Department for Transport

Local Transport Note 2/09

April 2009

Pedestrian Guardrailing

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London: TSO

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This Local Transport Note was researched and prepared by a team led by Transportation Research Group (TRG), University of Southampton, on behalf of the Department for Transport.

ISBN 978 0 11 553065 4

Printed in Great Britain on paper containing at least 75 per cent recycled fibre

Cover photographs
Top left and right: Hertfordshire County Council
Bottom left: English Heritage
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Contents

1. Introduction

1.1 Policy background

1.1.1 The Department for Transport's (DfT) policy of improving street design of local roads was heralded by the *Manual for Streets* (DfT/CLG/WAG, 2007) which aimed to bring about a transformation in the quality of residential streets. In addition, Local Transport Notes (LTNs) on *Traffic Management and Streetscape* (DfT, 2008a) and *Mixed Priority Routes: Practitioners' Guide* (DfT, 2008b) aim to enhance the appearance of the streetscape and extend this transformation to a wider range of roads respectively.

1.1.2 This LTN strengthens the emerging policy development by providing guidance on pedestrian guardrailing, which has been installed more and more over recent years in many roads and streets in our towns and cities.

1.2 Purpose

1.2.1 This LTN provides guidance that local authorities may choose to adopt, including:

- a description of the development of policy guidance on guardrailing;
- an assessment procedure for the evaluation of the need for the installation or removal of pedestrian guardrailing, particularly at pedestrian crossings and road junctions;
- encouragement for authorities to consider developing and using an audit trail, recording decisions and actions taken when considering pedestrian guardrailing schemes.

1.3 Scope

1.3.1 This LTN is suited to the assessment of the need for the installation or removal of guardrailing on the existing road network.

1.3.2 It is suggested that, for new scheme proposals, the same approach may be adopted as far as possible. However, this may entail developing simulation models to determine likely traffic flows, for example. Use of the assessment framework on newly constructed roads may require deriving information from analysis and modelling techniques.

1.3.3 The use of this LTN for existing roads that have been extensively redesigned may similarly require information from modelling or detailed consideration of the scheme and its impacts.

1.3.4 Pedestrian guardrailing is used across a wide range of types of site. These include:

- road junctions;
- pedestrian crossings;
- busy pedestrian streets;
- transport interchange entrances/exits;
- school entrances/exits;
- central reservations; and
- pedestrian refuge islands.

1.3.5 The main purpose of guardrailing is to improve safety by trying to prevent pedestrians from crossing the road at an inappropriate place or from straying into the road inadvertently. Guardrailing can also be used to offer some protection to pedestrians at locations where the swept path of large vehicles, such as buses and heavy goods vehicles, takes the vehicles close to the footway, sometimes overhanging it.

1.3.6 This LTN has been developed from a research study that provided an appreciation of how guardrailing affects the movement and behaviour of pedestrians and vehicles.

1.3.7 The assessment procedure uses a site record and an assessment framework to encourage informed decisions to be made and recorded as to whether guardrailing is necessary.

1.3.8 The assessment procedure is in two parts:

- site record (see Chapter 5):
  - site characteristics, details of pedestrian flows at crossing, vehicular traffic flow information, road collision information;
- assessment framework (see Chapter 6):
  - site assessment (see Section 6.2);
  - effectiveness assessment (see Section 6.3).

1.3.9 The responsibility for the installation of guardrailing rests with the relevant highway or traffic authority. This LTN describes a method for assessing the need for guardrailing.

1.3.10 Decision-makers will already have been taking these methods into account implicitly; the explicit framework means that the grounds for decisions and their consequences can be made clear and visible.

1.3.11 The LTN describes a formal and structured approach that provides a record of the decisions made about installing or removing guardrailing. As the assessment framework is adopted and increasingly used, it is anticipated that the procedure will be of value to local authorities as a tool for making decisions. It will also be a benefit to local communities by improving the streetscape and providing better accessibility whilst maintaining road safety.

1.3.12 This LTN does not represent a study of the current market for different types of guardrailing, nor does it recommend which specific types of guardrailing should be used. It is for local authorities to decide which type of guardrailing is most appropriate for use at each individual location being assessed.

2. Review of policy and key developments

2.1 Policy development

2.1.1 Pedestrian guardrailing was first introduced in the 1930s as a measure to improve pedestrian safety. Early designs comprised horizontal tubes between posts, with no infill. Initial evaluations showed that they had not significantly reduced accident numbers, because they could be climbed through. To address this, the first post-war report on road design *The Design and Layout of Roads in Built-up Areas* (Ministry of War Transport, 1946) stated that guardrails "should be so designed that pedestrians, particularly children, cannot crawl through them". This led to the development of the type of pedestrian guardrailing we know today.

2.1.2 The Report highlighted early concerns even then about the overuse of guardrailing by stating that: "the indiscriminate erection of guardrails or barriers (whether at the edge of the footway or along the central reservation) would give rise to an unpleasant feeling of restraint, and in considering their adoption regard should be had to particular circumstances relating to the character of the street and the type and volume of traffic which it carries".

2.1.3 Since the 1960s, guardrailing has been used for traffic management purposes, e.g. for channelling pedestrians and/or cyclists along particular routes (see Figure 2.1), towards designated crossing points, or splitting pedestrian crossing movements into sections to enable traffic signal control to operate more efficiently. It should be noted that guardrailing is not the only measure available to achieve this purpose (see Section 4.3).

2.1.4 Although generally unsuitable, guardrailing has also been used to deter inappropriate parking, loading/unloading and parking on the footway, particularly where pedestrians may be masked by parked vehicles. Traffic Advisory Leaflet (TAL) 4/93 *Pavement Parking* (DoT, 1993) stated:

"Standard guard rails can be used to prevent pavement parking. Their disadvantage is that they limit where pedestrians can cross a road or where people from parked vehicles can get onto the pavement. They are not generally suitable unless for safety reasons the aim is to channel pedestrians to particular crossing points."

2.1.5 In some schemes, pedestrian guardrailing has been introduced as the single feature in a line along the street. A number of different types of street furniture could be employed in such situations where needed to better accommodate the different expectations of public space and the streetscape. Recent street designs have included guardrailing, bollards, seating and planters together as linear features.

2.1.6 In *Developing a Strategy for Walking* (DETR, 1999) reference is made to people being deterred from walking by inappropriate placement of barriers designed for pedestrian safety. In *Encouraging walking: advice to local authorities* (DETR, 2000), it is noted that "staggered crossings are sometimes necessary", but suggests that problems associated with them may be alleviated through redesign or implementation of other more modern pedestrian crossing technology (e.g. the use of Puffin crossings should help solve the problem of aggressive drivers moving forward during the flashing amber sequence while pedestrians are still on the crossing).

Figure 2.1 Guardrailing in Camden, London, used for channelling pedestrians and cyclists (photo: English Heritage)

2.1.7 The House of Commons Select Committee report on *Walking in Towns and Cities (*Select Committee on Environment, Transport and Regional Affairs, Eleventh Report, 2001) considered that danger reduction through the use of speed management would "allow miles of guardrailings and many staggered, cattle pen crossings to be scrapped. These grotesque items both inconvenience pedestrians and disfigure our cities."

2.1.8 The Government's response to this report (DTLR, 2001a) acknowledged that both danger reduction and collision reduction are desirable, as is a more attractive environment for pedestrians. It suggested that new policy guidance could encourage local authorities to develop a more pedestrian-friendly environment. This might simply entail the replacement of staggered crossings, or "it may need changes much further back in the planning process, for example to reduce traffic speeds and flows at particular locations to levels where guardrails are not required".

2.1.9 This issue was raised again in the House of Commons Select Committee (2002) report into *Road Traffic Speed*, where it suggested that "pedestrian railings, barriers and staggered crossings are designed to maintain traffic flows and restrict pedestrian movement". The Government's response in this case (DfT, 2002a) acknowledged that guardrailing "has been used in this way for many years and has left a legacy that can be inconvenient to pedestrians, and lead to an unattractive and cluttered environment".

2.1.10 In general, it is recommended that the installation of new guardrailing should not be considered if alternative safety measures could be used (see Section 4.3).

2.2 Other developments

2.2.1 In recent years, thinking has also started to change towards a reduction of the dominance of the motor vehicle in inappropriate places. This has often resulted in the use of traffic calming to reduce vehicle speed and complementary measures to improve the street environment and its accessibility, in particular the facilities for pedestrians.

2.2.2 There are increasing calls for the reduction in the use of guardrailing. For example, an objective of the *Mayor of London's Transport Strategy* (Greater London Authority, 2004) was to make London one of the most walking-friendly cities by 2015, placing emphasis on providing good facilities for pedestrians, eliminating street clutter and improving the streetscape. It suggested "programmes of improvements ... to make the street environment more accessible, removing barriers and obstructions that make it difficult or unsafe for pedestrians to use the street". (At the time of publication of this LTN a new Mayor's Transport Strategy was expected.)

2.2.3 Work to improve the streetscape has been carried out at locations such as Kensington High Street, London, where, as part of the overall enhancement of the streetscape, over 700 metres of guardrailing was removed. The scheme has been subject to careful continued monitoring of pedestrian flows, behaviour and collision trends to ensure that safety has not been adversely affected.

2.2.4 Guardrailing was also removed in St Albans as part of the Mixed Priority Routes project (see Figure 2.2) (DfT, 2008b). The wider streetscape can

Figure 2.2 St Albans before and after the removal of guardrailing (photo: Hertfordshire County Council)

Figure 2.3 Structural balustrades in Whitehall, London

Figure 2.4 Use of planters, structures, bollards and pedestrian guardrailing for security purposes and also to deter pavement parking

be readily seen, and this allows the entire street environment to be appreciated as a place rather than as a thoroughfare for vehicles.

2.2.5 Living Streets (formerly the Pedestrians Association) and others advocate reducing the use of guardrailing, as it can take pedestrians away from their direct routes (or 'desire lines'). However, this may encourage higher vehicle speeds as a result of a lower perceived risk, and in areas of high demand, take away valuable footway space and degrade the streetscape.

2.2.6 *Research, Development and Implementation of Pedestrian Safety Facilities in the United Kingdom* (Davies, 1999) examined the development and implementation of pedestrian safety facilities, and noted that "Rather oddly, considering how widely it is used, there is very little research into the effectiveness of guardrailing". However, the before-and-after research that is available indicates that the provision of pedestrian guardrailing improves safety (e.g. Simmonds, 1983; Bagley, 1985). In his 2007 paper, *A Clearer Vision for Pedestrian Guardrails* (Stewart, 2007), Stewart reaches the same conclusion.

2.2.7 Certain sites may have anti-ram protective security measures installed to protect them from vehicle-borne criminal and terrorist attack. These measures, which are designed to blend into the urban streetscape, include structural balustrades, bollards, planters, walls and structures concealed within common streetscape items such as shelters, cabinetry, sign posts and lighting columns (see Figures 2.3 and 2.4). Their position is usually as far from the vulnerable asset as possible, typically at the existing or revised kerb edge.

2.2.8 If designed to prevent vehicles encroaching through the gaps, the structures will be no more than 1.2 metres apart, which still provides permeability to pedestrians and mobility impaired users. As these measures are designed to resist forced attack, they are unlikely to be frangible if accidentally hit.

2.2.9 *Road Safety Audit* (IHT, 2008) contains more details on protective security.

2.3 Legislation, guidance and standards

2.3.1 Section 66 of the Highways Act 1980 (as amended) provides powers for a highway authority to provide, maintain, alter and remove guardrailing in a highway, and also refers to related matters.

2.3.2 There is currently no dedicated UK guidance defining the overall criteria for the installation of guardrailing.

2.3.3 Some recommendations on the installation of guardrailing are contained within standards and guidance for the design of particular highway and pedestrian facilities, although decisions about installation of guardrailing are mainly based on good engineering judgement in conjunction with any available guidance and in the light of local circumstances.

2.3.4 *Transport in the Urban Environment* (IHT, 1997) offers advice on installing guardrailing:

"The installation of pedestrian guardrails should be considered only where there are real risks of accidents should pedestrians walk onto the carriageway. Guardrails are intrusive and unsightly. Their purpose is to restrict people's freedom of movement. This will be resented unless the installation is self-evidently necessary. The use of guardrails should be avoided unless there is no alternative in terms of pedestrian safety."

It provides further guidance on the provision of guardrailing at junctions and crossings and where retail or commercial premises do not have rear service facilities.

2.3.5 Technical Advice (TA) 57/87 *Roadside Features* (DoT, 1989) gives general guidance on the use of guardrailing in both rural and urban areas. In particular, it states:

"Guardrailing should be used to assist, rather than to impede, pedestrians by channelling them to the point at which they may cross in greatest safety and its use should therefore be carefully considered."

2.3.6 LTN 2/95 *The Design of Pedestrian Crossings* (DoT, 1995) recommends the practices to be followed when planning, designing and installing at-grade pedestrian crossings. It describes all types of crossings, other than those at signalled junctions, and includes a section on guardrailing.

2.3.7 Traffic Advisory Leaflet 5/05 *Pedestrian Facilities at Signal-Controlled Junctions* (DfT, 2005) offers a cautionary approach to the use of guardrailing and states that:

"Guardrailing can be the right solution, at the right place and in the right amount. If it is poorly sited, or over installed it can alienate pedestrians, look unsightly and easily become damaged, leading to increased maintenance costs and complaints…when considering guardrailing at junctions the objective should be to provide only as much as is necessary for the safe and convenient use of crossings."

Box 2.1 Road safety audits

The emphasis in planning and designing urban streets is changing. More recognition is being given to the function of streets as places for people, in addition to their role as thoroughfares for vehicles. Road safety auditors are being encouraged to consider the broader design objectives of schemes and assess the risk to road users, concentrating on those features with the potential to cause injury and describing likely collision scenarios that may occur:

"Road Safety Auditors should think laterally in order to recommend solutions to potential safety problems that respect design objectives. For example if an objective is to encourage walking and there is concern about conflict with vehicles at a particular point, it is likely to be more appropriate to address driver behaviour than to attempt to deflect pedestrians from their desire line to a 'safer point'." *Road Safety Audit* (IHT, 2008)

2.3.8 *Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure* (DfT, 2002b) provides guidance on pedestrian guardrailing and other aspects of pedestrian infrastructure design for disabled people.

2.3.9 The Department for Transport, Local Government and the Regions report *A Road Safety Good Practice Guide* (DTLR, 2001b), suggests a cautious approach to the installation of pedestrian guardrailing:

"Guardrail or fencing to channel pedestrians to the designated crossing may be deemed necessary on busy roads. However, their use should only be considered where the risks of walking onto the carriageway are very high, as they have a number of disadvantages. They are visually intrusive, reduce footway width, can obscure children, and can cause access difficulties to commercial premises."

"The problems associated with pedestrians stepping out from bus stops onto the main carriageway can be limited by the use of pedestrian guard-rails at strategic locations. Pedestrian refuges to the rear of the stopped bus deter vehicles from overtaking and offer additional protection to the alighted passengers."

2.3.10 *Manual for Streets* (MfS) (DfT/CLG/WAG, 2007) identifies the need to bring about a transformation in the quality of streets and advocates the use of guardrailing only where there is a clear need for it:

"Guardrailing is generally installed to restrict the movement of vulnerable road users. In some cases guardrailing has been introduced in specific response to accidents."

"Guardrailing should not be provided unless a clear need for it has been identified. Introducing measures to reduce traffic flows and speeds may be helpful in removing the need for guardrailing. In most cases, on residential streets within the scope of MfS, it is unlikely that guardrailing will be required."

2.3.11 LTN 1/08 *Traffic Management and Streetscape* (DfT, 2008a) aims to "help all those involved in the design of traffic management measures to prepare schemes that consider and care for the streetscape. It assists hands-on designers, project enablers and decision makers alike". Specifically, it aims to enhance the streetscape by encouraging design teams to minimise the various traffic signs, road markings and street furniture associated with traffic management schemes. Advice on achieving this is given with reference to a series of case studies.

2.3.12 It is good practice to provide an audit trail of decisions or action taken when evaluating pedestrian guardrailing sites. The importance of inspection, assessment and recording regimes, as well as highway risk and liability, is described in *Well Maintained Highways* (Roads Liaison Group, 2005).

2.3.13 *Streets For All: Practical Case Study 3 Guardrails and crossings* (English Heritage, 2008) also deals with the streetscape and states:

"It is widely recognised that improving pedestrian accessibility and the public realm environment is essential to help maintain the vitality and viability of town and city centres. It has been found that the reduction of vehicle speeds and the redesign of street space to be more friendly to pedestrians has led to a transformation and revitalisation of the street scene."

2.3.14 Technical Direction (TD) 19/06 *Pedestrian Restraint Systems* (HA/Transport Scotland/WAG/DRDNI, 2006) is, in the most, part related to the provision of guardrailing on and around structures. Therefore TD 19/06 is not directly related to the theme of this LTN.

2.3.15 The current British Standard for guardrailing is BS 7818:1995 *Specification for pedestrian restraint systems in metal* (British Standards Institution, 1995). This is a technical design standard that specifies the requirements for the construction of pedestrian and other non-vehicle user restraint systems in metal for use on roads and highways. It includes useful guidance on the layout and intervisibility of restraint systems. This British Standard superseded BS 3049:1976.

2.3.16 Rule 9 of the *Highway Code* (DSA/DfT, 2007) outlines what pedestrians should do at safety barriers (which includes pedestrian guardrailing):

"Where there are barriers, cross the road only at the gaps provided for pedestrians. Do not climb over the barriers or walk between them and the road."

2.3.17 However, regardless of this and of the quality of guidance currently available to highway engineers, it is inevitable that sometimes pedestrians will purposely evade the guardrailing by climbing over it or walking along the carriageway side of it, thereby potentially increasing their risk of conflict with a vehicle.

3. Research summary

3.1 The need for research

3.1.1 There was a clear need to appreciate the current practice of installing guardrailing and understanding the way in which the railing affects the movement and behaviour of pedestrians and vehicles and how it affects safety.

3.1.2 The DfT commissioned a study to:

(a) review the advice currently available on the use of guardrailing;

(b) provide an objective assessment of the benefits and disbenefits, with particular emphasis on safety; and

(c) develop advice for the installation and removal of pedestrian guardrailing that will promote road safety without unduly restricting pedestrian access.

3.1.3 The research (Hall et al., 2005) built on the work already undertaken in a study carried out by the Transportation Research Group (TRG) at the University of Southampton (Zheng and Hall, 2003) for Transport for London (TfL). In the TfL research (TfL, 2005), the criteria for the installation of guardrailing were reviewed, and included the analysis of pedestrian and vehicle interaction at a range of crossing sites. In the DfT research, sites at various locations throughout the UK (not in London) were surveyed and the subsequent analysis aimed to provide an appreciation of the ways in which guardrailing affects the movement and behaviour of pedestrians and vehicles, and to explore how it affected safety.

3.1.4 The sites were selected from observation without obtaining the background for the reason for the provision of guardrail or whether there was a known collision history that may have been improved by the use of it.

3.2 Surveys

3.2.1 Pedestrian behaviour was surveyed using video cameras at 78 sites throughout the UK (not in London). There were 37 sites with guardrailing and 41 sites without guardrailing. The selection covered a range of different types of sites, including signal controlled, priority and roundabout junctions, Pelican, Puffin and Zebra crossings, and refuge islands (see Figure 3.1). Site types that were included in the London study, but not selected for inclusion in the national study, were transport interchanges (such as London Underground entrances and exits), and school sites, where the use of guardrailing has historically been unquestioned.

3.2.2 The safety benefit of preventing a sudden or unexpected influx of pedestrians entering the carriageway is not in doubt. Traditionally, at locations with high volumes of pedestrians, especially those frequented by children, such as school entrances/ exits, playground areas, leisure centres, transport interchanges and exits from alleyways or stairways that lead directly to the road edge, it is unlikely that existing guardrailing should be removed. Thus, the assessment procedure described in this LTN is designed primarily for pedestrian crossing and road junction sites.

3.2.3 The survey at each site lasted for 12 hours (from 07:00 to 19:00), covering peak and off-peak hours. The pedestrian movement recording method developed for the London study was adapted for use as part of this research. Vehicle speeds and flows were also measured, and 85th percentile vehicle speed and traffic flows were calculated to characterise the traffic conditions of the sites. The main objective of the behaviour survey was to obtain information on pedestrian movement characteristics at sites with and without guardrailing under varying traffic and pedestrian flow situations.

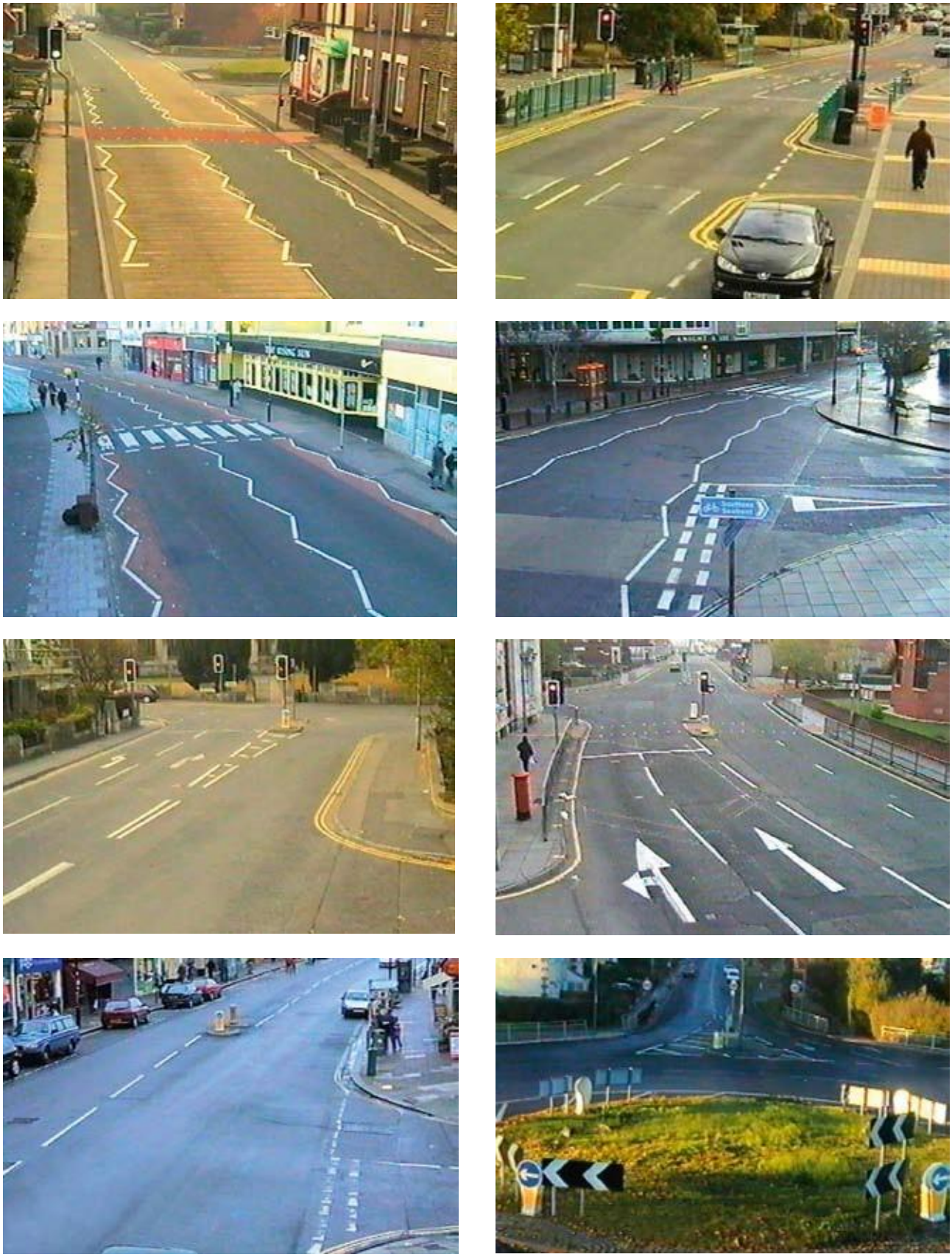

Figure 3.1 Video stills from DfT research project showing different types of surveyed crossings (including Zebra crossing, signal controlled junctions, refuge crossings and roundabout crossings) with and without guardrailing (video stills: Southampton University)

3.2.4 Collision records for at least three years up to the end of 2003 were obtained and analysed for all sites surveyed. For each type of site, comparisons were made of the average number of collisions per year at sites with and without guardrailing. All collisions including pedestrian collisions within the following areas were included:

- for pedestrian crossing sites – 25 metres each side of the crossing; and
- for junction sites – 25 metres from the crossing on the observed arm and central part of the junction adjacent to the observed arm.

3.2.5 The effect of guardrailing was analysed using behaviour effectiveness indices together with the safety record. Effectiveness indices defined in the London study for use at junctions and pedestrian crossings were employed, to enable direct comparison with the results from that study. These indices were the Utilisation Rate (UR), Correct Use Rate (CUR) and Formal Use Rate (FUR) (see Box 6.2 and Appendix C). The safety effect of guardrailing was indicated by total collision rate and pedestrian collision rate for all types of site.

3.2.6 For each different type of crossing surveyed during the study, the 'designated crossing area' was defined as follows:

- Zebra crossing: the extent of the black and white painted surface;
- Pelican and Puffin crossing: the extent of road width between crossing studs;
- refuge island: the length of the gap in the island (which should be the same as the dropped kerb at the carriageway edge); and
- priority junction: the crossing arm of junction, if not one of the above – the extent of the road width between the dropped kerbs at each side of the carriageway.

3.2.7 Toucan crossings were not surveyed. However, the procedure may be used for crossings of this type.

3.2.8 At sites where none of the above is applicable, the designated crossing area is based on road geometry and local conditions. See Appendix C for more details.

3.3 Results

3.3.1 Data for each of the different types of sites within the study, i.e. signal controlled, roundabout and priority junction sites, refuge islands, and Zebra, Pelican and Puffin crossings, indicated that traffic speed, traffic flow and pedestrian flow did not differ significantly between sites surveyed with and without guardrailing.

3.3.2 For all of the different types of sites taken together:

- the total collision frequency at sites with guardrailing was 1.5 times that at sites without guardrailing, although the difference was not statistically significant; and
- the pedestrian collision frequency at sites with guardrailing was 1.6 times that at sites without guardrailing, although the difference was not statistically significant.

3.3.3 It is likely that guardrailing was installed to help address a perceived problem concerning safety or traffic management (particularly for pedestrians). However, the sites with guardrailing had higher traffic flows (by 10.5 per cent) and slightly higher speeds (by 0.4 mph) which would at least partly account for the higher collision frequencies.

3.3.4 Site type specific analysis indicated that the effectiveness of guardrailing is likely to be different at sites with different features. The following results have also been summarised into a table of library reference data (see Table D1, Appendix D). The Formal Usage Rates (FUR) are reported in the following bullet points:

- **For traffic signal controlled junction sites**, an average of 83 per cent of pedestrians were found to cross within the designated crossing area at sites with guardrailing, compared with 40 per cent at sites without guardrailing, the difference being statistically significant. The collision total and pedestrian collisions were fewer at sites without guardrailing, but the differences were not statistically significant.
- **For roundabout sites**, an average of 90 per cent of pedestrians were found to cross within the designated crossing area at sites with guardrailing, compared with 32 per cent at sites without guardrailing. The difference was statistically

significant. Total and pedestrian collision frequencies were lower at sites without guardrailing. However, the differences were not statistically significant.

- **For the priority junction sites**, an average of 72 per cent of pedestrians were found to cross within the designated crossing area at sites with guardrailing, compared with 56 per cent at sites without guardrailing, but the difference was not statistically significant. Total and pedestrian collision frequencies were lower at sites with guardrailing. However, the differences were not statistically significant.

- **For the Zebra crossing sites**, an average of 89 per cent of pedestrians were found to cross within the designated crossing area at sites with guardrailing, compared with 56 per cent at sites without guardrailing, the difference being statistically significant. Total and pedestrian collision frequencies were slightly lower at sites with guardrailing. However, the differences were not statistically significant.

- **For the signalised pedestrian crossing sites** (Pelican and Puffin), an average of 74 per cent of pedestrians were found to cross within the designated crossing area at sites with guardrailing, compared with 53 per cent at sites without guardrailing, and the difference was statistically significant. Total and pedestrian collision frequencies were lower at sites without guardrailing, but the differences were not statistically significant.

3.4 Conclusions

3.4.1 For four of the five site types analysed by Formal Usage Rate (FUR), the differences between sites with and without guardrailing were statistically significant. The exception was for priority junction sites. For all the five site types analysed for total and pedestrian collisions, the differences between the sites with and without guardrailing were not statistically significant. Results are, at best, indicative and should be interpreted with caution. Total and pedestrian collisions were lower at the following types of sites without guardrailing: traffic signal junctions, roundabouts and signalised pedestrian crossings. Collisions were lower, or slightly lower respectively at the following types of sites with guardrailing: priority junctions and Zebra crossings. For all of the different types of site taken together, total and pedestrian collision frequencies were higher at sites with guardrailing. The higher collision rates at these sites may be the reason why guardrailing was installed in the first place (see paragraph 3.3.2).

3.4.2 Similar analyses carried out in the London study indicated that the presence of guardrailing had a similar, but much less marked effect on the behaviour of pedestrians at all types of crossings, together with a lower pedestrian collision frequencies.

3.4.3 It should be noted that the difference in results between this study and the London study are not statistically significant. Additionally, vehicle flows and 85th percentile speeds at the London sites were much higher than at the sites elsewhere in the country, which this data is based on, and may have contributed to the marked difference in results.

3.4.4 Analysis of a survey of pedestrians' attitudes to walking in general, and guardrailing in particular, indicated that guardrailing is viewed as a necessary road safety device offering protection from traffic. However, over three-quarters of respondents felt that the use of guardrailing should be restricted to where it is 'absolutely necessary' and, while the great majority of respondents agreed that using a pedestrian crossing is safer than crossing elsewhere, there is general agreement that it can be difficult to cross the road where they 'most want to cross'.

3.4.5 Thus, while there is no conclusive evidence that the inclusion of pedestrian guardrailing at any type of pedestrian crossing or junction has any statistically significant effect on the safety record, there is certainly an effect on pedestrian behaviour, especially where traffic flows are relatively low; the volume of traffic may be one of the main factors affecting pedestrian behaviour at junctions and pedestrian crossings.

3.4.6 An assessment framework (see Appendix B) has been devised which encourages the use of a detailed site record (Appendix A), a comparison of current traffic and pedestrian flows and behaviour, and historical collision data with reference sites, to determine the potential effects of installing or removing guardrailing. In general, the installation of new guardrailing should not be considered if alternative safety measures could be used. Guardrailing should only be considered when the expected effectiveness is significant, and unnecessary guardrailing should be removed.

4. Assessment procedure

4.1 General

4.1.1 This assessment procedure provides a recommended method for assessing whether new guardrailing should be installed or whether existing guardrailing should be removed at different types of site, particularly pedestrian crossings and road junctions. It can also be applied to:

- link edges/central reservations;
- entrances/exits to transport interchanges; and
- entrances/exits to schools.

4.1.2 The assessment procedure is intended to be equally applicable to situations where the introduction of new railings or the removal of railings is the only measure or where it is part of other measures.

4.1.3 The procedure provides criteria for the introduction of new guardrailing or its removal on the existing road network. However, even when the criteria are met or exceeded, it does not necessarily mean that guardrailing must be installed/removed. Alternative measures also need to be considered, particularly if safety benefits similar to those provided by guardrailing can be achieved. For example, a 'chicane' could be used at entrances/exits where on-rushing children, pedestrians and cyclists need to be slowed down before they emerge onto the footway. Guardrail located on the carriageway side of the entrance/exit (i.e. the edge of the verge) is not always effective, because the short sections often used do little to prevent or even slow children from running diagonally into the carriageway.

4.2 Effects of guardrailing on pedestrians

4.2.1 In many situations, the presence of guardrailing can have adverse effects on the convenience of pedestrians, the streetscape, footway capacity etc.

4.2.2 In general, it is recommended that guardrailing is installed only where it is considered absolutely necessary to ensure safety or where there are requirements to direct pedestrians along a particular route.

4.2.3 In situations where it is necessary to install guardrail, it is recommended that local authorities consult with the local community, including residents, vulnerable road users and other groups that represent those who might be affected.

4.3 Alternatives to guardrailing

4.3.1 Before considering the installation of new guardrailing, it is recommended that alternative measures should be considered. Such engineering measures include but are not limited to:

- speed limit reduction;
- traffic calming;
- relocation of a pedestrian crossing to better fit pedestrian desire lines;
- installation of a new pedestrian crossing at a desired location;
- installation of bollards; and
- footway improvements and widening.

4.4 The need for guardrailing

4.4.1 Decisions on the removal of existing guardrailing should follow a philosophy that:

- unnecessary guardrailing should be removed;
- the removal of existing guardrailing should be considered if alternative measures are feasible that compensate for its loss; and

- poorly installed guardrailing (e.g. with excessive gaps between railings) should be improved, removed or relocated.

4.4.2 Where guardrailing (new installation or existing) is considered necessary, it can still be provided in conjunction with some of the above alternative measures.

4.4.3 Using a site record, the procedure leads to the production of an assessment framework. The record should include the collection of site information, photographs, maps, records of any representations, etc. All relevant factors included in the assessment framework need to be considered when deciding whether to include guardrailing, its location and extent, or removal of existing guardrailing. The assessment framework should include factors quantifying the difficulties experienced by vulnerable road users and disabled people.

4.4.4 The decision whether or not to provide or remove guardrailing should be a balanced judgement based on consideration of all the information included in the assessment framework, together with the judgement of the professional staff involved in highway, traffic, safety and street design, local circumstances and political approval.

4.4.5 The Assessment Procedure is illustrated in Figure 4.1.

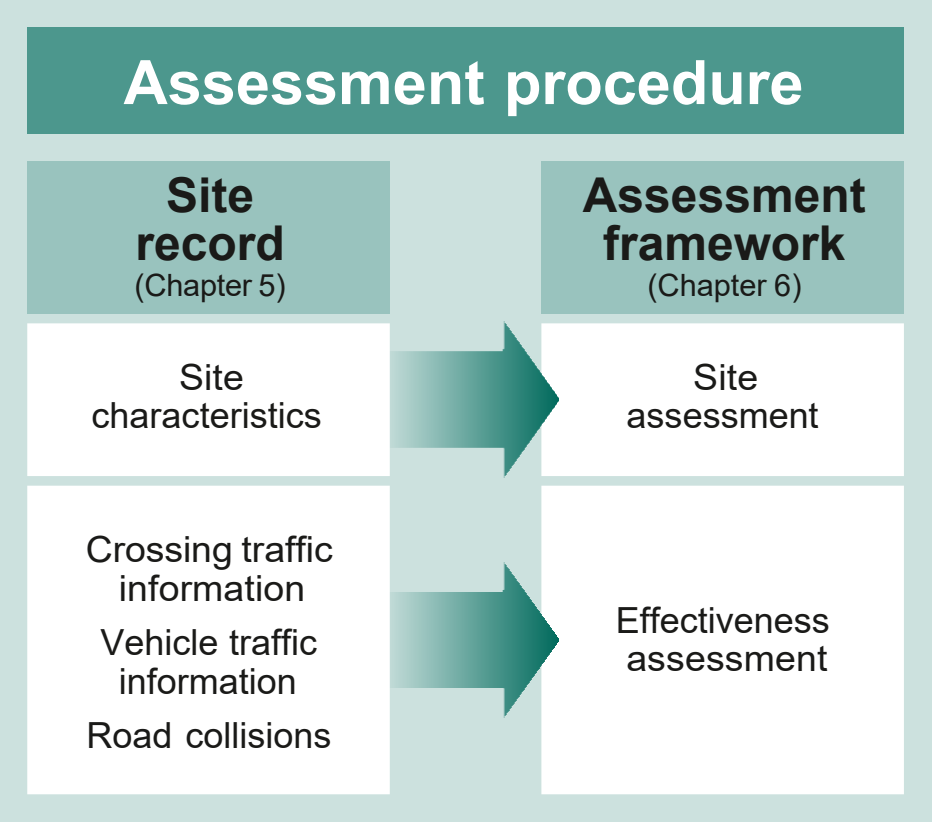

Fig 4.1 Assessment procedure

5 Site record

5.1 General

5.1.1 It is recommended that a site survey and record of all relevant local and traffic factors is made by an experienced engineer. An example of a site record is shown in Appendix A. The record will form the basis for the assessment framework (Appendix B), and as much background information as possible should be gathered so that a fully informed decision can be made. In the case of roads not yet built, or where future development is likely, the information should be estimated and the basis noted. For existing roads the information should be measured.

5.1.2 The survey should include sufficient adjacent road space to the proposed site of guardrailing installation or removal. For instance, at a busy pedestrian crossing it may be necessary to include up to 50 metres of road either side of the site (100 metres in total). The exact length of road surveyed may be dictated by the existence of side roads, major entrances/exits, etc. and the current or envisaged locations and extent of guardrailing.

5.1.3 Factors to be taken into account are considered in the remainder of this chapter.

5.2 Carriageway and footway type and width

5.2.1 The width of the carriageway and its arrangement into lanes should be recorded, as this will relate to the degree of difficulty that people have in crossing.

5.2.2 The width of the available footway should be recorded and, if necessary, a level of service assessment conducted, because the addition of guardrailing along a stretch of footway will reduce the effective footway width. The position of other street furniture, which may affect the footway width, should also be taken into consideration.

5.2.3 It is important that the usable footway width is sufficient for pedestrians both walking along the footway and waiting to cross where the guardrailing is directing pedestrians towards a crossing point. Pedestrians with prams or pushchairs and wheelchair users must also be accommodated. A minimum clear width of two metres is recommended.

5.3 Visibility requirements

5.3.1 The visibilities to and from the site, from the point of view of both a pedestrian and a driver, should be recorded. The presence of guardrailing is likely to affect the visibility, particularly of children, at a crossing point. Guardrailing can also influence driver/driver and driver/road visibility, especially at junctions where the geometry may include horizontal and vertical curvature. The use of high visibility guardrailing offers improved inter-visibility between pedestrians/drivers and drivers/drivers, and may help to mitigate the effect of poor visibility. It is recommended that, where guardrail is to be used, high visibility designs should be considered and installed as the highway authority deem appropriate.

5.3.2 Minimum distances for drivers' forward visibility at controlled pedestrian crossings are set out in Table 1 of LTN 2/95 *The Design of Pedestrian Crossings* (DoT, 1995). *Manual for Streets* (MfS) (DfT/CLG/WAG, 2007) focuses on lightly-trafficked residential streets, but many of its key principles may be applicable to other types of street, such as high streets, but not the trunk road network. For roads within the scope of MfS, it may be suitable to use the stopping sight distances stated within MfS.

5.4 Characteristics of surroundings

5.4.1 Details of the nature of the surrounding area should be recorded, including the presence of:

- refuge islands;
- public transport stopping points;
- waiting, loading and stopping restrictions;
- possible trip generators;
- proximity and type of nearby junctions;
- pedestrian crossings;
- school crossing patrols; and
- surrounding land use.

5.4.2 The presence of any of the above features could have an effect on the decision whether to install new guardrailing or remove existing guardrailing at a particular site.

5.5 Site photos and plan

5.5.1 The site layout and its major features should be recorded in the form of photographs and a plan at a scale of at least 1:1250 – a larger scale would more accurately identify features. Photographs are particularly useful as an aide-memoire for the assessment. They should show such details as the driver's views of the site from, say, 30 and 100 metres away, the pedestrians' views, and any accesses or side roads. The location and date should be recorded for each photograph.

5.6 Vehicular/pedestrian flows and composition

5.6.1 For pedestrian crossings and road junctions, pedestrian flows should be measured to determine the crossing activity and behaviour. The pedestrian flow data should represent the typical flows and behaviours at the site. The length of time over which the count should be taken will vary from site to site. However, a 12-hour count from, say, 07:00 to 19:00, would be suitable at most sites, and analysis of the data will identify the peak periods. The data should be used to determine the usage rates. Definitions of usage rates are given in Box 6.2.

5.6.2 Many factors will affect usage rates and influence pedestrian behaviour, including traffic flow and speed, location of any existing guardrailing, pedestrian desire lines and other aspects of road geometry. The condition, design, length and quality of any existing guardrail could also influence pedestrian use and behaviour. Poorly maintained and sub-standard guardrail could possibly be as ineffective as no guardrail at all.

5.7 Road collisions

5.7.1 The existing injury collision record for the site, including the crossing area and 25 metres each side, should be noted. It is often useful to record details of age, location of collision, and time of day to establish if any pattern emerges. State the period over which the figures apply and describe any significant local changes to the site layout in that time.

5.7.2 If possible, collate the injury collision data over the previous five years. A minimum of three years' data is recommended. Both pedestrian collision and all collision records should be taken into account.

6 Assessment framework

6.1 General

6.1.1 The assessment framework consists of a site assessment and an effectiveness assessment (see Appendix B).

6.2 Site assessment

6.2.1 Site characteristics from the site record (Appendix A) should be included in the site assessment, together with their impacts on pedestrian and vehicle behaviour.

6.3 Effectiveness assessment

6.3.1 Details of the traffic and pedestrian flows from the site record (Appendix A) should be included in the effectiveness assessment.

6.3.2 The installation or removal of guardrailing can be justified by its effect on safety or on pedestrian behaviour. These effects are determined by gathering information on safety and behaviour at the site in question and comparing this with a similar reference site or sites (see Box 6.1) with or without guardrailing.

6.3.3 A flowchart showing an overview of the decision making procedure for installing or removing pedestrian guardrailing is at Figure 6.1.

Box 6.1 Reference sites

A reference site should be similar to the site under consideration in terms of its main characteristics, such as:

- site type, e.g. pedestrian crossing, traffic signal controlled junction, roundabout; and
- traffic flow.

but, where possible, also

- land use, e.g. residential area, town centre location;
- traffic speed, e.g. high speed road, local road; and
- pedestrian flow and characteristics.

If you are considering the installation of guardrailing, reference sites with guardrailing should be used. If you are considering the removal of guardrailing, reference sites without guardrailing should be used (see Table 6.1).

Table 6.1 Type of reference site to be used when installing/removing guardrailing

Proposal	Type of reference site
Installation of guardrailing	Site with guardrailing
Removal of guardrailing	Site without guardrailing

To identify reference sites, individual locations near the proposed site with similar characteristics should be identified and surveyed for comparison with the proposed site. There is no intention to produce a national database of reference sites to use. It is for individual local authorities to decide if they wish to develop a local database that can be established and refined over time.

Box 6.2 Definition of behavioural indices

Pedestrian behaviour at junctions and crossings is defined in Appendix C and can be categorised as:

(A) pedestrians who use the crossing within the designated crossing area;

(B) pedestrians who either start or end the crossing movement within the designated crossing area; and

(C) pedestrians who cross away from the crossing, within 25 metres.

The indices selected to assess the use of designated crossings are as follows:

- **Utilisation rate: (UR) = (A+B)/(A+B+C)**

The proportion of pedestrians who used the crossing fully or partly to all crossing pedestrians, UR, is an indication of the effectiveness of the guardrailing in increasing the overall use of the crossing.

- **Correct use rate: (CUR) = (A)/(A+B)**

The proportion of pedestrians who used the crossing fully to those who used the crossing fully or partly, CUR, is an indication of the effectiveness in guiding pedestrians within a safe area.

- **Formal use rate: (FUR) = (A)/(A+B+C)**

The proportion of pedestrians who used the crossing fully to all crossing pedestrians, FUR, is closely related with utilisation rate and can be taken as an indication of the overall effectiveness of guardrailing in guiding pedestrians to cross within the designated crossing area.

· Indices at reference sites are denoted with the suffix R, e.g. $UR_{(R)}$

· Indices at the specific site at which the installation or removal of guardrailing is proposed are denoted with the suffix S, e.g. $UR_{(S)}$

6.3.4 The effectiveness assessment may be broken down into two key stages:

(a) the effect on behaviour of pedestrians; and

(b) effect on pedestrian and other road user safety.

6.4 Effect on pedestrian behaviour

6.4.1 Effectiveness of guardrailing can be assessed by the extent to which it encourages desired pedestrian behaviour. Such behaviour is likely to differ according to the type of site: guardrailing at pedestrian crossing sites aims to channel pedestrians to a safe crossing location, while guardrailing installed along a kerb edge aims to discourage pedestrians entering the carriageway where it is unsafe to do so.

6.4.2 Based on observation and analysis of pedestrian behaviour at crossings and junctions, indices of the effect of guardrailing on behaviour can be calculated (as described in Appendix C) and compared to similar data from reference sites. See Box 6.2 for definition of behavioural indices.

6.4.3 These reference sites can provide an approximation of the pedestrian behaviour patterns after installation or removal of guardrailing.

6.4.4 If no observational data are available, Table D1 in Appendix D provides average behavioural indices for pedestrian crossings and junction sites. The minimum and maximum values of these indices across the sample of sites are also given to indicate the range of values that are likely to be found.

6.5 Criteria for the installation of guardrailing

6.5.1 For a new installation of guardrailing, reference sites with guardrailing should be used to compare pedestrian behaviour.

6.5.2 If similar or better levels of behaviour have been observed at the site before guardrailing is installed, it is unlikely that installing guardrailing will increase the desired compliant behaviour.

6.5.3 Conversely, it is worth considering the installation of guardrailing if the observed pedestrian behaviour levels are worse than at sites with guardrailing.

6.6 Criteria for the removal of guardrailing

6.6.1 For the removal of existing guardrailing, the site indices should be compared with that of reference sites without guardrailing.

6.6.2 If observations suggest that the proportion of pedestrians displaying the desired behaviour at a site with guardrailing is greater than the average for reference sites without guardrailing, removal might result in a decrease in the desired behaviour and should not be considered.

6.6.3 If the comparison indicates that the site with guardrailing offers little benefit, then removal may be considered further.

6.7 Retaining existing guardrailing

6.7.1 If the decision is taken to retain existing guardrailing, it should be assessed to ensure the design, condition and quality is fit for purpose. Points to consider include:

- Is the existing length adequate?
- Are there any missing or damaged panels that require replacing?
- Is the type of guardrail suitable?

6.8 Effect on safety

6.8.1 To assess the impact of guardrailing on safety, collision records in at least the last three years at the site being considered should be compared with collision statistics for similar reference sites. Both pedestrian collision and all collision records should be taken into account.

6.8.2 For a new installation of guardrailing, reference sites with guardrailing should be used for comparison of collision records.

6.8.3 Installation of guardrailing should not generally be considered as a safety measure if the collision record of the site in question is lower than the average of the reference sites with guardrailing.

6.8.4 For the removal of existing guardrailing, reference sites without guardrailing should be used.

6.8.5 Past collision records of the site being considered for guardrail removal should be analysed in detail to identify the contribution of guardrailing on the collisions.

6.8.6 Collision records at reference sites without guardrail can be used as an approximation to the expected future safety record of the site, should the guardrail be removed. If this shows that the collision rates following guardrail removal are likely to be much higher than the average of the reference sites, or higher than the collision rates currently being experienced with guardrail in place, removal of guardrailing should generally not be considered further.

6.8.7 If in any doubt, the decision to remove guardrailing may need to be further justified.

6.8.8 Caution should be exercised so that the collision potential is not increased by installing/removing guardrailing.

6.9 Monitoring

6.9.1 Where a decision has been made to remove guardrailing, or exclude it from a new scheme, sites should be monitored to ensure the collision record does not increase. Monitoring will also provide data for future use as a reference site.

6.9.2 Regardless of whether the decision is made to install, remove or retain guardrailing, details of the scheme and decisions taken should be recorded by each authority to build up a database for future use and reference.

6.9.3 The assessment framework should present clearly the various likely effects of installing new guardrailing or of removing or relocating existing guardrailing. The final decision on the installation or removal of guardrailing, and the extent of the amount of guardrailing installed or removed, will depend on a combination of factors. These include the number and profile of collisions, current pedestrian behaviour, cost, the outcome of any local consultation undertaken (e.g. with residents) and the views of local elected members.

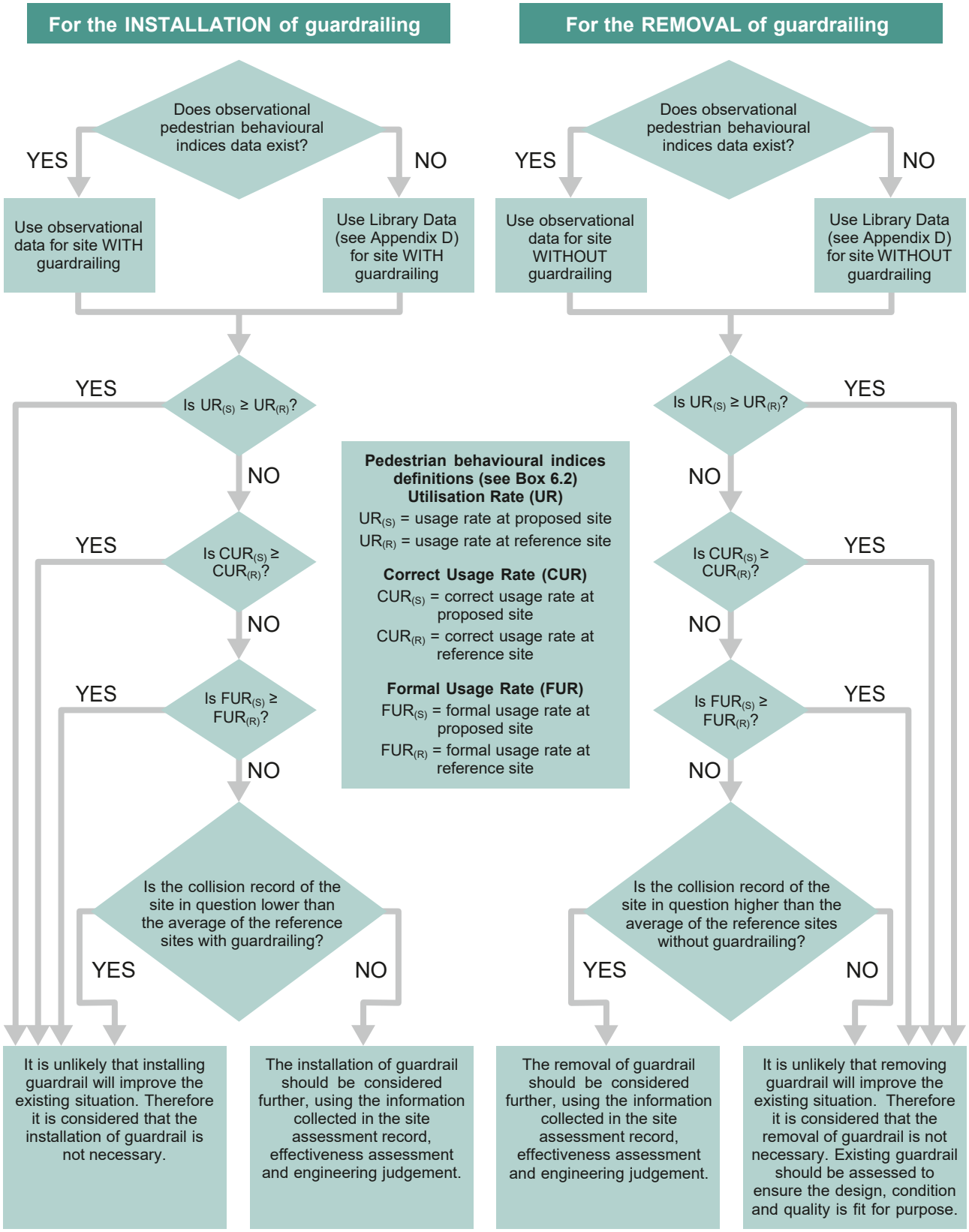

Figure 6.1 Pedestrian guardrailing assessment framework flowchart

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Appendices

Appendix A Site record

This checklist and record sheet is recommended for use when assessing the need for the installation of new guardrailing, or removal of existing guardrailing. This record is applicable to a pedestrian crossing, link, or arm of a road junction.

Does the site being assessed already have guardrail? ☐ Yes ☐ No

Site characteristics

1.1	Site location	Description	
	Ordnance Survey grid reference		
1.2	Carriageway type	☐ Single	☐ Dual
	☐ One-way	☐ Two-way	
	☐ Number of lanes		
1.3	Carriageway width	metres	
1.4	Minimum footway width	Side 1	metres
		Side 2	metres
1.5	Refuge island		☐ Yes ☐ No
1.6	Minimum visibility		
	site to vehicle	Direction 1	metres
		Direction 2	metres
	vehicle to site	Direction 1	metres
		Direction 2	metres
1.7	Waiting/loading/stopping restrictions		
	At site		☐ Yes ☐ No
	Within 50 metres of site		☐ Yes ☐ No
1.8	Public transport stopping points		
	At site		☐ Yes ☐ No
	Within 50 metres of site		☐ Yes ☐ No
1.9	Nearby junctions		
	Distance to nearest significant	Direction 1	metres
	traffic junction	Direction 2	metres

1.10 Other pedestrian crossings

Distance to next crossing	Direction 1	metres
	Direction 2	metres

Type of crossing ☐ Zebra ☐ Pelican ☐ Puffin ☐ Toucan ☐ other

1.11 School crossing patrol

Distance if less than 100 metres ____ metres

1.12 Surroundings (entrances within 100 metres)

Hospital/sheltered housing/workshop for disabled people	☐ Yes	☐ No
School	☐ Yes	☐ No
Post office	☐ Yes	☐ No
Railway/bus station	☐ Yes	☐ No
Shopping/leisure	☐ Yes	☐ No
Sports stadia/entertainment venue	☐ Yes	☐ No
Junction with cycle route	☐ Yes	☐ No
Equestrian centre or junction with bridle path	☐ Yes	☐ No
Others (for example a fire station)	☐ Yes	☐ No

Crossing users information

2.1 Flow and composition

Pedestrians	no. per hour
Prams/pushchairs	%
Older people	%
Unaccompanied young children	%
Severe mobility difficulties	no. per day
Visually impaired	no. per day
Crossing cyclists	no. per day
Equestrians	no. per day
Others	no. per day

2.2 Time to cross the road

Able pedestrians	seconds
Older or disabled people	seconds

2.3 Usage rates

(A)	Pedestrians who use the crossing within the designated crossing area	
(B)	Pedestrians who either start or end the crossing movement within the designated crossing area	
(C)	Pedestrians who cross away from the crossing, within 25 metres	

Utilisation Rate (UR) = (A+B)/(A+B+C):	%
Correct Use Rate (CUR) = (A)/(A+B)	%
Formal Use Rate (FUR) = (A)/(A+B+C)	%

(NB: Rates expressed as percentages for ease of comparison)

Vehicle traffic information

3.1	Flow and composition		
	Vehicle count	no. per hour	%
	Cyclists	no. per hour	%
	Heavy goods vehicles	no. per hour	%
	Public service vehicles	no. per hour	%
3.2	Vehicle speed		
	85th percentile	mph	
	Speed limit	mph	

Road collisions

4.1	Mean personal injury collision frequency	
	Number per year at site (at least three years)	P.I. collisions/year
	Number per year at an average local site (at least three years)	P.I. collisions/year

Appendix B Assessment framework

Site assessment

Site type (junction, link, pedestrian crossing, etc.)

Site characteristics

Carriageway type	Single	Dual
	One-way	Two-way
Number of lanes		
Carriageway width	metres	
Minimum footway width	Side 1	metres
	Side 2	metres
Presence of refuge island		☐ Yes ☐ No
Surrounding land use		

Impacts

Visibility: Are desirable visibility standards met?	☐ Yes ☐ No
If present, do the following affect pedestrian and vehicle behaviour?	
Bus stops/parking bays	☐ Yes ☐ No
Parking/loading restrictions	☐ Yes ☐ No
Presence of nearby junctions	☐ Yes ☐ No
School crossing patrol	☐ Yes ☐ No
Pedestrian entrance/exit to nearby building/station/school	☐ Yes ☐ No
Are other measures more appropriate?	☐ Yes ☐ No
Funding available?	☐ Yes ☐ No

Effectiveness assessment

	Proposed site	Reference data	Notes
Traffic information Vehicle flow (vehicles per hour) Vehicle speeds (mph) mean 85th percentile Speed limit **Other considerations** Cyclists per hour Percentage of HGVs			
Pedestrian information Pedestrian crossing flow (pedestrians per hour) **Crossing usage rates (%)** Utilisation Rate (UR) Correct Use Rate (CUR) Formal Use Rate (FUR) **Other considerations** Children per hour Pushchairs per hour Wheelchair users per hour Use by blind or partially sighted?			

	Proposed site	Reference data	Notes
Safety information Total collision frequency (collisions per year) Pedestrian collision frequency (collisions per year)			
Other considerations Number of KSI collisions per year Are there any similarities or patterns in the collision profile?			
Other comments and judgments **Effects of installing or removing guardrailing:** **Decisions and actions taken:**			

Appendix C Method of recording behavioural indices

Introduction

This appendix explains how to analyse pedestrian movements at designated crossing sites and calculate pedestrian behavioural indices.

Definitions

A designated crossing is defined as follows:

- Zebra crossing: the extent of the black and white surface;
- Pelican and Puffin crossing: the extent of road width between crossing studs;
- refuge island: the length of the gap in the island (which should be the same as the dropped kerb at the carriageway edge); and
- crossing arm of junction, if not one of the above: dropped kerbs at each side of the carriageway.

At sites where none of the above is applicable, the designated crossing area should be based on road geometry and local conditions.

Pedestrian movement

Pedestrian movements at junctions and at crossings on links should be categorised and counted as follows:

(A) Pedestrians who use the crossing within the designated crossing area;

(B) Pedestrians who either start or end the crossing movement within the designated crossing area; and

(C) Pedestrians who cross away from the crossing, within 25 metres.

Site layout and recording of pedestrian movement

Link sites

For links, the observation area could be divided into seven sections, the designated crossing itself, and three road sections on each side of the designated crossing. In the example shown in Figure C1, ‘S–L’ is used to represent a pedestrian movement from the kerb section between 10 and 20 metres from the designated crossing, to the opposite kerb within 10 metres of the designated crossing. This is a C-type crossing movement. Similarly, ‘M–V’ is an A-type crossing movement and ‘M–Y’ is a B-type crossing movement.

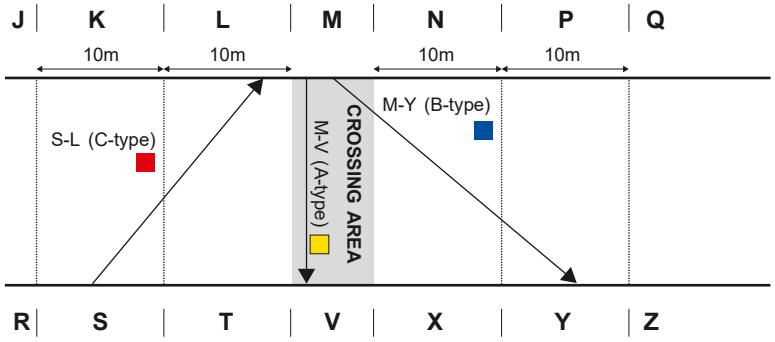

Figure C1: Typical layout for a link site with reference letters for use in origin-destination grid co-ordinate system (see Figure C2)

Pedestrian movements should be recorded using an origin–destination grid co-ordinate system. The example in Figure C2 is colour-coded to show which category each of the possible movements falls into.

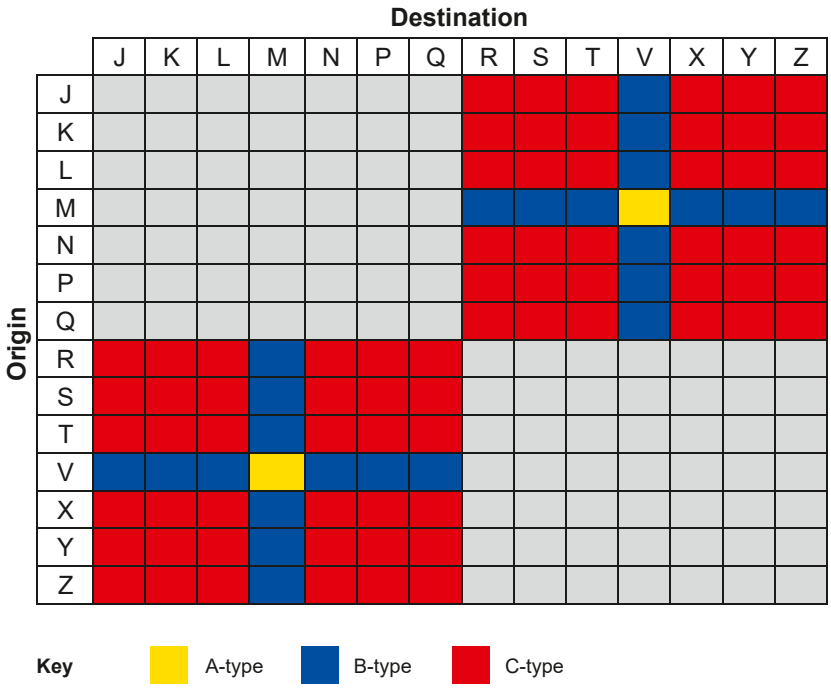

Figure C2: Origin–destination grid co-ordinate system for use with link sites (see Figure C1)

An example from the study is given in Figure C3 from a Puffin site without guardrailing. Numbers are the percentage of all observed crossing pedestrians who used a particular O–D (i.e. 21.5 per cent of all pedestrians observed crossed from M to V, using the crossing as designed). Note that pedestrians crossing from J, K, L to X, Y, Z and vice versa were amalgamated, as these numbers were generally small. Similar amalgamations were made for movements from V to J,K and P,Q and M to R,S and Y,Z.

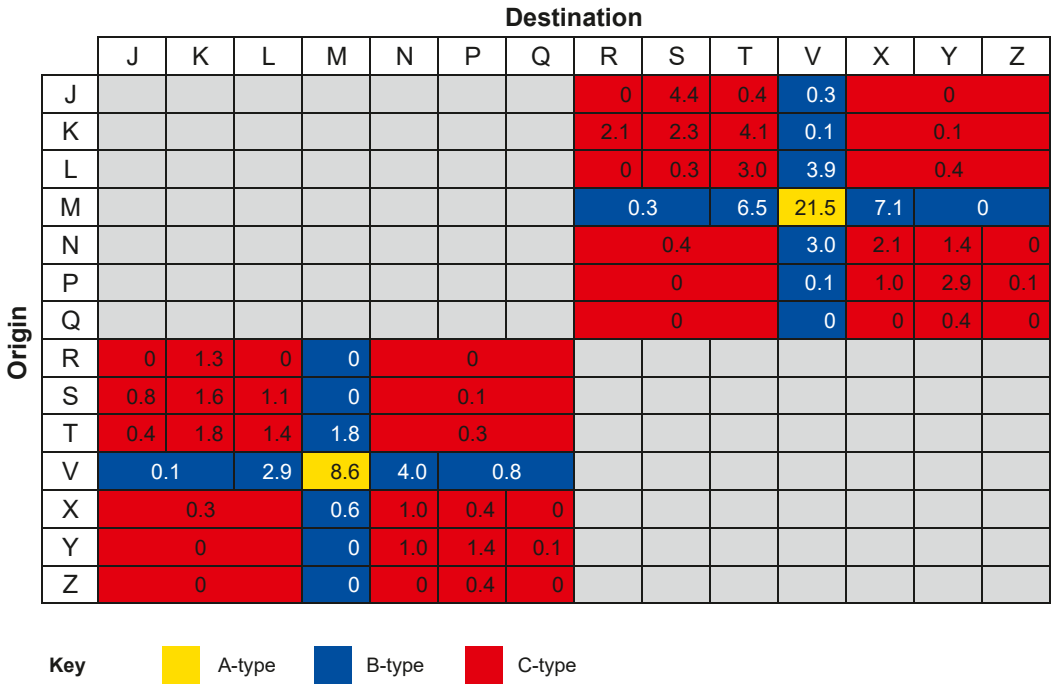

Figure C3: Example origin–destination grid co-ordinate system

The example matrix data illustrated in Figure C3 for a Puffin crossing site without guardrailing in Oxford (see Figure C4 for site video still). The figures shown represent a summary of the site details recorded during the study. Table C1 shows the key information for the Oxford site.

Table C1: Example Puffin crossing without guardrailing

Site	**OX-09**	**Puffin crossing**	
Location – OXFORD		**High St**	
Guardrail		No	
Refuge		No	
Vehicle flow		408 vph	
85th percentile speed		18.0 mph	
Crossing pedestrian flow		691 pph	
All collisions (48 months)		3	
Pedestrian collisions		2	
Total collisions per year		0.75	
Total pedestrian collisions per year		0.5	
Behavioural Indices	UR(%)	CUR(%)	FUR(%)
	61.6	49.0	30.2

Figure C4: Site OX-09, Oxford – video still of site

Junction sites

For junction sites, a similar approach should be adopted, shown in Figure C5. The observation area could be divided into six sections, the designated crossing itself, and three road sections on the side away from the junction, the kerb between the crossing point and the junction, and within the junction centre.

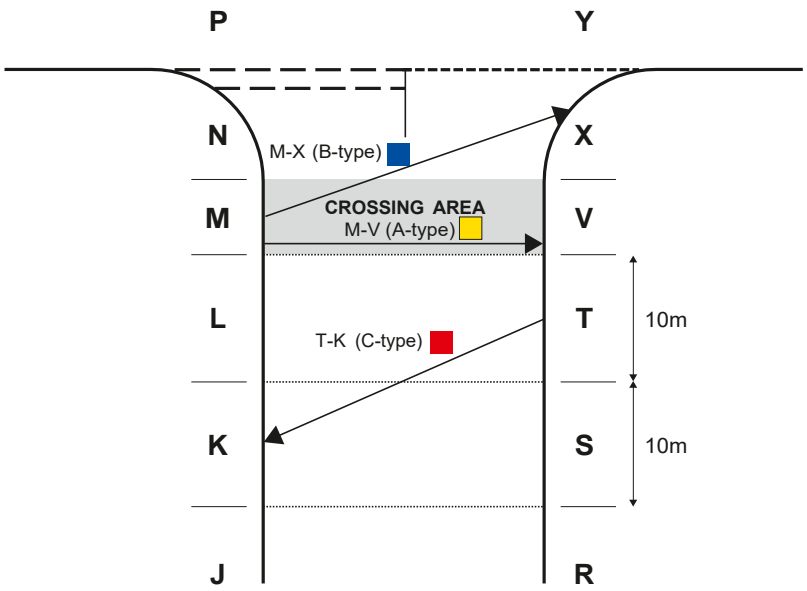

Figure C5: Typical layout for a junction site with reference letters for use in origin-destination grid co-ordinate system (see Figure C6)

The pedestrian movements origin–destination grid coordinate system for junction sites is similar to the one for link sites. The example in Figure C6 is colour-coded to show which category each of the possible movements falls into.

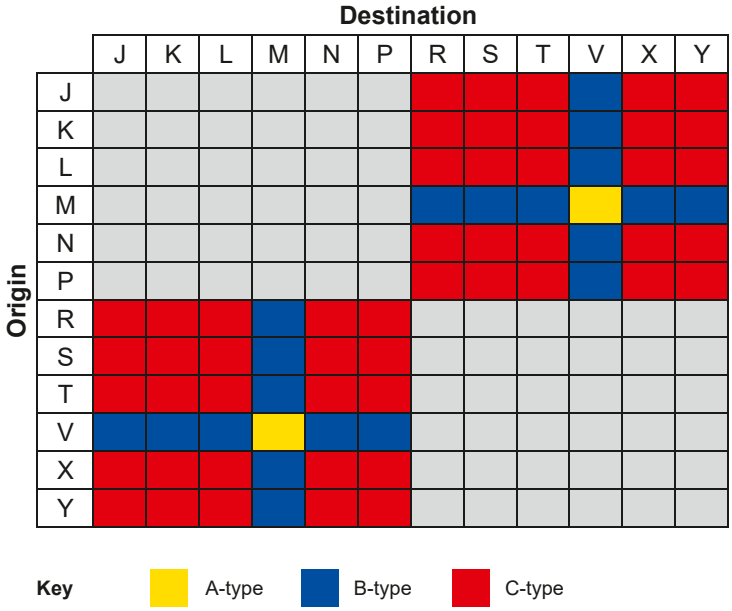

Figure C6: Origin–destination grid co-ordinate system for use with junction sites (see Figure C5)

Appendix D Library reference data

If local observational data are not available from a reference site, the indices listed in Table D1 should be used as the primary measures of behaviour (see paragraph 3.3.4 for further information). These values may also be used to validate a chosen reference site.

Table D1: Average effectiveness indices of a sample of sites. The figures indicate the number of sites used to determine the average values for each of the indices, as well as the minimum and maximum values of each of the indices of those sites

Site type	$UR_{(R)}$ (%)	$CUR_{(R)}$ (%)	$FUR_{(R)}$ (%)
Signalised junction arm			
With guardrailing	94	89	83
(7 sites)	min 86 / max 100	min 79 / max 99	min 71 / max 98
Without guardrailing	61	64	40
(7 sites)	min 43 / max 78	min 37 / max 98	min 19 / max 72
Roundabout arm			
With guardrailing	97	93	90
(6 sites)	min 89 / max 100	min 83 / max 98	min 81 / max 98
Without guardrailing	55	56	32
(5 sites)	min 21 / max 78	min 47 / max 71	min 12 / max 55
Priority junction arm			
With guardrailing	90	78	72
(6 sites)	min 80 / max 99	min 28 / max 97	min 22 / max 96
Without guardrailing	77	67	56
(6 sites)	min 47 / max 99	min 19 / max 91	min 9 / max 86
Zebra crossing			
With guardrailing	96	93	89
(8 sites)	min 88 / max 100	min 82 / max 97	min 72 / max 97
Without guardrailing	85	65	56
(11 sites)	min 69 / max 99	min 44 / max 91	min 35 / max 86
Signalised pedestrian crossing			
With guardrailing	90	82	74
(11 sites)	min 78 / max 100	min 54 / max 100	min 42 / max 97
Without guardrailing	78	68	53
(10 sites)	min 62 / max 89	min 49 / max 79	min 30 / max 65

Department for Transport

Local Transport Note 2/09

April 2009

Pedestrian Guardrailing

This Local Transport Note provides guidance about pedestrian guardrailing for local authorities. It describes the development of policy guidance on guardrailing and an assessment procedure for the evaluation of the need for the installation or removal of pedestrian guardrailing, particularly at pedestrian crossings and road junctions. It encourages authorities to consider developing and using an audit trail, recording decisions and actions taken when considering pedestrian guardrailing schemes.

ISBN 978 0 11 553065 4

£25

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ISBN 978-0-11-553065-4

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