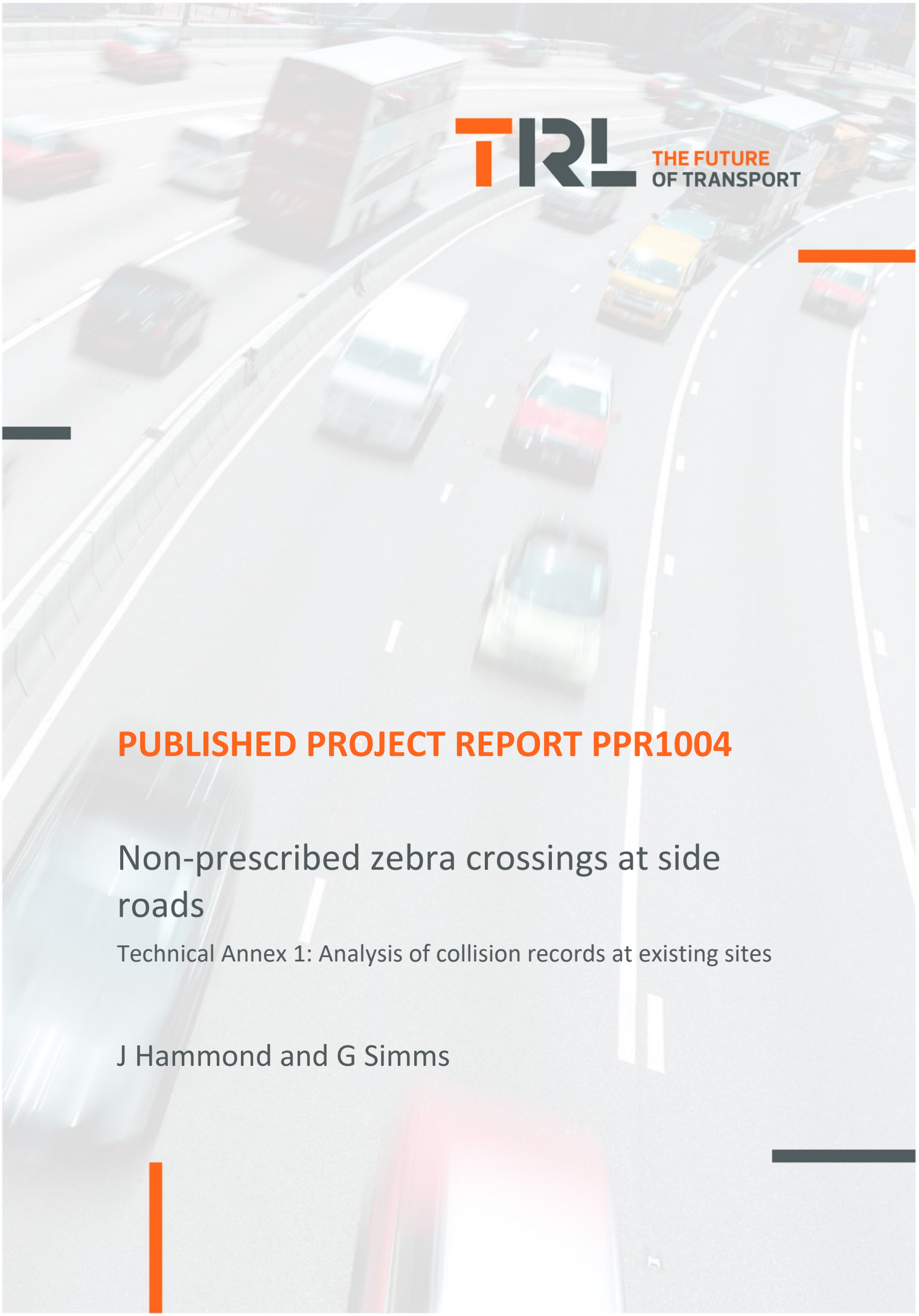

THE FUTURE OF TRANSPORT

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Non-prescribed zebra crossings at side roads

Technical Annex 1: Analysis of collision records at existing sites

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Report details

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Executive summary

This document forms a Technical Annex to the report *Trials of non-prescribed Zebra crossings at side roads: Final Report*. It forms part of a programme of research involving desk-based research, behavioural studies and on-street trials commissioned by Transport for Greater Manchester (TfGM), to understand how non-prescribed zebra crossings can be positioned flush against the mouths of side roads. This technical annex reports on a study of the collision record at sites with existing (non-compliant) zebra crossings.

There are two main questions addressed in this report:

- What is the collision record for 'full' zebra crossings at side roads and how does this compare with other nearby side roads with no markings?
- What is the collision record for 'non-full' zebra crossings at side roads and how does this compare with side roads with no markings in general?

The locations of 15 'full' zebra crossings (zebra crossings with Belisha beacons and zig-zag lines) placed flush against the mouths of side roads and 38 'non-full' zebra crossings (zebra markings only and no Belisha beacons or zig-zag lines) were identified by reviewing lists of zebra crossings sites provided by TfGM against a set of criteria.

Collision data covering the period 2008-2017 was collated for these locations. For each of the 'full' zebra crossings included in analysis, a comparator site on a nearby side road with no zebra markings or other pedestrian crossing facilities was found and collision data collated for these locations too. In order to provide a comparison dataset for the 'non-full' zebra crossings, collision data for general side roads with no pedestrian crossings across Great Britain was collated. There were 57,661 collisions across all minor side roads with no pedestrian crossings in Great Britain between 2008 and 2017.

Eight of the 'full' zebra crossings identified had an island or refuge in the middle of the crossing and seven did not so collisions from 'full' zebra crossings with and without islands and their respective comparators were analysed separately.

Statistical tests showed that there was no significant difference in the number of collisions per site per year at 'full' zebra crossings and the number at nearby comparator side roads with no markings. This result was true for both crossings with islands and crossings without. In total, there were 16 collisions at 'full' zebra crossings with islands and 15 at comparator sites between 2008 and 2017 which occurred whilst the crossing in question was in place. There were 24 collisions at 'full' zebra crossings without islands and 23 at the respective comparator sites.

Analysis of collision characteristics such as casualty class, severity, vehicle manoeuvre and location and contributory factors showed little different between the types of collisions which happened at 'full' zebra crossings both with and without islands and their comparators. However, the total numbers of collisions at the different locations were too small to perform statistical analysis on the distributions of individual collisions characteristics.

The number of collisions at 'non-full' zebra crossings was much smaller than at 'full' zebra crossings, there were only 29 during the period of interest. This meant that the number of collisions at 'non-full' zebra crossing sites was too small to perform statistical tests comparing

collision characteristics with side roads in general. However, the characteristics of collisions at general side roads and the specific locations with 'non-full' zebra crossings were generally similar.

The analysis presented in this report has shown no indication that the collision record at 'full' zebra crossings is different to the collision record at nearby side roads with no markings. Also, when comparing 'non-full' zebra crossings and side roads with no markings in general, there are no apparent differences in any particular collision characteristic. However, it is important to note that all comparisons should be treated with caution as the numbers of collisions available for analysis is small.

The analysis presented in this report is only the first element of the investigation into side road zebra crossings and should be considered in conjunction with planned research into other important areas such as road user behaviour and understanding of the crossings. Later stages of this project will involve undertaking on-road trials. Nothing in the analysis in this report has indicated any previously unidentified risks that would need to be considered in the design of these trials.

1 Introduction

1.1 This document

This document forms a Technical Annex to the report *Trials of non-prescribed zebra crossings at side roads: Final Report*, which presents the findings of a programme of user research and trials into the proposed use of a non-prescribed form of zebra crossing at side-roads. Technical Annex 1 sets out the methodology and findings from the first stage in this programme, an investigation of the collision statistics (Stats19) from existing sites where zebra crossing markings have been installed at the mouth of side-road junctions. The overall conclusions from the research programme are set out in the Final Report.

1.2 Background

TfGM is seeking to understand the risks and safety benefits of different types of side road zebra crossings. 'Side road zebra crossing' in this context refers to a zebra crossing positioned flush against or close to the mouth of a side road in an urban area. Such a crossing design gives pedestrians a much more direct route compared with having to divert to crossings located at a distance down each side road. TfGM commissioned TRL to conduct research into the proposed crossing design which involves desk-based research and behavioural studies followed by on-street trials. The design of the trials will be informed by the findings from the earlier stages of the project, enabling risks to be identified and mitigated before infrastructure is implemented on street.

Although the requirements for zig-zag markings would preclude positioning a fully compliant zebra crossing at the mouth of a side road crossing, examples of non-prescribed crossings can nonetheless be found across the UK, in particular on private roads such as in retail and industrial parks. Non-compliant designs range from being otherwise 'full' in that, apart from lacking the full zig-zag marking, they have all the other features of a zebra crossing, simple crossings that have only the striped markings ('non-full').

The aim of the research presented in this report was to investigate the collision record at existing side road zebra crossings of different types and to explore what effect such zebra crossings have on the number, severity and characteristics of collisions. This report aims to answer the following two main research sub-questions.

1. What is the collision record for 'full' zebra crossings at side roads and how does this compare with other nearby side roads with no markings?
2. What is the collision record for 'non-full' zebra crossings at side roads and how does this compare with side roads with no markings in general?

To undertake the research for the first question, characteristics of collisions at specific locations where these types of crossings are installed were explored and compared with characteristics of collisions at specific nearby roads with no zebra markings or pedestrian crossing facilities. Results of this analysis are presented in section 3.

The aim of the second question was to explore the collision record at 'non-full' zebra crossings. Characteristics of collisions at specific sites where these types of crossings are in place have been compared with characteristics of collisions at side road crossings across Great Britain in general. Results of this analysis are presented in section 4.

2 Methodology

This section describes the methodology used to identify the locations of crossings to be used in the analysis and extract collision data for these locations.

2.1 Identifying locations

The crossing locations were chosen by reviewing lists of crossings provided by TfGM against a list of criteria. Crossing locations were viewed using Google Streetview and those which met the criteria were included in analysis.

The criteria for identifying crossing locations were developed from a set of characteristics provided by TfGM for locations were side road zebra crossings have been or are likely to be installed. This list included criteria on attributes such as road class, number of lanes, width of road and footway, flow and surrounding environment (e.g. residential area). However, some of these characteristics, such as flow and width were not accurately identifiable from looking at the crossings on Google Streetview. Also, there was a risk of an insufficient number of crossing locations which matched the criteria being identified for analysis if the criteria were too stringent. Therefore, a shortlist of characteristics was chosen, and criteria set based on this shortlist:

- Crossing is on C-road or unclassified road (this was used as a proxy for flow, to ensure that crossings on larger, busier roads were not included)
- Crossing is placed close to the mouth of a side road
- Both the side road and the main road are 2-way (i.e. all turning manoeuvres in and out of the side road are permitted)
- The side road has only one lane in both directions

Further criteria were then applied to split the crossing locations into two sets: crossings with beacons and zig-zag lines (i.e. 'full' zebra crossings) and crossings without beacons and zig-zig lines (i.e. 'non-full' crossings with zebra black and white give way markings only).

In addition, crossings where the two halves of the crossing were separated by an island were excluded from the second set. Most 'non-full' crossing locations eligible for inclusion in this analysis did not have an island and therefore those with an island were excluded to ensure that all the crossing locations used in the analysis were as similar as possible.

There were fewer eligible crossing locations for the 'full' zebra crossing analysis and approximately half had an island. Therefore, to ensure a sufficient number of crossings were included for robust analysis, both crossings with and without islands have been included; although the analysis has been split by this variable.

For each 'full' zebra crossing location included in the analysis, another similar junction close by (on the same road if possible) which had the same characteristics was found to act as a 'comparator' location. There was one crossing location where no suitable comparator location could be found so this crossing location was excluded from analysis.

There were 15 'full' zebra crossing locations identified for inclusion in the analysis and 38 'non full' crossings. A full list of the crossing and comparator locations can be found in Appendix A.

2.2 Extracting collision data

Once the crossing and comparator locations had been identified, data about the collisions at each of these locations was extracted from the Stats19 database. The Stats19 database is a database of reported injury collisions on public roads in Great Britain, owned by the Department for Transport, which records information about collisions, the vehicles and casualties involved, and factors which may have contributed[1]. There are no damage-only collisions recorded in Stats19 and collisions resulting in only slightly injured casualties are also known to be under-reported in the database.

Each crossing or comparator identified to be included in analysis had latitude and longitude coordinates recorded as part of the crossing review process. Map coordinates are also recorded in Stats19 and, using GIS software, all collisions within 20 metres of each location were identified. To account for any errors in the collision coordinates recorded in Stats19, a further criterion was applied to ensure that only collisions which were recorded as having happened at a junction were included.

Originally, only collision data for the 5-year period 2013-2017 was to be used in analysis. However, too few collisions at the locations of interest were identified and therefore the period of interest was increased to 10 years meaning the collision data used covers the period 2008-2017.

As the crossings were all installed at different times, only collisions which occurred whilst a crossing was in place have been included in analysis. This means collision data from different crossing sites covers different periods of time between 2008 and 2017. To enable direct comparison of collision numbers between the crossing and comparator sites, only collisions at the comparator sites which occurred whilst the relevant crossing was in place have been included in analysis. The date of installation of each crossing included in analysis was estimated by using Google Streetview to find the earliest image where the crossing was in place. These dates are presented in the lists of crossings in Appendix A.

For the 'non-full' zebra crossing analysis, a dataset of collisions at side roads with no zebra markings across the whole of Great Britain was also required. This was collated by identifying all collisions in Stats19 between 2008 and 2017 which matched the following criteria:

- Road type: single carriageway

[1] For more information about Stats19 see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/259012/rrcgb-quality-statement.pdf

- Junction type: T or staggered junction[2] without traffic lights
- Road class of minor road at junction: C or unclassified
- No physical or human controlled pedestrian crossing facilities within 50m[3]
- At least one vehicle involved in the collision either leaving or entering the main road

[2] Stats19 does not differentiate between T junctions and staggered junctions

[3] 50m is distance specified in Stats19 reporting form

3 What is the collision record for 'full' zebra crossings at side roads and how does this compare with other nearby side roads with no markings?

This section presents the results of analysis of collisions at 15 'full' side road zebra crossing locations and 15 comparator locations.

Of these 15 crossings, eight have islands in the middle and seven do not. For robust analysis, crossings grouped together need to be as similar as possible and crossings with islands are likely to have different characteristics and risks to those without. Therefore, collisions at these two types of crossing (and their respective comparators) have been analysed separately. Comparisons are made between each type of crossing and their comparator sites, but the two types of crossing should not be directly compared.

3.1 Collision record summary

The results presented in this section are numbers of collisions at the various crossing and comparator locations. The overall collision numbers at the different types of locations are presented along with high-level details about the numbers of vehicles and casualties involved to provide background for the more detailed analysis presented in subsequent sections (analysis of collisions involving pedestrian casualties is presented in section 3.2.2).

Table 1 shows the number of collisions at crossings with and without islands and their respective comparator sites. The number of collisions per site per year is also presented.

Table 1: Total number of collisions and collisions per site per year at crossings with/without islands and their comparators

	Total number of collisions		Collisions per site per year	
	Crossing	Comparator	Crossing	Comparator
Crossings with islands	16	15	0.11	0.12
Crossings without islands	24	23	0.11	0.12

As shown in Table 1, crossings and their comparator sites have very similar numbers of collisions. This is true for both types of crossing (with and without islands). The number of collisions per site per year at crossings both with and without islands was 0.11 and the number of collisions per site per year at both sets of comparator sites was 0.12.

A Poisson test[4] was performed to compare the number of collisions per site per year at crossings with islands and their comparators. The test showed that there was no significant

[4] This test compares the collision rates at the two locations to establish whether they are more different than would be expected by chance (significantly different). As part of the test, a 'p-value' is calculated which is a measure indicating the probability of any difference being explained by chance (generally a p-value less than 0.05 indicates statistical significance).

difference between the number of collisions per site per year at crossings with islands and their comparators (p-value = 0.85).

The same test was performed for crossings without islands and it gave the same result: there was no significant difference between the number of collisions per site per year at crossings without islands and their comparators (p-value = 0.88).

Figure 1 shows the total number of collisions at the two types of crossings and their comparators split by the number of vehicles involved.

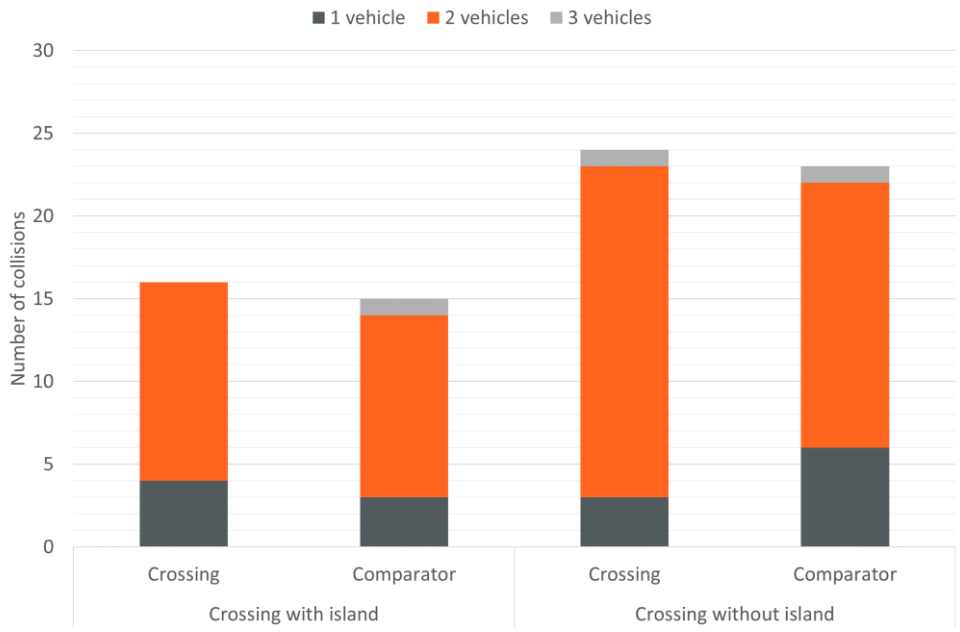

Figure 1: Number of collisions at crossings with/without islands and their comparators; by number of vehicles involved in collision

As shown in Figure 1, the vast majority of collisions at crossings and comparators involved two vehicles. The highest number of vehicles involved in any collision was three and there were only three such collisions.

Almost all collisions included in this analysis had only one casualty recorded. There were four collisions which involved two casualties and these collisions all occurred at comparator sites for crossings without an island. However, the numbers are too small to draw any robust conclusions from this fact.

Key points – collision record summary

- There is no statistically significant difference between collision rates at crossings with islands and their comparators or crossings without islands and their comparators.
- Almost all collisions involved only one casualty and most casualties had injury severity recorded as ‘slight’.

3.2 Further collision characteristics

This section aims to further explore the characteristics of the collisions of interest to understand any differences there may be between the characteristics of collisions at crossing and comparator sites.

3.2.1 Summary of casualty numbers

This section presents a summary of the characteristics of the casualties involved in the collisions, so all numbers presented are counts of casualties rather than collisions. Table 2 shows the total number of casualties at the different types of locations and the corresponding casualties per site per year.

Table 2: Total number of casualties and casualties per site per year at crossings with/without islands and their comparators

	Total number of casualties		Casualties per site per year	
	Crossing	Comparator	Crossing	Comparator
Crossings with island	16	15	0.11	0.12
Crossings without island	24	27	0.11	0.12

Almost all collisions had only one casualty and therefore the casualty numbers presented in Table 2 follow a similar pattern as the collision numbers reported in Table 1. The only exception is that there are slightly more casualties at non-island comparators than non-island crossings. This is because there were four collisions at non-island comparator sites which involved two casualties. The collisions per site per year and the casualties per site per year are the same for both types of crossings and their comparators.

There were no fatal casualties at any of the crossings or comparators during the period of interest. Almost all the casualties had severity recorded as slight and there were only five serious casualties, all of which happened at crossings without islands. All five of the seriously injured casualties were drivers or riders of vehicles.

Figure 2 shows the number of casualties at the different types of location split by whether the casualty was a driver/rider, passenger or pedestrian.

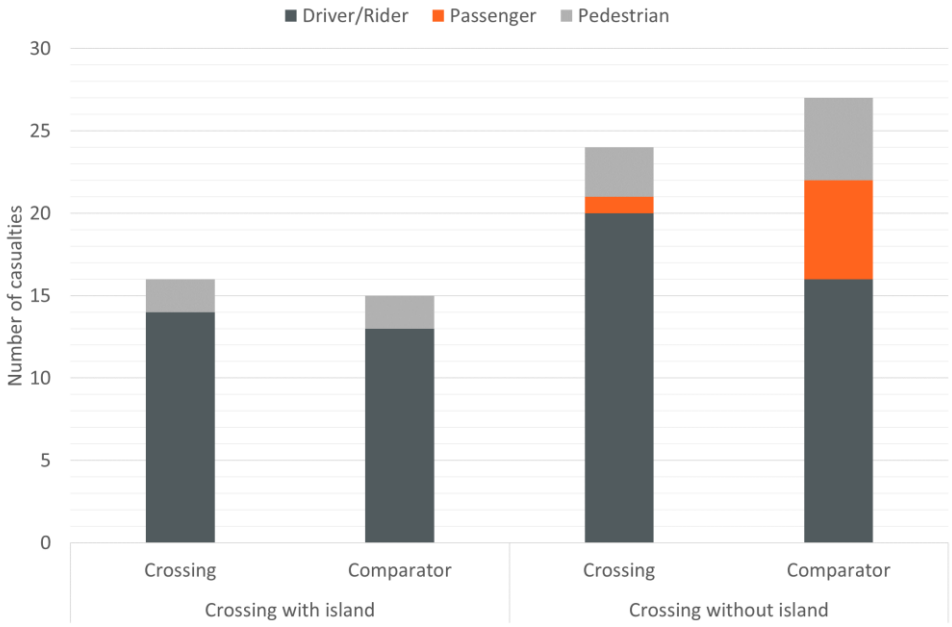

Figure 2: Number of casualties at crossings with/without islands and their comparators; by casualty class

For crossings with islands, both the crossings and comparator sites had a similar distribution of casualty classes with around 87% of casualties being drivers or riders and around 13% being pedestrians.

At crossings without islands, the distribution varies more between the crossings and comparator sites. At crossings, 83% of casualties were drivers or riders while passengers and pedestrians made up 4% and 13% of the total respectively. At the comparator sites the distribution of casualty class is different: passengers made up 22% of the total and pedestrians 18%. However, the number of casualties in each casualty class category is too small to perform reliable statistical comparisons between crossings and comparators.

3.2.2 Pedestrian casualty analysis

There are two fields in the Stats19 database which record what a pedestrian was doing when a collision occurred: pedestrian location (e.g. in carriageway, on footway, on refuge) and pedestrian movement (e.g. crossing from driver's nearside/offside, walking along, stationary in carriageway). These fields are recorded for injured pedestrians only, the presence of uninjured pedestrians in only recorded if they were deemed to have been a 'carriageway hazard'. None of the collisions included in this analysis had the presence of an uninjured pedestrian reported.

There were 12 casualties involved in the collisions included in this analysis. One casualty had both pedestrian location and movement recorded as unknown. The location and movement for the remaining 11 casualties are shown in Table 3.

Table 3: Number of pedestrian casualties at crossings with/without islands and their comparators; by location and movement

Pedestrian location	Pedestrian movement	Crossing with island		Crossing without island	
		Crossing	Comparator	Crossing	Comparator
Crossing on pedestrian crossing	Crossing from driver's nearside	1			
	Unknown			1	
Crossing elsewhere	Crossing from driver's nearside		2		2
	Crossing from driver's offside	1		2	2
Total*		**2**	**2**	**3**	**5**

* Includes casualty where location and movement were unknown

The figures presented in Table 3 indicate that all the pedestrian casualties for which pedestrian location and movement were known (11 casualties), were injured whilst crossing the road. Two were crossing on a pedestrian crossing: one at the site of a crossing with an island and one at the site of a crossing without. The remaining nine were all crossing elsewhere but it is not possible from the data to know whether they were crossing the side road or the major road.

All 12 pedestrian casualties were injured in collisions which involved only one vehicle. Table 4 shows the vehicle manoeuvres for the vehicles which collided with these pedestrian casualties. The figures are also split by the location of the vehicle at the junction.

Table 4: Number of pedestrian casualties at crossings with/without islands and their comparators; by junction location of vehicle and vehicle manoeuvre

Junction location of vehicle	Vehicle manoeuvre	Crossing with island		Crossing without island	
		Crossing	Comparator	Crossing	Comparator
Approaching junction	Overtaking on nearside		1		
	Going ahead			1	2
Cleared junction/ waiting at exit	Going ahead	1			
Leaving main road	Turning right			1	
Entering main road	Turning right			1	
Mid-junction	Reversing		1		
	Moving off				2
	Turning right	1			1
Total		**2**	**2**	**3**	**5**

As the number of casualties is so small and most location and manoeuvre combination categories shown in Table 4 contain only one casualty, it is difficult to make comparisons between crossing and comparator sites at this level.

When considering vehicle manoeuvre only, it is interesting to note that none of the pedestrians at any of the location types were injured by a vehicle turning left, although two

pedestrians at crossings without islands, one at the comparator for a non-island crossing and one at a crossing with an island were injured by a vehicle turning right.

3.2.3 Vehicle analysis

In total there were 147 vehicles involved in collisions at crossings with/without islands and their comparators. This section presents analysis of all vehicles involved in collisions at the different types of locations, regardless of whether there was a casualty in the vehicle or not.

As discussed in section 3.1, the majority of collisions at each of the different location types involved two vehicles and none of the collisions of interest involved more than three vehicles. Table 5 shows the total number of vehicles involved in collisions at the different types of site to provide context for the charts presented in this section

Table 5: Total number of vehicles involved in collisions at crossings with/without islands and their comparators

	Crossing	Comparator
Crossings with island	28	28
Crossings without island	46	45

As expected, the number of vehicles involved in collisions is similar between crossings and comparators for both crossings with islands and those without.

Figure 3 shows the distribution of vehicle types involved in collisions at crossings with/without islands and their comparators.

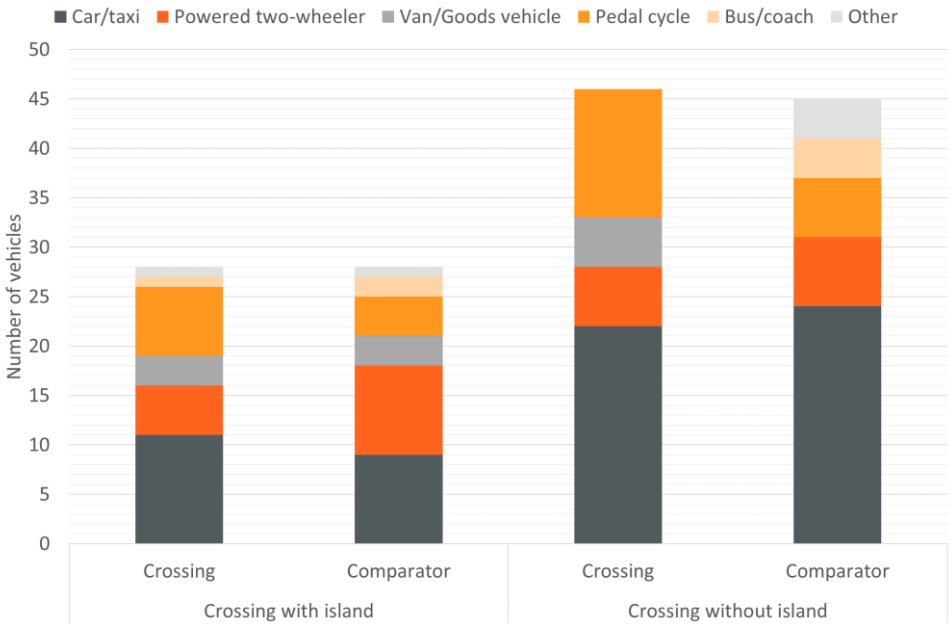

Figure 3: Number of vehicles in collisions at crossings with/without islands and their comparators; by vehicle type

For crossings with islands, Figure 3 shows that there were more powered two-wheelers involved in collisions at comparator sites (9 vehicles) than sites with crossings (5 vehicles).

Also, there were more pedal cycles in collisions at crossings (7 pedal cycles) than comparators (4 pedal cycles).

For crossings without islands, there are also differences in vehicle type distribution between crossings and comparators. At crossings, there were 13 pedal cycles involved in collisions at crossings whereas at comparator sites there were only six. Also, there were four vehicles in the 'Bus/coach' category involved in collisions at comparators but none at crossings and five vans/goods vehicles in collisions at crossings but none at comparators.

In both cases, crossings with islands and those without, the number of vehicles of each type at the different locations are too small to perform statistical analysis. As exposure could not be accounted for here, the differences in vehicle type distribution are likely to be a result of differences in the total number of vehicles of different types which use the different side roads.

Figure 4 and Figure 5 show the number of vehicles involved in collisions at crossings with/without islands and their comparators split by location of vehicle at junction (Figure 4) and vehicle manoeuvre (Figure 5).

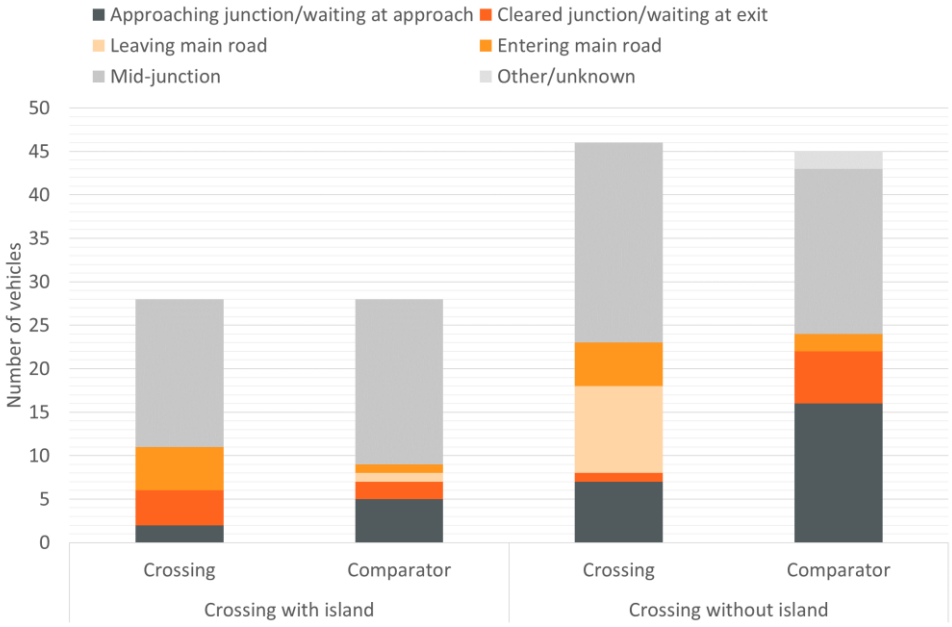

Figure 4: Number of vehicles in non-pedestrian collisions at crossings with/without islands and their comparators; by junction location of vehicle

Figure 4 shows that at crossings and comparators for sites both with and without islands, the junction which was recorded for the largest number of vehicles was 'mid-junction'.

At crossings with islands, five vehicles were entering the main road when they were involved in a collision but at comparator sites there was only one vehicle in this location.

For crossings without islands, a larger number of vehicles involved in collisions had junction location recorded as 'leaving main road' (10 vehicles) than 'entering main road' (5 vehicles). However, at the corresponding comparator sites, there were five vehicles entering the main road and none leaving it.

Similar to the vehicle type analysis presented above, the number of vehicles in each junction location category at each location is not enough to perform statistical comparisons of junction location between crossings and comparators. This is also true for the analysis of vehicle manoeuvre presented in Figure 5 below.

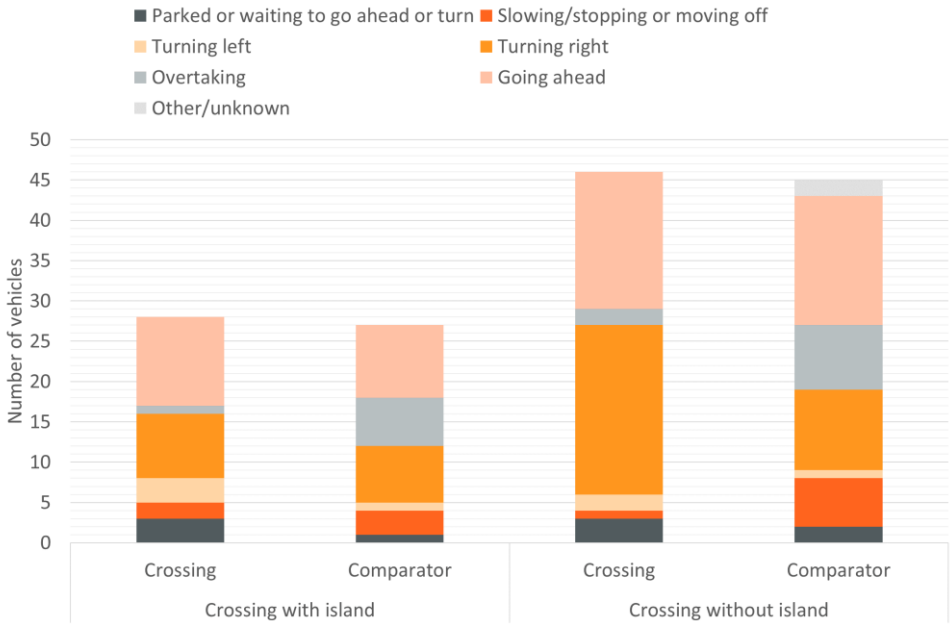

Figure 5: Number of vehicles in non-pedestrian collisions at crossings with/without islands and their comparators; by vehicle manoeuvre

Figure 5 shows that a large number of vehicles involved in collisions at each type of locations were 'going ahead'. This is expected as this manoeuvre is one of the most common manoeuvres recorded for vehicles involved in collisions in general.

Also, at all types of locations, there were more vehicles involved in collisions whilst turning right than turning left. This supports the results shown in Table 4 for vehicles involved in pedestrian collisions.

Figure 5 also shows that, at crossings with islands, there was only one vehicle involved in a collision whilst overtaking. However, at the corresponding comparator sites there were six vehicles involved in collisions whilst doing this manoeuvre. This pattern is also true for crossings without islands: the number of vehicles overtaking was two at crossings and eight

at comparators. Also, for crossings without islands, there were over twice as many vehicles turning right (21 vehicles) as there were at comparators (10 vehicles).

Key points – further collision characteristics

- Most casualties at each type of location were drivers or riders.
- There were 11 pedestrian casualties across the locations, all of which were injured whilst crossing the road.
- For all types of location, a higher proportion of vehicles involved in collisions were turning right than turning left. This pattern is also true when looking only at vehicles which hit pedestrians.

3.3 Contributory factor analysis

For each collision recorded in Stats19, up to six factors are recorded which the police believe contributed to the collision. Not all collisions are attended by the police and have contributory factors recorded. Therefore, only the subset of collisions at each type of location where the police were in attendance and at least one contributory factor was recorded is analysed here. It is important to note that, as contributory factors are recorded by the police after the collision, there is some subjectivity in the data.

Table 6 shows the contributory factors which were recorded for collisions at crossings with islands and their comparators, ordered by most common. The proportion of total collisions (where police attended and at least one contributory factor was recorded) which had each contributory factor recorded is also presented. As multiple factors can be recorded for each collision, the numbers in the 'Number of collisions' collisions column do not sum to the total number of collisions where police attended and at least one contributory factor was recorded and should not be added up.

As the number of collisions analysed is small, there were a number of factors which were only recorded in one collision. These factors are not reported in Table 6; the table only shows those factors which were recorded for two or more collisions.

Table 6: Contributory factors recorded for collisions at crossings with islands and their comparators

	Contributory factor category	Contributory factor	Number of collisions	Proportion*
Crossing	Driver error/reaction	Driver failed to look properly	13	81%
	Driver error/reaction	Misjudged other's path or speed	5	31%
	Driver behaviour	Driver careless/reckless/in a hurry	4	25%
	Driver error/reaction	Junction restart	4	25%
	Driver error/reaction	Poor turn or manoeuvre	2	13%
	Driver injudicious action	Disobeyed Give Way/Stop sign/markings	2	13%
	Driver error/reaction	Sudden braking	2	13%
	Total collisions where police attended & at least one CF was recorded		**16**	**100%**
Comparator	Driver error/reaction	Driver failed to look properly	6	50%
	Driver error/reaction	Poor turn or manoeuvre	4	33%
	Driver behaviour	Driver careless/reckless/in a hurry	4	33%
	Driver error/reaction	Misjudged other's path or speed	3	25%
	Driver injudicious action	Travelling too fast for conditions	3	25%
	Driver error/reaction	Sudden braking	2	17%
	Driver error/reaction	Loss of control	2	17%
	Total collisions where police attended & at least one CF was recorded		**12**	**100%**

* Proportion of collisions where police attended and at least one CF was recorded

All the collisions at crossings with islands and 80% (12 out of 15) of collisions at the comparators for these crossings were attended by police and had a contributory factor recorded.

At both crossings and comparators, the most common contributory factor was 'Driver failed to look properly'. This is expected because this is one of the most common contributory factors recorded for collisions in general in Stats19. Other factors which were recorded at both crossings and comparators include 'Misjudged other's path or speed', 'Poor turn or manoeuvre' and 'Driver careless/reckless/in a hurry'. Again, these are also very common contributory factors in general.

Two collisions at crossings had 'Disobeyed Give Way/Stop sign/markings' recorded, and both of these collisions involved a vehicle turning right in or out of the side road. However, the data in Stats19 does not contain enough detail to establish whether the presence of the pedestrian crossing contributed in any way to the driver disobeying the give way markings in these two collisions.

Table 7 presents the same analysis as Table 6 but for crossings without islands.

Table 7: Contributory factors recorded for collisions at crossings without islands and their comparators

	Contributory factor category	Contributory factor	Number of collisions	Proportion*
Crossing	Driver error/reaction	Driver failed to look properly	13	72%
	Driver error/reaction	Misjudged other's path or speed	6	33%
	Driver error/reaction	Poor turn or manoeuvre	5	28%
	Driver behaviour	Driver careless/reckless/in a hurry	4	22%
	Vision affected by	Vehicle blind spot	3	17%
	Vision affected by	Stationary or parked vehicle(s)	3	17%
	Pedestrian	Pedestrian failed to look properly	2	11%
	Driver impairment	Distraction in vehicle	2	11%
	Driver impairment	Distraction outside vehicle	2	11%
	Pedestrian	Impaired by alcohol	2	11%
	Pedestrian	Wearing dark clothing at night	2	11%
	Total collisions where police attended & at least one CF was recorded		**18**	**100%**
Comparator	Driver error/reaction	Driver failed to look properly	9	53%
	Driver error/reaction	Misjudged other's path or speed	5	29%
	Driver error/reaction	Poor turn or manoeuvre	3	18%
	Pedestrian	Pedestrian failed to look properly	3	18%
	Vision affected by	Pedestrian careless/reckless/in a hurry	3	18%
	Driver behaviour	Driver careless/reckless/in a hurry	3	18%
	Driver error/reaction	Sudden braking	3	18%
	Pedestrian	Stationary or parked vehicle(s)	2	12%
	Driver error/reaction	Failed to signal/misleading signal	2	12%
	Driver injudicious action	Exceeding speed limit	2	12%
	Total collisions where police attended & at least one CF was recorded		**17**	**100%**

* Proportion of collisions where police attended and at least one CF was recorded

Of the 24 collisions at crossings without islands and the 23 collisions at their comparators, 75% (18 out of 24) and 74% (17 out of 23) respectively were attended by the police and had at least one contributory factor recorded.

Again, the most common contributory factor recorded for collisions at both crossing and comparator sites was 'Driver failed to look properly'. 'Misjudged other's path or speed' and 'Poor turn or manoeuvre' were also commonly recorded at both types of location.

'Vision affected by stationary or parked vehicle(s)' was recorded at both crossings (3 out of 18 collisions) and comparators (2 out of 17 collisions). Of the collisions where this factor was recorded, three happened in the same area (one at a crossing and two at its comparator) and the other two happened at another crossing. This suggests that there are some particular

sites where stationary or parked vehicles are impacting drivers' or pedestrians' vision, but it is not possible to know if the presence of the crossing has contributed to this impact.

Key points – contributory factor analysis

- 'Driver failed to look properly' was the most common contributory factor for all location types (but this is a very common contributory factor across collisions in general).
- 'Disobeyed Give Way/Stop sign/markings' was recorded at two collisions at crossings with islands but it is not possible to know if the crossing was a cause.
- 'Vision affected by stationary or parked vehicle(s)' was recorded at crossings without islands and their comparators but this is likely to be a site-specific problem.

4 What is the collision record for 'non-full' zebra crossings at side roads and how does this compare with side roads with no markings in general?

This section presents analysis of collisions at 38 'non-full' zebra crossings and collisions at side roads with no markings in general. Results are presented as proportions of total collisions or casualties to enable comparisons between the two sets of collisions. However, as the number of collisions at 'non-full' zebra crossings is very small and the number of collisions at side roads with no markings during the same period is much larger, the results of any comparisons should be treated with caution.

4.1 Characteristics of collisions at side roads with no markings

The analysis presented in this section is of collisions at side roads with no markings across Great Britain between 2008 and 2017. The criteria used to extract the set of collisions for analysis is described in section 2.2.

A summary of the collision numbers is presented in section 4.1.1, followed by more detailed analysis of the characteristics of these collisions in the subsequent sections.

4.1.1 Summary of collision and casualty numbers

Between 2008 and 2017, there were 57,661 collisions at minor side roads with no pedestrian crossing facilities or zebra markings. This section presents a summary of these collisions and the vehicles and casualties involved.

Collisions in Stats19 are assigned to be either urban or rural where urban is defined as an area with population 10,000 or more and rural is anywhere which is not classed as urban. Figure 6 illustrates the proportional split of total collisions by urban or rural classification.

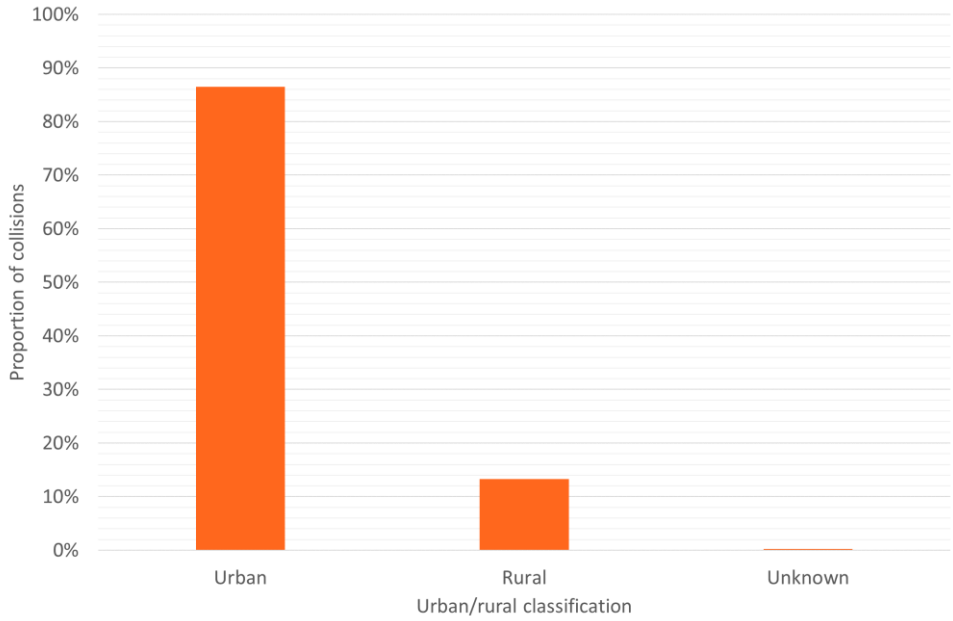

Figure 6: Proportion of side road collisions; by urban/rural classification (total: 57,661)

Most collisions, as shown in Figure 6, occurred in areas classified as urban (86%). As urban areas are more likely to be similar to the areas where the crossings used in the site-specific analysis in section 4.2 are located, analysis from this point onwards has been limited to collisions in urban areas (49,873 collisions).

Figure 7 shows the proportion of urban side road collisions split by the number of vehicles and the number of injured pedestrians involved. Uninjured pedestrians are not included in the data shown in this chart.

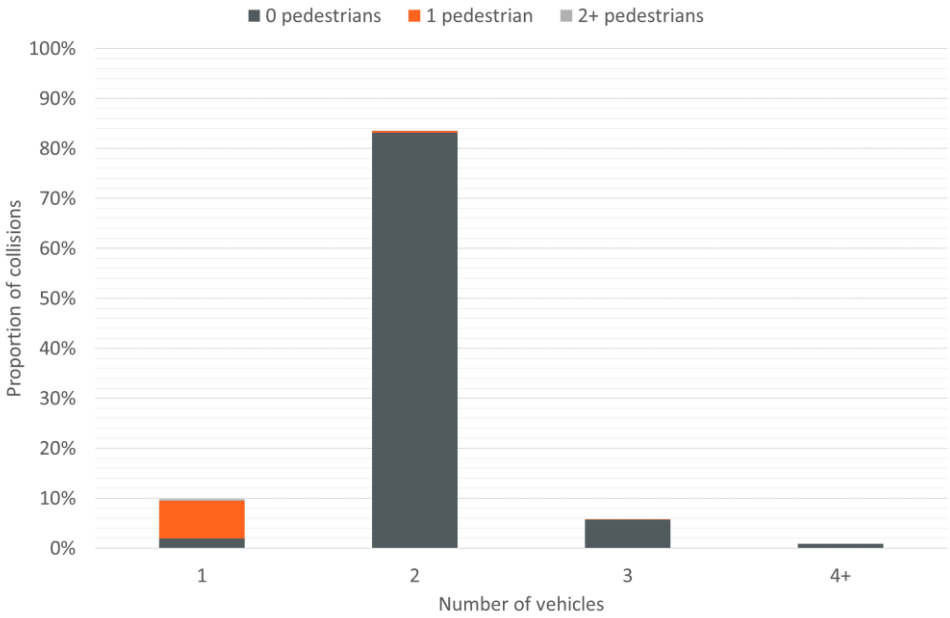

Figure 7: Proportion of urban side road collisions; by number of vehicles and number of pedestrian casualties involved (total: 49,873)

The majority of collisions (83%) involved two vehicles and no pedestrians, with 91% of collisions overall involving no pedestrian casualties. Figure 7 also indicates that almost all pedestrian casualties were involved in a collision with a single vehicle. The characteristics of these collisions involving pedestrian casualties are explored further in section 4.1.3.

The proportion of urban side road collisions by number of casualties involved is shown in Figure 8.

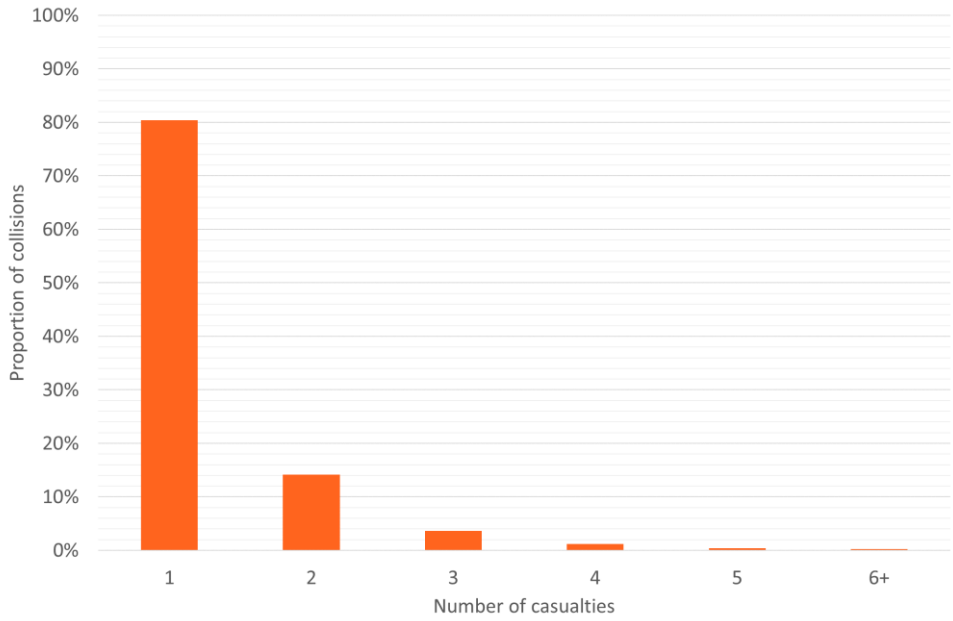

Figure 8: Proportion of urban side road collisions; by number of casualties (total: 49,873)

The majority (80%) of urban side road collisions involved one casualty and 14% involved two casualties. Collisions involving three or more casualties accounted for 6% of the total. Overall, there were 63,808 casualties in collisions at urban side roads and Figure 9 shows this total broken down by casualty class (driver/rider, passenger or pedestrian) and severity.

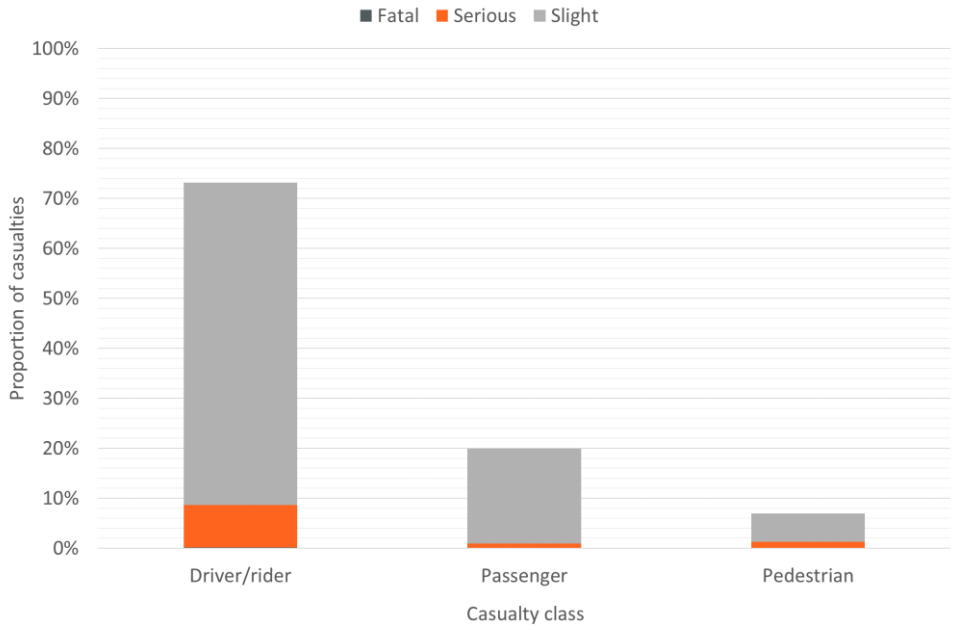

Figure 9: Proportion of casualties in urban side road collisions; by casualty class and severity (total: 63,808)

Driver/rider casualties accounted for 73% of casualties in urban side road collisions and passengers accounted for 20% and this is likely to be because most cars are singly occupied[5]. The casualty class which accounted for the smallest proportion of casualties was pedestrians (7%). The majority of the casualties in each casualty class had injury severity recorded as 'slight'. However, the pedestrian category had a much higher proportion of killed or seriously injured (KSI) casualties than the drivers/riders or passenger categories (although the majority of pedestrian casualties were still recorded as 'slight').

4.1.2 Vehicle analysis

As shown in Figure 7 in section 4.1.1, most collisions involved two vehicles. In total, there were 98,658 vehicles involved in urban side road collisions and this section presents analysis of vehicle type and manoeuvre for these vehicles.

Figure 10 shows the distribution of vehicle type for vehicles in urban side road collisions.

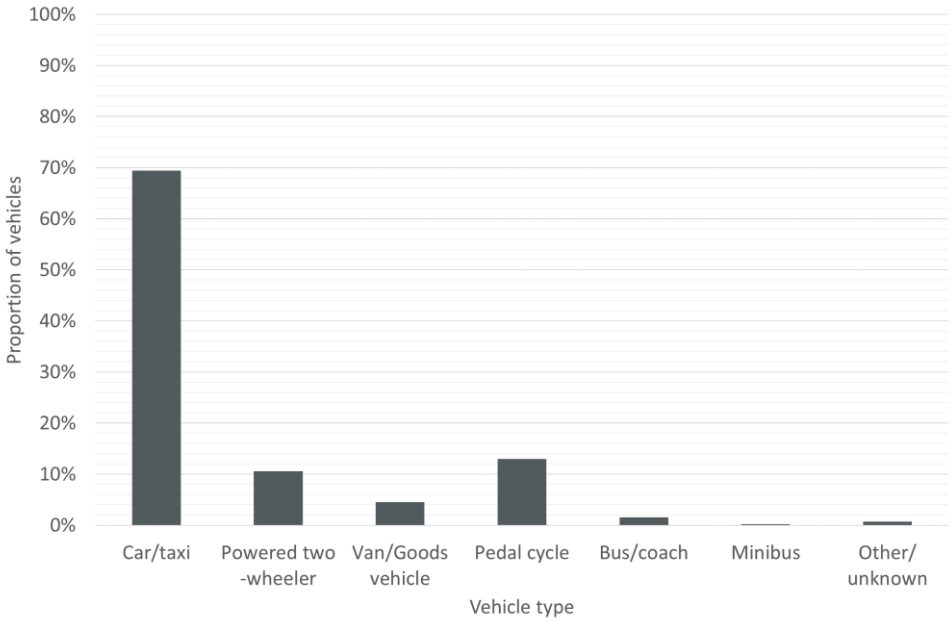

Figure 10: Proportion of vehicles in urban side road collisions; by vehicle type (total: 98,658)

As shown in Figure 10, most of the vehicles involved in urban side road collisions were cars or taxis (69%). This is expected because, in general, cars/taxis make up the largest proportion of the vehicles on the roads in urban areas. Pedal cycles and powered two-wheelers (13% and 11% respectively) were the two next most common vehicles types involved in urban side road collisions. It is important to note that exposure (i.e. number of road users and vehicles of each type on the roads) could not be accounted for in this analysis but will have an effect on the vehicle type distribution.

[5] National Travel Survey Table NTS0905: https://www.gov.uk/government/statistical-data-sets/nts09-vehicle-mileage-and-occupancy

The proportion of vehicles split by vehicle manoeuvre and location of vehicle at the junction is shown in Figure 11.

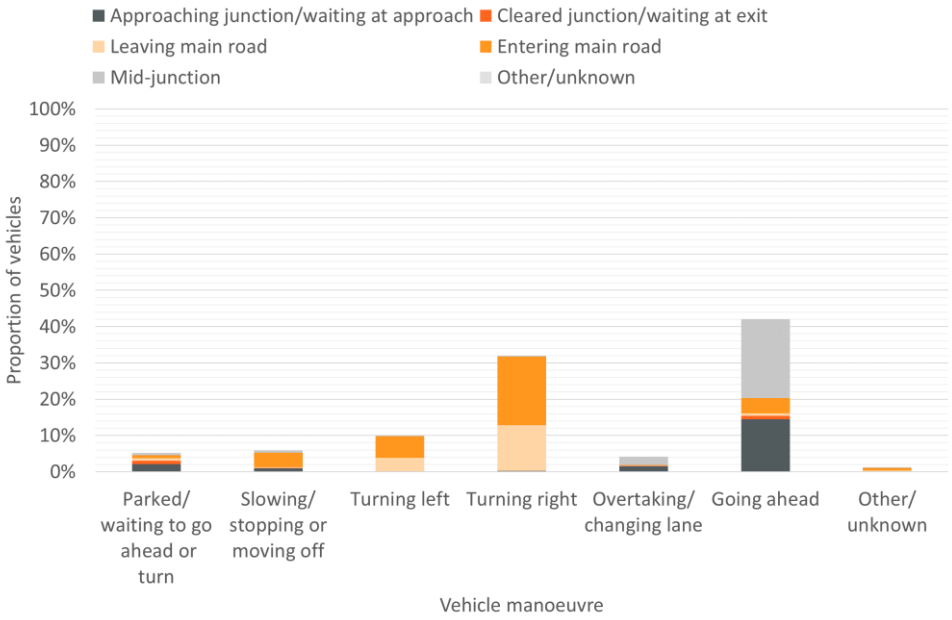

Figure 11: Proportion of vehicles in urban side road collisions; by vehicle manoeuvre and junction location of vehicle (total: 98,658)

One of the criteria used to extract the collisions for this analysis was that at least one vehicle in the collision had to have junction location of vehicle recorded as either 'leaving main road' or 'entering main road'. Naturally, vehicles with these locations recorded are very likely to have 'turning right' or 'turning left' recorded as the manoeuvre. Figure 11 shows that vehicles turning right accounted for 32% of total vehicles in urban side road collisions but vehicles turning left accounted for only 10%.

The highest proportion of vehicles had manoeuvre recorded as 'Going ahead' (42%). As mentioned in section 3.2.3, this is expected because 'Going ahead' is one of the most common manoeuvres of vehicles in collisions in general. Only a small proportion of these vehicles had location recorded as entering or leaving main road. As all collisions have at least one vehicle entering/leaving the main road, this suggests that most of the 42% of vehicles with manoeuvre recorded as going ahead were in a collision with a vehicle turning left or right in or out of a side road onto the main road.

4.1.3 Pedestrian casualty analysis

This section focuses on the 4,413 pedestrian casualties in urban side road collisions. The vast majority (81%) of these casualties had severity recorded as 'slight', 18% were seriously injured and only 1% were fatally injured.

Figure 12 shows the proportion of pedestrian casualties split by location and movement at the time of the collision.

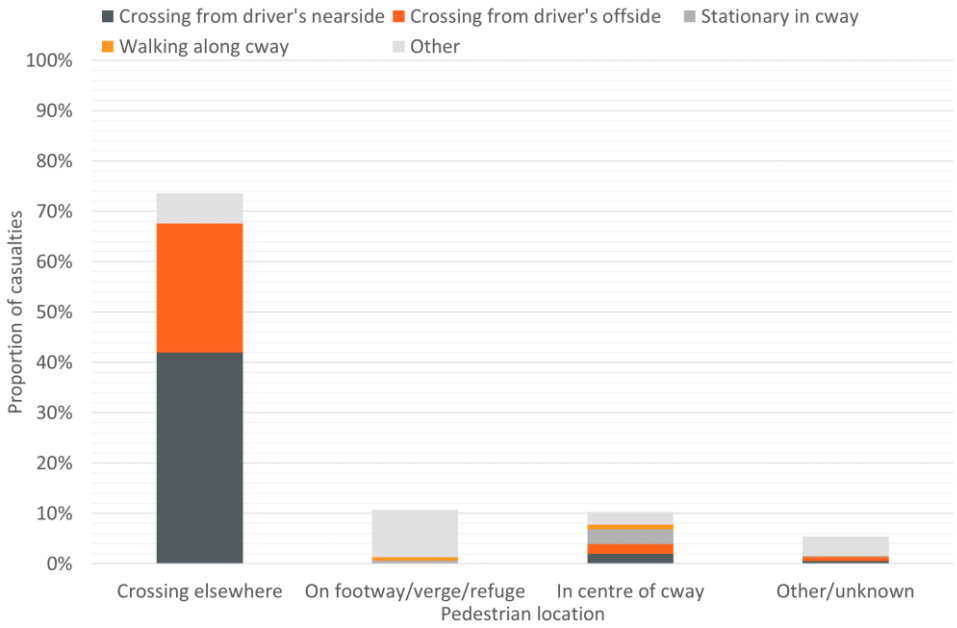

Figure 12: Proportion of pedestrian casualties in urban side road collisions; by pedestrian location and movement (total: 4,413)

As shown in Figure 12, most pedestrians casualties (74%) were crossing the road 'elsewhere', i.e. not on a pedestrian crossing facility, although the data is not detailed enough to know whether they were crossing the side road or the major road. It is to be expected that pedestrians were not crossing on pedestrian crossing facilities because one of the criteria in extracting the collision data was that the collision should not have happened within 50m of a pedestrian crossing facility.

Almost all pedestrian casualties (93%) were from collisions which involved only one vehicle. Stats19 does not record in what order events in a collision happen and therefore, in multi-vehicle collisions involving pedestrians, it is not possible to know whether the pedestrian was hit before or after other vehicles in the collision had already collided. Therefore, analysis of vehicle location and manoeuvre for pedestrian collisions has been limited to single vehicle collisions.

There were 3,886 vehicles involved in single vehicle collisions with pedestrians. Analysis of the junction location and manoeuvre of these vehicles is presented in Figure 13.

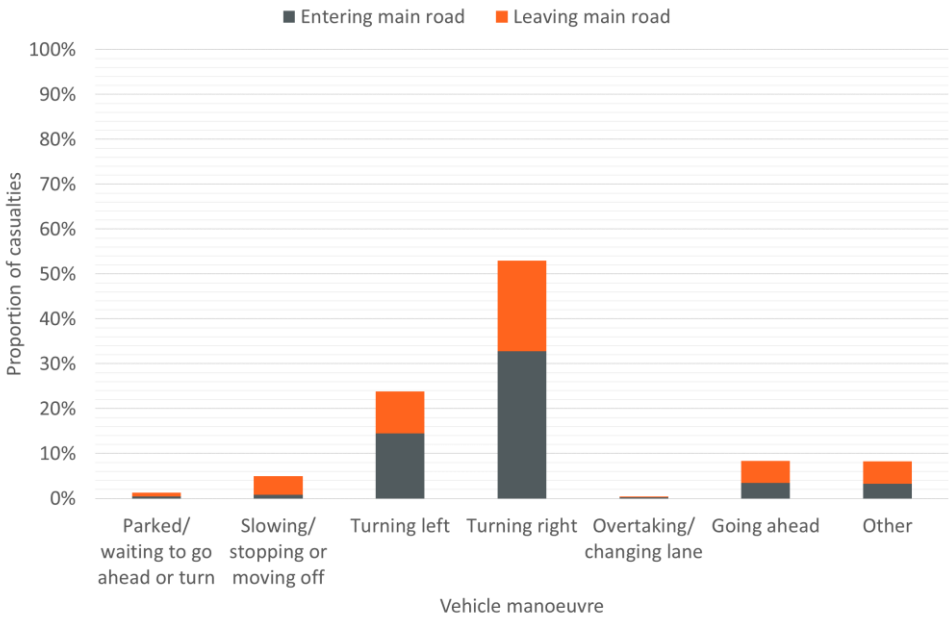

Figure 13: Proportion of casualties by manoeuvre and vehicle location at junction for single vehicle urban side road collisions involving pedestrians (total: 3,886)

Figure 13 shows that the two most common vehicle manoeuvres for vehicles which hit pedestrians at urban side roads were turning left and turning right although vehicles turning right accounted for 53% of casualties and turning left only accounted for 24%. Vehicles 'going ahead' accounted for only 8% of total vehicles in pedestrian collisions which is much lower than the 42% of vehicles going ahead in all urban side road collisions (Figure 11).

All vehicles involved in single vehicle pedestrian collisions were either entering or leaving the main road (as expected because the criteria used to extract the collisions specified that at least one vehicle in each collision had to have one of these manoeuvres recorded). This result suggests that the 74% of pedestrian casualties injured whilst crossing the road (Figure 12) were crossing the side road rather than the main road.

4.1.4 Collisions involving uninjured pedestrians

As mentioned in section 3.2.2, there is a field in the Stats19 data called 'carriageway hazard' and one of the categories in this field is 'Pedestrian in carriageway – not injured'. This is the only way which uninjured pedestrians involved in collisions are recorded. However, analysis of this field does not provide a comprehensive view of the involvement of uninjured pedestrians as the presence of an uninjured pedestrian is only recorded if they were deemed to be a hazard.

Of the total number of urban side road collisions, 99% had no carriageway hazard recorded. There were 36 collisions (0.07%) with 'Pedestrian in carriageway – not injured' recorded as a carriageway hazard and this section explores the characteristics of these collisions.

Figure 14 shows the number of collisions with an uninjured pedestrian recorded, split by number of vehicles involved and severity of collision. As the total number of collisions is small, raw collision numbers are presented instead of proportions.

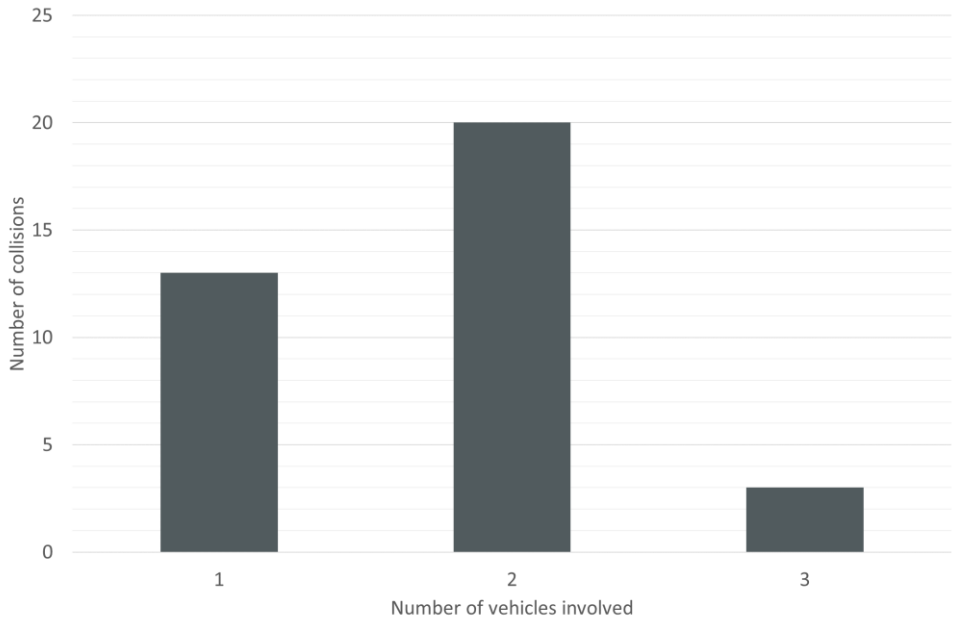

Figure 14: Number of urban side road collisions involving uninjured pedestrians; by number of vehicles involved and collision severity (total: 36)

Figure 14 shows that most urban side road collisions involving uninjured pedestrians involved two vehicles (20 out of 36 collisions) and 13 were single vehicle collisions.

There were 62 vehicles in total involved in the 36 collisions involving uninjured pedestrians. The proportion of these 62 vehicles by manoeuvre and junction location is shown in Figure 15.

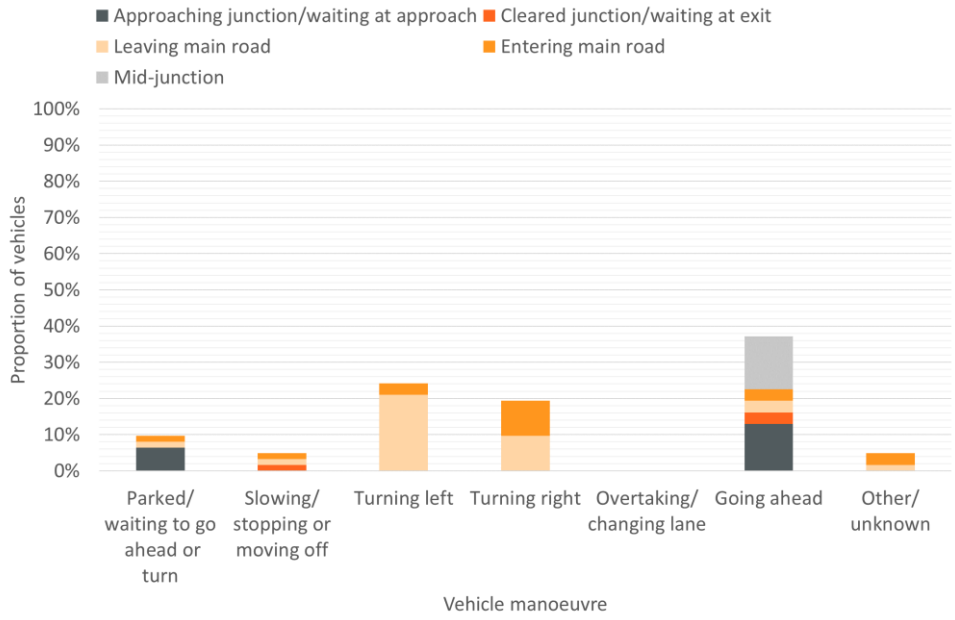

Figure 15: Proportion of vehicles in urban side road collisions involving uninjured pedestrians; by vehicle manoeuvre and junction location of vehicle (total: 62)

Similarly to the results of vehicle manoeuvre analysis for all urban side road collisions (Figure 11), 'going ahead' accounted for the largest proportion of vehicles in collisions involving

uninjured pedestrians (23 out of 62 vehicles, 37%) and 'turning right' and 'turning left' were also common. This result, however, is different to the distribution of manoeuvres for vehicles involved in collisions with injured pedestrians, where going ahead accounted for a much smaller proportion of vehicles (Figure 13).

Also, the proportion of vehicles turning left (15 vehicles) is slightly higher than the proportion turning right (12 vehicles) which is again different to the vehicle manoeuvre distribution for all vehicles and for vehicles involved in collisions with injured pedestrians.

However, as the number of vehicles involved in collisions with uninjured pedestrians is so small, no robust conclusions can be made.

4.1.5 Contributory factor analysis

Table 8 shows the ten most common contributory factors recorded for collisions at urban side roads. The number of collisions as a proportion of the total number of urban side road collisions where the police attended and at least one contributory factor was recorded is also presented.

Table 8: Ten most common contributory factors recorded in urban side road collisions

Contributory factor category	Contributory factor	Number of collisions	Proportion*
Driver error/reaction	Driver failed to look properly	24,677	66%
Driver error/reaction	Misjudged other's path or speed	10,209	27%
Driver error/reaction	Poor turn or manoeuvre	8,768	24%
Driver behaviour	Driver careless/reckless/in a hurry	6,186	17%
Vision affected by	Stationary or parked vehicle(s)	3,368	9%
Driver injudicious action	Disobeyed Give Way/Stop sign/markings	2,868	8%
Driver injudicious action	Exceeding speed limit	2,042	5%
Driver error/reaction	Junction overshoot	1,941	5%
Driver behaviour	Inexperienced/learner driver	1,733	5%
Road	Slippery road (weather)	1,721	5%
Total collisions where police attended & at least one CF was recorded		**37,245**	**100%**

* Proportion of collisions where police attended and at least one CF was recorded

Out of the 49,873 urban side road collisions between 2008 and 2017, 75% were attended by the police and had at least one contributory factor recorded. As expected, the most common contributory factor reported was 'Driver failed to look properly'.

Only three of the top ten factors recorded could be interpreted as being related to the junction: 'Stationary or parked vehicle(s)', 'Disobeyed Give Way/Stop sign/markings' and 'Junction overshoot'. All the other factors are more general and are likely to be common at all collision locations. None of the most common factors were attributed to pedestrians, however this is likely to be because only a small percentage of urban side road collisions

involved pedestrians and therefore collisions with pedestrian contributory factors make up a smaller proportion of total collisions.

Key points – characteristics of collisions at side roads with no markings

- Most urban side road collisions (83%) involved two vehicles and no pedestrians
- Driver/rider casualties accounted for 73% of casualties, pedestrians accounted for only 7%.
- Most vehicles involved in collisions were going ahead but a large proportion were turning right (much larger than the proportion turning left).
- In contrast to all side road collisions, 53% of vehicles in collisions with pedestrians were turning right (only 8% were going ahead').
- 74% of pedestrians injured in collisions were crossing the road (not on a pedestrian crossing).
- The most common contributory factor reported was 'Driver failed to look properly'.

4.2 Characteristics of collisions at 'non-full' zebra crossings

This section presents the results of analysis of collisions at 38 specific 'non-full' zebra crossings at side roads. Where possible, comparisons are drawn between the characteristics of these collisions and the characteristics of collisions at side roads with no markings across the whole country discussed in section 4.1. The number of collisions at the specific 'non-full' zebra crossing sites is too small to perform statistical tests to compare the characteristics of these collisions with the characteristics of collisions at side roads in general. Therefore, any comparisons made can only give an indication of similarities or differences between the two sets of collisions.

A summary of collision numbers and the casualties involved is presented in section 4.2.1 and then further analysis such as pedestrian casualty analysis and contributory factor analysis is presented in subsequent sections.

4.2.1 Summary of collisions

There were 29 collisions at the 38 sites included in analysis between 2008 and 2017 which occurred whilst the crossings were in place.

Figure 16 shows the proportion of these collisions by the number of vehicles and number of injured pedestrians involved. None of the 29 collisions had the involvement of an uninjured pedestrian recorded however the presence of non-injured pedestrians in not well recorded in Stats19.

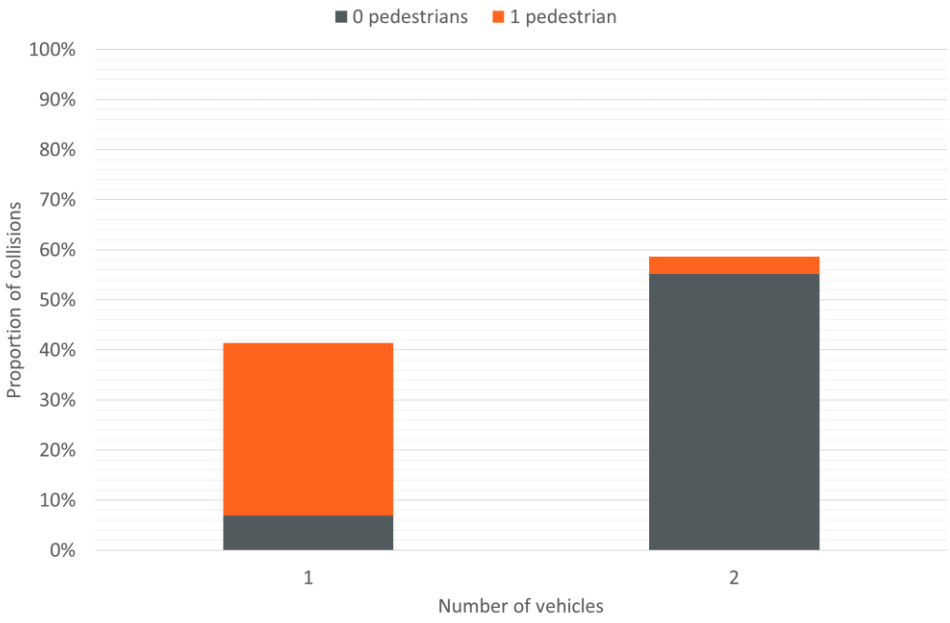

Figure 16: Proportion of total collisions at 'non-full' zebra crossings; by number of vehicles and number of pedestrians involved (total: 29)

Similarly to the national analysis shown in Figure 7, Figure 16 shows that the largest proportion of collisions at 'non-full' zebra crossings involved two vehicles and no pedestrians (55%, 16 collisions). The next largest proportion was collisions involving one vehicle and one pedestrian (35%, 10 collisions). Overall, 38% of the 29 collisions included in analysis (11 collisions) involved a pedestrian.

All the 29 collisions included in analysis involved only one casualty. Figure 17 shows the proportion of total casualties split by casualty class and casualty severity.

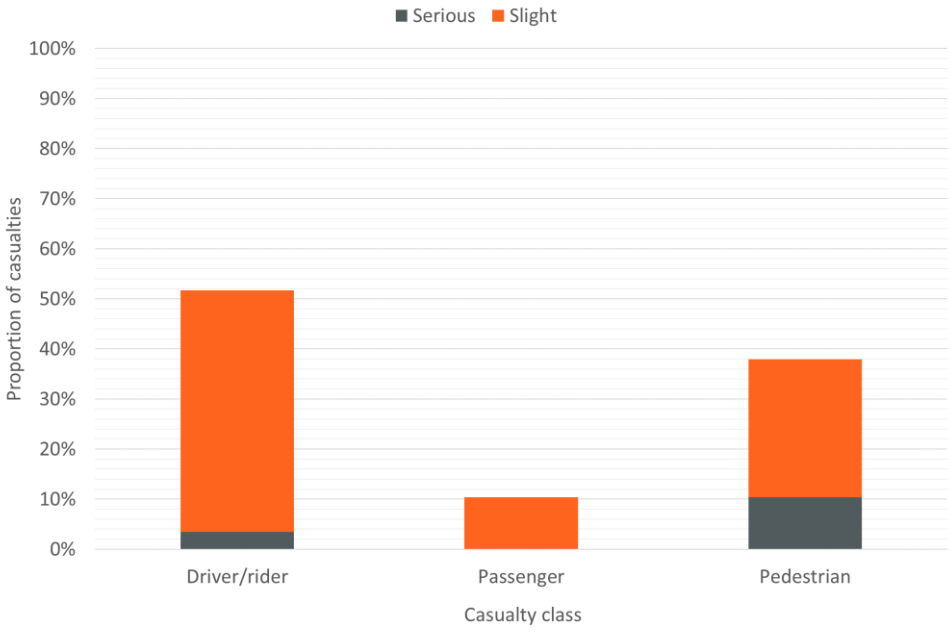

Figure 17: Proportion of total casualties at 'non-full' zebra crossings; by casualty class and severity (total: 29)

Fifty-two percent (15 casualties) of casualties at the 38 crossings included in analysis were drivers or riders and 38% (11 casualties) were pedestrians. This differs from the results of the national analysis presented in Figure 9 where pedestrians made up the smallest proportion of total casualties at urban side roads (7%). This larger proportion of casualties in the pedestrian category at 'non-full' zebra crossings may be because the pedestrian flows at these crossings are higher relative to the vehicle flows than at side roads in general.

There were no fatal casualties at any of the 38 crossing sites during the period of interest and only four casualties in collisions at these sites were seriously injured.

4.2.2 Vehicle analysis

There were 46 vehicles involved in the 29 collisions at 'non-full' zebra crossings. This section presents the distribution of vehicle type (Figure 18) and junction location and manoeuvre (Figure 19) for these vehicles.

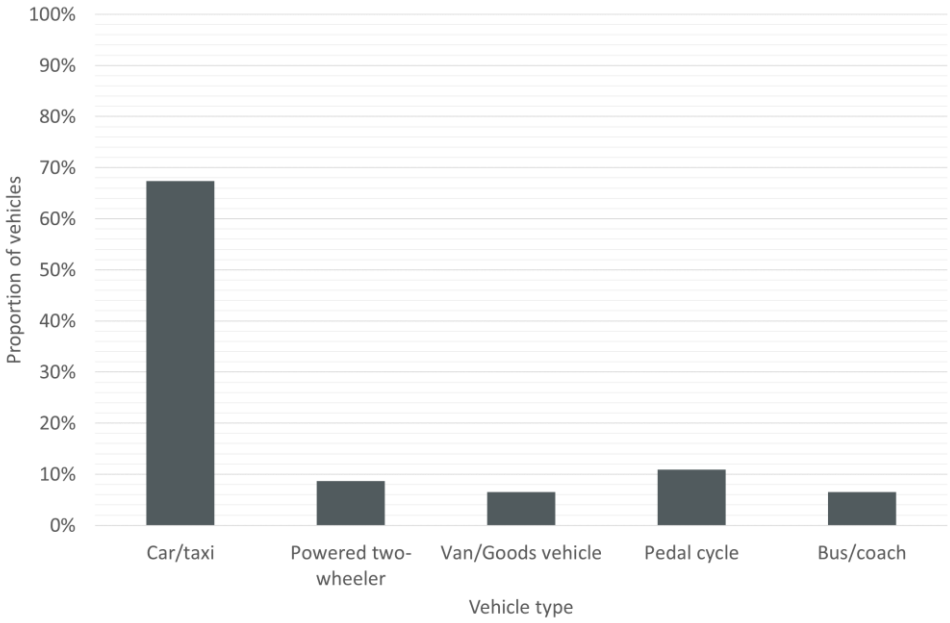

Figure 18: Proportion of vehicles involved in collisions at 'non-full' zebra crossings; by vehicle type (total: 46)

Figure 18 shows that the majority of vehicles involved in collisions at 'non-full' zebra crossings were cars or taxis (67%, 31 vehicles). The second largest category was pedal cycles, followed by powered two-wheelers. This pattern is the same as for vehicles in collisions at side roads in general (Figure 10). Again, it should be noted that the distribution of vehicle type in the fleet at these locations could not be accounted for here but will have had an effect on the types on vehicles involved in collisions.

The proportion of vehicles in collisions at 'non-full' zebra crossings split by vehicle manoeuvre and location of vehicle at junction is presented in Figure 19.

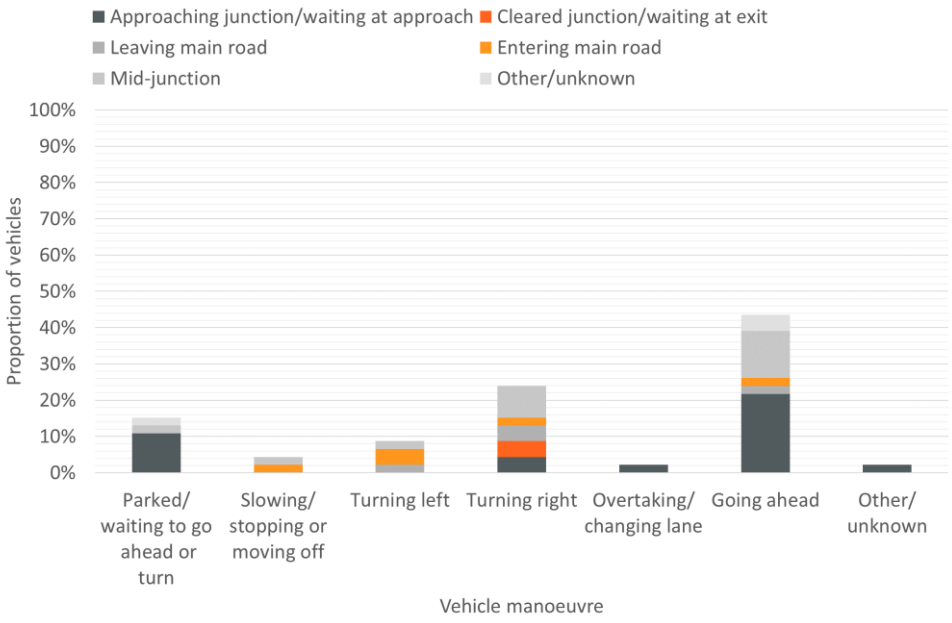

Figure 19: Proportion of vehicles involved in collisions at 'non-full' zebra crossings; by manoeuvre and junction location (total: 46)

Figure 19 shows that most vehicles were going ahead (43%, 20 vehicles). Eleven vehicles (24%) were turning right and only four vehicles (9%) were turning left. Again, this distribution of vehicle manoeuvres is similar to that of vehicles in general side road collisions (Figure 11).

4.2.3 Pedestrian casualty analysis

There were 11 pedestrian casualties in collisions at 'non-full' zebra crossings. Of these 11 casualties, three were seriously injured and eight had injury severity recorded as 'slight'. This section presents analysis of these casualties by pedestrian location and movement and the location and movement of the vehicle which collided with them.

As described in section 3.2.2, Stats19 records movement and location at time of collision for pedestrian casualties and Figure 20 shows the breakdown of pedestrian casualties from collisions at 'non-full' zebra crossings by these two fields. Casualty numbers instead of proportions are presented here because the total number of pedestrian casualties is small.

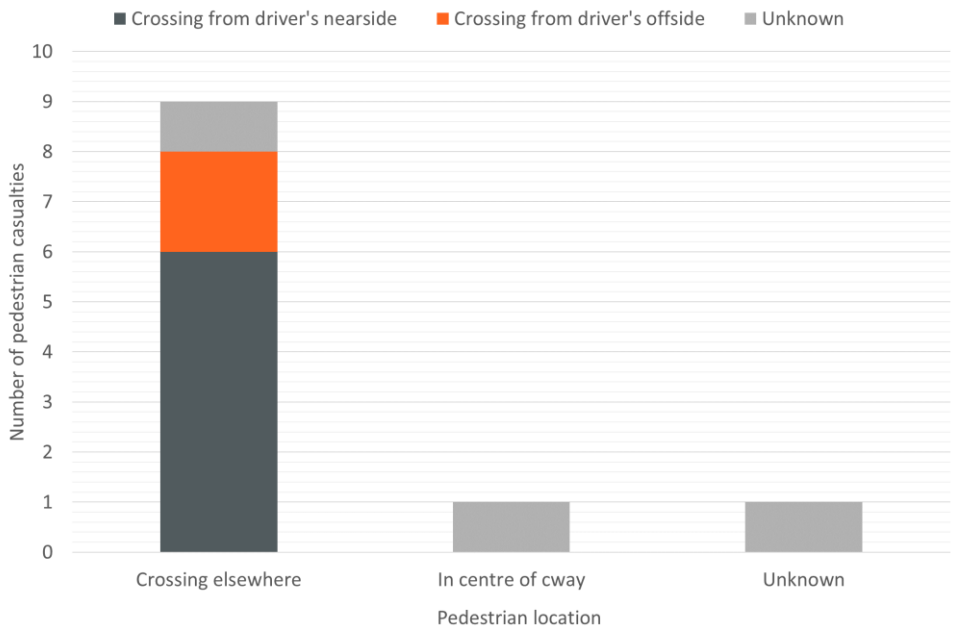

Figure 20: Number of pedestrian casualties at 'non-full' zebra crossings; by pedestrian location and movement (total: 11)

One of the categories for pedestrian location is 'In carriageway, crossing on pedestrian crossing facility'. None of the casualties had this category recorded but nine out of eleven casualties had location recorded as 'In carriageway, crossing elsewhere'. This suggests that police officers may not be considering 'non-full' zebra crossings as pedestrian crossing facilities. However, it is not possible from the data to be sure that pedestrians were definitely crossing on the zebra markings when they were involved in a collision.

Of the 11 collisions involving pedestrian casualties, 10 involved one vehicle and only one collision involved two vehicles. Figure 21 shows the number of vehicles which collided with pedestrians, split by vehicle manoeuvre and junction location of vehicle.

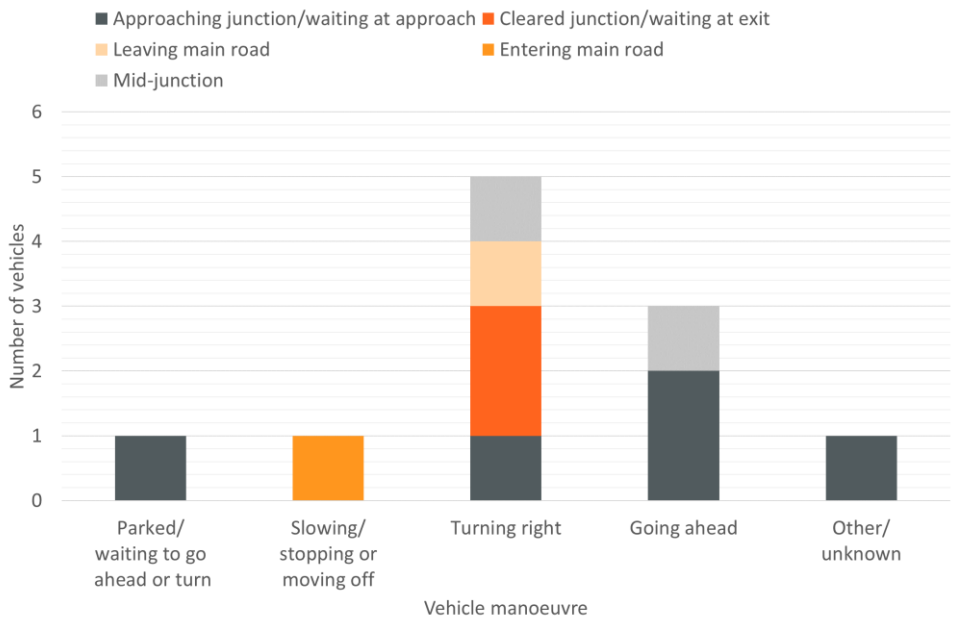

Figure 21: Number of vehicles which collided with pedestrians in collisions at 'non-full' zebra crossings; by vehicle manoeuvre and junction location (total: 11)

Figure 21 shows that five vehicles in collisions with pedestrians were turning right and, similarly to the analysis of general side road collisions, this was the most common manoeuvre. The number of vehicles going ahead (3 vehicles) was lower than the number turning right and again this is the same as what was shown in the general analysis of vehicles in pedestrian collisions at side roads (Figure 13).

4.2.4 Contributory factor analysis

Table 9 lists of the contributory factors recorded at more than one collision at 'non-full' zebra crossings. Similar to previous sections, the number of collisions each factor was reported for is also presented as a proportion of total collisions where police attended and at least one contributory factor was recorded.

Table 9: Contributory factors recorded for collisions at 'non-full' zebra crossings

Contributory factor category	Contributory factor	Number of collisions	Proportion*
Driver error/reaction	Driver failed to look properly	7	37%
Pedestrian	Pedestrian failed to look properly	7	37%
Driver behaviour	Driver careless/reckless/in a hurry	5	26%
Pedestrian	Pedestrian careless/reckless/in a hurry	4	21%
Driver error/reaction	Poor turn or manoeuvre	3	16%
Driver error/reaction	Misjudged other's path or speed	3	16%
Total collisions where police attended & at least one CF was recorded		**19**	**100%**

* Proportion of collisions where police attended and at least one CF was recorded

Out of the 29 collisions at 'non-full' zebra crossings, 19 (66%) were attended by the police and had at least one contributory factor recorded. As expected, the most common contributory factor recorded was 'Driver failed to look properly' although 'Pedestrian failed to look properly' was equally common.

With the exception of 'Pedestrian careless/reckless/in a hurry', all the contributory factors presented in Table 9 were included in the list of top ten most common contributory factors recorded in general urban side road collisions (Table 8). 'Pedestrian careless/reckless/in a hurry' is likely to appear as more common in collisions at 'non-full' zebra crossings because a higher proportion of casualties at these crossings are pedestrians than at side roads in general.

Key points – characteristics of collisions at 'non-full' zebra crossings

- The number of collisions at 'non-full' zebra crossings was very small so comparisons with side roads with no markings should be treated with caution, however, in general, characteristics of collisions at 'non-full' zebra crossings were similar to those at side roads with no markings.
- Pedestrians made up a much larger proportion of total casualties at 'non-full' zebra crossings than at side roads with no markings. This is likely to be because of differences in flow.
- Similar to side roads with no markings, most vehicles involved in collisions were going ahead but a large proportion were turning right (much larger than the proportion turning left).
- Almost all pedestrian casualties (9 out of 11) were crossing the road (not on a pedestrian crossing).
- Five out of eleven vehicles which hit pedestrians were turning right.

5 Discussion

5.1 Analysis of the collision record for 'full' zebra crossings at side roads

The collision analysis of 'full' zebra crossings showed that there was no significant difference in the total number of collisions per site per year between 'full' zebra crossings and their comparators; this result was the same for crossings with and without islands. There were also no major differences in collision characteristics between crossings and comparators for either of the type of crossing site.

For crossings without islands, there were slight differences in the distribution of casualty class and vehicle type between crossings and comparators. Collisions at comparator sites involved more passenger casualties than those at crossings and there were more pedal cycles involved in collisions at crossings than comparators. Even though the comparator for each crossing is located near to the crossing, there could still be small differences in pedal cycle or pedestrian flow between the crossing and comparator sites, resulting in a slight difference in casualty class or vehicle type distribution.

Analysis of the characteristics of collisions involving pedestrians showed that all the pedestrians injured in collisions at each type of location were crossing the road, suggesting that pedestrians are being involved in similar types of collisions whether they are crossing at a 'full' zebra crossing or not.

Again, comparison of the distribution of vehicle manoeuvre suggests that the types of collision happening at both crossings and comparators are similar (true for crossings with and without islands). Common manoeuvres across all types of location were 'going ahead' and 'turning right'. Noticeably, a larger number of vehicles involved in collisions were turning right than were turning left. This is likely to be because there are more possible conflict points for a vehicle turning right in or out of a side road than there are when a vehicle is turning left. Also, speed may be different for vehicles turning left and right because the geometry of the road may mean vehicles making left turns are travelling more slowly.

Overall, the analysis has shown the collision record for 'full' zebra crossings at side roads is similar to that for nearby side roads with no markings. However, these results are based on small numbers of collisions so should be treated with caution.

5.2 Analysis of the collision record for 'non-full' zebra crossings at side roads

The analysis of collisions at general side roads with no markings supports the findings from the analysis of 'full' zebra crossings. The analysis showed that the number of casualties and vehicles involved and the common vehicle types and manoeuvres in collisions at side roads were similar to those at the 'full' crossing and comparator sites analysed.

Most pedestrians involved in collisions at side roads with no markings were crossing the side road. This is indicated by the most common manoeuvres of the vehicles which hit them being turning left or right in or out of the side road rather than 'going ahead'. The site-specific analysis of collisions at 'non-full' zebra crossings showed the same result.

Generally, analysis of collision characteristics at 'non-full' zebra crossings showed the same findings as the analysis of collisions at side roads in general. The only difference was in casualty class distribution: general analysis showed pedestrians making up the smallest proportion of total casualties but the 'non-full' zebra crossing analysis showed pedestrians accounting for a higher proportion of casualties than passengers. This very slight difference is likely to be mostly a result of pedestrian flows being higher relative to vehicle flows at the specific sites included in analysis than is the case at side roads in general. Also, the total number of casualties at 'non-full' zebra crossings is very small compared to the total casualties in the general analysis.

In summary, analysis of collisions at general side roads with no markings and specific 'non-full' zebra crossings sites has shown no major differences between the characteristics of both sets of collisions. These observations are indicative of there being no substantive differences in risks between the two types of crossings; however, the number of collisions at the specific 'non-full' zebra crossings sites was too small for more specific analysis.

5.3 Conclusions and next steps

The analysis presented in this report forms an important part of the research into side road zebra crossings but should not be considered in isolation. It is the first step in a programme of research that will involve off-street investigation of road user awareness and understanding eventually progressing to on-street trials. Each step informs the design of the following ones which helps to ensure that risks are understood and managed. The analysis presented in this report has not identified any additional risks that would need to be considered in the future phases of the project.

Appendix A Lists of crossing sites included in analysis

Table 10: 'Full' zebra crossing sites

ID	Location description	Latitude	Longitude	Estimated date installed
1f	St Aldate's/ Speedwell Street, Oxford	51.7485516	-1.2565889	September 2018
1g	Outside 55 Broadway, Westminster	51.4996817	-0.1330187	July 2008
1h	Park Lane/Unthank Road	52.6254337	1.2786939	September 2010
1i	Hatton Garden/ Clerkenwell Road	51.521952	-0.109272	September 2012
1k	Roman Road/ Morpeth Street, London	51.5288169	-0.0482342	Jun 2008
1m	Highgate High Street/South Grove, London	51.5707154	-0.1479029	May 2014
1q	Oakfield Road/London Road, West Croydon	51.3792553	-0.1036846	October 2008
1s	Eaton Rise/Castlebar Road, Ealing	51.5165689	-0.3063955	September 2012
1v	Highbury Grove/ Highbury New Park, Islington	51.5480616	-0.0983982	July 2008
1w	Stanwell Road/Victoria Road, Penarth	51.4361969	-3.1757082	July 2008
1x	Tothill Street/ Storey's Gate, Westminster	51.4997046	-0.1298041	August 2011
1ab	Burbage Road/ Half Moon Lane, Herne Hill	51.452877	-0.096612	August 2009
2a	Irlam Road/Flixton Road, Flixton, Trafford	53.4474893	-2.3814908	May 2018
2b	Queen Charlotte Street/Baldwin Street, Bristol	51.4535007	-2.5936039	July 2008
2c	Brewery Road & Caledonian Road, Islington	51.5456723	-0.117859	July 2008

Table 11: Comparator sites for 'full' zebra crossings

ID	Crossing ID	Location description	Latitude	Longitude
1zf	1f	St Aldate's/Floyds row, Oxford	51.7483658	-1.2564819
1zg	1g	Tothill St/Matthew Parker St, Westminster	51.4996955	-0.1305664
1zh	1h	Unthank Road/Trinity St, Norwich	52.6251369	1.2783269
1zi	1i	A5201/Back Hill, London	51.5220097	-0.1096157
1zk	1k	Roman Rd/Usk St, London	51.5291963	-0.0465957
1zm	1m	Highgate High St/Bisham Gardens, London	51.5704597	-0.1462457
1zq	1q	London Rd/Kidderminister Rd, Croydon	51.3814301	-0.105768
1zs	1s	Blakely Avenue/B455, London	51.5166278	-0.3078798
1zv	1v	Highbury Grove/Baalbeck Rd, Islington	51.549846	-0.098078
1zw	1w	Stanwell Rd/Victoria Ave	51.436287	-3.177452
1zx	1x	Storey Gate/Matthew Parker St, Westminster	51.5003261	-0.1295798
1zab	1ab	Half Moon Ln/Howletts Rd, Herne Hill	51.453183	-0.094189
2za	2a	Flixton Rd/Holly House Dr, Urmston	53.447322	-2.381868
2zb	2b	High Street/Broad Street, Bristol	51.454908	-2.592738
2zc	2c	A5203/Brewery Road	51.5448548	-0.1177976

Table 12: 'Non-full' zebra crossing sites

ID	Location	Latitude	Longitude	Estimated date installed
E4	Birmingham	52.436055	-1.8916669	August 2018
E7	Bristol	51.4471929	-2.5991029	July 2018
E10	London	51.4981634	-0.1751843	April 2016
E12	Edinburgh	55.9234687	-3.1772261	May 2016
E15	London	51.4438014	-0.0261682	May 2012
E17	London	51.5035725	-0.087872	June 2016
E18	Manchester	53.4550831	-2.158609	Oct 2012
E23	Stockport	53.414773	-2.1509801	August 2011
E24	Essex	51.5589857	0.4517107	May 2012
E28	Bristol	51.406338	-2.5997414	September 2012
E30	Northumberland	55.0324533	-1.5184948	November 2008
E33	Portsmouth	50.7859129	-1.0861289	May 2011
E37	Bristol	51.4169845	-2.5003353	June 2016
E38	Cardiff	51.5129158	-3.1444205	August 2014
E39	London	51.5074547	-0.0683034	April 2019
E40	Warwick	52.2871187	-1.5651325	September 2008
E42	Ely	52.4137474	0.2762818	October 2008
E43	Warwick	52.2908782	-1.5863737	September 2008
E45	Bluewater	51.4407168	0.2761188	June 2016
E47	Bradford	53.7588886	-1.790992	August 2009
E49	Warrington	53.4254794	-2.5226659	October 2009
E50	Wakefield	53.6930578	-1.4870457	May 2018
E52	Penzance	50.1159671	-5.5307755	April 2010
E60	Cambridge	52.2081324	0.1453175	August 2008
E66	Southampton	50.9233233	-1.4666784	September 2008
E67	Shrewsbury	52.7070252	-2.7413276	June 2011
E72	Warrington	53.4024684	-2.667391	October 2008
E75	Warrington	53.4273061	-2.5238924	October 2009
E77	Rotherham	53.4318762	-1.3537502	October 2014
E78	Leicester	52.6255878	-1.1460301	May 2016
E82	Oxford	51.7535521	-1.2629378	June 2008
E83	Stirling	56.1435031	-3.9203745	April 2017
E84	Chorley	53.6546602	-2.6292851	July 2017
E85	Bristol	51.4587807	-2.59836	May 2014
E86	London	51.5205332	-0.0586794	June 2012
E89	Lancaster	54.0406976	-2.7991934	August 2018
E90	Blackburn	53.7353146	-2.4580918	June 2011
E91	Warwick	52.290018	-1.5821994	June 2015

Non-prescribed zebra crossings at side roads

Technical Annex 1: Analysis of collision records at existing sites

This report contains analysis of collisions at zebra crossings positioned flush against the mouths of side roads. It is part of a project commissioned by Transport for Greater Manchester (TfGM) which seeks to understand how such crossings could be used in urban areas. The analysis compares two different categories of side road zebra crossing: zebra crossings with Belisha beacons and zig-zag lines, and crossings with zebra markings only.

The collision record at 15 specific sites with crossings of the first type were compared with nearby roads with no crossings. The characteristics of collisions at 38 sites of the second type were compared with those identify in analysis of side-roads in general.

Full crossings had similar number of collisions to nearby control sites. The sample of 'non-full' crossings was too small for statistical analysis; however their characteristics were similar to junctions with no crossing. No indication was found that the use of non-full zebra crossing would introduce significant additional risk in comparison to a full crossing.

Titles in this subject area

PPR1003	Non-prescribed zebra crossings at side roads. Final Report. Jones M., Matyas M. and Jenkins D. 2021
PPR1004	Non-prescribed zebra crossings at side roads. Technical Annex 1: Analysis of collision records at existing sites. Hammond J. and Simms G. 2019
PPR1005	Non-prescribed zebra crossing at side roads. Technical Annex 2: User surveys at existing sites. Verwey L., Novis K., Wallbank C. and Stuttard N. 2020
PPR1006	Non-prescribed zebra crossing at side roads. Technical Annex 3: Effectiveness of alternative markings. Novis K., Hyatt T., Stuttard N. and Wallbank C. and Verwey L. 2020
PPR1007	Non-prescribed zebra crossing at side roads. Technical Annex 4: Road user perceptions and understanding. Blunden A., Gupta B., Matyas M., Mazzeo F., Wallbank C. and Wardle A. 2021
PPR1008	Non-prescribed zebra crossing at side roads. Technical Annex 5: Implications for people with disability. Blunden A., Gupta B., Verwey L., Butler, R. and Wallbank C. 2021
PPR1009	Non-prescribed zebra crossing at side roads. Technical Annex 6: Driver simulator trials. Jenkins D., Ramnath R., Stuttard N. and Chowdhury S. 2021
PPR1010	Non-prescribed zebra crossing at side roads. Technical Annex 7: Observations of conflict and giving-way during on street trials. Greenshields S., Ognissanto F., Lee R. and Macgregor E. 2021

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