality ratings (++, +, -) and descriptions devised by National Institute for Health and Clinical Excellence as part of its public health guidance research, particularly Public Health Guidance PH8, *Promoting and creating built or natural environments that encourage and support physical activity* (various papers prepared, 2006–08).

Table 4.1 Summary of findings of international and NZ experience with slow zone treatments

Slow zone type	Description of intervention studied	Number of studies we included in our review	Quality of monitoring/ evaluation			How changes in walking/cycling (w/c) activity were measured	Measured reductions in injuries, speed, and traffic flow
			Good	Fair	Poor		
Traffic calming (TC)	Area coverage variable and often not specified; Speed humps/blisters most common (7), then pedestrian treatments (5); 12 did not specify mixture used; posted speed limit usually not changed	24 (8 were meta-analysis/reviews)	9	8	7	5 – surveyed residents about w and/or c 2 – counted w or c 3 – did both *12 – not measured*	6 – reduced crashes 6 – reduced vehicle speeds 1 – reduced traffic flow
20mph (30km/h) zones	Implemented in residential areas, generally neighbourhood-wide; TC measures: road narrowing, pedestrian crossing treatments, humps/blisters; plus 30km/h speed limit signs	7 (5 were reviews/evaluations of several zones)	2	5		4 – counted w and c *and* surveyed residents 1 – surveyed residents for w and c *2 – not measured*	3 – reduced in crashes 4 – reduced vehicle speeds 3 – reduced traffic flow 2 – 'too soon' to say
Mixed priority routes (MPR)	Usually shopping or high street, between 0.5 and 1.5 km long; huge range and variation of treatments: TC measures common; plus parking treatments and improved lighting	10 individual case studies in UK (one not evaluated); 10 case studies in one report in Australia	4	5[6]	1	2 – counted cyclists only 4 – counted w and c 1 – counted w only Australia – none counted	11 – reduced crashes 10 – reduced vehicle speeds 6 – reduced traffic flow
Home zones (HZ)	Residential areas of varying sizes (one street block to whole neighbourhood); range of physical measures, commonly designed for speeds less than 30km/h	6 (4 contained reviews of several home zones)		5	1	2 – surveyed residents about w and c 2 – surveyed residents about w only	Crashes not monitored 4 – reduced vehicle speeds 4 – reduced traffic flow
Neighbourhood accessibility planning (NAP)	Neighbourhood-based; mixture of education, enforcement, and engineering measures (including pedestrian	5 individual case studies in NZ (one not evaluated)		1	3	1 – counted walk only	1 – reduced crashes 1 – no change in crashes 2 – no perceived change in

[6] We have counted the Australian case studies as one item for this part of our assessment, as all were completed by the same evaluation team using the same methodology. The measurable results are counted individually.

Slow zone type	Description of intervention studied	Number of studies we included in our review	Quality of monitoring/ evaluation			How changes in walking/cycling (w/c) activity were measured	Measured reductions in injuries, speed, and traffic flow
			Good	Fair	Poor		
	treatments, speed humps/blisters, awareness campaigns, and cycling facilities)						vehicle speeds 1 – reduced vehicle speeds 1 – no perceived change in traffic flow
Road diet (road capacity reduction) (RCR)	Commonly one length of road; features at least one road lane closure or conversion to cycling and/or pedestrian facilities plus pedestrian crossing treatments	7 (4 reviewed multiple examples) – one no evaluation	1	5		3 – counted walking only 3 – counted cycling only 1 – counted both	2 – reduced crashes 1 – reduced vehicle speeds 3 – no change in traffic flow 2 – reduced traffic flow
Shared space		No evaluation/ monitoring studies sighted – a finding corroborated by MVA Consultancy (2009)					
Complete streets		No evaluation/ monitoring studies sighted					

None of the studies we included (or excluded) in our review measured changes in mode use or travel patterns The closest substitute measures for this that we could record were changes in walking, cycling and vehicle traffic counts (see table 4.2), which may or may not be indicative of a change in mode use. For example, walking and cycling might increase and vehicle traffic flow decrease in the slow zone without any real change in mode use by individuals (eg because the activity has simply switched from or to nearby streets).

Only three studies considered, and found, displacement of *vehicle* traffic to streets surrounding the treated area (Grant-Muller et al 2000; DFT 2008f; Webster and Mackie 1996). Some 'road diet' proponents argue – and a few provide evidence – that decreasing the number of road lanes does not affect the capacity of the road to carry traffic. For example, Transport Canada (2005) provides evidence that the road capacity reduction, from four lanes to two lanes on St Georges Street, Toronto, did not affect the 'before' traffic volume of 16,000 vehicles per day in 1993, as the road carried the same volume in 2003. During this time period, the overall volume of traffic in the Toronto area was unchanged (Transport Canada 2005). Victoria and Shalom (2003) found that vehicle speeds decreased in both traffic calm treated areas and untreated surrounding areas while Grundy et al (2008), in their review of 20mph (30km/h) zones in the UK, found that crashes reduced on surrounding streets, albeit at a lower rate than within the zone. None of the studies investigated the 'source' of increased pedestrian and cyclist numbers (ie identifying if they were new users or had migrated from another route to the treated area).

Table 4.2 Number of studies documenting particular changes in mode use following slow zone treatment

	Walking			Cycling			Vehicle traffic flow	
Type of intervention	**Increased**	**Decreased**	**No change**	**Increased**	**Decreased**	**No change**	**Decreased**	**No change**
TC: Speed humps/blisters and pedestrian treatment	3		1					
TC: Speed humps/blisters	1							
TC: Mixture of infrastructure/ operational changes	5*	2		1*	2		1	
30km/h zones			5				3	
MPR	3		1	2	1	2	6	
NAP	1							1
HZ			2			2	4	
RCR/road closure	3			3			2	3
Total	16*	2	9	6*	3	4	16	4

*One study was of school travel plans, which include a mixture of traffic calming measures and programmes (such as walking school buses) to promote active transport.

The nature of the changes in walking or cycling could also depend on the network conditions outside the treated area. For example, implementing a cycle friendly treatment on a small part of the network

surrounded by multi-lane high-speed arterials with no provision for cycling would not be expected of itself to produce much change in cycle mode share.

Counts were the most common means of monitoring pedestrian and cyclist use of treated areas. Few studies specified whether the counts were done manually or automatically. The count methodologies for the mixed priority route pilots were generally well specified and sound (ie, occurred at the same time of the year, same day(s) of the week, same hours of duration), while those for the road diet studies and some of the traffic calming ones were not specified at all. Also, we observe that given that slow zone treatments may restructure or reallocate cyclist and pedestrian movements within an area, conducting counts at fixed locations before and after may sometimes be a less than satisfactory method for evaluating change.

Household interviews have a greater potential to assess whether walking or cycling had generally increased *as a result* of the slow zone scheme; in some cases, studies included surveys of residents that either supplemented the counts or were used in place of counts. It appears that the surveys asked residents – either adults or children or both – to state their perceptions around whether or not they were walking and/or cycling more or less frequently (since the treatment was implemented). In some cases, adults were asked about whether children were playing outside more and/or walking or cycling independently (eg Newby and Sloman 1996; Ross Silcock Ltd and Social Research Associates 1999b; Layfield et al 2003; Webster et al 2006). Often there was a mismatch between respondents' perceptions of either themselves or others walking more frequently with either actual count data or their own self-reported walking trips: for example, DFT (2001b; 2001c) and Hodgkinson and Whitehouse (1999) both found that respondents reported greater walking following the implementation of 20mph zones in their areas, while pedestrian counts showed either a decrease or no change.

MVA Consultancy (2009) noted that, in addition to counting cyclist and pedestrian movements, it could be appropriate to monitor the *nature* of their activity, such as whether or not the treated area is now perceived as a destination or 'place', rather than a travel corridor. They noted some examples where anecdotal evidence suggested pedestrians, in particular, were stopping to use the seats on the street and browse in shop windows. Geoplan Urban & Traffic Planning et al (1998), in reporting on 10 case studies of Sharing the Main Street in and around Sydney Australia, found several cases where shoppers and traders/retailers felt that shoppers were lingering on wider footpaths and/or seats. Other researchers have found indications that the numbers of pedestrians visiting 'pedestrianised' and slow zone-treated shopping areas increased after implementation (Hummel et al 2002; Wooller 2010).The total actual expenditure in shops in those areas was said to increase (compared with other shopping areas); property values and rents rose after implementation (Hummel et al 2002) and/or the percentage of shop vacancies decreased (DFT 2008g). Geoplan Urban & Traffic Planning et al (1998) surveyed approximately 50 businesses in each of 10 case studies and reported that, in six cases, 60%–70% of businesses reported the implementation of the scheme had a 'positive impact' on their business while two additional cases had 40%–50% of businesses reporting the same.

As can be seen in table 4.2, where walking and cycling were measured, the results were fairly evenly split (ie 16 studies showed increases in walking while 11 had decreases or no change in pedestrian activity; six studies showed increased cycling activity and seven decreased or had no change. Where traffic flow was measured, it more consistently showed reductions, but there were many studies where no mode use was monitored and/or reported). Overall, while some types of slow zone treatments are effective in reducing vehicle traffic speed and vehicle and pedestrian crash rates, the results of our review are inconclusive with respect to whether or not slow zone treatments:

- increase walking and cycling activity

- decrease vehicle traffic flow
- cause people to alter their mode use.

Recall that there were 60 studies (covering a much greater number of cases) included in the review, and only a minority reported on modal use.

Furthermore, it was not possible to identify any particular slow zone treatment as being conducive to walking and/or cycling. Our analysis suggested home zones could result in reduced traffic flow in the treated area, although none of the evaluations considered the effect on roads surrounding the home zone. The sparseness and inconsistency in the results suggest we are a long way from establishing an evidence-based positive relationship between slow zone treatment and mode use or travel patterns.

4.3 A brief scan of travel behaviour change literature on the built environment and its effects on mode use

As a check on the completeness of our assessment of the effect of slow zone treatments on mode choice and mode use, we scanned 40-plus key travel behaviour change and transport planning articles reviewing the evidence for effects of various aspects of the built environment, including some traffic calming measures, on walking, cycling, public transport use, and/or physical activity levels. After eliminating those which described or discussed cases already included in the slow zone review (eg the NICE (2008) review includes five such case studies), as well as those which make suppositions about the relationship (often with little or no evidence), we had five comprehensive and peer-reviewed reviews (Saelens and Handy 2008; Handy et al 2005; Handy 2005; Badland and Schofield 2005; TCRP 2008). There was agreement among these researchers that evaluations to date had not provided sufficient evidence on the effects of various physical measures on walking or other mode use:

> *…evidence on what aspects of the built environment affect what types of physical activity to what degree is slim as is evidence on the nature of causal relationships.* (Handy 2005, p38)

> *[The research needs identified include] research on the impact of design features (e.g., mixed land-use, traffic calming, bus bulbs, short blocks, street furniture), travel patterns, transit ridership, or the decision to locate in a TOD [transit oriented development]. Intuitively we know "design matters" but there is very little data to show the impact of design on transit use, location decisions to live in a TOD or what design features have the greatest impact.* (TCRP 2008, p56)

> *Traffic calming measures such as speed humps, traffic circles, and pedestrian refuges have merit as self-regulating automotive speed designs, and may provide opportunistic occurrences for non-motorized travel such as utilizing road closure thoroughfares and pedestrian crossings. Although traffic calming may increase activity opportunities, it is unknown what effect the devices have on modifying LTPA [leisure time physical activity] and TPA [transport-related physical activity] levels.* (Badland and Schofield 2005, p180)

Saelens and Handy (2008) reviewed 13 reviews and 29 original studies to gain an understanding of the specific characteristics of the built environment that correlate most strongly with walking. They identified several weaknesses of the reviews and studies to date, which they observed resulted in the inability to 'produce "definitive conclusions" on the relationship of particular attributes of the built environment with particular walking behaviors' (pS559), such as utilitarian or transport-related walking or recreational walking, and noted a need for 'prospective' or time series rather than cross-sectional

research designs. However, Saelens and Handy (2008) also concluded that the results of their review supported a recommendation to invest in traffic-calming programmes as a means of increasing the viability of walking.

4.4 Implications of findings for evaluability assessment

Given these findings, what about the evaluability assessment? Ideally, we wanted to create an evidence-based logic model for use as a conceptual framework for evaluating the impact of slow zone treatments on mode choice, particularly active transport use. However, we found the overall international evidence was insufficient and the results too inconsistent to identify the slow zone treatment having the greatest effect on mode shift or travel patterns. This is perhaps not surprising given the focus of such treatments, and their evaluation, on crash and vehicle speed reduction.

In the absence of being able to clearly identify the factors giving rise to changes in mode use or travel patterns, or even to consistently showing increases in walking, cycling, or public transport use and/or reductions in private vehicle use, we have developed some guidance on a suitable monitoring framework for slow zone treatments. Such guidance could provide project teams with support in designing and implementing a more robust evaluation methodology that would be valuable for future development of a logic model for slow zone treatments and for defining the wider benefits of slow zones, therefore helping to justify future funding.

5 Towards evaluating the impact of slow zone treatments on mode use

5.1 Overview

In broad terms, the monitoring design for evaluating mode use and/or travel behaviour changes occurring as a result of slow zone treatments is similar to that of any other transport-related monitoring programme, in that it requires consistent measurement of activity both before and after any physical environment changes. The measurement should occur within the area to be treated and in the immediate surrounding area (to take account of possible diversion of users).

To control for environmental changes (in the broad meaning of the term) there could also be a need to monitor a control area so external factors (ie background changes) in mode choice, use or travel patterns can be quantified. This is discussed further in section 5.7.

To ascertain the characteristics effective in encouraging alternative mode use, different types of treatments should be evaluated. A starting point could be to select slow zone treatments found to be most effective from a safety perspective. To be effective,

> *Monitoring and feedback need to be planned from the outset and linked with scheme objectives and public involvement...On a broader basis, it would be helpful for local authorities to carry out an annual review (or other structured programme of evaluation) of schemes completed and the changes that resulted from them. There is a lack of reflective evaluation which could feed into subsequent traffic calming schemes.* (Social Research Associates and Jacobs Babtie 2006, p12)

An underlying problem making it difficult to identify best practice across multiple studies is the lack of standardisation for many slow zone 'treatments'. Whereas implementation of 30km/h zones may be relatively clear cut and comparable across different sites, even a treatment component such as speed bumps can be implemented in a remarkably diverse number of ways.

The remainder of this chapter focuses on the considerations for an evaluation programme designed to identify and measure changes in mode use, including identifying the potential data for collection. Given the focus of this research project on mode use impacts, data collection parameters for monitoring of slow zone treatment effects on safety- and speed-related objectives are not discussed in detail.

No specific advice is given on the techniques for data collection (eg the questionnaire design or use of specific counting technologies) or analysis of the data collected. Any questionnaires and survey design for data collection will likely need to be tailored to the evaluation objectives for a specific project. In many cases, assistance from specialists in the market research and/or travel survey field may be required.

5.2 Key outcomes to be monitored

The evaluation of any slow zone treatment has to reflect its particular objectives. Our review showed there may be a variety of motivations behind the development and implementation of a slow zone treatment, including:

- slowing traffic speeds
- reducing motor vehicle traffic volume

- reducing crash risk for pedestrians, cyclists, and/or vehicles
- improving neighbourhood or community liveability (quality of life for residents, pedestrians and cyclists)
- increasing pedestrian and cyclist and/or public transport use in the area, for transport or health reasons
- increasing consumer spending and/or activity in a retail area.

We found the primary driver for a slow zone treatment was to improve safety, particularly for pedestrians and cyclists, often by reducing vehicle traffic speeds. A common secondary motive was creating 'nice' or more liveable neighbourhoods or areas to visit. Mode use or travel behaviour change was not commonly an explicitly stated motive for implementing slow zone treatments, except in a few cases, for example, Oxford, UK, where 20mph speed limits have been implemented on most roads in the city. The objectives of the Oxfordshire County Council 20mph speed limit programme are three-fold:

- to increase safety levels and help reduce accidents
- to improve the environment and quality of life for pedestrians, cyclists and residents
- *to encourage more people to walk and cycle* to reduce congestion and pollution, and to improve health (www.oxfordshire.gov.uk/20limits – italics added).

It is unclear whether or not Oxfordshire County Council intends to evaluate the effect of the recently implemented programme against the programme objectives.

5.3 Distinguishing walking and cycling activity

5.3.1 'Link' and 'place' functions of a street

As a *link*, a street connects places (suburbs, towns, cities, states), serving primarily as a through passage for traffic of all kinds, particularly road vehicles but also goods traffic, public transport, pedestrians and cyclists. Figure 5.1 shows that in contrast, as a *place*, the street is a 'destination in its own right' (Jones and Boujenko 2009), a location where activities occur either on or adjacent to the street. Jones and Boujenko noted that as a link, streets should provide minimal disruption to users in their travel and good connectivity from one street to the next. As noted above, a common objective of slow zone treatments in residential areas is to improve community liveability or the amenity of the neighbourhood. In a retail area, it may be to create a sense of place, where people want to linger, shop or meet their friends. In both instances, the purpose of the treatment is to emphasise the 'place' rather than 'link' functions of a street.

Figure 5.1 Two functions of streets: link and place (Source: Jones and Boujenko 2009; NZTA 2008)

	
Link Street as a movement conduit	**Place** Street as a destination in its own right

All urban streets function as both links and places, although the emphasis on either function will depend on the street type and possibly time of day. For example, an urban motorway's link function, as part of the city or even national transport network, will overshadow its place function; while a pedestrianised local shopping area has a strong place function and a very narrow, localised link function.

A slow zone treatment could be targeted to improve or modify link conditions (eg slow down vehicles so pedestrians and cyclists can use it safely; reduce accidents or crashes to minimise traffic delays and/or allow a different mix of traffic to use the road). Alternatively, a treatment may be more targeted towards the street as a place, to improve liveability; create a stronger sense of community, or attract users to shop, meet, or do other activities there. In some cases, slow zone treatments will address the street's link and place functions equally and simultaneously (as is the case with MPR).

5.3.2 Distinguishing link-oriented versus place-oriented pedestrian and cyclist activity

Distinguishing the two functions of a street as link and place suggests that a similar distinction for cyclist and pedestrian activity may be useful as this affects the collection and interpretation of data. For example, at any given time, people present on/adjacent to the street may be:

- using the street as a place/destination to socialise, recreate, do errands and so on
- in the process of travelling to or from the street as a 'place'
- using the street as a link to travel from one area to another.

Table 5.1 illustrates how different pedestrian and cyclist activities may be seen as link-oriented (transport-related) or place-oriented (social/leisure/recreational). To measure an objective of improving the function of the street as a place would require some type of monitoring of the change in the *presence* of people on and in the street, participating in the activities available there, while measuring an objective of shifts in mode use would require counting people who are *travelling*, either to the street as a destination, or using the street as a thoroughfare or route to go from one place to the other.

Table 5.1 A possible classification of pedestrian and cyclist activities

	Link: street as a movement conduit	**Place: street as a destination**
Pedestrians	Present on the footpaths or road for transport purposes (ie walking to a destination), for example: • adults walking for transport (eg to go to work, shopping, activities, errands) • children walking for transport (eg to school, library).	Present on or adjacent to the street for non-transport reasons (ie social, leisure or recreational), for example: • adults engaged in social contact • adults window-shopping/shopping/other business • adults engaged in domestic-related activities (gardening, tidying, car maintenance etc) • recreational walkers/joggers • children engaged in social contact/play with others • children playing alone.
Cyclists	Present on the road; cycle lane; or shared footpath for transport purposes (ie cycling to a destination), for example: • adults using bicycle as transport • children using bicycle as transport (eg to school).	Present on or adjacent to the street for non-transport reasons (ie social, leisure or recreational), for example: • adults recreational cycling • children 'mucking around' on bikes.

Particularly in residential neighbourhoods, it may be easier to monitor mode shifts among certain segments of the population: for example, implementing traffic calming measures or 30km/h zones may induce parents to let children walk or cycle to school. We found one study that specifically evaluated slow zone treatments around schools, namely the 'Safe Routes to School' programme in California (Orenstein et al 2007). What was implemented varied by school, but included traffic calming measures, cycling facilities, traffic signals and pedestrian crossing improvements, with the result that more children walked and cycled to school. A second study, evaluating an Auckland-based Travel Wise for Schools (school travel planning) programme (Hinckson et al 2008) found that, across 68 schools, car use (mode share) decreased by 3.4%, with most of the trips affected (2.4%) switching to active travel and a lesser proportion (1.0%) to public transport. Note this was achieved through a combination of traffic calming measures and education and promotional (eg walking school bus) programmes.

This discussion suggests that, in establishing the evaluation programme and identifying the before and after measures for monitoring purposes, it may be useful to consider the following two questions (in addition to others) and, subsequently, to select appropriate performance measures for any outcome evaluation:

1. Is an objective of the slow zone treatment to generate street-oriented (non-transport) 'place' activity, such as children playing outside more, better access to and use of a retail area?
2. Is an objective of the slow zone treatment to generate transport-oriented 'link' activity (ie people going somewhere)?

Depending on the objectives for the treatment, different measurement activities will be required. Some possible techniques are discussed in section 5.8.

5.4 Selecting key performance or evaluation measures

The purpose of the evaluation determines the performance measures to be collated and the associated monitoring activities to collect the data. Table 5.2 summarises the performance measures found in our review of international and NZ experience with slow zone treatments, categorised by the objectives identified above.

Some measures are more suitable when an area-wide treatment is being evaluated (eg number/presence of children walking/cycling to school), while others may be useful for smaller treated areas.

Table 5.2 Performance measures identified in review of international and NZ experience with slow zone treatments

Objective	Performance measures	Comments
Mode shift	• Percentage mode share (eg through NZHTS or other travel diary) • Self-reported changes in mode use: eg kilometres travelled; trips or journeys; travel time (Newby and Sloman 1996; SRA 2001)	• To be 'mode shift' would have to report what other modes were affected
Mode use	• Pedestrian, cyclist, vehicle (specified types) counts • Changes in kilometres travelled by mode by respondent living in treated area • Amount of leisure and/or transport-related walking per week (in minutes) relative to implementation of SZ treatment or changes to speed of traffic	• Have to take into account any 'external' changes within (and outside) slow zone, eg DFT 2008c – pedestrian movement monitoring was inconclusive due to confounding factors, such as college closing and a new supermarket opening • Risk that weather could affect

Objective	Performance measures	Comments
	• Number of walking trips to specific destinations (Carver et al 2008) • Journey to school: hands-up survey of mode used to travel to and from school (Orenstein et al 2007; Hinckson et al 2008) • Journey to work: census every five years	results, especially where number of days limited (eg census is one day only)
Liveability or improved amenity of neighbourhood/ street	• Percentage of adults reporting that children cycle, walk, or play outside more (Kirby 2001) • Percentage of children playing out, walking and/or cycling independently (Morrison et al 2004; Newby and Sloman 1996; DFT 2007; Babtie Group 2001) • Frequency of children walking/cycling *independently* (unaccompanied) to specific neighbourhood destinations, such as different types of shops, parks and other recreational facilities (Carver et al 2008; DETR 1999) • Percentage of respondents finding streets 'more attractive' (Layfield et al 2003) • Percentage of respondents finding that walking is 'more pleasant' (Layfield et al 2003) • Percentage of respondents finding streets to be safer for walking/crossing/playing (Hummel et al 2002; Newby and Sloman 1996; DFT 2008g; Webster et al 2006; Centre for Transport & Society 2006)	
Lingering/retail effects	• Number of pedestrians visiting/occupying pedestrianised/SZ area (Hummel et al 2002) • Expenditure in shops (retail turnover) (Hummel et al 2002) • Property values and rents in area (both retail and residential areas) (Hummel et al 2002) • Business activity – eg percentage of shop vacancies (DFT 2008g) • Business activity – has treatment had a positive or negative impact on your business? (Geoplan Urban & Traffic Planning et al 1998)	• Should compare SZ treated area with untreated shopping area • In monitoring retail spend and consumer visits, it should be recognised that 'spending' may be a zero sum game wherein increased trade in one place probably means loss of trade elsewhere.
Physical activity levels	• Survey respondents asked if they walked and/or cycled more in the area since SZ implementation (Morrison et al 2004) • Survey respondents asked if children walked and/or cycled more or played out more in the area since SZ implementation (Morrison et al 2004)	• May be best to infer from changes in w/c levels, although there could be the risk of substitution effect (where walking or cycling substitutes for a different physical activity) • Care must be taken to relate any changes with the SZ treatment, and not any other factor • Could use travel diaries before and after
Speed	• Proportion of vehicles travelling > speed limit (urban, rural) • Change in 85th percentile speeds (Austroads 2009b)	• Compare speeds on treated streets with control streets (without treatments) (Austroads 2009b;

Objective	Performance measures	Comments
	• Zone of influence on free speed (approach to SZ treatment and on departure) (Austroads 2009b)	Webster and Mackie 1996)
Safety – reduced crash risk	• Reported fatal and/or injury crashes per xx people by mode – many studies simply compare absolute number of deaths and/or injuries which does not recognise changes in mode use (eg Bunn et al 2003) • Theoretical crash reduction factor (based on measured speed reduction) (Austroads 2009b) • Percentage change (reduction) in vehicle crashes (irrespective of whether or not injury/death involved)	• Minimum of 2 years, up to 5 years of before *and* after data required (average is 3 years) in order to establish trend • Use 'control sites' to check for accident migration (Webster and Mackie 1996) • Adjust for 'annual background decline' in casualties (Grundy et al 2008)
Safety – proxy measures	• Number of pedestrians crossing in the crossing (Hodgkinson and Whitehouse 1999; DFT 2008g; DFT 2008h) • Pedestrians for whom motorists yielded (Huang and Cynecki 2000; Hummel et al 2002). • Number of pedestrians present at different times of day (DFT 2008k) • Number of cyclists using route • Number/presence of children walking/cycling to school (Orenstein et al 2007; Hinckson et al 2008; Newby and Sloman 1996) • Number of children playing in the street/neighbourhood (Morrison et al 2004; Newby and Sloman 1996; Ross Silcock Limited and Social Research Associates 1999b; Webster et al 2006)	• In some cases, slow zone treatments may reduce or eliminate the need for formal pedestrian crossings. In this situation, it may be more practical to questions users about their perceptions of personal safety
Safety – perception of users	• Perceptions of pedestrians (eg feel safer in crossing roads) (Hodgkinson and Whitehouse 1999; DFT 2008g) • Percentage of people who would allow children to play in streets (DFT 2001c; Babtie Group 2001)	
Personal security	• Reduction of public disorder offences (crime), eg violence against a person, robbery, burglary, car theft, breaking into a car, criminal damage (DFT 2008e; Opus International Consultants 2008) • Perceptions of personal security (safety from crime) (DFT 2008b; DFT 2008f; DFT 2008g)	

5.5 Taking into account the size of the treated area

The size and usage of the area given the slow zone treatment may affect the ability to successfully evaluate its impact on any of the objectives, not just the change in mode use. Small or fragmented slow zones will be limited in terms of what data can be collected, and in the possibility of interpreting it meaningfully. Examples of small slow zones are home zone programmes (typically) or the 30kmh speed limits being implemented in suburban shopping areas of Wellington which often affect less than 0.5km of road. By *fragmented* slow zones we mean that some streets are treated and others are not. For example, with small slow zones, speeds could be monitored within the treated area, and in the approach and

departure zones, but it is unlikely there would be sufficient data to monitor changes in injury crashes, unless there were very high rates of these prior to treatment and/or there are very high traffic volumes using the site. Treatments on a busy shopping or main street with high pedestrian, cyclist or vehicle traffic counts may permit monitoring of changes in volume, flow, crashes and speed, but it would probably still be difficult to detect shifts in mode use.

Even in a large area, it may be difficult collect sufficient data to monitor for the achievement of specific objectives: for example in all six of the UK cycling demonstration towns, the occurrence of cycling accidents was 'relatively rare' (Cope et al 2009b, p136). As a result, researchers estimated five years data would be required to derive any statistically significant conclusions about the effect of the intervention on accident or crash rates. In another example, personalised travel planning evaluation, which has had a major focus on identifying modal shift (changes in mode use), has struggled to prove (1) how design influences outcomes and (2) the significance of the shift:

> *Despite the consistency of outcomes reported and many aspects of good practice in project evaluations, there are some concerns about evaluation methodology which mean there is the possibility that outcomes might be systematically biased. The main concerns relate to independence of evaluators, sample sizes and survey response biases. A priority in future project evaluations is to use independent evaluators and to collect aggregate-level travel data with which to corroborate survey-based results and enable monitoring of outcomes over longer time-scales. Another priority is to increase understanding of how design elements of PTP [personalised travel planning] projects influence behavioural outcomes and appropriate research methods are required to investigate this.* (Chatterjee 2009, p293)

Irrespective of the size of the treated area, it will be necessary to consider carefully what objectives can be meaningfully evaluated, over what timeframe, and how data can be collected.

5.6 Allowing for mode use variability

Walking and cycling, in particular, tend to vary by day of the week and by season, and are somewhat weather dependent; so is public transport use, albeit to a slightly lesser extent. The extent of the day-to-day variability for different modes has implications both for sample sizes and timing of data collection. If attempting to measure changes in mode use by individuals or households or general pedestrian or cyclist activity in an area, it is imperative to ensure before and after surveys are conducted on the same day(s) of the week, preferably the same month of the year, and it may also help to record the weather patterns for both surveys. Transport for London (2006) recommends monitoring be carried out in 'neutral' months, that is, not December, January, school term holidays, or statutory holidays such as Easter, Labour Day, or Queen's Birthday. If an adequate control population or area is prepared and the control samples before and after surveys are conducted at the same time as the target sample survey, it would be feasible to correct for the effect of a seasonality error in the analysis (Bonsall 2007).

The sample size required for a survey to powerfully establish any causal effects of a slow zone treatment may be surprisingly large and will depend, in part, on what the objective of the survey is and the level of background variability in the travel behaviour. For example, to detect a difference of 20% in public transport use on weekdays, O'Fallon and Sullivan (2004) estimated an Auckland-based matched sample size of more than 2000 people was required to complete a one-day trip diary, and they also showed cycling had much higher variability than public transport use (and so would require even large sample sizes to reliably detect changes). Professional assistance should be sought to ascertain the required sample size and survey content.

5.7 Accounting for external factors

The three-year monitoring programme for UK cycling demonstration towns (Cope et al 2009a) was intended to:

- ensure any changes (particularly those that may be statistically significant) in cycle use were detected
- allow for external factors that might affect results
- be able to identify affected population segments (eg workers, school children, cycle activity versus cycling trips per person).

At the outset, the monitoring of cycle use was recognised as 'challenging' due to its relatively low occurrence within the overall traffic stream, meaning the use of 'an overly simple monitoring regime' would risk that the impacts of even a large-scale programme would be undetected.

Hence, multiple methods were used to collect data, including automatic counters, manual counts, counts of parked bikes at key locations (eg railway stations and town centres), hands-up and other school travel surveys to identify any change in children's cycling, workplace travel surveys and travel behaviour surveys (done in conjunction with individualised marketing projects). Overall, an increase in cycling was consistently identified through the various methodologies, but the *size* of the increase varied greatly depending on the method employed. *Statistically significant* changes were only recorded in some towns for manual cycle counts and/or parked bike counts. Automatic counts were not checked for significance, probably because there was no evidence of having validated counter data in any of the towns. Unlike hands-up surveys, workplace and travel behaviour surveys, counts of cyclists or parked bikes provided little indication on their own of *who* was cycling, how often they cycled, or trip length.

Cope et al (2009a) found that, despite incorporating several methodologies for monitoring cycle use in the six demonstration towns and attempting to take into account external factors, isolating and proving the effectiveness of the pilot programme was difficult:

> *other programmes were active at the same time as the Cycling Demonstration Towns programme - attributing any change observed in the above data sources to the Cycling Demonstration Towns programme is challenging in itself. This becomes especially complicated when other interventions, the outcomes of which could reasonably include increases in levels of cycling, are active in the town at the same time.* (p16)

With respect to walking and cycling in New Zealand, weather may be a key external factor to take into account, particularly if an annual manual counting regime, such as that used in the Auckland region, is adopted. ARTA (2010) and its research company, Gravitas, found weather clearly affected the validity of the data collection: in 2006, during the sunny morning peak, 1579 cyclists were counted across 12 monitoring sites. By contrast, 1050 cyclists were counted during the rainy evening peak on the same day – a decrease of 34% from the morning. This result led them to establish rules about the annual manual count regime (counts are conducted on predominantly good weather days; if it is raining in the morning, then monitoring in the evening was also postponed to the next day).

In summary, establishing a suitable monitoring regime for mode shift attributable to slow zone treatment in New Zealand, requires care to identify and take account of other 'external' factors that may have a role in any changes the data reveals. For example, an increase in walking and cycling could be a function of increased petrol prices, the weather, other economic factors or other government programme(s) to change travel behaviour or encourage health and fitness (rather than any particular slow zone treatment).

The ideal situation would be to use more than one data collection method and to have a matched control area or town for comparison, so adjustments could be made for any underlying general trends in the behaviour of people both inside and outside the target area.

5.8 Sources and approaches to pedestrian and cyclist data collection

5.8.1 Pedestrian counts

Counting pedestrian footfall or movements provides a sense of change in walking activity, although it is not a measure of changes in mode shares, the actual number of pedestrians, trip-making habits, or kilometres travelled. To monitor these changes, interviews or surveys are recommended (refer section 5.8.2).

Counting may be done either manually or using automatic counters. The US National Bicycle & Pedestrian Documentation Project (NBPD 2009) provided an overview of automatic counting technology, including where each type can be used, its ability to distinguish between cyclists and pedestrians; its cost (in US dollars) and flexibility in relocation. Given the margins of error with current automatic counter technology, NBPD (2009) recommended that automatic counters be supplemented with manual checks in order to correct for inherent error rates. Schweizer (2005), in a research project testing a wide range of pedestrian count methodologies (including manual, laser sensor and video) in several Swiss cities, concluded that manual counting was still the most reliable method, particularly when a hand-held clicker was used.

The NBPD (2009; 2010), Schweizer (2005) and Transport for London (2006) outline additional advice and guidance for pedestrian counting, including:

- Schedule the 'before' count for a forecasted dry/good weather day, and have a backup in place if this day is not suitable. The 'after' count should take place on the same day of the week, and same week of the month in later years (Transport for London 2006). NBPD (2009) also noted counts could occur on a seasonal basis (eg once every three months).
- At the bare minimum, the two-hour afternoon peak period should be counted on a weekday (usually Tuesday, Wednesday or Thursday) and the heaviest trafficked two-hour period on a Saturday, again in order to derive the best estimation of maximum, daily pedestrian traffic volumes. If possible, conducting 12-hour counts (eg 7am – 7pm) provides the most accurate information.
- The best time to count pedestrians is generally in the late afternoon peak period, when pedestrian traffic is at its maximum. However, in some locations, it may be that the lunchtime hours are the busiest for pedestrian traffic, and the timing of the count could reflect this to allow for the best estimation of maximum, daily pedestrian traffic routines (Schweizer 2005; Transport for London 2006).
- Schweizer (2005) recommends counting for a minimum of 15 minutes per hour to estimate the pedestrian traffic for one hour, while Transport for London (2006) recommends a minimum of 10 minutes per hour (or five minutes per half hour). The NBPD (2010) proposes counting for the whole two-hour period.
- Schools, shopping areas, pedestrian crossings, and bus stops/train stations can strongly influence pedestrian flows and the length and timing of counting should be adjusted to take this into account (Schweizer 2005; Transport for London 2006).

5.8.2 Other sources of data for monitoring pedestrian activity

In addition to footfall or pedestrian flow counts, data on pedestrian activity could be collected through:

- Counting pedestrian use of formal crossings – this is more commonly used as a measure of improved safety, although in some cases the desired direction of the performance measure can be ambiguous (eg fewer people using the crossing, but more crossing informally could mean people perceive the environment to be much safer).
- Use of use of global positioning systems (GPS) devices. Testing of recent devices found they gave direct and detailed information about pedestrian movement in city centres (van der Spek 2006).
- Interviews or surveys of pedestrians – collecting data from pedestrians, such as origins and destinations, trip purpose, trip length, trip rates, and journey times, through short face-to-face interviews or by handing out freepost-return self-completion questionnaires. The NBPD (2010) has devised a short survey, designed to be completed face to face; Transport for London (2006) noted the need to ensure the on-street sample was representative of the total pedestrian flow and created an algorithm to assist with sample selection. Refusal rates should also be recorded, as high rates could indicate potential bias in the results.
- Travel behaviour surveys, including those for workplace travel plans.
- Walking to and from school could be measured by simple 'roll surveys' (Hinckson et al 2008; Cope et al 2009a), where students are asked to indicate, by putting up their hand, how they travelled to school on a given day and how they will be travelling home again.
- NZ Household Travel Survey (refer section 5.8.5) and the 5-yearly census (refer section 5.8.6) are other potential sources of data.

5.8.3 Cycle counts

Counting cyclist movements provides a sense of change in cycle use, although it is not a measure of changes in mode shares, the actual number of cyclists, trip-making habits, or kilometres travelled, as is noted the annual report on the manual cycle monitoring programme in the Auckland region, eg in 2010:

> *The limitations of the [count] methodology used mean that, due to the close proximity of sites to one another (particularly in Auckland City's CBD), it is possible for the same cyclist to be counted at more than one site. It is also possible to 'double count' cyclists if they use the same intersection more than once during a shift. At the same time, there will be many cycle trips that were not counted at all by this methodology, if a cyclist's route does not pass through a monitoring location. Because of these limitations, it cannot be said that 12625 different cyclists were counted on the Auckland region's roads using these sites; the actual number of cyclists, and the number of cycle trips they take, may be higher or lower than the number of cycle movements counted through this methodology.* (ARTA 2010, p1)

Even so, cycle counting is a useful methodology for identifying trends in cycle use particularly when implemented as part of a consistent measurement programme, as is the case of the Auckland Regional Transport Authority (ARTA) annual regional manual cycle monitoring programme which counts cyclists at the same locations[7], time of day, day of week and date of year. The weather and daylight conditions are

[7] New sites have been added to the locations each year since the programme began in 2007, so that a total of 84 sites are now monitored.

recorded in detail for each count. In addition, recognising that students cycling home from school could be largely excluded from the manual counts (which take place between 4pm and 7pm in the afternoon peak), ARTA has established a school 'bike shed count'. Most of the region's intermediate, secondary and composite (combined primary, intermediate and secondary or combined intermediate and secondary) schools are invited to count the number of cycles parked on their school grounds on a designated day, during the same week as the manual counts occur. In 2010, 78% of eligible schools submitted bike shed count data (ARTA 2010). A full description of the methodology is provided in each ARTA annual report.

The NZTA has been sponsoring research into cycle counting methodology (see for example McDonald et al 2007; ViaStrada 2008 and 2009) which provides additional advice and guidance for cycle counting, including:

- In evaluating cyclist use of new facilities, such as a cycle lane or lockers, the first (before) cycle count should be done prior to the installation of new facility. Follow-up counts can be conducted in the short term (one month after) and medium to long term (two to three years following) (McDonald et al 2007).
- McDonald et al (2007) recommend manual validation counts be carried out if automatic pneumatic tube counts are undertaken, in order to differentiate school cyclists and/or large groups of cyclists (which ViaStrada (2009) noted are not counted accurately by *either* pneumatic *or* inductive-loop counters).
- For off-road paths or cycle lanes, do counts on any adjacent roads, ie 'after' counts should take place on both off-road and adjacent roads so that the proportion of cyclists transferring from the road to the off-road path or lane can be determined (McDonald et al 2007).
- Testing to identify where specific automatic and continuous cycle counting technology could be usefully employed (ViaStrada 2009).
- McDonald et al (2007) recommends a methodology for setting out pneumatic tube counters to ensure consistent use of such counters across New Zealand.
- A methodology for extrapolating one-day annual manual counts to average annual daily traffic flows was developed by ViaStrada in 2007 for ARTA, as reported in ARTA (2010).

5.8.4 Other sources of data for cycle monitoring

In addition to manual or automatic cycle counts, data on cyclist activity could be collected through:

- cycle parking surveys – counts of bikes parked at key locations, such as bus or rail stations, swimming pool, library, civic buildings, school or shopping areas
- use of GPS devices
- interviews or surveys of cyclists – Transport for London (2006) suggests collecting data from cyclists (eg trip-length, trip rates, trip purpose, origins and destinations, and journey times) through short face-to-face interviews or by handing out freepost self-completion questionnaires
- travel behaviour surveys, including those for workplace travel plans
- in addition to 'bike shed counts', cycling to and from school could be measured by simple 'roll surveys' (Hinckson et al 2008; Cope et al 2009a), as discussed previously for walking to school
- the NZ Household Travel Survey (refer section 5.8.5) and the five-yearly census (refer section 5.8.6).

5.8.5 Use of the NZ Household Travel Survey

A whole city, town or local authority area may undergo a slow zone treatment as in Portsmouth UK or Oxford UK. Or a large area may have slow zones, such as Hull UK where 26% of roads (191km) were part of 20mph zones in 2002 (IPPR 2002). In such cases, it may be feasible to measure effects on overall mode shares through analysis of NZ Household Travel Survey (NZHTS) data, particularly if the sample is expanded for a particular location[8].

While walking was a reasonably common activity (based on the NZHTS 2005–2009), the Ministry of Transport (2009) reported that New Zealanders walking activity formed 17% of all trip legs and 13% of total time travelled per annum, cycling was quite uncommon, forming 1% of all trip legs and 2% of total time travelled. Given both the low levels of cycling and the known variability of cycling in the New Zealand population[9], changes in cycling kilometres travelled or trips per annum *on their own* (ie separately from pedestrian activity) may not be possible to detect even with an expanded survey sample. It would be more practical, depending on the programme objectives, to combine cycling and pedestrian activity and analyse 'active transport'.

Another option with respect to cycling could be to examine the cycling-specific questions introduced in 2003 as part of the ongoing NZHTS, namely:

> *In the last 12 months, that is since _____ last year, have you ridden a bicycle at all? –* Responses: Yes/No
>
> *Thinking about just the last four weeks, how often have you ridden a bike? – Responses: Not at all this month; on 1–4 days this month; on 5–9 days this month; on 20 days or more this month.*[10]

The analysis of these questions would provide an indication of change in cycle use generally for all purposes (eg recreational, fitness or transport) but would not provide information on potential mode shift by the affected population.

5.8.6 Use of census data

The New Zealand population census journey-to-work data could be used, on a five-yearly basis, to monitor change in mode use for the main way in which the population of an area travelled to work, based on the census question:

> *On Tuesday 7 March, what was the one main way you travelled to work – that is, the one you used for the greatest distance? – Worked at home; did not go to work on Tuesday 7 March; public bus; train; drove a private car, truck or van; passenger in a car, truck, van or company bus; motorbike; bicycle; walked or jogged; other.*

Statistics New Zealand reported on commuting patterns for the Auckland and Wellington metropolis areas and Christchurch city for the 2006 Census, including some historic trends (Statistics NZ 2009).

---

[8] In 2008/09, Environment Canterbury, Christchurch City, Waimakariri and Selwyn Districts contributed to an expanded sample that permits analysis of the three council areas using solely the 2008/09 data.

[9] Refer to section 5.6 for further discussion of variability

[10] The NZHTS household and individual questionnaires are available from www.transport.govt.nz/research/Pages/DetailedTravelSurveyInformation.aspx

It is possible to approach Statistics NZ for analysis of specific suburbs or locations, provided confidentiality requirements will not be breached.

Care would need to be taken to identify external factors or explanatory variables (eg petrol price rises; closures in the roading network; weather conditions from one census period to the next) that could influence walking and cycling trends in an area under examination. Advantages of using the census are that its completeness allows comparisons with many other similar areas without incurring extra data collection costs and that the systematic response bias threatening stand-alone travel behaviour change surveys is not present[11]. The most obvious disadvantage is that only journey to work data is collected, so any changes in non-work travel behaviour, for example shopping, personal business and recreation will not be picked up in that data.

5.8.7 Use of walking (or cycling) audit tools

Walking audit tools, such as the Pedestrian Environment Review System (PERS) developed in the UK by Transport Research Laboratory and Transport for London[12] or New Zealand's 'community street review' survey[13] allow for evaluation and prioritisation of walking improvements through a consistent methodology. Focused on physical assessment, they do not measure pedestrian traffic in the area, and as such, do not provide a basis monitoring change in use or flow.

5.8.8 Measuring place-oriented pedestrian and cycling activity

Transport for London (2006) terms this 'space occupancy' and identifies the performance measure as the 'number of people per unit area in a fixed time interval' (p3). The intention is to monitor the quality or popularity or use of the street as a place (including the use of public space, footpaths in a shopping precinct, a park, shopping mall) after a slow zone treatment has been implemented.

Transport for London (2006) observed that while the performance measure is relatively well agreed, the methodology for selecting areas, timing of counts, technology used for counting, and so on have been subject to debate.

5.9 Summary

To be cost effective, we recommend the evaluation be designed at the outset to undertake combined outcome and impact monitoring for all relevant project objectives, along with any process evaluation if this is desired, than to conduct separate evaluations. The outcome and output evaluation will require the collection of data 'before' implementation of the slow zone treatment and 'after' implementation to monitor progress towards achieving the treatment objectives.

Of course, it should be acknowledged even the best-designed monitoring programme may not 'find' anything, given the number of variables, including external factors, which may be involved.

[11] With stand-alone travel behaviour change surveys, response bias can occur because respondents in areas who have received special treatment may be more likely to answer the survey (particularly if they believe they have changed their behaviour in a socially desirable way).

[12] A summary of the software capability is found at: www.trl.co.uk/pers.htm. Note that Transport Research Laboratory has recently developed a similar programme for cycling environments.

[13] For further information on community street review surveys and walkability measurements, readers are referred to www.levelofservice.com.

6 Conclusions and recommendations

6.1 Overview: purpose and methodology

The purpose of this research project was to explore the potential impact of slow zone treatments on mode choice and travel behaviour, with the view to understanding the potential for slow zone treatments to contribute to wider New Zealand transport objectives such as more effective and efficient use of transport network capacity and transport modes; improving community and individual health and well-being outcomes; and lowering transport costs. We hypothesised that the often dramatic and clearly visible changes to streets created by establishing slow zones could have substantial impacts on aspects of travel behaviour, in particular mode choice.

Hence, we proposed to examine international and New Zealand experience in the development, implementation and evaluation of slow zones to identify what types of slow zone treatments contributed to changes in mode use and/or travel behaviour. Following this, we intended to compare these treatments with ones planned or implemented in New Zealand to identify where slow zone treatments might be suitable for an impact evaluation focusing on changes in mode use.

We adopted an evaluability assessment framework as the methodological approach for this research project. It is a systematic process that helps identify whether a planned programme evaluation is justified, feasible and likely to provide useful information. Generally speaking, the evaluability assessment process incorporates the following steps:

- determine the purpose of the assessment (programme justification, modification, process or outcome evaluation, etc)
- define the boundaries of the programme being studied
- identify and analyse available documentation
- develop/clarify the logic model, programme theory or causal model
- identify and interview key stakeholders to ascertain their perceptions, needs and concerns about the programme
- determine the plausibility or validity of the programme compared with the logic model – assessing how likely its implementation and activities will produce the desired outcomes
- draw conclusions and make recommendations, including how to utilise the information in the evaluability assessment.

We defined slow zone treatments in such a way to encourage investigating a broad range of physical and/or environmental measures that would contribute to slowing vehicle traffic down and improving the liveability and safety of an area, Some of these measures are:

- traffic calming (including local area traffic management)
- 30km/h zones
- 30km/h limits
- home zones
- mixed priority routes/Sharing the Main Street
- neighbourhood access planning (New Zealand)

- road capacity reduction (also known as road diet)
- shared space
- complete streets.

We specifically excluded speed change management approaches and speed-reducing measures.

6.2 Findings

After identifying and analysing the available evidence (ie international and New Zealand experience with slow zone programmes), we came to the conclusion that it was not feasible to develop a comprehensive logic model by identifying the 'best practice' slow zone treatment programmes. The evaluation methodology employed in most of the materials we obtained for the review was of a fair or poor quality. That poor research practice remains so prevalent in the topic area is surprising given the substantial investment in slow zones internationally over many years.

None of the studies we reviewed (some of which covered several or many cases) specifically documented evidence of mode use or travel behaviour change. Rather, we had to focus on changes in walking, cycling and vehicle traffic flow, which may or may not be indicative of a change in mode use. Overall the evidence was mixed: 16 studies showed increases in walking while 11 had decreases or no change in pedestrian activity; six studies showed increased cycling activity and seven decreased or had no change. Where traffic flow was measured, it more consistently showed reductions, but there were many studies where no traffic flow was monitored and/or reported. Overall, while some types of slow zone treatments were found to be effective in reducing vehicle traffic speed and vehicle and pedestrian crash rates, the results of our review are inconclusive with respect to whether or not slow zone treatments:

- increase walking and cycling activity
- decrease vehicle traffic flow
- cause people to alter their mode use.

Because it was not feasible to develop a comprehensive evidence-based logic model of the type we planned for use in an evaluability assessment of the impact of slow zone treatments on mode choice and given the absence of well-established good practice or guidance internationally, we chose to summarise the existing good practice literature and provide some guidance on developing suitable evaluation programmes for slow zone treatments.

6.3 Proposed framework for evaluating impact on mode use

Our proposed evaluation framework focuses on collecting evidence of impacts of slow zone treatments on modal shift, whereas the most common reasons for implementing slow zone treatments are to improve safety, reduce vehicle speeds and/or improve liveability in an area. The methodology and considerations for measurement of changes in safety and vehicle speeds, in particular, were outside the purview of this research project. However, given the lack of consistent evaluation of slow zone treatments to date, whether implemented for safety or other reasons, we recommend that any evaluation address all relevant objectives.

In broad terms, the design for evaluating mode use and/or travel behaviour changes associated with slow zone treatments is quite straightforward and requires the consistent measurement of pedestrian, cycling,

public transport and vehicle activity within the area to be treated and in the surrounding environs (to take account of possible diversion of users). This should be done before carrying out a slow zone treatment and after its implementation.

Ideally, data would be collected for both the treatment and also a control area where no treatments were undertaken; however, this may not be feasible or practicable. To ascertain the characteristics effective in encouraging alternative mode use, we recommend different types of treatments should be evaluated.

In designing the evaluation programme, we noted several factors to be considered including:

- key outcomes to be evaluated
- distinguishing the functions of street and roads, and walking and cycling activity (eg transport related versus social/recreational activity)
- selecting key performance or evaluation measures
- taking into account the size of the treated area
- allowing for mode use variability in planning sample size and timing of data collection
- accounting for external factors
- sources and approaches to pedestrian and cyclist data collection (eg pedestrian and cyclist counts; and other data sources, including the NZ Household Travel Survey and census data).

6.4 Recommendations

We recommend careful consideration of whether or not an evaluation is required in the early stages of designing a slow zone treatment (ie well before it will be implemented). This is to ensure, as far as is feasible, the collection of 'before' data suitable for establishing the effect of the treatment in terms of its stated objective(s) and outcome(s). Furthermore, good evaluation practice includes allocating some evaluation resource for identifying impacts, such as unintended side-effects, beyond the stated objectives (Davidson 2004).

However, we also caution that our review of the overseas evidence suggests that implementing an evaluation framework in New Zealand on a sufficiently large scale to reliably estimate effects on mode choice on its own may not deliver good value for money. Even an evaluation designed to address multiple objectives may not be cost effective, as many New Zealand-based slow zones treatments target smaller areas than those overseas (ie they are not 'area-wide') and/or design speeds or speed limits are commonly 50km/h or 40 km/h, as opposed to 30km/h, which is more widespread in international examples. Reducing speeds to 30km/h or lower have been found to have significant safety effects, and are assumed to encourage more walking and cycling as well as creating more liveable communities. As a result of these differences, the overall expected effects on vehicle traffic flow and speed, and safety, let alone mode choice, within a New Zealand-based slow zone would be smaller and, therefore, more difficult (and costly) to detect.

We recommend including the findings of the review of international and New Zealand experience in the NZTA integrated planning toolkit as appropriate.

7 Bibliography

AECOM and Tavistock Institute (2009) Review of 20 mph zone and limit implementation in England. Summary report prepared for the UK Department for Transport. Accessed June 2010. *www.dft.gov.uk/pgr/roadsafety/research/rsrr*

Appleyard, B (2006) At home in the zone: creating liveable streets in the US. *Logistics management and distribution report 72*, no.9: 30–35.

ARTA (2010) Manual cycle monitoring in the Auckland region – regional summary. Prepared by Gravitas Research and Strategy Limited. Accessed July 2010. *www.arta.co.nz/home/regional_cycle_monitoring.html*

Arup Services New York Ltd (May 2003) Downtown Brooklyn traffic calming project: final report: chapter 4: Traffic calming. Prepared for New York City Department of Transportation. Accessed July 2010. *www.transalt.org/resources/dbtc/arup*

Austroads (2009a) Guide to traffic management – part 7: Traffic management in activity centres. AGTM07/09. Accessed July 2010. *www.Austroads.com.au*

Austroads (2009b) Impact of LATM treatments on speed and safety. Austroads publication no.AP-T123/09. Sydney: Austroads. Accessed March 2009. *www.Austroads.com.au*

Babtie Group (2001) Urban street activity in 20mph zones. Final report. Prepared for Department of Transport, Local Government and the Regions.

Badland, H and G Schofield (2005) Transport, urban design and physical activity: an evidence-based update. *Transportation Research part D 10*: 177–196.

Barrell, JM and M Groll (2005) Home zones – meeting the challenge. *Proceedings of the European Transport Conference,* Strasbourg, France, 2005.

Bonsall, P (2007) Does individualised travel marketing really work? *Proceedings of the European Transport Conference*, The Netherlands, 2007.

Brindle, R (1997) Traffic calming in Australia – more than neighbourhood traffic management. *ITE Journal 67*: 26–31.

Brindle, R (1991) 'What is traffic calming'? in Australian College of Road Safety, Road Safety Position Papers, pp9–13. Armidale: University of New England.

Bunn, F, T Collier, C Frost, K Ker, I Roberts and R Wentz (2003) Traffic calming for the prevention of road traffic injuries: systematic review and meta-analysis. *Injury Prevention 9*: 200–204.

Burden, D and P Lagerwey (1999) Road diets – losing width and gaining respect. Walkable Communities, Inc. Accessed March 2010. *www.walkable.org*

Cairns S, C Hass-Klau and P Goodwin (1998a) *Traffic impact of highway capacity reductions: assessment of the evidence – Luneburg*. London: Landor Publishing.

Cairns S, C Hass-Klau and P Goodwin (1998b) *Traffic impact of highway capacity reductions: assessment of the evidence – Orpington*. London: Landor Publishing.

Carver, A, A Timperio and D Crawford (2008) Perceptions of neighbourhood safety and physical activity among youth: the CLAN study. *Journal of Physical Activity and Health 5*: 430–444.

Centre for Transport & Society (2006) *Southville home zone: an independent evaluation*. Final report prepared for Bristol City Council. Bristol: University of West England.

Cervero, R and C Radisch (1995) Travel choices in pedestrian versus automobile oriented neighbourhoods, WP 644 UC Transportation Center, UCTC 281. *www.uctc.net/*

Charlton, SG and PH Baas (2006) Speed change management for New Zealand roads. *Land Transport NZ research report no.300*. 144pp.

Chatterjee, K (2009) A comparative evaluation of large-scale personal travel planning projects in England. *Transport Policy 16*, no.6: 293–305.

Cleland, VJ, A Timperio and D Crawford (2008) Are perceptions of the physical and social environment associated with mothers' walking for leisure and for transport? A longitudinal study. *Preventive Medicine 47*: 188–193.

Cope, A, L Muller and A Kennedy (2009a) Cycling Demonstration Towns monitoring project report 2006 to 2009. Prepared for Cycling England and the UK Department for Transport. Accessed December 2009. *www.dft.gov.uk/cyclingengland/cycling-cities-towns/*

Cope, A, L Muller and A Kennedy (2009b) Cycling Demonstration Towns monitoring project report 2006 to 2009 – appendix. Prepared for Cycling England and the UK Department for Transport. Accessed December 2009. *www.dft.gov.uk/cyclingengland/cycling-cities-towns/*

Davidson, EJ (2004) Evaluation methodology basics: the nuts and bolts of sound evaluation. Thousand Oaks, CA: Sage Publications.

Department for Transport, UK (DFT 2009) A safer way: consultation on making Britain's roads the safest in the world. Accessed June 2010. *www.dft.gov.uk/pgr/roadsafety/roadsafetyconsultation/*

Department for Transport, UK (DFT 2008a) Mixed priority routes: practitioners' guide. Local transport note 3/08 (October 2008). London: The Stationery Office. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/*

Department for Transport, UK (DFT 2008b) Mixed priority routes road safety demonstration project A306 Wandsworth Road, Lambeth. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008c) Mixed priority routes road safety demonstration project, A534 Nantwich Road, Crewe. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008d) Mixed priority routes road safety demonstration project Cowley Road, Oxfordshire County Council. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008e) Mixed priority routes road safety demonstration project, Newland Avenue, Kingston-upon Hull. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008f) Mixed priority routes road safety demonstration project, Parade, Victoria Terrace and Bath Street, Leamington Spa. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008g) Mixed priority routes road safety demonstration project, Prince of Wales Road, Norwich. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008h) Mixed priority routes road safety demonstration project, Renshaw Street/Berry Street, Liverpool City Council. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008i) Mixed priority routes road safety demonstration project, St Peter's Street, Hertfordshire County Council. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008j) Mixed priority routes road safety demonstration project, Walworth Road, London Borough of Southwark. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2008k) Mixed priority routes road safety demonstration project, Wilmslow Road, Rusholme, Manchester. Accessed February 2009. *www.dft.gov.uk/pgr/roadsafety/dpp/mpr/schemereports/*

Department for Transport, UK (DFT 2007) *Traffic calming*. Local transport note 1/07 March 2007.

Department for Transport, UK (DFT 2005) *Home zones: challenging the future of our streets*. UK: Department for Transport. 100pp.

Department for Transport, UK (DFT 2001a) *Home zones – planning and design*. Traffic advisory leaflet 10/01 December 2001.

Department for Transport, UK (DFT 2001b) *Urban street activity in 20 mph zone, Ayres Road area, Old Trafford*. Final report results.

Department for Transport, UK (DFT 2001c) *Urban street activity in 20 mph zone – Seedley, Salford*. Traffic advisory leaflet 3/01, April 2001.

Department of Environment, Transport and the Regions, UK (DETR 1999) *Personal security issues in pedestrian journeys*. London: DETR.

Dunn, E (2008) Planning for cost-effective evaluation with evaluability assessment. Impact assessment, primer series, publication 6. Prepared for the US Agency for International Development. Accessed 2009. *www.usaid.gov*

Ernish, E, P Harrison and J Yuvan (1998) Streets for people: calming in your neighbourhood.

European Commission (2004) Reclaiming city streets for people – chaos or quality of life? Accessed February 2009. *ec.europe.eu\environment*

Ewing, R (1999) Traffic calming: state of the practice. Prepared by Institute of Transportation Engineers for the U.S. Department of Transportation, Federal Highway Administration, Office of Safety Research and Development and Office of Human Environment. FHWA-RD-99-135. Accessed July 2010. *www.ite.org/traffic/tcstate.asp*

Gemzoe, L (2001) Copenhagen on foot: thirty years of planning and development. *World Transport Policy and Practice 7, no.4*: 19–27.

Geoplan Urban & Traffic Planning, Christopher Stapleton Consulting and Westerman Consultants Pty Ltd (1998) *Review of the sharing the main street program*. Report prepared for the NSW Roads and Traffic Authority. NSW.

Gilman, C and R Gilman (2007) Shared-use streets – an application of 'shared space' to an American small town. *Paper presented at the 3rd Urban Street Symposium*, 24–27 June 2007, Seattle, Washington.

Goodwin, P, C Hass-Klau and S Cairns (1998) Evidence on the effects of road capacity reduction on traffic levels. *Traffic Engineering and Control 6*: 348–354.

Grant-Muller, SM, AS Fowkes, A Jopson, AD May, P Mackie, B Matthews, J Nellthorp, M Page, T Sansom and S Shepherd (2000) Assessing the impact of local transport policy instruments. Working paper 549. Institute of Transport Studies, University of Leeds, Leeds, UK. Accessed July 2010. *www.its.leeds.ac.uk/*

Grundy, C, R Steinbach, P Edwards, P Wilkinson and J Green (2008) *20mph zones and road safety in London: a report to the London Road Safety Unit*. London: LSHTM.

Hamilton-Baillie, B (2008a) Shared space: reconciling people, places and traffic. *Built Environment 34,* no.2:161–181.

Hamilton-Baillie, B (2008b) Towards shared space. *Urban Design International 13*, no.2: 130–138

Handy, S (2005) Does the built environment influence physical activity? Examining the evidence – critical assessment of the literature on the relationships among transportation, land use and physical activity. *TRB special report 282*.

Handy, S. XY Cao and PL Mokhtarian (2005) Correlation or causality between the built environment and travel behaviour? Evidence from Northern California. *Transportation research part D 10.* pp427–444.

Highway Safety Information System (HSIS 2010) Evaluation of lane reduction 'road diet' measures on crashes. Summary report prepared by B Persaud and C Lyon for the US Department of Transportation Federal Highway Administration. FHWA-HRT-10-053. Accessed July 2010. *www.fhwa.dot.gov*

Hinckson, E, S Duncan, R Kearns and H Badland (2008) *Auckland Regional Transport Authority school travel plan evaluation: 2007 school year*. Auckland: AUT University.

Hodgkinson, M and J Whitehouse (1999) Urban street activity in 20mph zones: emerging findings. *Traffic management, safety and intelligent transport systems: proceedings of seminar D held at the European Transport Conference*.

Huang, H and M Cynecki (2000) Effects of traffic calming measures on pedestrian and motorist behavior *Transportation research record 1705. Paper No. 00-0443*. Pp26–31.

Hummel, T, A Mackie and P Wells (2002) Traffic calming measures in built-up areas – literature review. Unpublished project report PR/SE/622/02 prepared for Swedish National Road Administration.

Institute of Transport Engineers (ITE 2006) *Context sensitive solutions in designing major urban thoroughfares for walkable communities*.

Institute for Public Policy Research (IPPR 2002) Streets ahead – safe and liveable streets for children. Accessed November 2008. *www.ippr.org*

Jamson, S, F Lai, H Jamson, A Horrobin and O Carsten (2008) Interaction between speed choice and road environment. Road safety research report 100. Prepared for the Department for Transport, London. Accessed July 2010. *www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme4/interaction/*

Jones, P and J Baulch (2001) A tale of two home zones. Proceedings of the European Transport Conference, Cambridge, UK, 2001. Accessed April 2009. *www.etcproceedings.org/*

Jones, P and R Childs (1999) Home zones – a step towards Europe. Proceedings of the European Transport Conference, Cambridge, UK, 1999. Accessed April 2009. *www.etcproceedings.org/*

Jones, P and N Boujenko (2009) 'Link' and 'place': a new approach to street planning and design. *Proceedings of the 32nd Australasian Transportation Research Forum*, Auckland, New Zealand, 29 September – 1 October 2009.

Kane, L and R Behrens (2000) The traffic impacts of road capacity change: a review of recent evidence and policy debates. *Proceedings of South African Transport Conference*, South Africa, 17–20 July 2000.

Kennedy, JV (2005) Psychological traffic calming. Proceedings of the 70th ROSPA Road Safety Congress 2005, Brighton, UK. Accessed February 2009. *www.rospa.com/roadsafety/conferences/congress2005/info/kennedy.pdf*

Kirby, T (2001) *20mph zones in Kingston Upon Hull*. Presented at 'Managing Vehicle Speeds for Safety: Latest Developments', Aston University, 19 September 2001.

LaPlante, J and B McCann (2008) Complete streets: we can get there from here. *ITE Journal 78*: 24–28.

Layfield, R, L Chinn and D Nicholls (2003) *Pilot home zone schemes: evaluation of The Methleys, Leeds*. UK: Transport Research Laboratory.

MacBeth, AG (2008) *Mainstreaming active modes on urban and rural road*s. Presentation to NZ Transport Agency/NZIHT Conference Napier, 13 October 2008.

MacBeth, AG (2005) *Creyke Road living streets pilot project – traffic calming an arterial road in Christchurch, New Zealand*.

MacBeth, AG (1999) Bicycle lanes in Toronto. *ITE Journal (April)*: 38–46.

Martin, A (2006) Factors influencing pedestrian safety: a literature review. Unpublished project report Upr Se/199/05, TRL Limited.

McCann, B (2005) Complete the streets! *American Planning Association. Planning magazine*, May 2005.

McDonald, AA, AG Macbeth, KM Ribeiro and DS Mallett (2007) Estimating demand for new cycling facilities in New Zealand. *Land Transport NZ research report no.340*. 124 pp.

Michaelson, J, G Toth and R Espiau (2008) *Project for public spaces inc: great corridors, great communities: the quiet revolution In transportation planning.*

Ministry of Transport (2009) Comparing travel modes. Household travel survey, v2 (revised November 2009). Accessed June 2010. *www.transport.govt.nz*

Morrison, D, H Thomson and M Petticrew (2004) Evaluation of the health effects of a neighbourhood traffic calming scheme. *Journal of Epidemiology and Community Health 58*: 837–840.

Morrison, D, M Petticrew and H Thomson (2003) What are the most effective ways of improving population health through transport interventions? Evidence from systematic reviews. *Journal of Epidemiol Community Health 57*, no.5: 327–333.

MVA Consultancy (2009) DFT shared space project – stage 1: Appraisal of shared space. Report for the UK Department for Transport. Accessed July 2010. *www.dft.gov.uk/pgr/sustainable/sharedspace/*

National Bike and Pedestrian Documentation Project (NBPD 2009) Automatic count technologies. Accessed September 2010. *http://bikepeddocumentation.org/*

National Bike and Pedestrian Documentation Project (NBPD 2010) Instructions. Accessed September 2010. *http://bikepeddocumentation.org/*

National Institute for Health and Clinical Excellence (NICE 2008) Promoting and creating built or natural environments that encourage and support physical activity. Public health guidance PH8. Accessed February 2009. *http://guidance.nice.org.uk/PH8*

New Zealand Transport Agency (NZTA 2009) Neighbourhood accessibility plans: guidelines for coordinators. Accessed July 2010. *www.nzta.govt.nz/*

New Zealand Transport Agency (NZTA 2008) Pedestrian planning and design guide (PPDG). Final report. Accessed April 2009. *www.nzta.govt.nz/resources/pedestrian-planning-guide/*

New Zealand Transport Agency (NZTA 2007a) Nelson city centre neighbourhood accessibility plan. Summary poster. Accessed March 2008. *www.nzta.govt.nz/resources/neighbourhood-accessibility-plans/summary-posters/index.html*

New Zealand Transport Agency (NZTA 2007b) Papatoetoe, Manukau City Council neighbourhood accessibility plan. Summary poster. Accessed March 2008. *www.nzta.govt.nz/resources/neighbourhood-accessibility-plans/summary-posters/index.html*

New Zealand Transport Agency (NZTA 2007c) South Dunedin neighbourhood accessibility plan, Dunedin City Council. Accessed March 2008. *www.nzta.govt.nz/resources/neighbourhood-accessibility-plans/summary-posters/index.html*

Newby, L and L Sloman (1996) *Small steps, giant leaps. A review of the Feet First project and the practice and potential of promoting walking*. London: Transport 2000 Trust.

O'Fallon, C and C Sullivan (2004) Personalised marketing – improving evaluation. *Transport Engineering in Australia 9*, no.2:85–101.

Opus International Consultants (2008) Neighbourhood accessibility planning case study research. Report prepared for Land Transport NZ. Accessed May 2009. *www.nzta.govt.nz*

Orenstein, M, N Gutierrez, TM Rice, JF Cooper and DR Ragland (2007) Safe routes to school: safety & mobility analysis: Report to the California Legislature. Accessed 21 February 2011. *www.saferoutespartnership.org/media/file/SR2S_Final_Report_3_1_07.pdf*

Ourston, L (1993) Wide nodes and narrow roads. *Paper presented to the Transportation Research Board, 72nd annual meeting in Washington, DC*, January 1993.

Project for Public Spaces Inc (2008) Streets as places: using streets to rebuild communities. Accessed May 2009. *www.pps.org*

Rhodes, RE, KS Courneya, CM Blanchard and RC Plotnikof (2007) Prediction of leisure-time walking: an integration of social cognitive, perceived environmental, and personality factors. *International Journal of Behavioral Nutrition and Physical Activity 4*, no.51.

Roads and Traffic Authority NSW (2000) Sharing the main street – a practitioners' guide to managing the road environment and traffic routes through commercial centres. Accessed November 2010. *www.rta.nsw.gov.au*

Rosales, JA (2009) Road diet handbook: setting trends for liveable streets – overview. Prepared for Institute of Transportation Engineers. Accessed July 2010. *www.oregonite.org/2007D6/paper_review/D4_201_Rosales_paper.pdf*

Ross Silcock Ltd and Social Research Associates (1999a) Bypass Demonstration Project. Further research and analysis in relation to attitudes to walking. Presented to DETR Charging and Local Transport Division.

Ross Silcock Ltd and Social Research Associates (1999b) *The impact of traffic calming schemes in Scotland*. Prepared for the Scottish Executive Central Research Unit

Saelens, BE and SL Handy (2008) Built environment correlates of walking: a review. *Medicine &. Science in Sports & Exercise 40*, (no.7 suppl): S550-66

Schweizer, T (2005) Methods for counting pedestrians. Paper presented at Walk21-VI 'Everyday Walking Culture', The 6th International Conference on Walking in the 21st Century, 22–23 September 2005, Zurich, Switzerland. Accessed July 2010. *www.walk21.com*

Shared Space (2005) Shared space – room for everyone. Accessed November 2008. *www.shared-space.org*

Sharples, R (2009) Reducing road capacity to change travel behaviour. *Proceedings of the 32nd Australasian Transportation Research Forum*, Auckland, New Zealand, 29 September – 1 October 2009.

Skjoeveland, O (2001) Effects of street parks on social interactions among neighbours: a place perspective. *Journal of Architectural and Planning Research 8*, no.2: 131–47.

Social Research Associates and Jacobs Babtie (2006) *Public perceptions of traffic calming*. Report prepared for The County Surveyors Society, UK.

Social Research Associates (SRA 2001) *Gloucester City Council. Safer city project 2000, 2001*. Leicester: Social Research Associates.

State Services Commission (SSC 2003) Guidance on outcomes focused management – building block 3: intervention logic (version 2.1). Accessed July 2010. *http://io.ssc.govt.nz/pathfinder*

Statistics New Zealand (2009) Car, bus, bike or train: what were the main means of travel to work? Accessed September 2009. *www.stats.govt.nz/browse_for_stats/people_and_communities/geographic_regions/commuting-patterns-in-nz-1996-2006.aspx*

Surrey County Council (2007) Inventory of 20 mph zones in Surrey. Accessed October 2009. *www.surreycc.gov.uk/sccwebsite/sccwspages.nsf/LookupWebPagesByTITLE_RTF/20mph+zones+and+20mph+limits?opendocument*

Transit Cooperative Research Program (TCRP 2008) Effects of TOD on housing, parking, and travel. TCRP Report 128. Prepared by GB Arrington and R Cervero. Washington: Transportation Research Board. Accessed December 2008. *www.trb.org*

Transport Canada (2005) St George Street revitalisation: 'road diets' in Toronto. Case studies in sustainable transportation, case study 30. TP 14415 E. Accessed March 2010. *www.tc.gc.ca/utsp*

Transport for London (2006) LIP reporting and funding submission guidance 2007/08–2009/10. Accessed July 2008. *www.tfl.gov.uk/corporate/about-tfl/boroughpartnerships/1474.aspx*

Trevisan, MS and Y Huang (2003) Evaluability assessment: a primer. Practical Assessment, Research & Evaluation, 8(20). Accessed June 2009. *http://PAREonline.net/getvn.asp?v=8&n=20*

Van der Spek, S (2006) Legible city – walkable city – liveable city. Observation of walking patterns in city centres. Proceedings of the 7th International Conference on Walking and Liveable Communities (Walk21), October 23–25, 2006, Melbourne. Accessed November 2010. *www.walk21.com/conferences/conference_papers.asp?Conference=Melbourne*

ViaStrada (2009) Continuous cycle counting trial. Report prepared for the NZTA. Accessed July 2010. *www.nzta.govt.nz/resources/continuous-cycle-counting-trial/index.html*

ViaStrada (2008) Cycle counting in New Zealand. Report prepared for the NZTA. Accessed July 2010. *www.nzta.govt.nz/resources/sustainable-transport/cycle-counting-in-nz/*

Victoria, G and H Shalom (2003) A wide-scale safety evaluation of traffic calming measures in residential areas. *Proceedings of European Transport Conference 8-10 October 2003*, Strasbourg, France.

Webster, D, A Tilley, A Wheeler, S Nichols and S Buttress (2006) Pilot home zone schemes: summary of the schemes. Prepared for the Traffic Management Division, Department for Transport. *TRL report no.654*.

Webster, D and AM Mackie (1996) Review of traffic calming schemes in 20 mph zones. *TRL report no.215*.

Webster, D and RE Layfield (2003) Review of 20mph zones in London boroughs. Prepared for Transport for London, London Accident Analysis Unit. *TRL published project report no.PPR243.*

Woller, G and J Downing (2007) Developing a causal model for private sector development. Impact assessment primer series. Publication 4. Prepared for the US Agency for International Development. Accessed 2009. *www.usaid.gov*

Wooller, L (2010) What are the economic and travel implications of pedestrianising a roadway in Takapuna's shopping precinct? Master's thesis. Health Science, Auckland University of Technology. Accessed October 2010. *http://aut.researchgateway.ac.nz/handle/10292/999*

York, I, A Bradbury, S Reid, T Ewings and R Paradise (2007) The manual for streets – evidence and research. *TRL report no.661*.

Appendix A: International and New Zealand experience with slow zone treatments

Abbreviations

BE	built environment
c	cycling
CBD	central business district
env	environment
km	kilometres
km/h	kilometres per hour
m	metres
meas	measure(s)
mph	miles per hour
NHD	neighbourhood
n/r	not reported
ped	pedestrian
Q or Qs	question(s)
sig	significant
tpt	transport
vpd	vehicles per day
vph	vehicles per hour
w	walking
w/c	walking and/or cycling
Xg	crossing

Summary

			IMPACTS MEASURED					OPERATIONAL / FACILITIES / INFRASTRUCTURE CHANGES													
Author and date	Quality of study (relative to other studies examined in lit review)	Type of intervention (HZ; TC; MPR; NAP, RCR, 20mph)	W/C changes measured - Y/N	W/C - direction of change	Crashes &/or injuries reduced	Speed of vehicles reduced	Traffic flow reduced	Other impact reported	Road closure	Road narrowing / gateway	Pedestrian crossing treatment (incl bulb out; refuge island)	Speed humps/centre blisters	20mph (30km/h) speed limit	40mph reduced to 30mph	Removal of traffic markings / shared space	Cycling facilities	New parking facilities	Lighting	Unspecified / mixture	Roundabouts	Effect on surrounding roads
Austroads (2009b)	G (review)	TC	No		√	√						√								√	
Bunn, F, T Collier, C Frost, K Ker, I Roberts and R Wentz (2003)	G (meta analysis)	TC			√														√		
Carver, A, AF Timperio and DA Crawford (2008)	G (applies to teens only)	TC	Yes	incr	x	x		√			√	√									
Department of Environment, Transport and the Regions (1999)	F (applies to children)	TC	Yes	incr				√			√	√									
Ernish, E, P Harrison and J Yuvan (1998)	P	TC	No		√	√													√		
Huang, HF and MJ Cynecki (2000)	F - ped activity (use of Xg)	TC	No		x	x	x				√										
Hummel, T, A Mackie and P Wells (2002)	F - meta analysis	TC	Yes	incr	√	√	√	√											√		
Grant-Muller, SM, AS Fowkes, A Jopson, AD May, P Mackie, B Matthews, J Nellthorp, M Page and S Shepherd (2000)	P (review)	TC	No						√ (pedestrianisation)										√		≤ 65% of flow on minor roads diverted to main roads; traffic diverted from city centre to ring road
LaPlante, J and B McCann (2008)	P	TC	No			√													√		
MacBeth, AG (2005)	F - b4 only	TC	No		x	x	x														
Martin, A (2006)	P (review)	TC	No																√		
Morrison, D, H Thomson and M Petticrew (2004)	G	TC	Yes	incr	x	x	x	√				√									

			IMPACTS MEASURED					OPERATIONAL / FACILITIES / INFRASTRUCTURE CHANGES IMPLEMENTED												
Author and date	Quality of study (relative to other studies examined in lit review)	Type of intervention (HZ; TC; MPR; NAP, RCR, 20mph)	W/C changes measured - Y/N	W/C - direction of change	Crashes &/or injuries reduced	Speed of vehicles reduced	Traffic flow reduced	Other impact reported	Road closure	Road narrowing / gateway	Pedestrian crossing treatment (incl bulb out; refuge island)	Speed humps/centre blisters	20mph (30km/h) speed limit	40mph reduced to 30mph	Removal of traffic markings / shared space	Cycling facilities	New parking facilities	Lighting	Unspecified / mixture	Roundabouts	Effect on surrounding roads
Morrison, D, M Petticrew and H Thomson (2003)	G - review - (Elvik & Vaa)	TC	No		√	√	x				√	√				√					
Newby, L and L Sloman (1996)	F/P	TC	Yes	incr	x	x	x	√					√						√		
Orenstein, M, N Gutierrez, TM Rice, JF Cooper and DR Ragland (2007)	G (safe routes to school)	TC	Yes	incr	√	x	x												√		
Project for Public Spaces Inc (2008)	advocate	TC	No												√						
Ross Silcock Ltd and Social Research Associates (1999a)	F	TC	Yes	decr	x	x	x												√		
Ross Silcock Ltd and Social Research Associates (1999b)	G (several cases)	TC	Yes	incr	x	x	x				√	√									
Skjoeveland, O (2001)	P	TC	No		x	x	x	√													
Social Research Associates (2001)	P	TC	Yes	decr	x	x	x												√		
Social Research Associates and Jacobs Babtie (April 2006)	P - 13 case studies - no after monitoring	TC	No					√											√		
Victoria, G and H Shalom (2003)	F/P (several cases)	TC	No		x	√	x					√									Speed treatments lowered speeds on surr roads, not just treated roads
Cleland, VJ, A Timperio and D Crawford (2008)	G	TC	Yes	tpt walk high in TC NHD															√		

			IMPACTS MEASURED					OPERATIONAL / FACILITIES / INFRASTRUCTURE CHANGES IMPLEMENTED													
Author and date	Quality of study (relative to other studies examined in lit review)	Type of intervention (HZ; TC; MPR; NAP, RCR, 20mph)	W/C changes measured - Y/N	W/C - direction of change	Crashes &/or injuries reduced	Speed of vehicles reduced	Traffic flow reduced	Other impact reported	Road closure	Road narrowing / gateway	Pedestrian crossing treatment (incl bulb out; refuge island)	Speed humps/centre blisters	20mph (30km/h) speed limit	40mph reduced to 30mph	Removal of traffic markings / shared space	Cycling facilities	New parking facilities	Lighting	Unspecified / mixture	Roundabouts	Effect on surrounding roads
Hinckson et al (2008)	G (school children)	TC + educ progr	Yes	incr w/c	x	x	x				√	√					√		√		
Babtie Group (2001)	F (review)	20mph	Yes	no chg								√	√								
Dept for Transport (April 2001c)	G	20mph	Yes	no chg	too soon	√	√			√	√	√	√								
Dept for Transport (2001b)	G	20mph	Yes	no chg		√	√			√	√	√	√								
Grundy, C, R Steinbach, P Edwards, P Wilkinson and J Green (2008)	F (review)	20mph	No		√	x	x			√	√	√	√								Casualties also reduced on surr roads, but to lesser degree
Hodgkinson, M and J Whitehouse (1999)	F (review)	20mph	Yes	no chg	too soon	√	n/r	√		√	√	√	√								
Kirby, T (2001)	F	20mph	Yes	no chg in counts / perceptions chgd	√	x	x	√		√	√	√	√								
Webster, DC and AM Mackie (1996)	F - meta - 200 20mph schemes	20mph	No		√	√	√			√	√	√	√								Flows on surr roads incr by 12% (fell 27% in zone); no accident migration
Department for Transport (2008d) Cowley Rd	F	MPR	Yes	cyc incr	√	√	√			√	√	√	√		√	√	√				
Department for Transport (2008g) Norwich	G	MPR	Yes	c: no chg / w: incr	√	√	√			√	√	√	√				√	√			

			IMPACTS MEASURED					OPERATIONAL / FACILITIES / INFRASTRUCTURE CHANGES IMPLEMENTED													
Author and date	Quality of study (relative to other studies examined in lit review)	Type of intervention (HZ; TC; MPR; NAP, RCR, 20mph)	W/C changes measured - Y/N	W/C - direction of change	Crashes &/or injuries reduced	Speed of vehicles reduced	Traffic flow reduced	Other impact reported	Road closure	Road narrowing / gateway	Pedestrian crossing treatment (incl bulb out; refuge island)	Speed humps/centre blisters	20mph (30km/h) speed limit	40mph reduced to 30mph	Removal of traffic markings / shared space	Cycling facilities	New parking facilities	Lighting	Unspecified / mixture	Roundabouts	Effect on surrounding roads
Department for Transport (2008f) Leamington Spa	G	MPR	Yes	w: incr	√	√	√			√	√	√					√	√			Some indication that traffic diverted to side roads, then rejoins main road outside treated area
Department for Transport (2008b) Lambeth	P	MPR	No		x	x	x			√	√	√						√			
Department for Transport (2008e) Newland Ave	F	MPR	Yes	w/c incr	√	√	x			√	√	√	√			√		√			
Department for Transport (2008c) Nantwich Rd.	G	MPR	Yes	w: inconclusive; c: decr	√	√	x			√	√	√	√			√		√			
Department for Transport (2008k) Wilmslow Road	F	MPR	Yes	mixed	√	√			√		√	√	√			√		√			
Department for Transport (2008h) Renshaw Street	G	MPR	Yes	no chg	√	√	x				√	√					√		√		
Department for Transport (2008j) Walworth Rd	not done	MPR	No		√	x	x				√	√				√					
Department for Transport (2008i) St Peters Street	F/P	MPR	No		√	√	x				√	√	√		√		√				
Geoplan Urban & Traffic Planning et al (1998)	F (10 case studies)	MPR (Share the Main Street)	No		√ (in 7 cases)	√ (in 7 cases)	√ (in 3 cases)				√	√				√	√	√	√	√	x

			IMPACTS MEASURED					OPERATIONAL / FACILITIES / INFRASTRUCTURE CHANGES IMPLEMENTED												
Author and date	Quality of study (relative to other studies examined in lit review)	Type of intervention (HZ; TC; MPR; NAP, RCR, 20mph)	W/C changes measured - Y/N	W/C - direction of change	Crashes &/or injuries reduced	Speed of vehicles reduced	Traffic flow reduced	Other impact reported	Road closure	Road narrowing / gateway	Pedestrian crossing treatment (incl bulb out; refuge island)	Speed humps/centre blisters	20mph (30km/h) speed limit	40mph reduced to 30mph	Removal of traffic markings / shared space	Cycling facilities	New parking facilities	Lighting	Unspecified / mixture	Roundabouts	Effect on surrounding roads
Department for Transport (2005) Home zones	F/P	HZ	No		x	√	√						√						√		
Jones, P and R Childs (1999)	P (review)	HZ	No		x	x	x	√	√	√	√				√						
Kennedy, JV (2003)	F (review)	HZ	No		x	√	√ incr traffic			√	√			√	√		√	√			
Layfield, R, L Chinn and D Nicholls (2003)	F	HZ	Yes	no chg	x	x	x	√													
Centre for Transport & Society (2006)	F/P	HZ	No		x	√	x	√		√	√	√	√				√	√			
Webster, D, A Tilley, A Wheeler, S Nichols and S Buttress (2006)	F/P (several cases)	HZ	Yes	no chg	n/r	√	√	√		√	√	√	√				√	√			
Opus (2008) South Dunedin	P - survey per-ceptions	NAP	No		√ no chg	√ no chg	√ no chg	√ no chg			√	√				√		√			
Opus (2008) Papatoetoe	P	NAP	No		x	√ no chg	x				√	√				√					
Opus (2008) Southville	P	NAP	No		x	√	x			√	√	√				√	√				
Opus (2008) Nelson	F/P	NAP	Yes	w: incr	√	x	x				√	√				√					
Opus (2008) Tauranga	P	NAP	No								√										
Cairns, S, C Hass-Klau and P Goodwin (1998a)	F/P	RCR	Yes	w/c incr	x	x	x		√		√					√					
Cairns, S, C Hass-Klau and P Goodwin (1998b)	F/P	RCR	Yes	w: incr					√		√								√		
Transport Canada (May 2005)	F/P	RCR	Yes	c: incr / w: n/r	√	√	√ no chg		√		√					√					

			IMPACTS MEASURED					OPERATIONAL / FACILITIES / INFRASTRUCTURE CHANGES IMPLEMENTED														
Author and date	Quality of study (relative to other studies examined in lit review)	Type of intervention (HZ; TC; MPR; NAP, RCR, 20mph)	W/C changes measured - Y/N	W/C - direction of change	Crashes &/or injuries reduced	Speed of vehicles reduced	Traffic flow reduced	Other impact reported	Road closure	Road narrowing / gateway	Pedestrian crossing treatment (incl bulb out; refuge island)	Speed humps/centre blisters	20mph (30km/h) speed limit	40mph reduced to 30mph	Removal of traffic markings / shared space	Cycling facilities	New parking facilities	Lighting	Unspecified / mixture	Roundabouts	Effect on surrounding roads
Highway Safety Information System (HSIS) (2010)	G	RCR	No		√	x	√ no chg		√		√								√		
Burden, D and P Lagerwey (1999)	advocate	RCR	No						√		√								√		
European Commission (2004)	F/P	RCR	No		x	x	√		√		√					√					
MacBeth, AG (1999)	F/P	RCR	Yes	cyc incr	x	x	√ no chg			√				√		√			√		
Goodwin, P, C Hass-Klau and S Cairns (1998)	F	RCR	No		x	x	√		√												
Gemzoe, L (2001)	P	RCR	Yes	w incr; c n/r	x	x	√		√												

Walking and cycling – method and effects

		Method			Result			
Document (author & date)	type of intervention (HZ; TC; MP; NAP, etc)	w/c changes measured	survey	count	survey - perception of activity	survey - measuring activity	count	Description
Carver, A, AF Timperio, AF and DA Crawford (2008)	TC	√	√		↑			Parents reported on children's w/c to 15 destinations - some TC elements results in incr w/c
Department of Environment, Transport and the Regions (1999)	TC	√	√		↑			Parents reported on children's visits to parks and local shops
Hummel, T, A Mackie and P Wells (2002)	TC	√	?	?	↑			Review of several - some unspecified; incr peds in some areas; see also Newby & Sloman 1996
Morrison, D, H Thomson and M Petticrew (2004)	TC	√	√	√	↑	↑	↑	Very good methodology - 20% adults said walked more as a result; corroborated by the pedestrian count which recorded 'substantial increases at most sites and in most age groups'. 11.8% of children reported to play out more, 12.5% reported to walk more, 11.6% reported to be allowed to cycle more.
Newby, L and L Sloman (1996)	TC	√	√		↑	no chg		Perception: more children playing out; more people walking - respondents not walking more themselves
Orenstein, M, N Gutierrez, TM Rice, JF Cooper and DR Ragland (2007)	TC	√		√			↑	Good methodology - counts of children walking and cycling to school, passing different points
Ross Silcock Ltd and Social Research Associates (1999b)	TC	√	√		↑			Adults saying they walked &/or cycled more, and that their children played out or walked more
Ross Silcock Ltd and Social Research Associates (1999a)	TC	√		√			↓	Counts - methodology not detailed - declines in walk & cycle
Social Research Associates (2001)	TC	√	√	√	↑		↓	Counts - methodology not detailed- declines in walk & cycle counts although adults reported walking more
Cleland, VJ, A Timperio, and D Crawford (2008)	TC	√	√			↑		TC-areas found to have mothers spending more time walking & maintaining this over 2-year period
Hinckson et al (2008)	TC	√	√	√			↑	Counts - roll survey: all students in a school at specific times each term/year - asked how traveled to school and from school
Babtie Group (2001)	20mph	√	√	√	no chg		no chg	Reasonable methodology - no change in walk/cycle counts; no change in surveyed 'children playing out'
Dept for Transport (2001c)	20mph	√	√	√	↑		no chg	Counts - good methodology - no change; self-reported 'more likely to walk' now

		Method			Result			
Document (author & date)	type of intervention (HZ; TC; MP; NAP, etc)	w/c changes measured	survey	count	survey - perception of activity	survey - measuring activity	count	Description
Dept for Transport (2001b)	20mph	√	√	√	↑		↓	Counts - good methodology - decline in pedestrian crossings; no change in cyclist counts; self-reported 'more likely' to w/c & more frequent walking to shops
Hodgkinson, M and J Whitehouse (1999)	20mph	√	√	√	↑		no chg	Counts - methodology not fully described, appears reasonable - no change in w/c; self-reported 'more likely to walk' now
Kirby, T (2001)	20mph	√	√		↑	no chg		Self-reported: perception of more walking, cycling and children playing outside although other responses re: quantity of w/c did not support this
Department for Transport (2008d) Cowley Rd	MPR	√		√			↑	Counts - counting method = good; timing not given - cyclists increased; peds counted but not commented on
Department for Transport (2008g) Norwich	MPR	√		√			↑	Counts - good methodology - pedestrian footfall increased; cyclists inconclusive
Department for Transport UK (2008f) Leamington Spa	MPR	√		√			↑	Counts - annually; good methodology- pedestrian footfall increased
Department for Transport (2008e) Newland Ave	MPR	√		√			↑	Counts - cyclists: good methodology (annual cordon); peds - unclear - pedestrians and cyclists increased
Department for Transport (2008c) Nantwich Rd.	MPR	√		√			↓	Counts - reasonably good method - pedestrians inconclusive; cyclists declined
Department for Transport (2008k) Wilmslow Road	MPR	√		√			mixed	Counts - good methodology - mixed results for w/c - dependent on whether weekday or weekend
Department for Transport (2008h) Renshaw Street	MPR	√		√			no chg	Counts good methodology - no change in cyclists; pedestrians not counted
Layfield, R, L Chinn and D Nicholls (2003)	HZ	√	√		↑	no chg		Self-reported: adults no change in walking levels; children: allowed to play out more
Centre for Transport & Society (2006)	HZ	no data	√		↑			Some adults reported walking & cycling more
Webster, D, A Tilley, A Wheeler, S Nichols and S Buttress (2006)	HZ	√	√		↑	no chg		Self-reported: adults no change in w/c levels; children: allowed to play out more
Opus (2008) Nelson	NAP	√		√			↑	Counts - method not specified - increased pedestrian footfall
Cairns, S, C Hass-Klau and P Goodwin (1998a)	RCR	√		√			↑	Counts - method not specified - increased w/c

		Method			Result			
Document (author & date)	type of intervention (HZ; TC; MP; NAP, etc)	w/c changes measured	survey	count	survey - perception of activity	survey - measuring activity	count	Description
Cairns, S, C Hass-Klau and P Goodwin (1998b)	RCR	√		√			↑	Counts - method not specified - pedestrian flow increased
Transport Canada (May 2005)	RCR	√		√			↑	Counts - method not specified - cyclists increased; pedestrians not counted - surrounding streets counts: no change
European Commission (2004)	RCR	√		√			?	Counts - cyclists - intermittently carried out; poor methodology
MacBeth, AG (1999)	RCR	√		√			↑	Counts - method not specified - cyclists increased in 6 treated areas
Gemzoe, L (2001)	RCR	√		√			↑	Counts - method not specified - pedestrians increased

Traffic calming

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Austroads (2009b) Impact of LATM treatments on speed and safety, Sydney, A4, 75pp, AP-T123/08. Accessed from www.austroads.com.au	LATM Literature Review. Field trials re speed reductions, data analysis and findings. Computation of accident reduction based on power formula by Nilsson 1994.	Australia and NZ. 2 LATM (roundabouts and centre blisters) were selected for field trials	The literature review involved collation and aggregation of the results from similar empirical field trials for each of the LATM treatment types. The review was extended to international publications, mainly from the UK and US, to broaden the pool of available information. Varying quality of studies (Speed reductions by brindle et al 1997 and Cusack et al 1998.)	Long term - rigorous field trials suggested.	Traffic speed reduction (change in 85th percentile speeds); accident reduction (casualty crash reduction factor)	N/A	N/A	Theoretical crash reduction factor of 43% for roundabouts (based on speed reduction only). Lit review did not find crash reduction potential of ***centre blisters*** - a theoretical crash reduction factor of 18% was calculated (based on speed reduction) in the trial sample.	***Roundabouts*** Field trials - typical 85th percentile speed reduction at the local road roundabouts in the sample was 24km/h, or 44%. The zone of influence on the free speed was 60-80m on the approach and 100-120m on the departure. ***Centre blisters*** found in the trial sample could be described as 'mild' and did not have a major effect on speeds - typical 85th speed reduction was only 8km/h, or 14%.	
Bunn, F, T Collier, C Frost, K Ker, I Roberts and R Wentz (2003) Traffic calming for the prevention of road traffic injuries: systematic review and meta-analysis.	Systematic review and meta-analysis - Inclusion criteria: Randomised controlled trials, and controlled before/after studies of area-wide TCS designed to discourage and slow down through traffic on residential roads.		All studies in 1970s and 1980s - all but 2 in Europe. Found no randomised controlled trials of TC. Included studies with well matched intervention and control areas, with adequate before and after periods, which may avoid the problem of confounding by changes in the background rate of injury.	All had 2-5 years before and after data; wide range of intervention s (p.202)	Road deaths; road injuries	n/a	n/a	Sixteen controlled before/after studies met our inclusion criteria. Eight studies reported the number of road user deaths: pooled rate ratio 0.63 (95% confidence interval (CI) 0.14 to 2.59). Sixteen studies reported the number of injuries (fatal and non-fatal): pooled rate ratio 0.89 (95% CI 0.80 to 1.00). All studies were in high income countries.		This result (road user deaths) should be interpreted with caution since many of the studies include at least one period in which no road user deaths were observed.

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use -long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Carver, A, AF Timperio and DA Crawford (2008) Neighborhood road environments and physical activity among youth: the CLAN study. *Journal of Urban Health: Bulletin of the New York Academy of Medicine 85*, no. 4 doi: 10.1007/s11524-008-9284-9	Examined associations between objective measures of the local road environment and physical activity (including active transport) among youth.	Cross-sectional study of children aged 8–9 years (n=188) and adolescents aged 13–15 years (n=346) who were participants in the 3-year follow-up of the children living in active neighborhoods (CLAN) longitudinal study in Melbourne, Australia.	Parents reported how frequently their child (8-9) usually w/c to 15 specific destinations, while adolescents (13-15) self-reported this information. NHD destinations included bike/ walking tracks, friends' houses, sports venues/ leisure centers, parks/playgrounds, waterways, beach, other open spaces, PT, school, amusement arcades, DVD rental stores, convenience stores, takeaway/ fast food outlets, and other shops or destinations. participants wore accelerometer for 8 days. GIS used to examine objective measures of the road environment within an 800m radius of each participant's home - 're-engineering of road env' incl some TC measures.	Cross sectional study - survey before and after (3-year follow up).	Frequencies of w/c trips to all destinations were summed and dichotomized on conceptual grounds as <7 trips per week and >=7 trips per week to identify habitual w/c that equates to an average of at least one trip per day.		Regression analyses found no assoc. between road env. variables and children's likelihood of making 7+ w/c trips per week to neighborhood destinations. Adolescent girls residing in NHD with two to three traffic/pedestrian lights were more likely to make 7+ w/c trips per week as those whose neighborhoods had fewer traffic lights (OR: 2.7; 95% CI: 1.2–6.2). For adolescent boys, residing on a culde-sac, compared with a through road, was associated with increases in MVPA. Speed humps were positively associated with adolescent boys' MVPA during evenings.			
Dept of Environment, Transport and the Regions (1999) Personal security issues in pedestrian journeys. London: DETR.	Case study (+)	Residents of deprived inner urban area of Leicester with large Asian community (Highfields) n approx 200.	Blitz on prostitution', improved lighting, traffic calming (road humps); safe routes to destinations including schools.	One-off survey.	Self-assessed walking and cycling.	Reported increase in physical activity through children visiting local shops and parks.	N/A			No data presented on possible confounders - study used a retrospective measure of self-assessed physical activity.

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Ernish, E, P Harrison and J Yuvan (1998) Streets for people: calming in your neighbourhood. Transalt, US. Available from www.transalt.org/resources/streets4people	Basically 'how to' guide on creating neighbourhood streets network - some 'research'.	Traffic calming - based on examples from around the world.	Various suggested methods of traffic calming to resolve to resolve safety and quality of life standards.	N/A			Makes assertions without evidence (eg increased retail trade; reduced noise and pollution levels; how well neighbours know each other).	Berkeley: Crash totals dropped from 142 to 116 a year (TC), Stockholm/ Sweden: Crash totals declined by 25% (NHD TC). Seattle. Where mini traffic circles were installed have seen up to 90% fewer collisions. Bologna, Italy: traffic volumes were reduced 13% and the number of crashes dropped 22%. In Seattle, ***mini-traffic circles*** have resulted in as much as a 90% reduction in crashes.		
Huang, HF and MJ Cynecki (2000) Effects of traffic calming measures on pedestrian and motorist behaviour. Transportation Research Board 1705. Washington, DC: TRB, pp 26-31.		US	TC in 4 locations (either bulb outs; or refuge island & pavement markings).	Not given	1. Average pedestrian wait time 2. Pedestrians crossing in the crosswalk 3. Pedestrians for whom motorists yielded.	n/a	n/a	n/a		

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Hummel, T, A Mackie and Wells P (2002) Traffic calming measures in built-up areas - literature review. Unpublished project report PR/SE/622/02 prepared for Swedish National Road Administration.	Lit review examining context in which TC should be used in urban areas and detailed design of TC measures and reviews of their effects (incl env; eff on mobility; potential for accident migration; social eff; etc) - also considers urban safety management.		Specific measures: road humps; rumble devices (not effv); narrowings and chicanes; gateways and entry treatments; roundabouts; vehicle activated devices (speed cameras; speed reminder signs) advanced telematics; road markings, signs and street furniture).	Various	Design considerations; eff on speed, traffic flows; accidents; noise; vibration; emissions and air quality.	Surveys in Brighton, Leicester, Sheffield and York (Taylor and Tight 1996) indicated that there was an increase in independent mobility of children after the implementation of TC. Pedestrians felt safer while crossing roads, and motorists were more likely to let pedestrians cross. There was little evidence that the amount of walking by adults had increased.	Before and after studies in a number of German and UK towns (Hass-Klau 1993) revealed that pedzn and TC both have a positive affect on retailing. The research indicated that # of pedestrians visiting pedz and TC shopping areas increased substantially after implementation. Apart from the increased ped flows, the total actual expenditure in shops in those areas also increased (compared to other shopping areas). property values and rents in TC and pedz areas proved to rise after implementation.	A meta-analysis of 33 studies from 8 different countries on area-wide effects of TC (Elvik 1999) showed average reduction of accidents (injury and damage-only) of 15 – 20%. Reductions on local roads from 25–55%; on main roads from 8–15%. the variation btw diff TC schemes explained by variations in: Size of the area to which they were applied · Measures included in the scheme · Changes in traffic volumes. Elvik found a tendency for the greatest accident reductions to be assoc with the > reductions in traffic volumes.	The increase in property value after implementation of traffic calming programmes was also found in residential areas in US studies (Bagby 1980; Hughes & Sirmans 1992). Both studies found an increase in house values in residential areas by an average of 18%.	

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - Short term findings (<1 year)	Mode use - Long term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Grant-Muller, SM, AS Fowkes, A Jopson, AD May, P Mackie, B Matthews, J Nellthorp, M Page and S Shepherd (2000) Assessing the impact of local transport policy instruments.	Working paper. Generalised comments, with some evidence sprinkled here and there - brings tog. relevant material to assist the process of accessing local transport policy instruments.	UK	Various, incl cycle facilities, TC, pedestrianisation of city centre, travel planning.	Not given	Relatively little documented evidence on the impact on traffic and none on the impact on w/c.	Traffic cell scheme in Gothenburg - traffic flows fell by as much as 45% in centre and rose by 10% on ring road, with a net incr of 1% in veh-km; 'early experiments with speed humps, up to 65% of flow on minor roads was diverted to main roads.				
LaPlante, J and B McCann (2008) Complete streets: we can get there from here. *ITE Journal 78*, no. 5: 24-28.	Discusses US national complete streets coalition.-		Discusses various measures available to create context-sensitive solutions, including reducing speeds, TC measures.	n/a		n/a	n/a	n/a	Has some useful info on impacts of various speed limits on overall trip time by car.	

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
MacBeth, AG (2005) Creyke Road Living Streets Pilot Project. Traffic calming an arterial road in Christchurch	Is it possible to change a busy conventional minor arterial road in a busy urban environment to better accommodate pedestrians and cyclists, without reducing functionality for cars.	Christchurch Creyke Road.	Road narrowing, removal of on-street parking, provide cycle lanes, widened footpaths, planting of trees and installation of traffic islands. Providied right turning lanes at key intersections.	Comprehensive monitoring yet to be done. Before - Manual counts and automatic pneumatic tube motor vehicle and cycle counters installed in three locations.	Ped, cyc, traffic counts - BEFORE Recorded cyclists and pedestrians during two 10 hour days. 800 pedestrians walked the street, 1200 pedestrians crossed the road, 700 cycled the road and 300 cyclists crossed the street.	n/a	May not be realised for years to come.	n/a	A reduction of speed limit from 50km/h to 40km/h for the street would have been advantageous, but was not endorsed by decision-makers or technical staff. NZ road controlling authorities have generally been reluctant to experiment with speed limit reductions for urban roads, with most roads having a 50km/h speed limit. Police enforcement is usually not commenced until drivers exceed 60km/h. Overall, these are minor concerns for a project with significant implications for urban traffic engineering on strategic roads.	

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Martin, A (2006) Factors influencing pedestrian safety: a literature review. Unpublished project report UPR SE/199/05. TRL: Crowthorne.	Review of the relevant technical literature by TRL to investigate ways pedestrian behaviour might be influenced (in ways most acceptable to ped'ns and other road users) to reduce the #s of casualties on London's roads.	Literature review	Reviews a range of TC-type interventions for their impact on crash rates and traffic speed, including home zones; 20mph zones; narrowing streets; humps; cushions; chicaynes, etc.	Various	Speed reduction, accident reduction.	n/a	n/a	Much of the reporting asserts an increase in safety/no change in safety with respect to specific measures (eg various types of signalisation/crossing treatment; refuge islands; guard rails), without giving explicit evidence.	Evidence given of reductions in traffic speed for different physical interventions (similar to that summarised for Austroads LATM).	
Morrison, D, H Thomson and M Petticrew (2004) Evaluation of the health effects of a neighbourhood traffic calming scheme. *J. Epidemiol Community Health 58*: 837-840	To assess impact of traffic calming scheme over and casualty reduction.	Deprived outer urban housing estate residents. n=185; UK.	Traffic calming of a deprived outer urban housing estate using speed cushions, two zebra crossings with adjacent railings, and creation of parking bays.	Uncontrolled before and after - surveys undertaken 6 months before and after implementation of traffic calming scheme; pedestrian counts - short form physical activity survey included in survey.	Pedestrian counts (very good method: timing, day of week, hours all the same & weather recorded); self assessed pa; assessments of children's play, walking/cycling (survey).	20% adults said walked more as a result; corrob. by the pedestrian count which recorded 'substantial increases at most sites and in most age groups'. 4% reported cycling more. 11.8% of children reported to play out more, 12.5% reported to walk more, 11.6% reported to be allowed to cycle more. Physical health improved.	N/A			Possible selection bias - Self report data on physical activity increase supported by pedestrian counts.

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Morrison, D, M Petticrew and H Thomson (2003) What are the most effective ways of improving population health through transport interventions? Evidence from systematic reviews. *J Epidemiol Community Health 57*, no.5: 327–333.	To review systematic review literature that describes the effectiveness of transport interventions in improving population health.		Found one paper (Elvik) of sufficient quality reviewing TC measures and their effects; one paper (Vaa, T 1997) reviewing speed reduction measures and their effects - assessed against index for quality assessment of reviews & both found to have notable flaws.	Various (review)	Health effects included social, psychological, and physical effects that could be measured on humans - with respect to TC, primarily reported as accident reduction.	Area-wide traffic calming reduces the number of accidents by a mean of 15% in the whole area affected by the measures (main roads and local roads combined). The effects are relatively constant in different countries and in different years. Speed limit zones in built up areas reduce personal injuries but have no clear effect on material damage.	Controlled studies show smaller reductions in personal injuries (18%, 8–26%) than uncontrolled studies (43%, 42–45%). Speed limit zones in quieter peripheral roads are effective in reducing both personal injuries (21%, 9–31%) and material damage (18%, 9–26%). A change to differential speed limits (slower in more built up areas, faster in peripheral roads) is associated with an increase in accidents in the peripheral areas (17%, 0–37%). For 30 km/h zones, accidents are reduced by 3.5% per km/h speed is reduced, independent of study design.	Speed limit reductions may be effective on their own in reducing accidents but additional measures may be needed. Speed reduction by road humps shows non-significant reductions in personal injuries in controlled studies (37% reduction, 95% CI 67% reduction to 19% increase). Controlled studies show non-significant increases in accidents in areas surrounding road humps. Accidents are reduced by 4.5% per km/h speed is reduced, independent of study design.	Raised crossroads are associated with non-significant increases in personal and material accidents. Rumble strips approaching crossroads are associated with significant decreases in personal (33%, 25–40%) and material (25%, 5–45%) accidents.	

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Newby, L and L Sloman (1996) Small steps, giant leaps. A review of the Feet First project and the practice and potential of promoting walking. Environ, Leicester (GB); Transport 2000 Trust, London (GB).	To provide a review of the Feet First project - Projects began early 1990s.	Community members, various project locations in in Brighton, Leicester, Sheffield and York (UK). N=not stated	TC and changes to the aesthetic environment. Leicester - around 10km of roads in the area were traffic calmed and environmental improvements. Children were involved in redesigning the streets to be 'safer and more fun to play in'. Sheffield – included pedestrian crossings, road narrowing, paved gateways and 20mph zones.	Post data only (-) - survey.	Number of children playing in the street, number of children walking to school, People walking in the area, trips made by car.	Interview surveys indicated there were gains in independent mobility of children, with more children being allowed to play in the street, travel to school and visit local shops without direct adult supervision. The amount of walking by adults showed little evidence of increase, with most respondents saying the number of journeys made on foot remained the same.	Various; Leicester; the numbers of children allowed to play in the street and to walk to school have both increased by about 20%; 59% said there were more people walking in the area and 36% of drivers said they made fewer car trips. Sheffield; 55% of people thought there were more children playing in the street and about 1/3rd thought there were more people walking. Increased perceived level of safety and reduced traffic accidents.			Methods not reported. Possible selection bias. Possible recall bias. Possible measurement bias. Confounders not reported.
Orenstein, M, N Gutierrez, TM Rice, JF Cooper and DR Ragland (2007) Safe routes to school: safety and mobility analysis: report to the California Legislature.	SR2S: Safe routes to school in California - evaluation of impacts.	Eval. of a representative sample of 125 of the 570 projects that received SR2S funding in the first three years of the program. Compared with control areas where no action.taken	Varied by school - sidewalk installation and upgrading, traffic calming and speed reduction measures, installation of traffic signals, pedestrian and bicycle crossing improvements, and construction of bicycle paths or other bicycle facilities.	Few schools conducted before- or after-implementation surveys of traffic counts. 10 schools had b4/after counts over 2 day periods, 45 min at each end of school day; also parental survey: does child w/c more/same/ less than b4.	Walking and cycling counts; crashes.	8 schools - counts indicated incr w/c from 10%-850%; one decr 29%; survey in same 10 schools: avg 15% incr where route passed improvements; 4% incr where route did not - overall 11% incr; 18% w/c less than b4. 2 other schools had b4/after counts & both had large incr in w/c activity.		In project areas, overall reduction in injured ped/cyc of 13% (95% CI 2-23%) - when increases in w/c taken into account, changes are likely to have been bigger.		

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Project for Public Spaces Inc (2008) Streets as places - using streets to rebuild communities. Great corridors, great communities - the quiet revolution in transportation planning.	Largely an advocacy and 'how to' guide - some case studies on creating successful streets and places in communities.	USA - examples/case studies - very descriptive, success marked through number/range of activities on offer.	Placemaking - Rebuilding of roads, more creative parking; walkways, cycle lanes, commercial developments, plantings, lighting, improvement of train stations.	No evaluation.		No evidence, however some do refer to striking results; lots of pedestrian activity (and some increases in cycling) ; and some refer to reduced vehicle congestion.	No evidence.	Reduced - no evidence.	Reduced (narrowing of roads).	
Ross Silcock Ltd and Social Research Associates (1999b) The impact of traffic calming schemes in Scotland. Prepared for the Scottish Executive Central Research Unit.	To assess the community impact of traffic calming schemes.	Residents in 10 traffic calming scheme across Scotland. n=1750.	Community traffic calming (speed tables, round top humps, flat top humps, speed cushions and kerb 'build outs').	Post-only data (-) - Minimum of 6 months to follow up and no more than two years maximum. Before data gathering not stated - surveys.	Self-assessed walking and cycling.	In three of the residential interventions there had been some increases in walking and cycling reported. For those who increased their walking and cycling after the interventions (ranged between 15-34% for walking and 7-18% for cycling) there may have been an increase in fitness, health and wellbeing but self-reported.	Interview surveys on TC effects. Responses varied among schemes, with 4–28% of residents saying that they walked more; 4–15% that they cycled more; and 0–46% saying that they allowed their children to cycle, play out or walk more.	The lit. search covered documents published from 1990 - 1997- few studies examined public attitudes to TC mainly concentrated on perceptions of specific features and on public consult. Some studies showed often conflicting evidence in results of objective measurement used by engineers and planners contrasting with perceptions of local people. V little work carried out re a number of factors such as changes in people's behaviour, activities and travel patterns resulting from changes in the street function.		Possible selection and measurement bias and no adjustment by level of intervention.

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Ross Silcock Ltd and Social Research Associates (1999a) Bypass demonstration project. Further research and analysis in relation to attitudes to walking.	To assess walking and attitudes to walking following by pass demo project.	Residents and road users in six towns following bypasses and traffic calming. n=1446; UK.	Bypass construction and associated traffic calming (measures not reported).	Uncontrolled before and after (-) - Varied from 9 to 27 months between towns - counts (methodology not clear).	Counts of pedestrians and cyclists.	n/a	Slight declines in walking and cycling post intervention to the town centre.			Poorly reported methods - possible measurement, and recall bias, no data presented on possible confounders.
Social Research Associates (2001) Gloucester City Council. Safer City Project – 2000, 2001. Leicester: Social Research Associates.	To assess the impact of the Safer City Project at the end of the 5 and final year through an annual survey of attitudes and perceptions.	Residents and road users in Gloucester n=552.	Traffic calming measures, and associated traffic management measures. Specific types of traffic calming measures not reported.	Uncontrolled before and after (-) - 5 years follow up - survey.	Self assessed walking and cycling.	n/a	Adults walking reported to decline between 1996 and 2000 for all travel purposes (although the level of decline was not quantified, and it was noted that some people in TC areas are walking more). Cycle use declined for all travel purposes except for food shopping, going to the pub, and visiting friends (each remained at 1% of modal share).			Poorly reported methods - possible measurement, and recall bias, no data presented on possible confounders.

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Social Research Associates and Jacobs Babtie (2006) Public perceptions of traffic calming. Report prepared for The County Surveyors Society, UK.	people's perception of TC - particularly as affected by the consultation process, and attitudes and perceptions of particular TC design features.			Review - methodology generally not given.		13 case studies of TC - only in 2 instances had councils provided feedback on performance of scheme - 'Frequently there was no "after" monitoring at all and even when there was, this was not well disseminated to residents and others affected by the scheme.'	Monitoring and feedback need to be planned from outset and linked with scheme objectives & public involvement. On a broader basis, it would be helpful for local authorities to carry out an annual review (or other structured prog. of evaluation) of schemes completed and the changes that resulted from them. There is a lack of reflective evaluation which could feed into subsequent traffic calming schemes and local transport plans.			
Department for Transport (2007) Local Transport Note 1/07 March 2007. Traffic calming. London: DFT.	Review and summarise evidence on traffic calming measures - commissioned by the Department for Transport.	Examples used were Scotland, UK, Netherlands.		This summary is based on prior before and after studies - most of which are independently reviewed in this worksheet.	Traffic speeds; traffic flows; injury accidents; delays to emergency services; relative public acceptability; vehicle emissions (CO, Nox, PM) - appendix B has complete list.	There is some evidence that TC schemes can have a positive effect on the independent mobility of children, but less evidence that they have substantially affected the amount of W/C by adults. **Crawley** TC on child pedestrians (aged 8 to 11) found that the proportion of children who walked or cycled had increased (56-69%).	Traffic calming is likely to decrease traffic flows on the roads where it is applied, reducing severance. However, it may increase traffic flows on surrounding roads (n***o further evidence).*** Traffic calming has been shown to increase individual vehicle emissions because of slower vehicle speeds.	In some TC areas, **personal** injury accidents reduced by 60-70% following speed reductions of about 9mph. (Webster and Mackie 1996) found **ped.** accidents were reduced by 63% and **cyclist** and child cyclist accidents were reduced by 29 % and 48% respectively after intro of 20mph zones in UK. **Motorcyclists** crashes reduced by 70% following the installation of 20mph zones.	No evidence	

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Victoria, G and H Shalom (2003) A wide-scale safety evaluation of traffic calming measures in residential areas. Proceedings of European Transport Conference 8-10 October 2003, Strasbourg, France.	Evaluated effect of treatments on speeds.	Study comprised 37 residential areas in two towns in north Israel - comprehensive set of charcs supplied, incl. types of streets, rd charc, types of TC measures and their density on streets.	Speeds compared near point of installation & away; compared speeds on treated streets with control streets (without treatments).	Before and after data collected.					All treatments apart from rumble devices reduced speed at site & overall speeds; effv at reducing speeds in whole NHD, not just on treated streets. Intensity & combination of treatments (particularly woonerf) were most effective; single treatment - speed humps & raised pedestrian Xgs most effective - closer together is greater.	
Cleland, VJ, A Timperio and D Crawford (2008) Are perceptions of the physical and social environment associated with mothers' walking for leisure and for transport? A longitudinal study. *Preventive Medicine 47*: 188–193.	This study aimed to cross-sectionally and prospectively examine whether local physical and social environments were associated with mothers' walking for leisure and for transport.	Melbourne; mothers of school aged children.	In 2004, 357 mothers from Melbourne, Australia, provided information on local physical and social neighbourhood environments, and in 2004 and 2006 reported weekly time spent walking for leisure and for transp. Environmental predictors of high levels of walking and increases inwalking were examined using log binomial regression. Two env statements included in 2004: 'there are traffic slowing devices in our streets; the speed of traffic in our streets is usually slow (50kmh or less).	Survey - estimates of total walking for leisure & tpt in 1 week were given by each participant in 2004 & 2006. At 2004 baseline, series of Qs/ statements about NHD env also asked.	Levels of walking (leisure low-<=90 min per week; tpt low <=30 min per week) and how they changed between the two years.	x-sectionally & longitudinally, neither of TC or speed statements were relevant determinants of leisure walking; for tpt walking, speed featured as determinant for high level of tpt walking at baseline; TC & speed were determinants/ factors for persistent high levels, and TC for incr levels, in 2006.	'Practical' features of the environment are important for transport-related walking, while 'enjoyment' elements appear important for leisure-related walking.			High attrition rate.

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (inc measures -what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Hinckson, E, S Duncan, R Kearns and H Badland (2008) Auckland Regional Transport Authority school travel plan evaluation: 2007 school year. Auckland, New Zealand: AUT University.	Started in 2002, uses a school travel plan to encourage active transport (walking, cycling, scooting) by children to school.	Primary, intermediate and secondary schools in Auckland region.	School travel plans incorporate a site-specific mix of physical measures, (eg traffic calming, better parking options to drop-off and pick-up children, pedestrian-focused traffic light phasing, and safer bus stop locations) with educational and promotional campaigns to promote active transport and enforcement activities by the police and schools.	Hands up surveys of children's mode use - all children in schools at specific times each term/year; perception survey of parents; perception survey of schools.	% mode share (active transport; car; public transport).		The 2007 transport evaluation of 68 schools in the school travel plan programme (ARTA, 2008) found that, in absolute (% points) terms, car use decreased by 3.4 percentage points, with most of the trips affected (2.4 percentage points) switching to active travel and a lesser proportion (1.0 percentage points) to PT.		Visible reductions' in vehicle speeds (apparently not measured).	

20mph

Author and date	Study design and research type/ quality	Study pop-ulation: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Babtie Group (2001) Urban street activity in 20mph zones. Final report. For Department of Transport, Local Government and the Regions.	Evaluate various effects of self-enforcing 20mph zones.	Residents and road users. Number not stated; UK.	20mph speed limit zones with road narrowings, pavement 'build outs', road humps and cushions, and mini-roundabouts.	Uncontrolled before and after (+) - Before intervention, then 3 and 12 month follow-ups - counts and surveys.	Site observations; manual counts; assessment of level of children's play (survey).	No significant changes in levels of walking or cycling or changes in numbers of children playing in the street environment.	n/a			Possible selection and recall bias.
Dept for Transport (2001c) Urban street activity in 20mph zones - Seedley Salford. Leaflet 3/01 April 2001	Seedley, Salford Zone. Research the benefits and disbenefits of changes that might have occurred.	Seedley (City of Salford) UK	Gateway features, speed cushions (some with narrowings) round-top humps, 20mph roundel markings and realignment of junctions.	Household surveys; before; 3 and 12 months after - traffic counts, speed, noise and air quality - some attempt to monitor, not done effectively; manual counts (12 hour directional counts); monitored veh. speeds - all done before and after 3 months plus after 12 months.	Manual counts; monitored vehicle speeds at and btw cushion; mean and 85th percentile; likelihood of w/c.	Flow of vehicles reduced by 10% and 12%	The 'after 12 month' survey showed no real difference compared to the 'before' situation. A small percentage of respondents indicated that they were likely to walk more. The zone appears to have had little effect on cycling, with very low cycling use being recorded both in the 'before' and 'after' periods.	Insufficient time has elapsed for results.	Signif speed reduction (20%+ of mean & 85th percentile at & btw cushions), 25% resp. would allow children to play in 'safer' streets as a result (but no evidence to suggest they do); 59% of respondents felt that speed unchanged, 29% thought decreased, and 11% - increased. (before: 68% thought vehicles were too fast.)	While speeds were reduced, mean & 85th were still higher than 20mph, which may explain why people thought speeds hadn't been reduced.

Author and date	Study design and research type/ quality	Study pop-ulation: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Dept for Transport (2001b) Urban street activity in 20mph zone. Ayres Road area, Old Trafford. Final report results.	Does 20mph zones have a positive effect on reducing speeds?	A study into 6 20mph zones (Ayres Road area of Old Trafford.	Mixture of gateway features, speed cushions (some with narrowings) round-top humps and realignment of junctions. 76% of respondents in the 12 months after survey liked the measures; 66% preferred road humps; and 24% disliked speed cushions.	Household surveys before; 3 & 12 months after - traffic counts, speed, noise & air quality - some attempt to monitor, not done effectively; Manual counts (12 hour directional counts); monitored veh. speeds - before and after 3 mos plus after 12 mos.	Pedestrian counts at junctions; cyclist counts entering area.	Within the zone, weekday traffic flows fell between 12% to 40% on the more major roads in the zone, such as Ayres Road and Northumberland Road, but by much less than this on the minor connecting roads.	Pedestrians declined (may be that more people crossed outside of marked crossing. No change on cyclists. significant increase in the proportion of respondents who said they walked to shops on a daily basis; from 25% to 40%. Respondents were also asked whether they were more likely to walk or cycle, and 10% said they would.	Curently not available.	While mean speeds were reduced to 20mph or less, 85th percentile speeds in the Ayres Road Area zone were still above 20mph.Also, comparing the 3 month with the 12 month after measurements reveals that speeds increased.	

Author and date	Study design and research type/ quality	Study pop-ulation: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Grundy, C, R Steinbach, P Edwards, P Wilkinson and J Green (2008) 20mph zones and road safety in London: a report to the London Road Safety Unit. London: LSHTM.	Study aimed to provide robust evidence on the effects of 20mph zones on road safety in London - quantify effects of 20mph zones on collision and casualty risk; cost effective-ness (reduced # casualties: cost of implementation).	A review on 399 zones currently in London	Signage, speed humps and cushions. Buildouts, chicanes, pinch points and traffic islands, gateways and pedestrian crossings. Trialling of 'time over distance' cameras to enforce 20mph speed limit.	3 years before and after analysis on 152 20mph zones between 1991 and 2003 using collision and casualty data and GIS overlays.	Assigning data to zones by linking collisions to the road they occur on. Cost effective analysis conclusions: may be a cost effective way of reducing casualties in London in areas with >0.7 casualties per km.	No evidence (reports on TC studies by Silcock & SRA, 1999; Babtie 2002; Morrison et al 2004).	No evidence.	The time series regression analysis estimated a 42% reduction (95% CI 36%, 48%) in all casualties within 20mph zones compared with outside areas, adjusting for an annual background decline in casualties of 1.7% on all London roads. The largest effects found for all casualties aged 0 -15 killed or seriously injured (KSI) and for car occupants more recent 20mph had lesser effect, as annual background casualty decline was 6%.	Reduced	

Author and date	Study design and research type/ quality	Study pop-ulation: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Hodgkinson, M and J Whitehouse (1999) Urban street activity in 20mph zones: emerging findings. Proceedings of the European Transport Conference, 1999, pp 49-60.	To assess the effect on urban street activity in 20mph zones - Commissioned by DETR in 1996. (also reported in: Hodgkinson M, Whitehouse J, Grubb E. (2002) Urban street activity in 20mph zones. Traffic Engineering & Control, 43(1):12-15.)	6 Residential areas of North West England Sudellside, Darwen; Royton, Oldham; Seedley, Salford; Old Trafford; Fairfield, Warrington; Bootle, Sefton	1. To establish the environmental benefits and disbenefits of 20mph zones, for traffic noise and emissions, accident reductions and severance within and immediately outside zone; 2. To quantify whether 20mph zones can materially change the travel patterns and modes of residents of the zones particularly in terms of w/c; 3. To determine whether 20mph zones can influence or change the function of streets within the zones, and particularly the effect of this on children and the elderly. 4. To ascertain the perceptions and attitudes of residents to changes that have arisen in the 20mph zones and the area in the immediate vicinity.	5 year research study - each zone being surveyed 3 times over research period: Before zone implementation; 3 months after zone implementation; and 12 months after zone implementation.	Traffic counts; pedestrian counts; automatic speed counts; registration plate surveys; HH int-view surveys; discusssion groups; traffic, air quality & vehicle noise surveys.	Very little cycling before implementation; unchanged. Walking - no significant changes in number of ped observed in zone or crossing boundary roads. Resident's perception = 'more likely to walk/use a bicycle for the journey' after (no detail on survey); perception that it was easier to cross main roads.	No change in air quality; reduction in traffic and veh noise levels of btw 3 and 9 dB(A).	Limited data available. The main conclusion to date is that the provision of adequate physical measures will reduce speeds close to 20mph and is likely to reduce the incidence and severity of accidents.		

Author and date	Study design and research type/ quality	Study pop-ulation: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Kirby T (2001) 20mph zones in Kingston Upon Hull. Presented at 'Managing Vehicle Speeds for Safety: Latest Developments'. Aston University, 19 September.	To review impact of the introduction of self-enforcing 20mph zones in Hull	Residents and road users in 85 schemes. n = 546	20mph speed limit zones with road humps, cushions, road narrowing; pedestrian crossings; highway markings.	uncontrolled before and after 2(-)	Self assessment of walking, cycling, children's play	Over 25% of residents said that they walked or cycled more since the scheme was introduced. 60% of respondents felt that more children played in the street. 'Little evidence for increased walking and cycling'.	N/A	Injury accidents decrease by 56%; KSI accidents decrease by 90%; Pedestrian casualties decrease by 54%; Child casualties decrease by 64%; Child pedestrian casualties decrease by 74%		Poorly reported methods - possible selection, recall and measure-ment bias and confound-ing
Webster, DC and AM Mackie (1996) Review of traffic calming schemes in 20mph zones. TRL report 215. Prepared for Department of Transport, UK.	200+ TC/20mph schemes implement-ed.	UK; most zones in residential areas.	Combination of 20mph zones and TC measures - avg length of road 2.5 km; avg of 29 calming measures per scheme - most common round-top humps; flat top humps; raised junctions; speed tables.	72 schemes had been installed for at least 12 months - provided an avg of 30 months 'after' accident data; most had at least 3 years 'before' data.		Traffic flow in zones reduced by 27% but flows on surrounding roads increased by 12%; residents in favour of schemes.		Annual accident frequency fell by 60%. Child accidents by 67%. Child pedestrians fell by 70%. Overall accident reduction to cyclists of 29%; 6.2% reduction in accidents for each 1mph reduction in vehicle speed; accident migration not a problem at 40 sites investigated.	Avg speed at TC meas: 13.2mph; between TC meas - 17.8mph; overall veh speeds fell on average by 9.3mph (data for 32 sites.)	

New Zealand neighbourhood accessibility plans

Author and date	Study design and research type/quality	Study population: setting; country; sample	Description of intervention	Methodology - description	Physical activity outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
NZTA (2007a) Nelson city neighbourhood accessibility plan	(Some notes incl in other case studies as noted by OPUS heading) - Objectives of NAP: identify problems & hazards re: road-user casualties; improve major routes in/around city.	Nelson City, NZ	Pedestrian-only crossing phase; painting raised crossing; pedestrian-only streets; longer pedestrian crossing phases, audible and tactile warning systems; smooth out rough and steep drop kerbs;advanced stop boxes; cycle racks; better-researched infrastructure suitable for cyclists; encourage cars to reverse into angle parks; education programmes.	Monitoring of crashes; census data; pedestrian counts; crime perception survey.		OPUS: An increase in ped in the CBD. Trafalgar Street saw a sustained ped volume increase of 22.5% over 2006 and 2007, or 2,500 new ped per day; incr in w/c commuters in Nelson City - 17% in 2006 census (14% in 2001; 13% in 1996).		The lowest ever crash rate for pedestrians & cycts in Nelson City was recorded after the education campaign and some engineering changes. A reduction in crime within the CBD in 2006, ranging from 7% to 30% for public disorder offences within the CBD.		
Opus International Consultants (2008) Neighbourhood Accessibility Planning Case Study Research. Report prepared for Land Transport NZ. - South Invercargill	Drivers: # of schools reduced from 10 to 5 - significant change in children's travel patterns; new hospital built	South Invercargill	27 new initiatives (education and phys meas) identified; 18 existing to be upgraded/maintained - intersection improvements; changes to parking, road markings; footpaths; relocating bus stop.	Monitoring of crashes.				Crash reduction: no formal before and after studies. Chelsea/Scott Streets intersection had been 1 of 12 worst intersects in Invercargill and since the works have been completed, there have been no recorded crashes at the intersection.		

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Physical activity outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
NZTA (2007b) Papatoetoe, Manukau City Council neighbourhood accessibility plan	Objectives: Establish the main causes of safety concern for cyclists and pedestrians in the community; define signigicant risks and issues for cyclists and pedestrians; identify feasible solutions; establish baseline data for evaluation.	Papatoetoe, Manukau City, NZ	One-day education event for school cyclists and pedestrians; media campaign; speed enforcement; installation of pedestrian splitter islands at a number of locations; installation of signalised crossing to replace pedestrian crossing; maintenance and upgrading of road and pedestrian/cycle infrastructure; initiation of a school travel plan at Papatoetoe Intermediate school.	Monitoring of vehicle speeds.					Vehicle speeds reduced during campaign & immediately after, but no monitoring to show if maintained or not.	
NZTA (2007c) South Dunedin neighbourhood accessibility plan	Objectives; to audit five major roads , list engineering requirements and integrate these with the council's work plan; to work with the community to determine the priority for those requirements; to identify the main issues for cycling and walking in the area; to identify the main issues for cycling and walking in the area; to work with the community to identify education and enforcement activities and address any issues.	South Dunedin, Dunedin, NZ	Advertising campaigns; cycle hazard removal; intersection and crossing upgrades; drop kerbs and tactile paving; creation of five mobility routes; trial of six flashing 'school zone' signs; improved lighting.	Not given.	OPUS: The impact of the project on accessibility and safety, and more broadly environmental, social and economic wellbeing were hard to judge based on the results of the full evaluation (Parker, 2007).	OPUS: findings of the evaln show little evidence of even immediate outcomes (based on public perceptions of improvement) being significant with the overwhelming majority of people surveyed observing no change in speed of motor vehicles or improvements to pedestrian and cyclist safety.	Not reported.	Not reported.	Not reported.	

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Physical activity outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Opus International Consultants (2008) Neighbourhood Accessibility Planning Case Study Research. Report prepared for Land Transport NZ. - Greerton, Tauranga	Objectives: Improve safety of road users; Increase road safety awareness and ownership in the wider community; Reduce school-related car journeys; Increase the level of health and fitness; Increase pupil independence and road sense.	Greerton Village, Tauranga	Improved routes in and around Greerton; improved ped crossings; 2 primary school travel plans; walking school buses; education campaigns - begun in 2004 (date of reporting 2008).	Not given.	Walking to school.	Use of drop off zones had reduced chaos at the school gate; walking school buses established (no participation rates).				

Mixed priority routes

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008d) MPR. Cowley Road Oxfordshire CC	MPR pilot	Cowley Road, Oxfordshire, UK. 1km stretch of road AADT 10000 vehicles; 3000+ cyclists	Three 'special areas' extending between 75 and 150m where the carriageway was raised to footway level and the width of the running carriageway was reduced to 6.5m to act as a 'shared space'; 20mph speed limit in the core shopping area; minimum use of carriageway markings in this length; kerb buildouts at junctions; establishing formal parking and loading provision; additional cycle parking and seating; three additional zebra crossings; additional raised crossings at side road junctions; repaving of footway and planting of additional trees; and relocation of some of the bus stops.	Uncontrolled before and after study - 12 months follow up - counts - ped & cyc carried out at same locations; 12 hours; unclear on day & time of year; crash analysis; vehicle speed monitoring.	Ped and cycle counts combined; vehicle flows; crash /casualties; vehicle speed.	24% increase in cycle flows; 11% fall in car/taxi numbers. The total number of vehicles using the route has not changed from the before monitoring exercise, 'indicating a modal shift on this route.' (p15).		No serious or fatal casualties in 12 months after completion (compared to 11 serious and 2 fatal in 3 years before); 55% reduction in cyclist casualties; 18% reduction in pedestrian casualties; in 34 months of data following implementation: overal accident freq reduced by 36%.	Average speeds 1.7mph lower, 85th percentile speeds 2.1mph lower.	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008g) MPR. Norwich. Final report.	MPR pilot	Prince of Wales road, Norwich, UK (0.5km long)	Puffin Xings; uncontrolled pedestrian Xing places; removal of ped guard rails and use of a line of kerb with an up stand to act; removal of central reservation; widening of footways; reduction in on-street parking and restriction of parking; saxon paving; variable message and static carpark signing; traffic signal poles to be painted black; street lighting to incorporate facility for hanging banners and baskets; pub. area improvements w. introduction of trees, street furniture, public toilets, bollards & bins.	Uncontrolled before and after study; opinion surveys on various aspects of intervention were undertaken.; ped & cyc counts - good method (same month; locations; video) - 3 years follow up.	Ped and cyclist movements; veh speeds; bus movements; parking; turning movements - May 2002 & May 2005.	Pedestrian footfalls increased between 1-35% across different zones within the intervention. Pedestrian crossing movements provided. Cycle movement data were inconclusive.		12-18 casualties per year 2000/01-2002/03; 3-5 in 2004/05-06/07; perceptions: people thought it was safer 4 months after to do various things (e.g. cycle; walking in day or eve; crossing; etc), than they had in 'before' survey.	Average speeds reduced from 23 to 18mph in the left hand lane, and from 22 to 15mph in the right hand lane.	Measure-ments regarding pedest-rian crossing move-ments were found to have been poorly collected and so the figures were dis-counted.
Department for Transport UK (2008f) Leamington Spa. MPR Final Report.	MPR pilot	Parade and Victoria Terrace, Leamington Spa, Warwick District, UK. 0.8km length of road - at baseline: 700+ cyclist movements; 8500-17000vpd (depending where measured); ped: 14-60,000 per week (dep. Where meas)	20mph speed limit; removal of islands with ancillary lighting; carriageway reduction to two running lanes and reallocation to other road uses; pedestrian priority fields with raised tables between junctions and additional footway space at the signal controlled junctions; bus gate and bus priority measures; removal of on-street parking and reallocation elsewhere; improvements to street lighting; cycle lanes; removal of unnecessary clutter; urban traffic management control; measures on some adjacent roads to assist traffic circulation' and measures to reduce a cluster of casualties.	Uncontrolled before and after study - 7 months following phase 1 of construction.; annual ped counts using good methodology; Monitoring after phase 2 consists of 3 years ending october 2009, yet to be published	Ped counts; casualties and crashes; vehicle speeds.	Opinon surveys were carried out covering different aspects of the intervention. Pedestrian footfall measurements showed a 2.2% increase overall; after having declined for previous 5 years.		Casualties were halved and accidents even further reduced. However, limited data were available.	Average speeds were reduced by 5-19% to under 20mph across the project area. 85th percentile reduced from 22-26mph to 19-23mph; some traffic reduction.	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008b) Lambeth. MPR Final report.	MPR pilot	Wandsworth road, Lambeth, London, United Kingdom. 1.5km. Interviews carried out with businesses, n=90, and residents, n=260	Increased # ped Xg with a mixture of formal Xgs and wide refuges; all formal ped Xgs with Puffin technology; ped Xgs to be on raised tables suitable for buses; realloc. of carriageway space to ped, cycles and buses; bus lay-bys removed and facilities for low floor buses introduced; repaving existing footways; new footways; new traffic signal control; advanced stop lines for cyclists; side road entry treatment across minor roads; tree planting; and new street lighting.	Uncontrolled before and after study - length of follow up varied.	Not explained.	Opinion surveys were taken on various aspects of the street before or after the intervent. However questions were different and background changes had taken place, so no direct comparisions can be made on any relevant topics. Overall it was considered that the scheme had been beneficial.		There is no concrete data relating to road use.	No data.	
Department for Transport UK (2008e) MPR Newland Avenue, Kingston-upon-Hull CC	MPR pilot	Newland Avenue, Kingston-Upon-Hull, United Kingdom. 0.9km stretch of road.	Existing pelican crossings replaced by a combination of zebras and informal marked crossings on raised tables to meet desire lines; a 'median strip' in the centre of the carrieageway; raised bus boarding areas; gateway feature; echelon parking to maximise number of spaces; relocation of loading bays; speed cusions; 20mph zone; creation of an 'urban square'; seating and planters along the whole scheme; and bollard to prevent vehicle encroachment onto areas of widened footway.	Uncontrolled before and after study - 12 months follow up - PT patronage; ped counts (16 hour footfall counts - no details given) and cycle counts (annual 12 hour cordon count); casualties; vehicle speeds.	Ped and cycle counts; PT use; injury accidents; vehicle speeds.	Overall trend towards increased patronage of public transport. 20% increase in pedestrian footfall along eastern and western footways. 48% increase in cycle traffic (to 870 cycles per day).		Low initial accident rate means 12 months after-data is not reliable for detailed analysis: 24% reduction in all injury accidents; 100% reduction in pedistrian casualties; and 21% reduction in cyclist casualties.	Overall reduction in average traffic speeds, and reduction in highest recorded speeds, eg 15 of 21 measurements gave speed above 20mph, highest = 27mph; after: only 2 of 21 recorded avg speeds above 20mph, highest = 21.5.	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008c) Final report. Mixed priority routes A534 Nantwich Rd, Crewe.	MPR pilot	Nantwich road, Crewe, Cheshire, United Kingdom. Mixed priority section 0.92km in length.	Upgrading traffic signals; provision for pedestrians at all signal-controlled junctions and side roads; new puffin crossings; 20mph speed limit with speed humps, reinforced with changes in the carriageway; a system of one-way streets in side roads to reduce conflict points; revised signing strategy; improved street lighting; cycle facilities at all junctions and cycle lanes; emergency service priority through the urban traffic control system; new footways; a new parking bay; raised side road entry treatment to provide crossing points for pedestrians; and quality partnership bus stops.	Uncontrolled before and after study - 25 months follow up; counts (ped and cyclist - 12 hours, same day of week, ped same month (cyclist - time not clear); parking use; journey times; casualties; vehicle speed.	Ped and cyclist movements; veh speeds; bus movements; parking; turning movements; traffic volume; journey times.	Pedestrian - inconclusive due to confounding factors (eg college closed; new supermarket opened; etc) and errors in data collection; cycling - declined (reflects decrease nationally?); reduction in veh by 8-10% (originally about 7400 per day).		12.8 casualties per year in 4 years prior; 9.6 per year in 25 months after; 35% reduction in casualties.	5-7% reduction in mean veh & the 85th percentile speeds hence, 85th are now under the 30mph limit, and means speeds are now less that 4mph above the 20mph limit that applies on the scheme section of Nantwich Road.	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008k) MPR Demo Project. A6100 Wilmslow Road, Rusholme, Manchester	MPR pilot	1.2km in length	Reduction of 4-lane carriageway to a single running lane; widened footways with parking bays in places, wide refuges and central islands; clearly identified pedestrian crossing facilities at regular intervals; environmental improvements including gateway features, new quality footway paving, etc; replacement of the fragmented peak hour cycle lanes with full time continuous lanes; flow metering (via bus lanes leading to bus gates on the approaches either end) and the introduction of SCOOT; bus priority measures; new access kerbing and bus stop environments; and rationalised parking and loading arrangements.	Uncontrolled before and after study - ped counts (same timeframe and days of week; 7am to midnight); cyc counts - same, except 7.30am to 10pm.		Footfall surveys on Tues & Sat before and after at 4 sites: Tues 22% incr across 4 sites; Sat - 2 sites incr & 2 decr - 5% incr overall; cycling monitored on Tues and Sat before and after, on Tues 2.5 times number of cyclists (from 2.1% to 6.7% of vehicle traffic volume); on Sat a decline.		3 years before: 53.3 casualties per year; after 37.8 per year for almost 3 years; reduction of 29%.	Average and 85th reduced in both directions (though generally not by much, as avg speeds already under 20mph; and 85th % was under 27).	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008h) MPR Demo Project. Renshaw Street/Berry Street, Liverpool CC	MPR pilot	800 metres	Widening of footways; speed cushions; on-street parking and loading provided in formal bays; Adelphi Interchange re-design with new alignments and restricted turning movts from Brownlow Hill; 'median strip' along the full length of Berry Street; bus infrastr. improvements - wider footways, new bus stops level bus entry kerbs and creation of a bus clearway w. coloured surfacing; access control system to Wood Street; provision of open spaces.	Uncontrolled before and after study - no monitoring of ped footfall, only crossings; cycle counts (consistent location, method, timeframe).		Significant increase in use of formal crossings; very minimal cycle use before or after.		In 24 months after: 58% reduction in all casualties (3 years prior: avg 50; 24 months after: 26) - ped casualties down 69%.	Speed reduction (average and 85th %ile) down 2-3mph - recorded on 6 occasions before and after in different locations.	
Department for Transport UK (2008j) MPR. Scheme Report. Walworth Rd, London Borough of Southwark	MPR pilot - included commun-ity street audit	Walworth Road, Southwark, London, UK. 1.2km stretch of road.; 20000 vpd; up to 80 buses per hour.	Raised signalised crossings; significant footway widening and removal of existing guardrail; block paving of section of carriageway with no carriageway markings and raised crossing across the two side road junctions; loading bays provided in lay-bys as part of widened footway but using granite setts to differentiate; amended signal phasing to reduce pedestrian waiting times; re-alignment of service/access road entr. w. new road markings; combined signal/lighting columns; cycle stands throughout the route & limited car parking; advance cycle stop lines at most signalised junctions; tree planting and street furniture on the majority of the route.	Uncontrolled before and after study; follow up in progress - completed in Jan 2008 - at time of report. only 6 months of accident data available.	N/A; casualties; vehicle speeds	No data.		In 3 years prior: accident rate per year of 73 (6 serious) - in first 6 months following: 46% reduction in slight; no change in serious; overall casualty reduction of 42.5%.	No data.	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures)	Short-term findings (<1 year)	Long-term findings (> 1year)	Accident/crash (safety) impact	Speed of vehicles impact	Confoun ders/ potential sources of bias
Department for Transport UK (2008i) MPR. St Peters Street, Hertford-shire CC	MPR pilot	St Peter's Street and Chequer Street, Hertfordshire, UK. 0.53km stretch of road.	Footways widened, extended and repaved; signalised Xings along route raised flush with footway, plus diagonal pedestrian movts provided at one puffin Xing; establishment of 20mph zone; shared use of surfacing flush with footways on portion of road; no on street parking provision; bus-stop lay-bys; installation of a tourist bus stop.	Uncontrolled before and after study - 12 months.	N/A; casualties; vehicle speeds	Yet to be published.		50% reduction in all injury accidents in 12 months following completion - in 3 years prior, annual average of 16 slight/serious injury accidents - 8 in 12 months after.	1.7mph reduction in average speed.	
Geoplan Urban & Traffic Planning, Christopher Stapleton Consulting and Westerman Consultants Pty Ltd (1998) Review of the Sharing the Main Street Program. Prepared for the NSW Roads and Traffic Authority. NSW: Roads and Traffic Authority.	10 case studies in Sydney region (mixture of those within city and semi-urban)	About 50 shoppers and 50 businesses surveyed in each case study, also stakeholder interviews and interviews with council involved in street upgrade - method well explained and reported on.	Most treatments were 1-2 blocks, with up to 4 blocks involved. Particular focus on pedestrian environment (including footpaths, landscaping and crossings) and measures to slow vehicle traffic (although in most cases not to alter traffic volume). Parking treatments commonly implemented and in some cases cycle lanes and/or bus facilities were installed.	In some cases before (and in fewer instances, after) data was collected on some/all of pedestrian use/behav-iour; accidents, traffic flow, etc but not reported in the evaluation.	Perceptions of the environment - better or worse compared with before treatment (condition of footpaths; speed of traffic; conditions for cyclists).	In 6 cases, 60-70% of businesses survey'd stated implement. of scheme had positive impact on their business; in 2 more it was between 40-50% - only 2 cases had less than 20% saying business had been positively impacted. Effect on real estate values (generally, no change) provided by anecdote only. Shoppers survey asked how traveled to location NOW, but not before. Comparative freq of shopping trips noted for repeat visitors (largely no change, with those stating more visits often offset by some saying fewer visits).		2 case studies had data to prove accident reduction; 5 cases thought there were reduced accidents but no monitoring was undertaken.	Albury - avg vehicle speeds reduced from 40-45km/h to 23km/h; volumes declined from 12000vpd to 7000. - The Entrance: reduced vehicle speed (to 10km/h) and reduced volume. Yass had reduced traffic volume. 5 other cases said they had reduced vehicle speeds (no supporting data).	

Home zones

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Methodology - description	Outcome variables (including measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Appleyard, B (2006) At home in the zone: creating livable streets in the US. *Logistics management & distribution report 72*, no. 9: 30-35	History & benefits of HZ (woonerf) in Netherlands - basically an advocacy and some 'how to' tips.	Home zones should ideally be on streets that do not carry much traffic—about 100 vehicles during the afternoon peak hour when the likelihood is highest for conflict between vehicles and people, including children playing in the street.	The home zone streets should also be relatively short. The British suggest that the home zone street network should have a quarter-mile radius, the standard distance most pedestrians are willing to walk - aim w/b to have cars travel at 5-10mph; but accept may have to be higher initially.	n/a	n/a	n/a	n/a	n/a	n/a	
Department for Transport (2005) Home zones: challenging the future of our streets.	Intended to provide design guidance for delivering HZ	August 1999 first 9 pilot home zones in UK and Wales, followed shortly by another 4 in Scotland.	In addition to adapting the existing streets, greater awareness of the wider range of issues facing communities resulted in substantial modification of schemes. Many schemes expanded their original remit to include demolition, rebuilding and new facilities.	Mixed - counts; surveys; vehicle speeds - Data from after surveys is limited. There is no mention/evidence on cycling and walking in report.	Significant reductions in traffic flow. Both Manchester City Council and the London Borough of Camden have reported around 60% reductions in traffic flow within the treated areas.	39 of the 61 schemes have reported on the immediate effect of HZ on traffic, eg Morice Town in Plymouth - HZ has generated a new feeling of community and is improving the quality of life, making local journeys safer and contributing to the well being of the local population.	HZ development is considered to have improved sense of cmty; regenerated neighbourhoods; reduced crime; some suggestion more children playing in street; indications of house values increasing.	So far none of the schemes have reported any accidents following completion.	Over half estimate that speeds have reduced to between 10 and 15mph. The lowest mean speed of 6mph has been reported at the scheme in Southampton, with both the Kirklees and Wirral schemes achieving speeds below 10mph.	

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (including measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confound-ers/ potential sources of bias
Jones P and R Childs (1999) Home zones - a step towards Europe. Proceedings of the ETC 1999.	This was a pre-cursor to home zones pilot.	UK - Castle Vale Estate, the centre 8 development. Completed in 1998.	In conjunction with demolition of 8 blocks of high rise buildings and replacement with low rise buildings, re-did 'roadways' - installed gateways; 'tortuous' vehicle tracks (no wider than 6m); varied surfacing to encourage shared space.	Following year of completion - 1999 - face-to-face interviews/questionnaires. - 74 completed = 48% of the hh in new dwellings.	Concentrates on perceptions of personal and children's safety, speed of vehicles and car parking on shared spaces.	No evidence	No evidence	Most liked shared space, but many did not. Residents wish to see footpaths and kerbs introd; do not feel safe sharing the street with cars; and wish speeds to be reduced through more intensive TC.	No evidence	
Kennedy, JV (2005) Psycho-logical traffic calming. Proceedings of the Road Safety Congress, 2005.	Impact of psychological traffic calming (HZ and/or shared space) - without chicaynes or speed humps or one way working - reliance on other visual cues.	1 trial site implemented (Latton, Wiltshire).	In addition to gateways with speed limit signs (new limit of 30mph), visual and physical road narrowing along whole 800m - build outs. Limiting of forward visibility/ breaking up of sightlines to incr. driver awareness/ cognitive load. Removal of white line in conjunct. with physical narrowing at park. bays, to create uncertainty; new bus bay.	Jan 2003 and Nov 2004. Speed data collected 7 days before and after at two locations in centre of village - casualties/ accidents; vehicle counts.	Speed reduction; traffic flow; accidents.	Two way traffic flows in 'after' survey were 2200 per day (16% higher) than in 'before' survey (in line with growth in area).	n/a	No accidents in 3 years before, none in 1 year after.	Inbound mean speeds fell by 8mph/4mph at N/S gateways to 37mph at both. Sim. decr. in 85th %ile speeds to about 45mph. In the village, two-way mean speeds fell by 7-8mph to 31mph; 85th %ile speeds fell by 8-10mph to 37-38mph. Although within village >50% vehicles still exc. 30mph speed limit during the 'after' survey, the % exc. 40mph fell from 50% to around 10%.	

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (including measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confound-ers/ potential sources of bias
Layfield R, L Chinn and D Nicholls (2003) Pilot home zone schemes: evaluation of The Methleys, Leeds. Transport Research Laboratory, UK.	To assess the effectiveness of pilot home zone schemes - this is the detailed report of what was summarised in pilot report.	Community members, Methleys, Leeds, UK. Adults; Before n=97 After n=99 Children; Before n=8 After n=17 (+4 adults who had previously been interviewed as children). □	This included a shared surface made up of 4 main elements; buff paved areas, plant beds, coloured concrete block work and sections of tarmacadam, and traffic calming measures, such as road narrowing, chicanes and 20 mph zones.	Before and after study - length of follow up - 2 months - survey.	Cycling and walking levels, activities in the street.	Walking trips; 94% of adults felt there had been no change. 73% felt walking was more pleasant. Cycling: adults cycle use was very low in both the before and after surveys. Of the eleven children who owned bicycles, three (27%) said they rode them more often than they did before the home zone was implemented.	Short term: Objective measures suggested that the noise levels had reduced, although about 2/3s of the people surveyed thought that traffic noise and traffic pollution in the street hadn't changed. Most thought the friendliness of the street' had not changed. Children reported being able to spend time outdoors more safely. Almost all respondents thought the streets 'more attractive'.			Possible selection bias. Possible recall bias. Possible measure-ment bias. Confound-ers not reported.

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (including measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confound-ers/ potential sources of bias
Centre for Transport & Society (2006) Southville home zone: an independent evaluation. Final report prepared for Bristol City Council. University of West England, Bristol.	To rebalance the priorities of residential streets away from motor traffic in favour of 'streets as living spaces'.	One entire street, and sections of two other streets. Surveys distributed to 170 households, individual interviews, inspection and evaluation, information observation and opportunities to comment by post or email offered by letter to a further 230 households in the streets surrounding the HZ.	Construction of large planters, buildouts, and traffic islands, road narrowing, parking facilities, widening of pavements.	Independent evaluation. Household question-naire surveys. - Before 2003, after 2006 to both HZ and near-by HZ streets.	Response rates 'high', 34 (out of 52) in HZ streets and 70 (out of 128) in nearby streets, while around 20% of HHs in the wider area submitted comments - all qualitative, no measures of traffic counts; speeds; travel diaries; etc. other than at 'focal point' by school.	HZ street respondents felt strong that cycling and walking now safer and some reported using cycles and walking more. Cycle ownership somewhat higher in HZ areas.		No evidence	Speed reduced (20mph with the hope that people would travel at an average of 10mph), and reduction in vehicle ownership in Bristol.	

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (including measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confound-ers/ potential sources of bias
Webster D, A Tilley, A Wheeler, S Nichols and S Buttress (2006) Pilot home zone schemes: summary of the schemes. *TRL report 654*.	Evaluate the effect of home zones.	Residents in 7 locations - Ealing (London; Leeds, Manchester, Magor village; Nottingham; Peterborough; Plymouth, Sittingbourne (kent); Lambeth (London). Locations are varying sizes: some have fewer than 100 dwellings; two had about 400 and another 600 plus 3 old people's homes; some have a total of less than 0.5km of road, another has >2km. Mean # after survey respondents, n=74 (in each location).	Changes to the street though gateway entrances, 20mph zones, echelon parking, use of road humps and chicanes, shared road surfaces, tree and shrub planting.	Uncontrolled before and after (-) - before surveys in 2000 and after between 2002 and 2004 - not done in Lambeth and Peterborough as work not completed.	Self assessment of mode use; walking, cycling, children's play.	n/a	Little evidence of changes in w/c. Slight increase in the time spent playing outside the home (and adult activities such as chatting, gardening, and watching children.) Driving: Perception that motorists had changed the way they drove; safer for children w/c. amount of driving unchanged/ possibly increased.	Not really an issue in the 7 areas.	Traffic flow and speed measured during school term time over 3 weeks at var locations - same locations before and after where possible - avg flow reduction of 25% in all schemes, bar one. Ideally flows should reduce to max 100vph (two-way traffic) - 4 HZ were over this on the 'main' road. overall mean speed reduced by 5mph from 19.2 to 14.5mph; 85th reduced by 6mph from 24.4 to 18.4. % of people exceeding 20mph reduced from 42 to 12%.	Poorly reported methods

Road diet

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Cairns S, C Hass-Klau and P Goodwin (1998a) Traffic impact of highway capacity reductions: assessment of the evidence - Luneburg. London: Landor Publishing.	To assess the effects of an environment-ally friendly transport policy in Luneburg, Germany - closing or restricting access of town centre roads; lrg scale pedz'n; cycle network; improve PT.	Residents and road users of Luneburg, Germany. Number not stated.	Environmentally friendly transport policy in Luneburg Germany.	Before and after (-) - baseline 1991; intervention May 1993; follow-up May 1994 - counts.	Pedestrian/ cyclist counts	Changes in traffic flows on ring road and major roads included a 58.7% increase for cyclists and a 48.3% for pedestrians between 1991 and 1994.	n/a			Poorly reported methods.
Cairns S, C Hass-Klau and P Goodwin (1998b) Traffic impact of highway capacity reductions: assessment of the evidence - Orpington. London: Landor Publishing.	To assess the impact of a road closure (with exemptions) of a section or Orpington High Street.	Local residents, shoppers, through traffic in Orpington, Kent. Number not stated.	Closing a road (with exemptions) to motor traffic in Orpington High Street, England.	Uncontrolled before and after (-) - follow up after one year - counts.	Pedestrian counts.	Average increase of 19% in pedestrian flows measured at a central point on Orpington High Street.	n/a			Poorly reported methods.

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Transport Canada (2005) St George Street Revitalisation: 'Road diets' in Toronto. Case studies in sustainable transportation, case study 30. TP 14415 E. Accessed March 2010 from: www.tc.gc.ca/utsp	Uncontrolled before and after.	1.8km; 14m wide & 4 lanes - carried 7300vph in peak; 16000vpd; 2 bike lanes.	Road narrowed to 9.5 and 12.2m; road lanes decreased to 2; footpaths widened from 1.5-2m to 2.5-5+m; 2 bike lanes extended; more crossings installed.	1993 compared with 2003.	Traffic volume in 2003 virtually the same (7400 in peak;16000 vpd); cycle volumes incr by 10% from 1500 to 1600 (4 other streets monitored before & after narrowing road & adding bike lanes - average increase of 23% bicycles & no increase in traffic vols).			1991-97 - 24 vehicle crashes; 1998-2003 - 16 collisions (reduced 40%).	Speeding reduced (because no room for overtaking and for Xgs).	
Highway Safety Information System (2010) Evaluation of lane reduction 'road diet' measures on crashes. Summary report.	Evaluated road diets at several locations in CA and WASH using FHWA's Hwy safety Info Sys data - at least 1 year data each for before and after periods.	Treatment (road diet) and comparison group selected, before and after time periods - comparison sites = 4-lane roads near RCR roads - similar structure; speed limit; access; intersection spacing.-	12 RCR sites and 25 comparison in final set - length of road ranged from 0.13 - 4.09km for RCR; 02.1-4.88km for comparison roads.	1+ year after.	Crash freq; rate; severity; types.	ADT impacts ltd (appeared to be little diversionary effects on RCR).		Freq on RCR: 6% lower than comparison sites (sig); no significant change in crash rates or severity or type.	n/a	

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Burden, D and P Lagerwey (1999) Road diets - losing width and gaining respect. Walkable Communities, Inc.	Advocacy type paper.		Conversion from 4- to 3-lanes - road characteristics: moderate volumes (8-15,000 ADT); roads with safety issues; transit corridors; pop. or essential bicycle routes/links; comm. reinvestment areas; economic enterprise zones; historic streets; scenic roads; entertainment districts; main streets.	None specified.	Reports on ADT - in most cases, no decline (some growth, but this could be 'natural') despite reducing available lanes.	None reported.		Not mentioned.	Indicates that speeds are reduced eg Lewiston, Penn; 5 roads in Toronto (see separate paper).	
Macbeth AG (1999) Bicycle lanes in Toronto. *ITE Journal, April*: 38-46,	What was required to increase cycling, reduce motor vehicles and improve cycling safety.	Toronto. 6 cycle lanes installed and surveyed between 1993-1996.	Road narrowing, commonly from 4 lanes to 2 mid-block/3 intersection lanes to allow for cycle lanes - 46km added to existing lanes in central city (10km by 5km). In some cases, reduced car parks and replace with cycle lanes. Each road treated individually, in some cases, extensive landscaping, planting of trees to enhance TC. Traffic speed limits reduced to 40km/h for those streets.	Two year before and after survey - follow up 2 years after cycle lane installation.	Volume of cyclists and volume of vehicles.		On the 6 routes recorded the average increase in cycle traffic recorded was 24% (range 4%-42%), although cycling traffic overall in Toronto declined by about 4%. Vehicle traffic volume remained constant.	Not mentioned.	Not mentioned.	Survey/ count method-ology not given.

Appendix A: International and New Zealand experience with slow zone treatments

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Goodwin, P, C Hass-Klau and S Cairns (1998) Evidence on the effects of road capacity reduction on traffic levels.	Collected evidence of impact on traffic volumes on 60 different locations which faced temporary (eg as a result of an incident or maintenance) or permanent capacity reduction.	60 locations around the world.	Lots of explanation about different potential outcomes and where any traffic reduction may be diverted to - traffic does disappear in response to reductions in capacity, but only to the extent it needs to.	Varied	Traffic volume	Traffic will reduce if reduction in road capacity is not offset by spare capacity elsewhere or at some other time, and other actions, such as changes in traffic mgmt or motorists' driving style, do not permit the original number of vehicles to fit into the remaining space.	50% of locations showed overall reduction in flow of >16% on the roads affected.			
European Commission (2004) Reclaiming city streets for people - chaos or quality of life?	Best practice' guidelines for reducing road capacity for vehicles (through street closures).	Several case studies of varying quality are provided.	Kajaani, Finland; Wolverhampton, England; Vauxhall Cross, London, England; Nuremberg, Germany; Strasbourg, France; Gent, Belgium; Cambridge and Oxford, England.	Varies	Mostly about traffic flows and its 'evaporation'.	Generally not reported: Strasbourg reported growth in cycle path use (provides access to city centre) and mode share between car & PT has shifted to favour PT; 2 or 3 others reported modest increases in PT use (<5% in 2 cases; 8-9% in another).	Vehicle traffic on closed street disappeared.		Not relevant.	Counts only done on one or two days and subject to usual variability issues. Traffic on other streets not always well monitored.

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Gemzoe, L (2001) Copenhagen on foot: thirty years of planning and development. *World Transport Policy and Practice 7*, no.4: 19-27. (NICE PH8 evidence review)	To chart the increasing use of public space by pedestrians in Copenhagen which have been recorded in a series of surveys of the inner city since the 1960s.	General population of Copenhagen, Denmark. Number not stated.	Increasing the use of public space by pedestrians in Copenhagen.	Uncontrolled before and after - series of pedestrian counts undertaken between 1968 and 1995.	Pedestrian counts.	n/a	Increases in pedestrian activity between 1968 and 1995 three to four fold. Number of people walking through the streets fairly constant after initial doubling when the first street was opened (ie closed to vehicles) in 1962. Vehicle traffic reduced.			Poorly reported methods - possible measure-ment, and recall bias, no data presented on possible confound-ers.
A site with several examples: http://www.preservenet.com/freeways/index.html	Removing freeways and reclaiming env for cities - esp near waterfronts or where rivers have been 'covered' or diverted.	Examples: Embarcadero Freeway, San Fran; Harbor Drive, Portland; Cheonggyecheon Freeway, Seoul.	Usually have good PT in place; apparently don't do (that I've seen) before and after studies of traffic flows; w/c; or PT use.							

Author and date	Study design and research type/ quality	Study population: setting; country; sample size	Description of intervention	Method-ology - description	Outcome variables (inc measures) - what are they using to measure success?	Mode use - short-term findings (<1 year)	Mode use - long-term findings (> 1 year)	Accident/ crash (safety) impact	Speed of vehicles impact	Confounders/ potential sources of bias
Skjoeveland, O (2001) Effects of street parks on social interactions among neighbors: a place perspective. *Journal of Architectural and Planning Research 8*, no.2: 131-47.	Investigated the influences of residential street layout on presence in parks and measures relating to 'neighbour-ing'.	Community members using street parks, Bergen, Norway.; pretest n=23; post test n=33.	The intervention samples each ranged from 50-80m and involved the conversion of several streets into street parks where driving and parking were prohibited and buildings were demolished or improved to increased openness, improved naturalness and aesthetics, trees were planted, upkeep was raised, and street furniture was introduced.	Controlled before and after - 3 years follow up.	Presence of people in the street parks; observation.	None reported.	Increase in the presence of children in one of the intervention streets and decrease or no change in control street parks ($p<0.05$). Presence of adults showed decrease in both intervention and control streets ($p<0.01$). Supportive acts of 'neighbouring' and 'neighbour annoyance' both increased in the intervention streets.			Possible selection bias. Poorly reported methods.

Excluded studies

Study reference	Reason for exclusion
Barrell, JM and M Groll (2005) Home zones - meeting the challenge. Paper for the ETC 2005.	Descriptive discussion of UK experience.
Biddulph, M (Dec 2001) Planning and designing 'home zones'. Article in Findings, for Joseph Rowntree Foundation (www.jrf.org.uk).	Descriptive
CABE - Briefing. Published in 2008 by the Commission for Architecture and the Built Environment.	A brief designed to stimulate the debate on new street design - no evidence or outcomes.
Carver A, A Timperio and D Crawford (2008) Perceptions of neighborhood safety and physical activity among youth: the CLAN study. *Journal of Physical Activity and Health 5*: 430-444.	Examined associations between perceptions of neighbourhood safety and physical activity among youth. PA measured through use of accelerometers.
Complete streets - all material gathered (includes material on Bendigo and Auckland) is descriptive: outlining intervention.	No evidence (one article cited in 'possible case studies').
Department for Transport (2004) Encouraging walking and cycling: success stories, London: Department for Transport.	Insufficient data.
Department for Transport (2001a) Home zones - planning and design. Traffic advisory leaflet 10/01 December 2001.	No evidence.
Department for Transport (2007) Inventory of 20mph zones in Surrey. Updated August 2007.	Inventory, accompanied by review of three studies.
Department for Transport (2008) Mixed priority routes. Road safety demonstration project. Summary schemes report.	See individual reports.
Department for Transport (2006) The quiet lanes & home zones (England) regulations 2006. DFT Circular 02/2006.	Copy of regulations.
Duncan R (2008) Uplifting the CBD of a regional city. *The Quarterly Journal of Economic Development Australia 2*, no.3: 15–18.	
Falkirk Council - Development Services Roads and Development Unit (May 2009) Assessment of traffic calming on public roads within Falkirk Council. Draft report. Available from www.falkirk.gov.uk	No evidence - about process to select streets for application of TC.
Fildes, B and S Lee (Sept 1993) The speed review: road environment, behaviour, speed limits, enforcement and crashes. (Monash University) Paper for Roads and Traffic Authority NSW.	Reviewed in another paper I have.

Gill, T (2005) The home zone movement in the UK: history, progress and prospects. Childstreet 2005.	Data is drawn from TRL evaluations already summarised here.
Gill, T (2006) Home zones in the UK: history, policy and impact on children and youth. *Children, Youth and Environments 16*, no.1: 90–103.	Insufficient data.
Hargreaves, AJ (1996) Public preferences for traffic calming: an investigation using multi-criteria procedures. Proceedings of European Transport Conference. Available from etcproceedings.org/	Not relevant - purely about residents preferences for specifc TC treatments.
Independent Social Research (October 2009) Impacts of better use transport intervention: Review of the evaluation evidence base. Final report. Prepared for the Department for Transport, UK.	Review of wide range of interventions; insufficient detail provided. Have original documents in most cases.
Jones, P et al (2001) A Tale of two home zones. Proceedings of ETC 2001.	No evidence - describes development process for Morice & Clark Street HZ projects.
Kane, L and R Behrens (2000) The traffic impacts of road capacity change: a review of recent evidence and policy debates. Proceedings from South African Transport Conference, South Africa, 17-20 July 2000.	About induced and suppressed road traffic (incl. temporary road closures - no w/c; no detail).
Knapp, KK and JA Rosales (2007) Four-lane to three-lane conversions: an update and a case study. Proceedings of the 3rd Urban Street Symposium, June 24-27, 2007 Seattle, Washington.	Evidence from handbook discussed - unclear about purpose of paper.
Layfield, R and D Webster (1998) Urban traffic calming measures - design, effectiveness, public attitudes and environmental issues. Proceedings of European Transport Conference. Available from etcproceedings.org/ Pp.179–194.	Reports on the effect of specific TC measures on driver behaviour, passenger discomfort, traffic flows and accidents; public reaction to TC measures; vehicle generated noise, ground-borne vibration and vehicle exhaust emissions. - See LATM tables.
Los Altos Bicycle Transportation Plan Update (Plan) is based on the original plan adopted by the Los Altos City Council in April, 2002	No evidence - about the plan, rather than outcomes.
MacBeth, AG (2008) Mainstreaming active modes on urban and rural roads. . Presentation to NZ Transport Agency / NZIHT Conference Napier, Monday 13 October 2008.	Essentially 'how to' accommodate w/c into road network .
McCann, B (2005) Complete the streets. American Planning Association	No evidence (other than what actions some states are taking and to say cycling has grown in Oregon where a lot of cycle lanes were built).
MVA Consultancy (November 2009) DFT shared space project – stage 1: appraisal of shared space. Report for the UK Department for Transport. Accessed July 2010 from www.dft.gov.uk/pgr/sustainable/sharedspace/	Evidence from HZ; MPR and other studies already reported.

Owen N, N Humpel, E Leslie, A Bauman and JF Sallis (2004) Understanding environmental influences on walking; Review and research agenda, Am. J. Prev Med 27, no.1: 67-76	Review of physical activity and environmental attributes.
Pheby, T (1997) 'Killing speeds - saves lives' - the outcome of consulting on York's speed management plan. Proceedings of European Transport Conference. Available from etcproceedings.org/	No evidence - are from consultation process, asking what methods of speed reduction residents would prefer.
Potts, I, D Harwood and K Richard (2007) Relationship of lane width to safety for urban and suburban arterials. TRB 2007 Annual Meeting.	Cross-sectional safety analysis approach using data on lane width, traffic volume and crashes in Minnesota and Michigan, US. - investigates the relationship between lane width and safety for roadway segments and intersection approaches on urban and suburban arterials. No significant evidence that the use of lanes narrower than 3.6 m (12 ft) on urban and suburban arterials increases crash frequencies.
Project for Public Spaces (1998) Transit-friendly streets: design and traffic management strategies to support livable communities. TCRP Report 33: National Academy Press, Washington DC.	Design and implementation - some case studies, focus on ease of access and improvements to transit reliability.
Rietveld, P and V Daniel (2004) Determinants of bicycle use: do municipal policies matter? Transportation Research Part A 38 (2004) 531–550.	No specific slow zone interventions addressed.
Rosales, JA (2008) Road Diet Handbook. Presentation to Northwest Transportation Conference, February 7, 2008, USA.	Repackaging of material in handbook.
Shared space materials (descriptions of interventions)	No evidence; may be useful for case study/evaluation?
Sharples, R (2009) Reducing road capacity to change travel behaviour. Paper presented at ATRF 2009, Auckland.	Essentially lit review - did mention 1992 closure of Swanston St (see possible case studies, planning on closing all now).
Taylor, D (1995) Public attitudes and consultation in traffic calming schemes. Proceedings of European Transport Conference. Available from etcproceedings.org/	Not relevant - researches relationship between 'success' of TC scheme and satisfaction with consultation process (Feet first campaign).
Transportation Alternatives (1998 & revised) Streets for people: your guide to winner safer and quieter streets. New York.	Advocacy guide – nice photos.
Woodward, B (2009) Reduced traffic speeds - barriers benefits next steps. Presentation to …	(Good photos) – no evidence of impacts.
York, I, A Bradbury, S Reid, T Ewings and R Paradise (2007) The manual for streets – evidence and research. Prepared for Traffic Management Division, Department for	Comprehensive study of street geometric design elements – 20 survey sites selected in UK to obtain primary data to examine

Transport, UK. TRL Report TRL661.	relationship between geometry, the environment, speed and casualties – measured X- and Y-distances at junctions; visibility; road width; manual and automated speed data readings; observations – 190 links and 77 junctions including residents' perceptions survey – low response rate – focus on perceptions of neighbourhood and traffic issues.

Reports on design elements

Layfield, R and D Webster (1998) Urban traffic calming measures - design, effectiveness, public attitudes and environmental issues. Proceedings of European Transport Conference. Available from etcproceedings.org/ Pp. 179–194	Reports on the effect of specific TC measures on driver behaviour, passenger discomfort, traffic flows and accidents; Public reaction to TC measures; vehicle generated noise, ground-borne vibration and vehicle exhaust emissions. See LATM tables.
Potts, I, D Harwood and K Richard (2007) Relationship of lane width to safety for urban and suburban arterials. TRB 2007 Annual Meeting.	Cross-sectional safety analysis approach using data on lane width, traffic volume and crashes in Minnesota and Michigan, United States. 408mi of road was included. This research investigates the relationship between lane width and safety for roadway segments and intersection approaches on urban and suburban arterials. No sig evidence that the use of lanes narrower than 3.6m (12ft) on urban and suburban arterials increases crash frequencies. This finding suggests that geometric design policies should provide substantial flexibility for use of lane widths narrower than 3.6m (12ft). Inconsistent results were found which suggested increased crash frequencies with narrower lanes in three specific design situations.
York, I, A Bradbury, S Reid, T Ewings and R Paradise (2007) The manual for streets - evidence and research. Prepared for Traffic Management Division, Department for Transport, UK. TRL Report TRL661.	Comprehensive study of street geometric design elements - 20 survey sites selected in UK to obtain primary data to examine relationship between geometry, environment, speed and casualties - measured X- and Y-distances at junctions; visibility; road width; manual and automated speed data readings; observations – 190 links and 77 junctions incl residents perceptions survey – low response rate – focus on perceptions of neighbourhood and traffic issues.