Engineering solutions for urban route safety – a study in Taunton, U.K.

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Abstract

This paper describes a study on the accidents along an urban route and engineering solutions to improve safety. Bridge Street to Station Road in Taunton, a typical urban street of U.K. is the study area for the present study, where safety concerns have been identified. The paper focuses on the personal injury accidents that have occurred in the five years study period for from January 2001 to December 2005 on the road stretch from the junction of St. James Street with Bridge Street to the junction of Greenway Avenue with A3038 Kingston Road. The paper highlights the analyses performed on the 83 personal injury accidents that were reported in the study stretch during the study period considered. A detailed discussion on the accident patterns by various parameters like year, severity, month, week, day and time, types of vehicle, maneuver, location and age of casualties has been presented. An initial identification of accident cluster sites along the study stretch has been presented, followed by suitable measures to address both site specific accident occurrences and more general safety concerns. A number of interventions were considered which were later narrowed down to the most appropriate and suitable solutions based on various considerations like suitability at site, cost etc. The paper highlights the recommendations for improving safety and the accident reduction that can be achieved through implementing these countermeasures.

1. Introduction

This paper is based on the accident analysis along Bridge Street to Station Road in Taunton where safety concerns have been identified. The paper highlights the recommendations based on the analysis and assessment of the accident and site data.

The paper focuses on the personal injury accidents that have occurred on the road stretch from the junction of St. James Street with Bridge Street to the junction of Greenway Avenue with A3038 Kingston Road. There have been 83 personal injury accidents during the five-year study period from January 2001 to December 2005, including 11 KSI (killed or seriously injured) accidents and 72 slight injury accidents. No fatal accidents were recorded during the study period.

The paper follows the initial identification of accident cluster sites along Bridge Street to Station Road in Taunton, which is followed by suitable measures to address both site specific accident occurrences and more general safety concerns.

2. Accident scenario in U.K.

In the U.K., more than 198,000 accidents were reported in the year 2005 at the rate of 39 accidents per million vehicle kilometres. These accidents resulted in over 271,000 casualties with 1.18% of these casualties being fatalities and 11.86% being classified as KSI casualties.

Children and the elderly are particularly vulnerable when using the highway network. Almost 52% percent of the KSI casualties could be attributed to urban roads, of which over 43% may be attributed to A-classified urban roads. This is detailed in 'Road Casualties Great Britain 2005[1]'. The national trend of accidents shows that in 2005, the KSI casualties dropped by 6% compared to 2004.

3. Study Area

Bridge Street to Station Road in Taunton is mainly a single carriageway urban road, subject to a 30 mph speed limit. The road is street lit along its length. It is also a major bus and cycle route. The route has advisory cycle lanes along certain stretches. It is a major route to the town centre. The route commences just south of the bridge at Taunton at the junction of St. James Street with Bridge Street.

As illustrated through the photograph, there are a number of residential properties along its length. In addition, the road has extensive commercial activity along its length. There is significant pedestrian activity; pedestrian refuges have been provided at certain locations of recognised pedestrian activity. There are number of traffic signals along the route which may lead to driver frustration as the route is busy at most times of the day. Buff coloured surfacing has been used to highlight certain short stretches of road leading up to the railway station in Taunton. Box markings have been used at locations where it is important for vehicles not to block the junction.

A gyratory system of traffic movement has been implemented north of the Taunton railway station. The route ends at the junction of Greenway Avenue with A3038 Kingston Road. The road markings are generally in good condition.

4. Accident Analysis

4.1 Analysis by Year and Severity

83 personal injury accidents have been reported in the study area during the study period from January 2001 to December 2005, resulting in 89 casualties. 11 of the accidents was classified as KSI (Killed/Seriously Injury) giving an accident severity ratio of 0.134. In terms of casualties, there were 11 serious casualties and 78 slight casualties, giving a casualty severity ratio of 0.124 (KSI/Total Casualties). This is higher than the County average of 0.10 for A-classified urban roads. In the five-year period, accidents averaged 16.6 per annum and casualties averaged 17.8 per annum. The breakdown of accidents during the five year period is presented in Table 1.

[1] Road Casualties Great Britain 2005: Annual Report, Department for Transport (DfT), London.

Table 1: Accidents Breakdown: 2001 – 2005

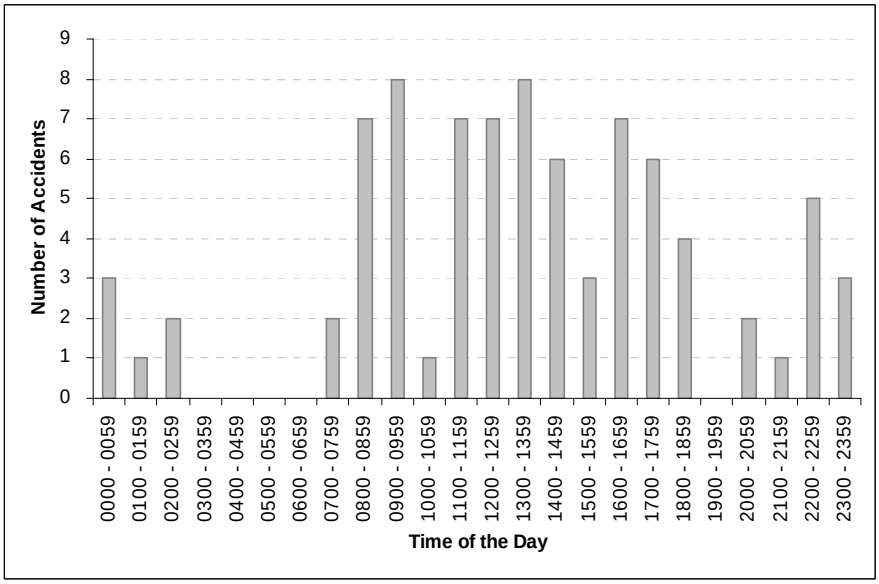
Year	Fatal	Serious	Slight	TOTAL
2001		1	19	**20**
2002		4	12	**16**
2003		1	12	**13**
2004		3	12	**15**
2005		2	17	**19**
TOTAL	**0**	**11**	**72**	**83**

4.2 Accident Analysis by Month, Day and Time of Occurrence

There is no noticeable trend of accidents with respect to the month of the year or the day of the week. However, the least numbers of accidents were observed on Sundays compared to the other days of the week, a phenomenon that may be explained by the fact that it is a weekend.

Accidents occurred throughout the day, with no observable pattern or trend. The pattern of accidents observed is characteristic of busy urban areas where there is hectic urban activity throughout the day. As expected, the numbers of accidents are low in the late night and early morning hours. The distribution of accidents during the day is presented in Figure 1.

Figure 1: Distribution of Accidents by Time of Day



4.3 Analysis by Lighting and Road Surface Conditions

All accidents occurred in either daylight conditions or with street lights lit.

Almost 75% of the accidents occurred on dry road surface conditions, while the remaining occurred under wet road conditions. Of the accidents that occurred under wet road conditions, 9 accidents occurred with street lights. There were five incidents of skidding accidents. Three of these were dry skids and two were wet skids. Almost 87% of the accidents occurred in fine weather. Only about 10% of the accidents occurred in rainy weather.

4.4 Accident Causation Factors

The main factors contributing to the occurrence of accidents are presented in Table 2. As can be observed from the Table, more than 56% of the contributory factors are driver related parameters, like injudicious action, error or reaction and driver behavior and inexperience. A further 7.2% of the accidents have been caused by the driver's vision being affected by external factors. Among the driver parameters, failure to look properly and reckless driving have been reported to be the major contributory parameters. Some of these parameters may be treated by a combination of traffic engineering and safety education measures and by providing a better visual environment on the road to guide road users. In addition, more than 11% of the accidents have been reported to have been caused by pedestrian factors, thereby accounting for almost 75% of the accidents to be caused by human parameters. Around 16% of the accidents were reported to have been caused by the road environment. Most of these accidents have been addressed by the recommendations listed out in subsequent sections of the paper.

Table 2: Accident Causation Factors

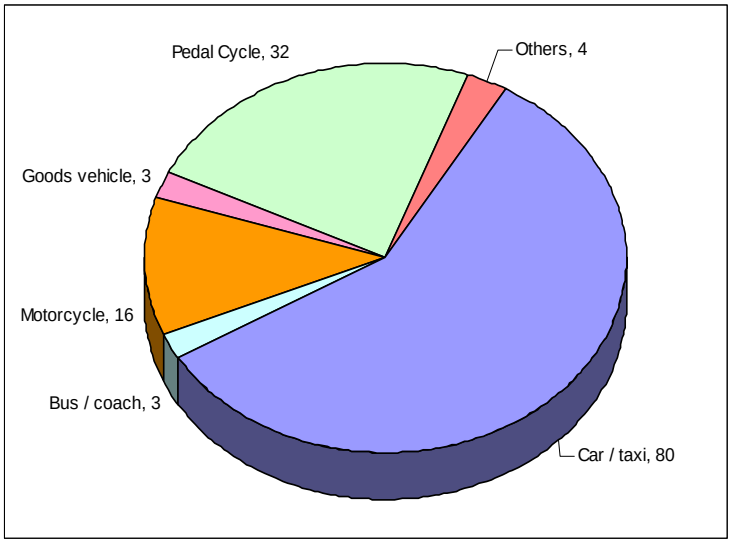
Contributory Parameter Class	Specific Cause with Percentage Contribution				Total
Road Environment Contributed	Animal or object in carriageway	Road layout (bend, hill, narrow carriageway)	Inadequate or masked signs or road markings	Other factors	
	6.50%	**3.90%**	**2.00%**	**3.30%**	**15.70%**
Vehicle Defects	Tyres illegal, defective or under-inflated	Defective brakes			
	1.30%	**0.70%**			**2.00%**
Injudicious Action	Disobeyed 'Give Way' or 'Stop' sign or markings	Following too close	Exceeding speed limit	Other factors	
	3.90%	**2.60%**	**2.00%**	**2.60%**	**11.10%**
Driver / Rider Error or Reaction	Failed to look properly	Failed to judge other person's path or speed	Poor turn or manoeuvre	Other factors	
	18.30%	**6.50%**	**3.30%**	**3.90%**	**32.00%**
Impairment or Distraction	Impaired by alcohol	Others			
	1.30%	**1.30%**			**2.60%**
Behaviour or Inexperience	Careless, reckless or in a hurry	Learner or inexperienced driver / rider	Others		
	7.20%	**2.60%**	**1.30%**		**11.10%**
Vision Affected by	Stationary or parked vehicle(s)	Vehicle blind spot	Other factors		
	3.90%	**1.30%**	**2.00%**		**7.20%**
Pedestrian Only (Casualty or Uninjured)	Failed to look properly	Impaired by alcohol	Other factors		
	5.20%	**2.60%**	**3.30%**		**11.10%**
Other Factors	Other factors				
	7.20%				**7.20%**

4.5 Analysis by Vehicles Involved and Manoeuvres

A total of 138 vehicles were involved in the 83 accidents observed during the five year review period. 61.5% of all accidents observed involved two vehicles. Over 36% of the accidents were single vehicle incidents and the remaining were multi-vehicle accidents.

Cars accounted for more than 57% of all the vehicles involved in accidents. Pedal cycles accounted for over 23% of the vehicles involved in accidents. The numbers of the different types of vehicles involved in accidents are presented in Figure 2.

Figure 2: Vehicles Involved in Accidents



The predominant manoeuvres at the time of accident were of vehicles going straight ahead and vehicles turning right. Among the vehicles going straight ahead, failure to look properly was reported as the main contributory factor in these accidents.

4.6 Analysis by Distribution of the Age of the Different Classes of Casualties

Distribution of the age of the different classes of casualties is presented in Table 3. It can be observed from the Table that the majority of the casualties are in the age group of 30 – 59 years (34 casualties) followed by those in the age group of 20 – 29 years (29 casualties). A high number of pedestrian casualties were reported which again reaffirms the urban activity prevalent in the site under study. It can also be observed from the table that a majority of the casualties are drivers / riders and pedestrians.

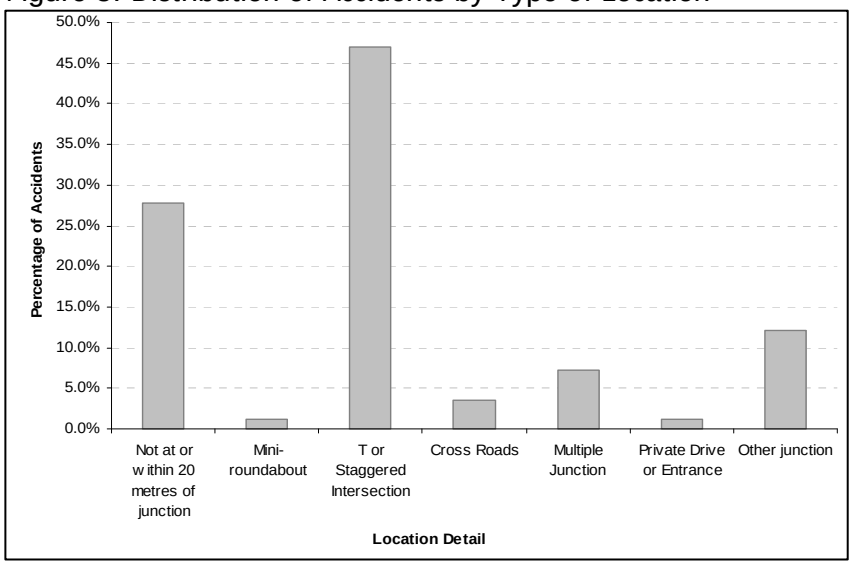
Table 3: Distribution of Age of Different Classes of Casualties

Casualty Age	Driver	Pillion / Passenger	Pedestrian	Total
0 - 4	0	0	0	**0**
5 - 15	4	0	4	**8**
16 - 19	9	0	4	**13**
20 - 29	13	5	11	**29**
30 - 59	25	0	9	**34**
> 60	3	0	2	**5**
Total	**54**	**5**	**30**	**89**

4.7 Analysis by Location

A majority of the accidents (47%) occurred at T or staggered intersections. Almost 28% of the accidents occurred on mid-blocks. Almost 11% of the accidents occurred at crossroads and multiple junctions. Distribution of accidents by the type of location is presented in Figure 3.

Figure 3: Distribution of Accidents by Type of Location



Among the junction accidents, 42.2% of the accidents occurred either at priority junctions or at uncontrolled locations and 28.9% of the accidents occurred at locations controlled by automatic traffic signals.

5. Cluster Analysis

Cluster sites were selected at locations that had a minimum of five accidents within an initial 50m radius, although this was amended to include accidents that were in close vicinity to the identified cluster. There were 6 clusters that met this criterion and these are detailed in Table 4 below. They are listed along with the number of accidents, number of fatal and serious accidents (KSI) along with severity ratio.

Table 4: Identified Accident Clusters with Number of Accidents, KSI and Severity Ratio

Cluster No.	Description	Number of Accidents (2001 – 2005)	Killed / Serious Injury (KSI)	Severity Ratio
1.	From the start of the route to the bridge	11	3	0.273
2.	From the bridge to Goodlands Lane	12	1	0.083
3.	Between Goodlands Lane and the Wood Street – Staplegrove Road junction	12	2	0.167
4.	Near the junction of Station Road with Albemarle Road and Priory Bridge Road	13	3	0.231
5.	Near the junction of Whitehall with Station Road and near the access to Taunton Station	9	0	0.000
6.	Near the main (northern) access to Taunton Station	14	2	0.143

6. Route Analysis

Each section of the network, from strategic routes to local roads, has been assessed in terms of the numbers of accidents that were reported during the study period. Police accident reports were analysed to enable efficient breakdown of all accident data and show accident trends throughout the area. There was a particular emphasis on identification of any patterns related to vulnerable road users (including injury to children), severity, causation and location and any trends where speed was cited as a contributory factor.

There have been occurrences of isolated accidents along the stretch as well as accidents occurring at / near the cluster site locations but the numbers being less than that defined for a cluster. These accidents have also been analyzed and can be treated by the given recommendations.

7. Recommendations

Engineering solutions for treating the cluster sites are presented in Figures 4, 5 and 6. Recommendations have also been provided for treating non-cluster accidents and these have also been presented in the figures.

Figure 4: Recommendations for Cluster Sites 1 and 2

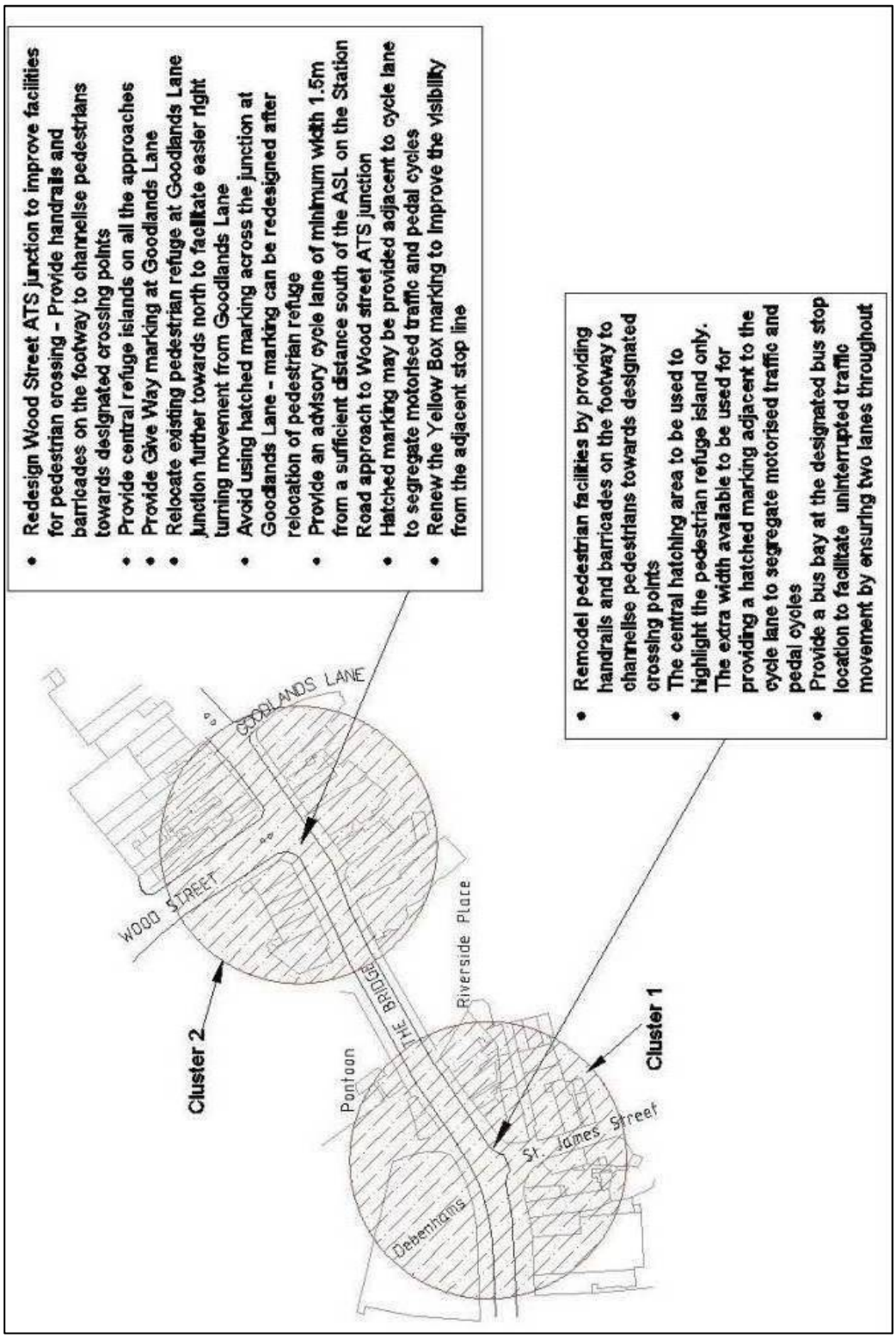


Figure 5: Recommendations for Cluster Sites 3 and 4 and other sites

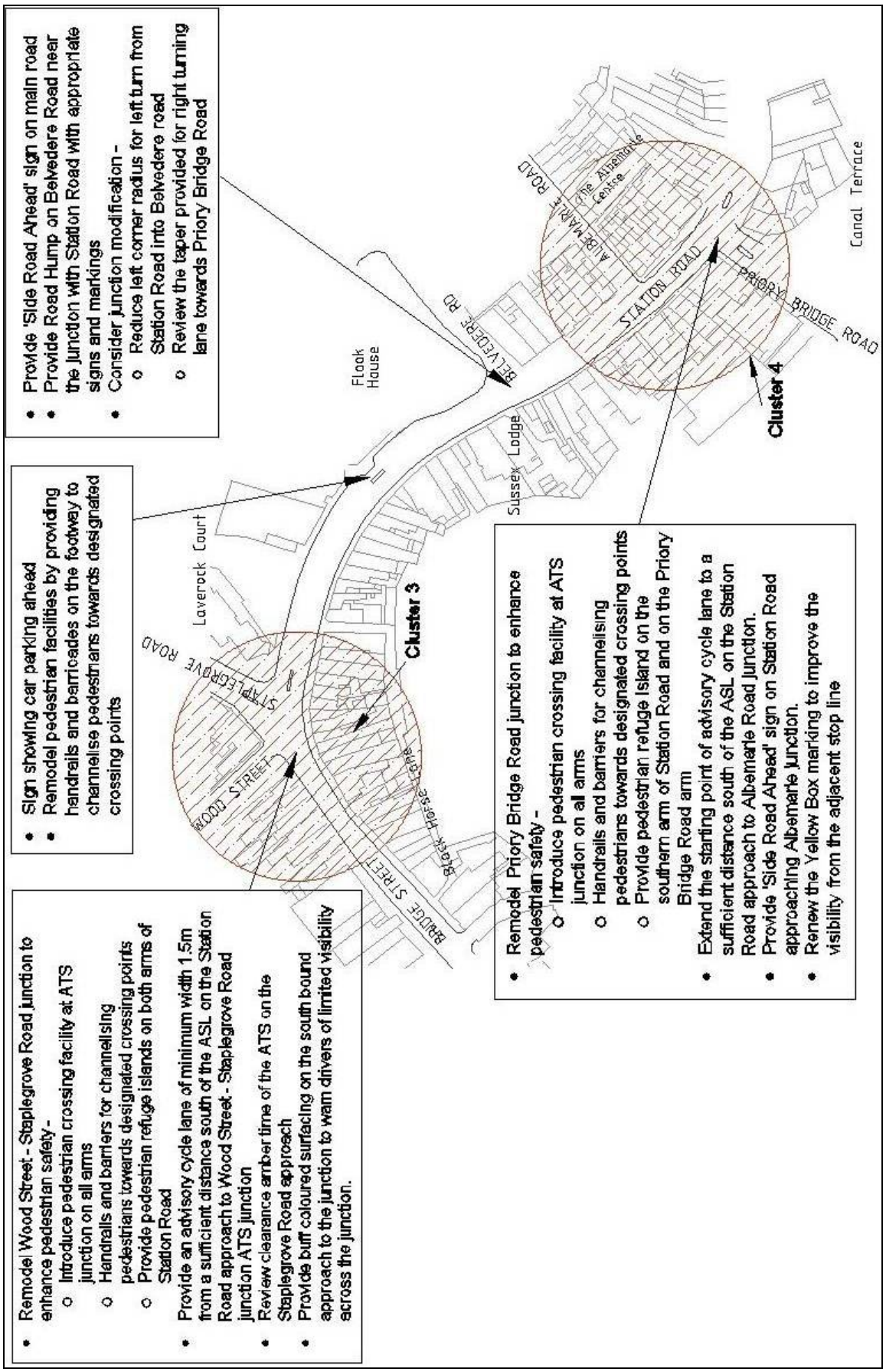
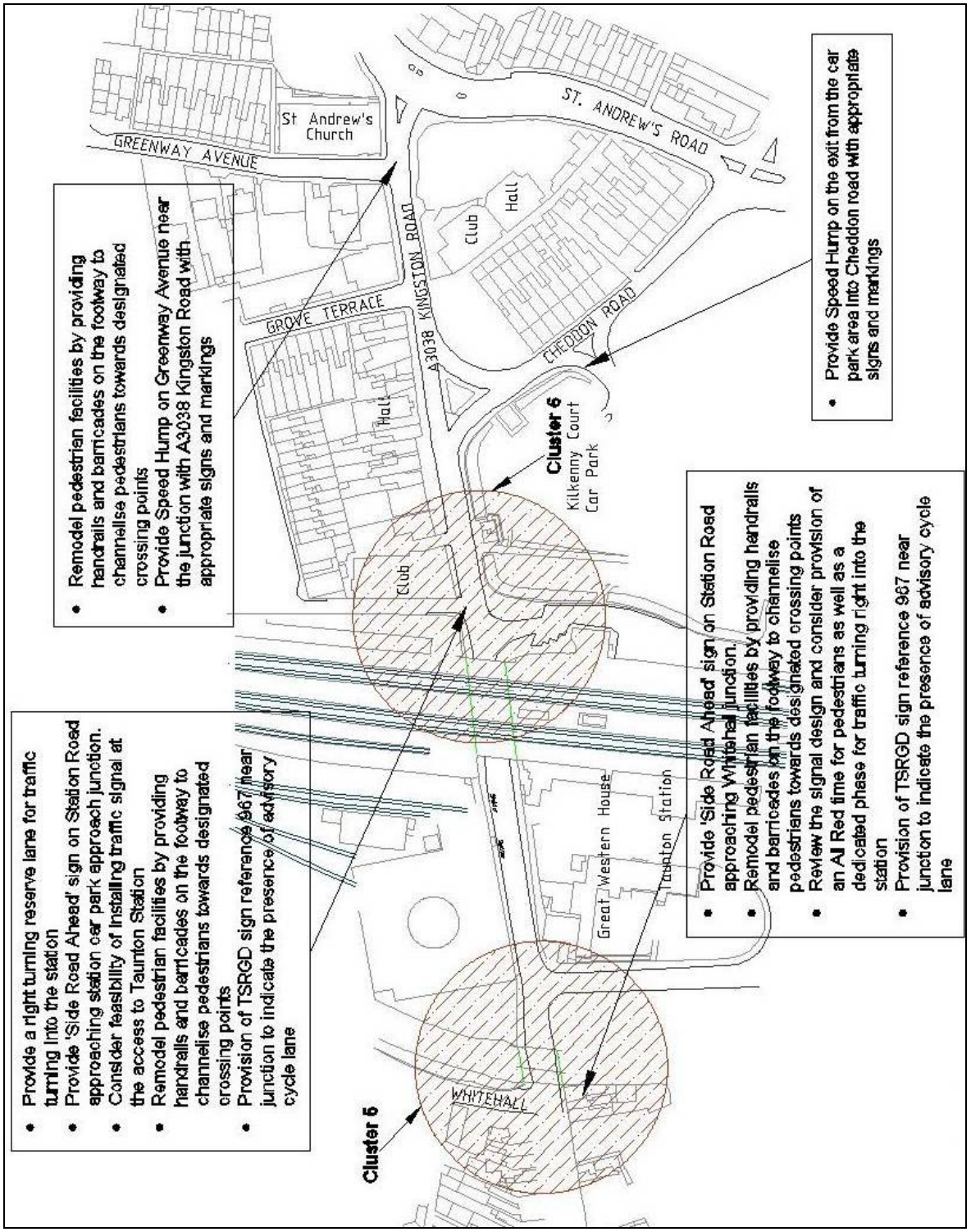


Figure 6: Recommendations for Cluster Sites 5 and 6 and other sites



8. Expected Accident Reduction

The expected reduction in the number of accidents due to the various countermeasures proposed is presented in Table 5. The expected percentage of reduction in terms of numbers of accidents for cluster sites and isolated sites has also been presented.

The table is based on the study carried out by TRL[2], on selected types of countermeasures in urban and rural settings, where the average annual accidents saved have been quantified for each type of treatment used. In the present study, the expected percentage reduction in the number of accidents for the study area has been estimated on the basis of this study for the type of measures proposed, assuming that the study area is of a similar nature to the urban roads used in the TRL studies.

From Table 5, it can be observed that around 37.9% reduction could be expected in the number of accidents after successful implementation of suggested counter measures.

Table 5: Expected Reductions in the Number of Accidents

Cluster No.	Description	Number of Accidents (2001–2005)	Expected Number of Accidents to be Saved	Expected Accident Reduction (in %)
1.	From the start of the route to the bridge	11	3.4	30.9
2.	From the bridge to Goodlands Lane	12	4.3	35.8
3.	Between Goodlands Lane and the Wood Street – Staplegrove Road junction	12	3.9	32.5
4.	Near the junction of Station Road with Albemarle Road and Priory Bridge Road	13	3.7	28.5
5.	Near the junction of Whitehall with Station Road and near the access to Taunton Station	9	3.1	34.5
6.	Near the main (northern) access to Taunton Station	14	5.7	40.7
Isolated Accidents No.				
1.	On the bend between Staplegrove Road and Belvedere Road near the Swimming Pool	2	0.8	40.0
2.	At the 'Give way' junction of Belvedere road with Station Road	2	1.2	60.0
3.	Near the junction of Greenway Avenue with A3038 Kingston Road	4	2.3	57.5
4.	On Cheddon Road on the gyratory	3	2.7	90.0
Total		**82**	**31.1**	**37.9**

[2] Website: http://www.trl.co.uk/molasses/new_page_6.htm

9. Discussions and Conclusions

The route under study witnessed an average of 16.6 accidents per year and 17.8 casualties per year. The casualty severity ratio of 0.124 is higher than the County average of 0.10 for A-classified urban roads. Six distinct clusters of accidents have been identified in addition to other isolated accident occurrences. Countermeasures have been suggested for the cluster sites as well the other isolated accidents that occurred along the route. Majority of the accidents occurred either at 'Give-Way' controlled locations or at uncontrolled locations. Almost 29% of the accidents occurred at locations controlled by automatic traffic signals. As a typical characteristic of any urban route, a high percentage of accidents involved pedal cycles and pedestrians. A majority of the accidents were reported to be caused by human factors, attributable to driver / rider, pedestrian or passenger. Deficiencies in the road environment were reported as causes in 15.7% of the accidents.

The largest cluster of fourteen accidents was observed near the main (northern) access to Taunton Station. Even though there is no dominant trend of accidents observed, most of these accidents were deemed treatable by simple countermeasures. Recommendations have been identified to treat specific patterns of accidents observed at the site. Based on a study carried out by TRL, the average annual reduction in the number of accidents in an urban setting for the type of countermeasures proposed was estimated. For the selected stretch, the expected reduction in the number of accidents once the scheme is successfully implemented could be around 37.9%. Hence, this scheme is expected to provide enormous benefit in terms of accident reduction.

10. Scope for Further Work

It has been estimated that the accident reduction of about 37.9% can be expected once the scheme is successfully implemented. However, routine accident monitoring and evaluation needs to be carried out once the scheme has been completed to ascertain if the expected accident reductions have been achieved.