An Investigation Into Cyclist Safety on the Supertram Network In Sheffield, South Yorkshire

Sheffield
City Council

Development
Environment
& Leisure

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Executive Summary

Since the introduction of Supertram onto Sheffield's streets, there have been problems concerning the safety of cyclists negotiating the tram routes. A great deal of publicity has been given to the subject by the local media and the local cycling lobby groups.

Various other studies have recently been commissioned on the general subject of co-ordination between the two transport modes of cycles and trams, these include C. Wood's *Trams and bikes: friends or foes?*[14] and *Integrating Cycling and Public Transport* as well as the MVA Consultancy's *Cycling and Light Rapid Transit* for the Department of the Environment, Transport and the Regions. The following study however, specifically addresses cycle safety problems related to the Sheffield Supertram, although many of the points brought out will be relevant to on-street tram systems throughout the world, and also useful to anyone involved in the design of a new on-street tram system.

Details of accidents were found from a variety of sources as it became obvious that the traditional method of collecting accident data would not provide a true picture of the situation.

The main objective of the study was to identify any measures that could reduce the number of dangerous incidents occurring to cyclists on the tram route. The specific problems encountered by cyclists were therefore investigated and defined from information collated from the numerous press reports available and after consultation with local cyclists.

Measures to encourage cyclists to take up a more commanding and visible position on the carriageway are suggested, as is research into and development of a suitable rubber track insert to allow safe crossing of the tram tracks. The provision of useful alternative routes for cyclists distinct from the Supertram route is also recommended.

More detailed work is now required to determine the feasibility of some of the recommended measures, whilst others should be tested in certain strategic locations to assess their suitability.

1.0 INTRODUCTION

The purpose of this investigation is to:

- Set out the parameters within which the South Yorkshire Supertram in Sheffield was built.
- Assess the level and appropriateness of specific cycle provision within modern tramway systems.
- Assess the breadth and level of problems posed for cyclists on the Supertram network.
- Investigate specific problems for cyclists in Sheffield relating to the street running tram system.
- Identify possible measures that could be applied in Sheffield to ease the identified problems.
- Recommend future work to improve cyclist safety on the Supertram network.

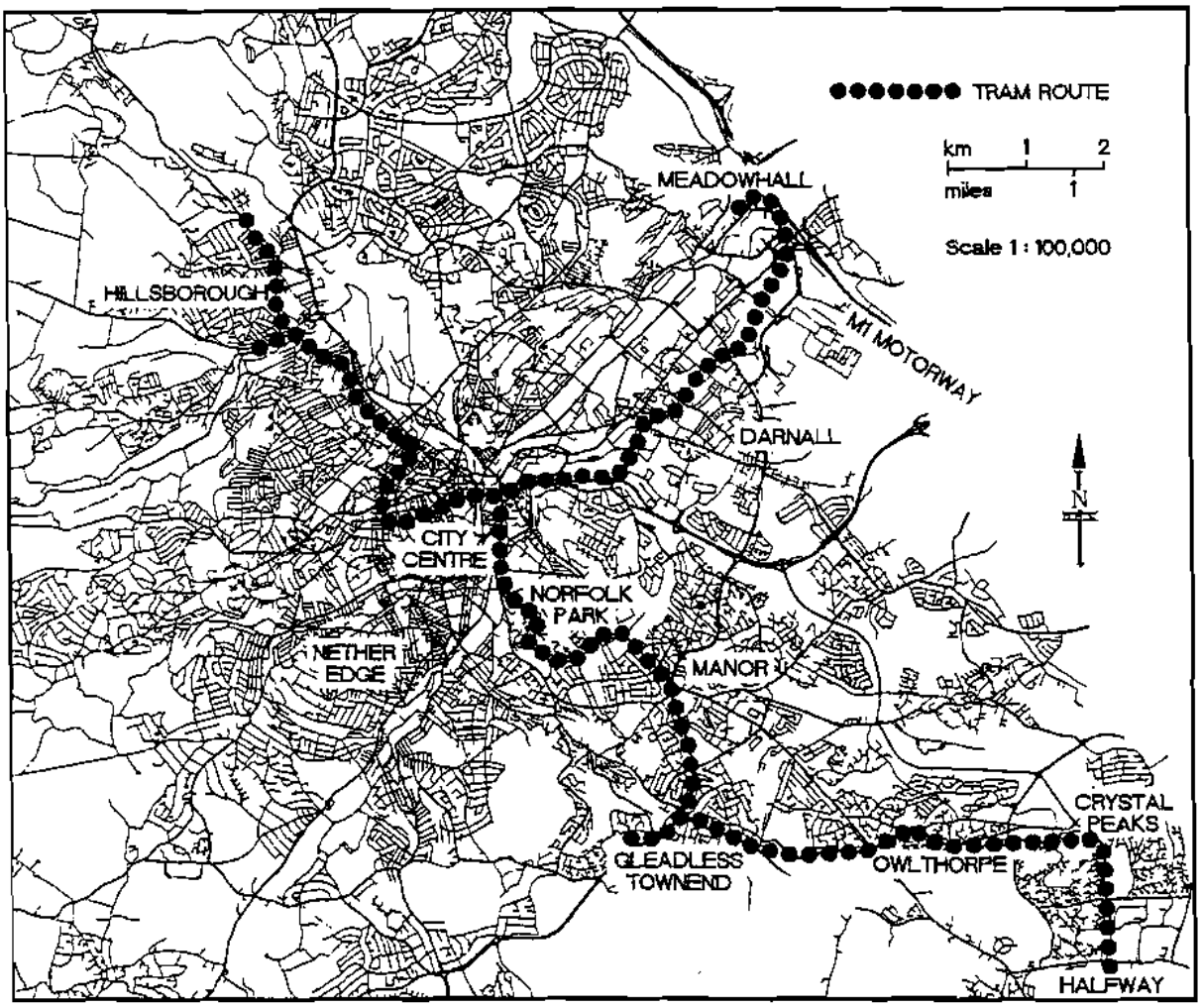


Figure 1: The extent of the Supertram network in Sheffield.

2.0 Background / Historical Information

2.1 The Supertram Network

Supertram is by far the largest on street light rail transport system in the United Kingdom. It comprises 45 tramstops on 35km of twin line route stretching from the city centre to the district of Hillsborough in the north west, to the Meadowhall shopping centre in the north east and through residential districts to the Crystal Peaks shopping centre and Mosborough townships in the south east. Most significantly, about half of the system is on street and on only a small proportion of this is the tram segregated from vehicular traffic. This means that significant lengths of road in Sheffield have trams, buses, cyclists, lorries, cars and, of course, pedestrians sharing the same road space.

The nature of the project was such that it was different from anything this country had seen in the last 30 years and thus there were no precedents and limited experience from which to learn. However, extensive feasibility studies and research into continental and American systems ensured design of a high quality state-of-the-art light rail system. Early publicity produced by South Yorkshire Supertram Limited stressed the safety of Supertram, its ease of use and accessibility for disabled and partially sighted groups. Emphasis was also put on the flexibility with which it would interact with other transport modes and it is obvious that each step in the design phase was carefully researched and evaluated.

Figure 2: Supertram's ease of access for all sections of the community.

In the late 1980's Acts of Parliament were made giving South Yorkshire Passenger Transport Executive the right to build a tram network and authority to install rails within specific highways in Sheffield. The associated alignment was defined and affected land and buildings were identified. Also identified at this early stage were some problems of inadequate highway widths.

The appropriate, Her Majesty's Railway Inspectorate (HMRI) guidelines, which were regularly updated and improved upon, were followed throughout the design process but as shown below there was never any specific requirement to install mitigating measures where cyclists may have encountered problems.

> *" 6.7 Where LRT tracks are on the side of the carriageway rather than the centre, provision should be made where practicable for cyclists. This can be done either by placing a separate cycle track adjacent to the footway or by providing a mandatory cycle lane within the carriageway. The width of this lane between the kerb and the nearest edge of the line to Diagram 1049 must not be more than 1000mm and the edge of the line to Diagram 1049 nearest to the LRT track must be at least 280mm from the DKE (Dynamic Kinetic Envelope). This cycle lane must be clearly marked and signed as such; vehicle parking and loading prohibitions must be applied. Where it is necessary for cycle lanes to cross LRT tracks, these intersections should be as nearly as possible at right angles as is reasonably practicable. At LRT stops at the side of a road, any cycle lane should, if practicable, pass behind the platform."*
>
> **Department of Transport (1989) Provisional Guidance Note on the Highway and Vehicle Engineering Aspects of Street-Running Light Rapid Transit Systems, DOT, London.[2]**

Unfortunately, most locations in Sheffield did not have sufficient space to allow the segregation approach which is recommended.

By 1991 construction had started and a year later the first tramlines were laid and substantial roadworks had commenced. In March 1994 Supertram made its first public journey on the Meadowhall to city line fully segregated from traffic and by September the following year trams were running on the whole network including the significant proportion of on-street route.

2.2 Transport Policy Considerations

Sheffield City Council has recently adopted a transport strategy shown in their Transport Matters leaflet[3] giving the priorities of different modes in order to achieve the balance required for sustainability within the city. The priorities are as follows:

- Pedestrians and people with disabilities
- Cyclists and Public Transport
- Commercial Vehicles
- Private cars

As can be seen from the above, environmentally friendly options are being encouraged whilst ensuring that easy access is available for people with mobility problems. Unnecessary private car journeys are to be deterred.

This policy mirrors the change in political opinion in the last five years, that is to say, away from the private car and towards sustainability in transportation, i.e. increases in public transport usage, walking and cycling. It is pertinent however to note that the feasibility, preliminary and detail design of Supertram was undertaken before the noticeable push by the Government towards sustainability, including specific promotion of cycling.

Due therefore to the magnitude of the construction project, transport users may be able to identify perceived deficiencies on the newly constructed highways; as they may, by now, be aware of other state-of-the-art solutions not available when the scheme was designed.

It is also pertinent to note that South Yorkshire Supertram Limited was set up to establish a light rapid transit system, and although Sheffield City Council was able to implement the City Centre Traffic Management Scheme in association with the tram construction, and thus improve the overall environment, Supertram monies were not available to be used for specific improvements to the infrastructure, particularly where these were not on the tram route. That said, Sheffield City Council made funding available for off-line works to control the associated highway networks, in order that redistributed traffic could be managed as effectively as possible.

There is no doubt that Supertram is of benefit to the people of Sheffield, it offers a comfortable alternative to the car, helping to reduce dependence on private transport and thus traffic congestion in the city centre. This is a primary aim of Sheffield's transport strategy, and so too is promotion of cycling by provision of better facilities. It has always been anticipated in Sheffield, that a significant reduction in private car traffic in certain defined public areas would open up the remaining highway for use by vulnerable road users and the public transport options.

This premise was incorporated within the City Centre Traffic Management Scheme in 1992/93, expelling through traffic to the Inner Ring Road by severing through routes. This scheme removed a significant number of private cars and provided a degree of public transport priority, which also created the opportunity for further environmental improvement works to be carried out in the future.

Figure 3: Looking towards High Street after removal of through traffic. Private transport has been reduced in the city centre.

The Infirmary Road - Middlewood Road corridor has been similarly addressed by the traffic management measures introduced concurrently with Supertram and the completion of the parallel route, Penistone Road dual carriageway. General traffic has been transferred to this upgraded route, leaving buses, trams, taxis, cyclists and pedestrians to benefit from the improved environment.

This is currently the planning approach adopted by most cities, in a short time creating an improved trading environment. It is now appreciated however, that in Sheffield, these numerous alternative modes of transport do not necessarily share the same space together completely harmoniously.

> *"As environmentally-friendly as Light Rail may be, the pedal cycle is still the most environmentally benign vehicle. For this reason alone, it is important that public transport co-operates with and does not hinder the promotion of the bicycle."*
>
> **Wood C (1996) A Railway Revolution...**[4]

2.3 Cycle Issues In Sheffield

In the early 1980's the former South Yorkshire County Council designed and implemented a series of cycle routes in the city that had been identified in the district plans of the time. Two of these routes were in outlying areas, on quiet streets in the suburb of Darnall and in and around the Rother Valley Country Park. Better known is the network installed in the city centre stretching west to the University and then south to the popular student areas of Broomhall and Nether Edge. This network linked loosely into the Abbeydale-Heeley route running about two miles south from the Inner Ring Road and this again was generally on quiet roads.

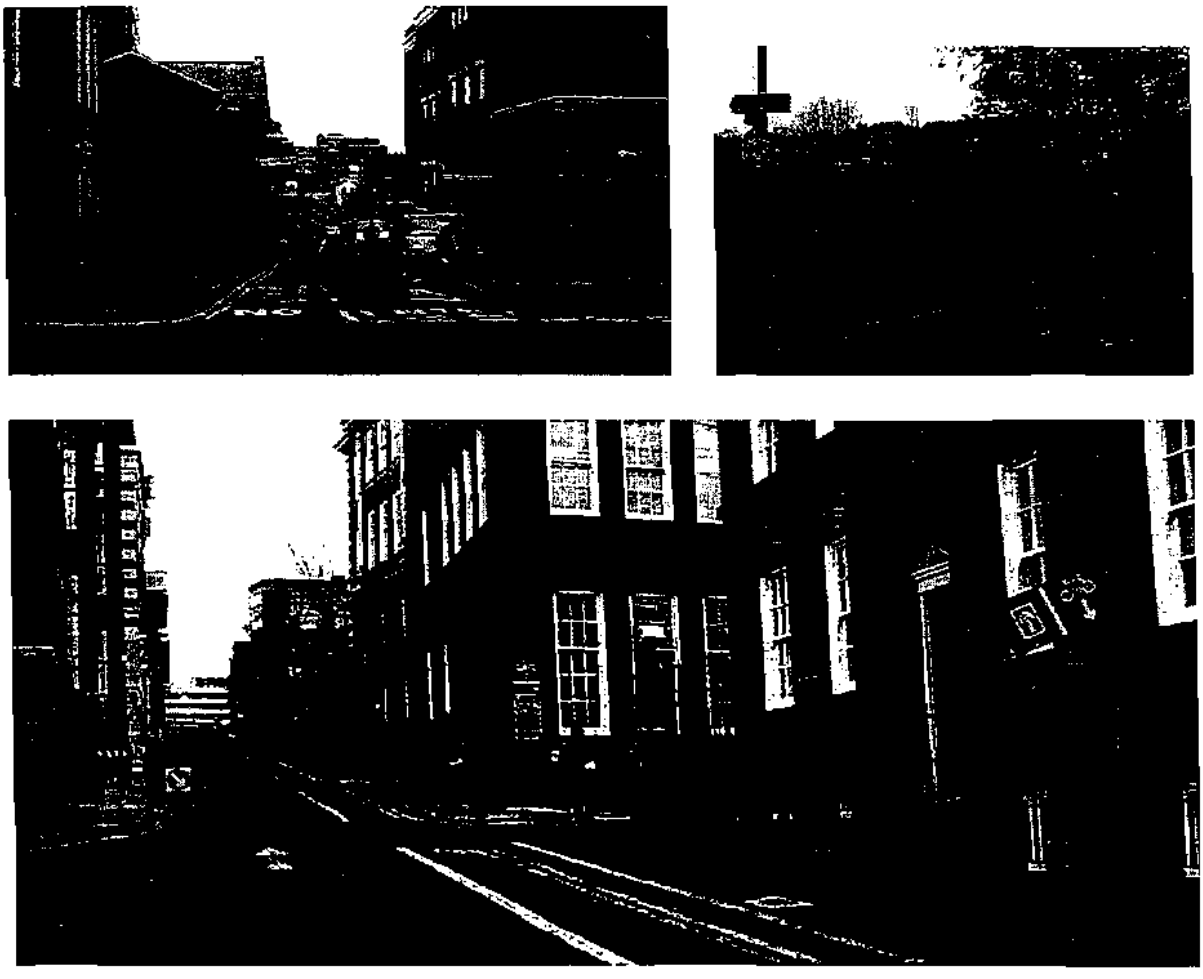


Figure 4: Some of the cycle facilities installed in the 1980's.

Following this early thrust towards cycle route implementation, progress slowed a little. The *easy to install* sections had been established and preliminary design work was undertaken on more complex routes in order to bid for funding. From this stage most cycle facilities were implemented through planning conditions which, although based upon a network plan, did not appear to follow a cohesive strategy. This method of procurement succeeded in leaving many short sections unused due to the fact that they did not link comprehensively. To a certain extent this situation is still prevalent today, however more efforts are now being made to link these sections together.

By 1993 the direction changed again with another gradual move towards cycle friendly design and cycle promotion in line with Government policy and the Package approach to funding. The proposed routes recognised in the Unitary Development Plan[5] (which superseded the district plans) were worked up to form the Sheffield City Council Cycle Routes Strategy Consultation Draft[6] that appeared in 1994. The document successfully identified a number of preferred arterial and city centre access routes providing a fairly comprehensive and cohesive programme. This strategy recently formed the basis for Sheffield's Strategic Cycle Network, which was the subject of a bid for funding from the Transport Package.

The pro-cycle movement has gathered momentum recently with:

- the Millennium Commission's £42.5m grant to Sustrans,
- the joint publication by the Bicycle Association, Cyclists' Touring Club, Department of Transport and the Institution of Highways and Transportation of Cycle-Friendly Infrastructure: Guidelines for Planning and Design[7],
- the launch of the Department of Transport's National Cycling Strategy[8],
- and more locally, Sheffield's Package submission[9] for 1997/8 which included a bid for £3.9m for implementation of a strategic cycle network. Although the Government did not approve any major schemes in 1997/98 (i.e. projects costing more than £2m), they were impressed by the submission and allocated £375,000 of additional grant to allow a start to be made.

Within Sheffield, in the last few years a significant number of cycle related schemes have been implemented and many more are at the design stage. General traffic schemes are looked at more carefully to ensure the safety of cyclists using them and a Cycle Forum has been established, bringing together Sheffield's cycling groups, planners and engineers on a regular basis.

2.4 Experience From Manchester

It is worthy of note that Manchester's Metrolink, then the only other recently constructed tram system in Britain (opened between April and September 1992), runs mainly on old British Rail lines into the satellite towns surrounding the city. For only about three miles in the city centre does the tram run on-highway and even here the majority of this length has the tram segregated from general traffic. This layout overcomes many of the problems associated with running in close proximity to other traffic. About half of the segregated areas are available to buses and hackney carriages whilst cyclists are prohibited for safety reasons. This approach is different to that adopted in Sheffield, where cyclists are allowed to use all bus facilities along with hackney carriages and, with very few exceptions, private hire vehicles. This regime allows cyclists access to lanes and areas that are restricted to general traffic. The number of these facilities is increasing at the moment with the current drive towards sustainable public transport priority.

Cyclists in Manchester rarely encounter problems with the tram or tram lines and it is understood that few complaints have been received. Where traffic does share space with the tram, efforts have been made to reduce the necessity for cyclists to cross the tracks at angles other than 90°. In most cases tram tracks cross a vehicle's route at or near right angles and there are believed to be only three places where cyclists would have had to cross the tracks at a more acute angle. In these situations the opportunity was available to cater specifically for cyclists by providing extra width cycle lanes or facilities to segregate them from other traffic and guide them across the tracks at a safer angle. Appendix 1 shows plans of these areas in Manchester.

2.5 DEFINITIONS

The original intention of this section was to define a highway as being a route available for all general road going vehicles as well as pedestrians, and thus state that one mode of transport has no greater right to use that route than any other. The Highways Act 1980[10], unfortunately, says nothing about rights to use a highway and defines it simply as, "*the whole or part of a highway other than a ferry or waterway*"[11]. For anything more specific one must look at historic decisions from the Common Law courts. The following statements help then to define a highway further:

- "*It is essential to the notion of a highway that it should be open to all members of the public*"[12].
- "*The term highway can be defined as a way over which the public has a right to pass and repass*"[13].
- "*An area of land over which there is a right of way on foot, on horseback or in or on a vehicle constitutes a carriageway*"[13].
- "*Bicycles are vehicles within common law and are thus entitled to use carriageways*"[13].

Cyclists must also obey any Traffic Regulation Orders in force on a particular stretch of highway and as such may be prohibited from using certain highways, e.g. pedestrianised areas or special roads, such as motorways.

These definitions indicate that the public have a right to expect reasonable provision for cyclists on a city's highways.

2.6 Media Coverage (Newspaper Reports)

Supertram has received its share of criticism in Sheffield's press, not least because of the disruption caused during construction.

Figure 5: Construction at Gleadless.

Soon after the tram rails were installed on street there were reports in the local press of accidents involving cyclists. It should be noted that these were not isolated incidents and that frequent reports were received by the Highway Authority of cyclists encountering problems. These related to:

- construction works,
- the presence of the tram tracks,
- difficulties in crossing tram tracks,
- intimidation from trams themselves, and
- a lack of consideration from other drivers when negotiating tram routes.

Sufficient numbers of Supertram related accidents prompted a doctor from Sheffield's Royal Hallamshire Hospital (RHH) to monitor the situation in the casualty department. It should however be noted that many of the accidents referred to were actually associated with the uneven road surfaces experienced in the construction situation:

> *"The increase in the number of injuries to cyclists whose bicycles wheels are caught in the tracks has become so marked over the past four months that accident and emergency staff have started to keep an official tally."*
>
> **Sheffield Telegraph 3rd June 1994.**

The press reports of accidents are also notable in that virtually all involve mature, experienced cyclists and not children, elderly people nor *Sunday afternoon* leisure cyclists as may be expected. The problems being encountered by established, competent cyclists cannot be attributed to the instability nor lack of control associated with novice cyclists. It is also apparent that after the initial spate of incidents, reports are still fairly frequently received of cyclists encountering significant difficulties with the tram tracks.

3.0 Accident Data

For reasons described below statistical analysis of the incidents concerned within this report is very difficult. The term *incident* has been used deliberately here, due to the precise definition of the term *accident* being different in Police and road safety circles to that in common parlance. This is explained in the next section.

This report is concerned with any intimidating or dangerous occurrence regarding cycling on the Supertram network, regardless of whether someone is injured or whether a motor vehicle is also involved. There have been incidents for example, where cyclists have been thrown from their bikes, which have been seriously damaged, but no injury has been sustained to the rider, and these incidents should be taken into account, even though they may not be officially recorded by the Police nor by any hospital.

Section 3.1 deals with the sources of information used for this investigation and, via a newspaper extract, gives a general view on the subject.

Section 3.2 presents a report which compiles all the data that has been uncovered that is deemed to be reliable, in order to form an estimated accident rate. It should be noted that, as discussed earlier, many incidents similar to that described previously would not be recorded anyway and so the conclusion reached in the report must therefore be considered as a minimum figure.

3.1 Problems With Accident Reporting

A road traffic accident (RTA) by definition only comprises a *motor* vehicle accident, thus excluding pedal cycles (unless of course a motor vehicle is also involved). South Yorkshire Police are obliged by law to record RTA details in STATS 19 format, only if a personal injury is involved.

For the purpose of this study then, STATS 19 records alone are unfortunately of little use. A large proportion of the incidents involving cyclists relate specifically to cycles encountering problems with the tram tracks themselves, and not necessarily involving motor vehicles at all. Consequently, these incidents tend to escape police accident records. It is well known that cycle accidents are amongst the most under-reported types of accident data, but it is not known if this situation is any different with respect to the tram route itself.

Accurate research into the nature of the dangerous incidents has therefore been very difficult. Information has been gathered from STATS 19 records, Supertram incident reports, newspaper reports, letters to the Highway Authority and hearsay from cyclists, cycle campaigners and the Sheffield Cycle Forum. Consequently, the views expressed in this report are not based only on road traffic accident data, but are taken from a wide range of sources in order to present a more accurate picture of the situation in Sheffield. The findings should nonetheless be considered valid, as all records used are believed to be accurate.

In order to try to obtain another method of quantifying the effects of Supertram on cyclists' safety, the previously mentioned work by Hallamshire Hospital officials to record Supertram related casualties was investigated further. Unfortunately the hospital refused to release specific accident information at the time, a public report was never produced and due to staff turnover within the hospital, the initiators of the survey are now unobtainable. Nevertheless the Sheffield Telegraph report from June 1994 (quoted in section 2.6) which publicised the hospital's initial findings was followed up a year later and casualty figures were quoted:

> *"Supertram has claimed 72 accident victims over the past year ... 28 of them suffered serious fractures.*
> *More than half were cyclists who fell off as their bikes hit the tracks or pedestrians who tripped over the tracks.*
> *Included in the 72 recorded accidents were ... 29 involving cyclists.*
> *In the last ten years of the original Sheffield tram system, around 65 people were injured each year when their bicycle wheels were caught in tram tracks. Three people were killed."*
>
> **Sheffield Telegraph 12th May 1995**

It should be noted that during this time period the tram was running on-street on some routes, large sections of the city's roads were in the construction phase and the highway was still open to traffic.

Although the hospital's study did not relate solely to cyclists injured, it was limited to people treated at the Hallamshire Hospital and the doctor involved is quoted as saying, it is "*almost certainly the tip of an iceberg*".

The hospital is not known to have come forward with any further injury figures, nor to have reported these findings in the technical press.

3.2 Analytical Report: Pedal Cycle Accidents & The Supertram Network

3.2.1 Introduction

This note is written in order to give advice regarding the above. The first part will deal with definitions of road accidents, which is an important element in understanding the position surrounding pedal cycle accidents in Sheffield. There is then an analysis made of what accident information has come to the attention of the South Yorkshire Police, the Highway Authority and South Yorkshire Supertram Ltd. All data refers to the period from the January 1st 1994 to the 8th August 1996.

3.2.2 Definition Of Accidents

Sheffield, like all Highway Authorities in Great Britain, receives a copy of what is called *STATS 19* information. This is the data that the Police collect when a road traffic accident is reported to them in which there is a human casualty. The Police supply this information to the Department of Transport (DOT), and also share it with the local Highway Authorities. Sheffield Highway Authority helps to collect this information by carrying out additions and amendments to the data before it is sent to the Department of Transport. This is done for the benefit of the Police, the DOT and Sheffield City Council.

The STATS 19 definition of an accident to be reported is given to the Police in Section 2.1 of the Instructions for the Completion of Road Accident Reports (STATS 20):

> *"All road accidents involving human death or personal injury occurring on the Public Highway ('road' in Scotland) and notified to the Police within 30 days of occurrence, and in which one or more vehicles are involved, are to be reported. This is a wider definition of road accidents than that used in Road Traffic Acts."*

In addition, as an example of such an accident, section 2.2(f) says that a STATS 19 should be completed for:

> *"Accidents to pedal cyclists, including where the pedal cyclists injure themselves or a pedestrian."*

In law however, the definition of a road traffic accident is narrower than this. Section 170 of the 1988 Road Traffic Act deals with the duty of a driver to report an accident. This section applies however only to a 'motor vehicle', which of course a pedal cycle is not. A driver of a motor vehicle can comply with this Act without reporting the matter to the Police, as long as he/she has given his/her "*...name and address, and also the name and address of the owner and the identification marks of the vehicle...*" to any person who has "*...reasonable grounds for so requiring*".

South Yorkshire Police are on record as saying that they will apply this legal definition to the reporting of single vehicle pedal cycle accidents. However whilst the Road Traffic Act gives instructions about what a driver should do with respect to reporting a road accident, this duty does not in the first instance mean that the accident has to be reported to the Police, but rather to any person who has "*...reasonable grounds for doing so*". The instructions to the Police about what to record as a road accident comes from STATS 20 as mentioned in 3.2.1.

As a result of this policy of South Yorkshire Police, while it is generally known that pedal cycle accidents are one of the most frequently under reported/recorded types of road accident, in South Yorkshire, the number of single vehicle pedal cycle injury accidents is especially low. Nonetheless, some of these accidents do get reported on the STATS 19 system. For example, between the years 1988 to 1993 inclusive (prior to Supertram), there were 27 single vehicle pedal cycle accidents recorded in Sheffield, including two fatal accidents and three serious accidents.

3.2.3 Accident Analysis

There have been five sources or types of accidents that have been analysed for this report:

- STATS 19 records in which a pedal cyclist has been injured following an accident where the cycle wheel was in contact with the tram rail/track.
- STATS19 records in which a pedal cyclist has been injured in an accident on the supertram network, but where there is no indication of any problem with any aspect of the supertram network.
- Newspaper or journal reports of accidents, which are recorded by the Technical Information unit within Sheffield City Council.
- A list of *incidents* recorded by South Yorkshire Supertram Ltd.
- Information from letters to the Council.

STATS 19 Records

Between the 1st of January 1994 and the 8th August 1996, there have been five accidents reported and recorded on the STATS 19 system in which only a pedal cyclist was involved. Each of these five accidents were where a cycle wheel was caught in the tram track. All of these accidents have been recorded by South Yorkshire Police as being slight in terms of the severity of injury.

There have been an additional eleven recorded accidents on the supertram network, where a pedal cyclist has been injured following a collision with another motor vehicle. The STATS 19 records of these accidents do not indicate that the tram track or any other element of the supertram network led to a problem for any of the road users involved. These accidents will not be considered further in this note.

Press and Journal Reports

The Technical Information Unit of the City Council supply the Road Safety Engineering Group with copies of press cuttings regarding road accidents in Sheffield. An examination of these reports show that there have been seven accidents in the time period mentioned above in which a cyclist has had an accident when a wheel of the cycle was caught in the tram track. **None of these accidents have been recorded as STATS 19 accidents.** Of the seven accidents, one has resulted in fatal injuries, four have resulted in serious injuries, and in two cases there were no reports of injuries, although it is likely that each of the casualties were at least slightly injured.

There have also been reports in the *Sheffield Telegraph* and *The Surveyor* about an internal study at the Royal Hallamshire Hospital, which is said to show that in the twelve months from May 1994 to April 1995 there were 29 accidents in which cyclists had been injured in accidents on the tram network, fourteen of whom had serious fractures. It is not known if any of these accidents is matched in either the STATS 19 records or the newspaper reports, although it is suggested that none will have been recorded as STATS 19 records, because there have been no reports of serious injuries. Hospital details are not usually shared elsewhere because of confidentiality rulings, although reports of this nature are commonly published in journals such as the *British Medical Journal* and *The Lancet*.

SUPERTRAM RECORDS

Since August 1994 the tram operators have recorded any known incidents on the tram system. This information shows that between August 1994 and the 8th August 1996 there have been five accidents in which a cyclist has had a collision on the tram tracks. **None of these accidents have been recorded as STATS 19 accidents. One of them was the fatal accident mentioned above.** Of the other four accidents recorded, one is said to be *serious*, one had head and leg injuries and was "...unconscious for five minutes" (and an ambulance attended), and another also had an ambulance in attendance. In the forth accident, the rider fell off his bike when the wheel was stuck in the tram track, and landed underneath a following tram. The Supertram records show that the cyclist was unhurt, however for the purpose of this analysis it is presumed that the cyclist sustained a slight injury.

LETTERS TO THE COUNCIL

There were three letters to the Council regarding pedal cycle accidents. Two occurred on West Street, and one on Glossop Road. In one accident the cyclist was detained at the Royal Hallamshire Hospital, having been concussed. In another the cyclist was treated for some time by his local GP and has attended at A & E Unit (most probably RHH). **None of these incidents have been recorded as STATS 19 accidents, nor have they been duplicated in press/Supertram reports.**

3.2.4 An Annual Accident Rate

From all of the above it is possible to construct an annual rate of pedal cycle accidents in which a cyclist has been injured in an incident related to the tram track. It should be borne in mind however, that a proportion of these recorded accidents occurred during construction of the tram network.

The official STATS 19 records show that there have been **five accidents** in 2.7 years. Added to this are the **seven accidents** in the same time period that have been reported in the local press. The Supertram records show an additional **four accidents** in the two year period between August 1994 and August 1996. The letters show that there have been an additional **three accidents** in 2.7 years. After avoiding double counting these records suggest a rate of 7.6 accidents per annum.

With respect to the 29 pedal cycle accidents that have been reported as occurring on the tram tracks between May 1994 and April 1995 and have been recorded at the Royal Hallamshire Hospital, it is suggested that this figure can be adjusted downwards. This can be done by assuming that any of the nineteen accidents mentioned in the above paragraph that occurred between May 1994 and April 1995 and are at least *serious* in nature or involved the Ambulance Service, were treated at the Royal Hallamshire Hospital. This figure is assumed to be four accidents (two mentioned in the press cuttings, one in May 1994, another in March 1995, and two mentioned in letters to the Council). This leaves an additional 25 accidents per year from the Royal Hallamshire Hospital study.

Thus the estimated rate of accidents where pedal cycles have difficulties with the tram track is given as a minimum of 33 accidents per annum. Over half of these accidents are at least serious in nature. In the time period studied there has been one fatal accident. It is highly likely that there are an unknown number of other accidents of the type described, that are either not recorded by South Yorkshire Police, do not involve any hospital treatment, nor will they have come to the attention of any of the agencies mentioned in this note.

4.0 PROBLEMS

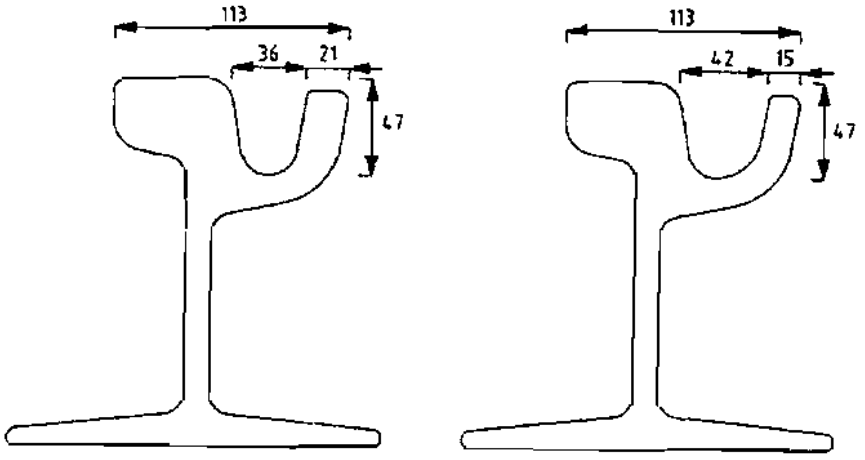
The high proportion of the tramway that is on-street and unsegregated from general traffic means that on some lengths of road within Sheffield, cyclists will find themselves riding alongside and also having to cross grooves (flangeways) set into the road surface. There are many problems that cyclists already face when riding on the carriageway in today's levels of traffic and congestion, and the combination of the uneven road surface due to the tram track grooves, and the intimidation brought about by the proximity and size of other vehicles, lead to several factors coming out as being specific problems. These factors are listed below and are dealt with in the following sections.

- Interface between cycle tyres and rail groove
- Crossing the tram tracks
- Positioning of the tram tracks
- Tram priority
- Tramstops
- Anti-pedestrian paving

4.1 Interface Between Cycle Tyres and Rail Groove (Flangeway)

The most widely voiced concern relating to trams and safety of cyclists in Sheffield is the bicycle tyre falling into the grooved tram rail. Reports suggest that rather than guiding the bicycle wheel along the track and causing the rider to lose balance and thus fall off, a scenario which may perhaps be anticipated and even compensated for, the front wheel unexpectedly becomes stuck fast, gripped within the rail groove. The effect is to throw the cyclist straight over the handlebars, often resulting in fractures and head injuries of varying severity.

In Europe this appears to be less of a problem as bicycle tyres generally tend to be wider than in Britain[14]. Nevertheless, in The Hague, Netherlands, a wider grooved rail profile has been installed at inherent danger points[15]. At these locations a rail is used that is similar to the standard rail except that the groove width is 42mm, slightly greater than the standard 36mm groove width.



Tramrail Ri 60 N *Tramrail Ri 59 N*

Figure 6: Tram rail profiles showing the wider grooved Ri 59N rail used in the Netherlands.

No information is available at present regarding the success of this measure. It is suggested that the extra width groove may increase the chances of cycles ending up in the rails, but that this would be offset by a reduction in the severity of the accidents. The widespread use of mountain bikes with wider tyres may also have a bearing on this situation, but conclusions are not possible given the variety of tyre widths and design now in common use.

Cyclist speed may be relevant to this specific problem. At low speeds it is easier to negotiate the rails accurately and so there is less chance of becoming stuck. However, it is accepted that riding particularly slowly or cautiously can be a hazard in itself with respect to other traffic becoming impatient.

4.2 Crossing The Tram Tracks

As previously stated, approximately half of Sheffield's 35km tram system is on general carriageway where Supertram shares road space with lorries, buses, cars and bicycles.

Throughout the network Supertram tracks often cross the traffic lane of the carriageway they were following. Where general traffic is prohibited from lanes, junctions, tramstops and where Supertram leaves the carriageway, the rails are laid at an acute angle to the direction of road vehicle flow. This is often effected by the traffic lane moving across the route of the tram and requires cyclists and general traffic to cross the tracks at a narrow angle.

Figure 7: Supertram rails crossing the path of road traffic at acute angles.

It should be pointed out that crossing the tracks itself is not a great problem in its own right. Given adequate time and space cyclists can align themselves to cross the track at an angle near to 45 degrees and thus cross in relative safety. Cycling in traffic is hazardous enough on a tram-free road, but the combination of trying to manoeuvre across the tracks to take up a safe position whilst necessarily moving into the path of other vehicles is what causes the true danger.

Manoeuvring into the path of traffic, for example in order to make a right turn, has always been a difficult operation for cyclists, consisting of looking back over one's shoulder to assess the proximity and speed of the traffic flow behind, as well as signalling the intention to pull out and thus riding with only one hand on the handlebars. The risk involved in this situation is therefore magnified significantly if the cyclist also has to contend with a hazard set into the carriageway capable of upsetting the rider's balance and concentration.

Crossing the tracks at near right angles in the way shown in the Supertram publicity brochures is simple in theory on an empty road, but trying the same manoeuvre in busy traffic, faced with the wrath of drivers seeing a slower moving vehicle pulling in front of them, taking *their* road space and holding them up, can be very intimidating. This intimidation is significantly increased when the following vehicle is a bus, lorry or tram with its huge difference in size.

A very pertinent but obvious point that tends to escape most driver's minds, and yet is always in the forefront of a cyclist's, is that getting too close or having a slight bump with a cyclist can so easily have a severe or fatal effect on the cyclist with no injury to the driver or very little damage caused to the vehicle. A minor error or inconsiderate action on the part of a driver can have a disastrous effect on a vulnerable cyclist.

This section is developing a view that to ride along a tram route in conjunction with other traffic, a cyclist must be extremely confident and ride fairly assertively, in order to ensure that other drivers will be aware of the unexpected manoeuvres that the cyclist may have to make. It is the aim of Sheffield City Council however, to encourage cyclists of all abilities to use the highway network. This includes children, inexperienced adults, elderly people and those with a disability, as well as commuter adults and sports cyclists.

"Our target is to increase cycle usage so that it represents 5% of the numbers of trips made by car by the year 2002. The target therefore is to increase existing cycle use fourfold."

South Yorkshire Package Bid 1996[16]

It has often been suggested by Supertram that trams mixing with cycles should present no problems, as they have done so on the Continent for many years without undue concern. The Dutch design manual[15], however, has this to say on the subject:

"The coming together of trams and bicycles therefore requires extra care on designing. Tram-rails in particular considerably aggravate the action of riding a bicycle. Cyclists must avoid crossing the rails at an acute angle especially in wet weather. In addition, tram-rails do not only cause direct accidents (cyclists slipping on rails) but also indirect accidents:

- *Cyclists sometimes need to pay so much attention to avoid falling (especially on following the rails at points and bends), that they miss other hazards;*
- *Cyclist are not always able to choose a safe path, for example at sufficient distance to parked cars;*
- *Tram-rails limit the freedom of movement at emergency manoeuvres."*

Also in the Netherlands it is recommended that cycle lanes run alongside the tram tracks, often with a one metre separation from the tram swept path.

Figure 8: Plenty of space for bikes - Amsterdam Roeterstraat in November 1993. *Chris Wood*

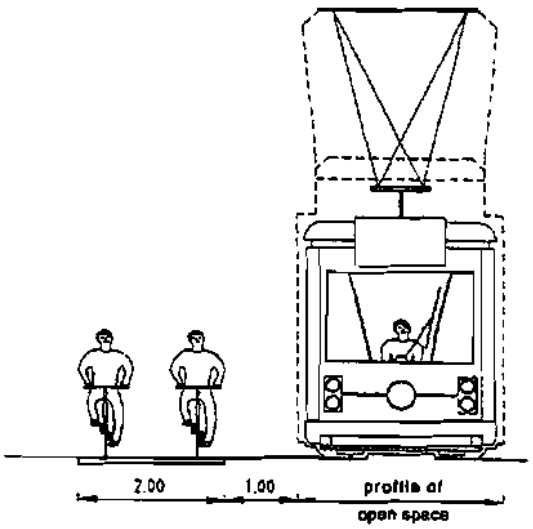


Figure 9: In the Netherlands a seperate cycle lane is often provided on-street adjacent to the tram and traffic lane.

4.3 Tramline Positioning

Typical sections of the on-street tram route in Sheffield have the tramline trough positioned approximately 1.1m from the nearside kerb edge. The distance between kerb and inner rail results from the requirement of HMRI for the kerb face to be 381mm from the tram kinematic envelope.

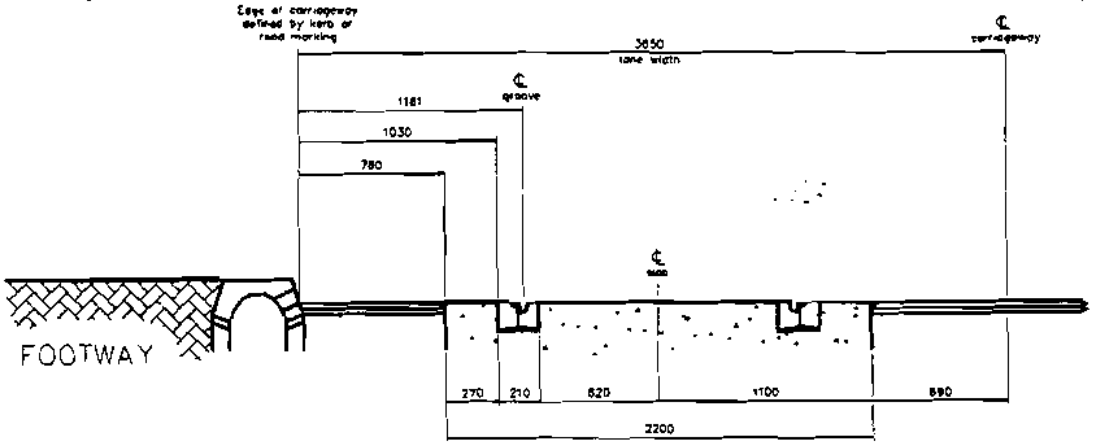


Figure 10: Typical section through straight carriageway lane showing positions of rails and slab.

This layout enables the tram to run close to the kerb, so called *gutter running*[14], and for tram stops to be located on the footway in order that tram passengers may step straight onto the tram from the pavement. The alternative layout to this has the tram tracks positioned towards the middle of the carriageway, requiring pedestrians to cross the road to a centrally positioned tramstop but removing the tram/cycle conflict at the nearside of the road. This latter arrangement requires considerable highway width but where practicable has been implemented on some sections of the Supertram route (e.g. the Hollinsend tramstop on Ridgeway Road).

The 1.1m available width encourages cyclists to position themselves here between the restrictions of the kerb and the rail. This space is where cyclists tend to ride, unless on occasion they feel the need to take up a more commanding position in the centre of the traffic lane between the rails, perhaps in heavy traffic conditions or for greater conspicuity. A width of 1.1m is within DETR guidelines for advisory cycle lanes and similar widths have been used successfully in the past. It is acceptable then as a reasonable width for cyclists to have to use. The intimidation of a rail groove to one side should however, not be underestimated, and it is clear that accidents do not only occur when cyclists attempt to cross the tracks, but are also prevalent when cyclists are riding alongside them.

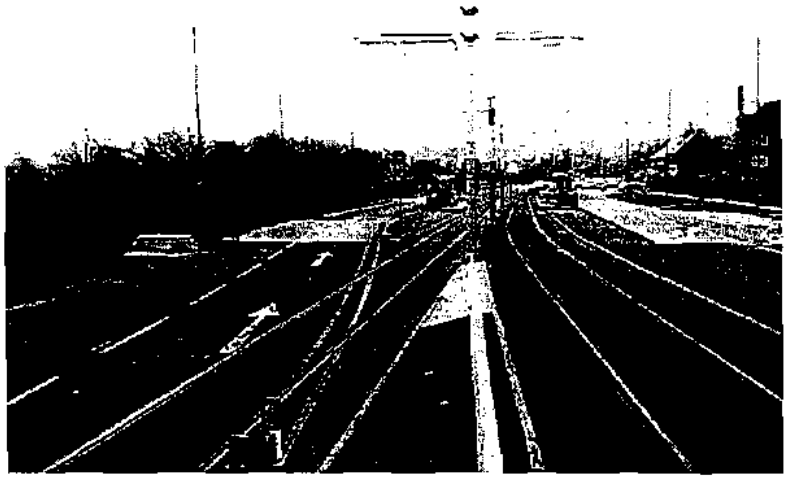


Figure 11: The Hollinsend tramstop positioned between opposing carriageways.

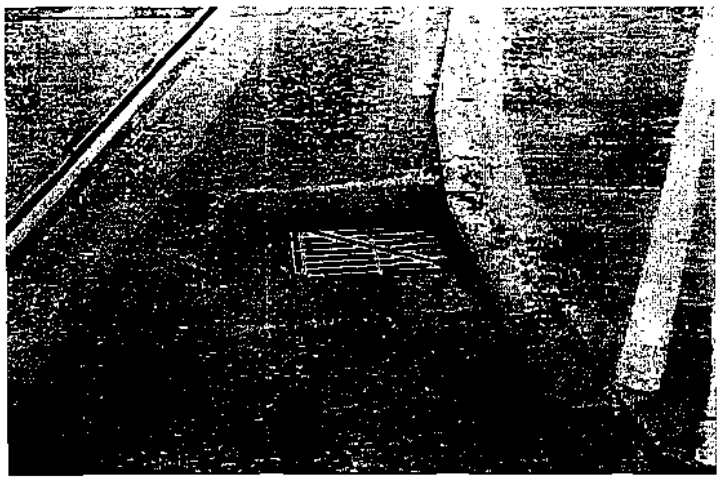


Figure 12: A poorly levelled grid recently installed on the tram route.

It is well known that this area on a carriageway nearest to the kerb, is less than ideal as the preferred position for riding a bicycle. Cyclists are required to navigate through litter, everyday road detritus, uneven surfaces due to badly levelled or positioned gullies, badly applied zig-zag and yellow lines and potholes, whilst also avoiding the hazards of left turning and parking vehicles and car doors opening from vehicles already parked[17].

That said, side entry gullies are used on some of the tram route, the surface is relatively free from potholes due to the recent carriageway construction, and the position of the rail does tend to define a path. Drivers though are inclined not to drive on the rails but tend to drive offset from them, as standard vehicle wheelbases are very similar to the gauge of the tram tracks and following the rails gives the driver a feeling of lack of control, as if the vehicle steers its own course.

This means that although a cyclist may be reassured by a feeling of delineation, he is still likely to find vehicles within the aforementioned 1.1m strip.

Figure 13: The beany block side entry drainage system.

In most documents regarding on-street cycle lanes it is specifically recommended that maintenance of the surface should be of primary importance, as cyclists are particularly sensitive to the quality of a road surface.Whilst in practice this is rarely implemented due to financial constraints, throughout the tram route the road has been remade and the surface re-laid and so is generally in good condition and can be expected to remain so for a number of years to come.

4.4 Tram Priority

A variety of measures have been used to afford Supertram a degree of priority over other vehicles on Sheffield's roads. Trams however, lose a certain amount of priority when in traffic as they cannot overtake slower moving vehicles nor bypass congestion due to their predetermined path. In these situations other vehicles do not move out of the way to let the tram pass and cannot reasonably be expected to do so. Supertram does not therefore have a priority over other road vehicles in the same lane but can be given some priority of movement through a signal controlled junction.

Some cyclists however, have experienced problems when they have found themselves ahead of a tram. Reports suggest that some cyclists have been *bullied* by Supertram drivers who have expected the cyclist to pull over, stop and allow the tram to pass. It should be reiterated that the tram has no right to this supposed priority and that, assuming no vehicles are prohibited by Traffic Regulation Order, all vehicles have an equal right to use the carriageway.

Supertram drivers have been accused of intimidating cyclists in this manner by sounding the warning bell, driving very close behind and attempting to pass without sufficient room. These actions have forced cyclists to stop for fear of serious injury. The situation here is compounded by the fact that Supertram publicity leaflets suggest in their advice to cyclists, "*when a tram is approaching move clear of the tramway*", and Supertram spokesmen have publicly supported this opinion. These views have understandably upset some cyclists, although they do not justify reports of cyclists allegedly riding deliberately slowly in front of trams - an action that the Police take a very dim view of.

The intimidation is not associated only with trams. Bus drivers have also been known to *hassle* cyclists when they feel they are being held up. This is often a symptom of narrow bus lanes, where a bus may pass queues of stationary cars and then the driver becomes frustrated when unable to pass a cyclist also using the bus lane. This of course is an inherent problem of fitting facilities into restricted highway widths, and in many cases must be accepted as the best compromise.

4.5 TRAMSTOPS

Each tramstop is designed such that the tram pulls up adjacent to the platform. The level of the tram floor and platform are similar and this allows safe, easy access for partially sighted, disabled, elderly and pushchair users.

Figure 14: Tramstops extend into the road to allow easy access.

To facilitate this arrangement, the platform is raised above the normal footway level and juts out into the carriageway to meet the tram doors. This is necessary to avoid users having to step up, step down or over a gap to access the tram.

When travelling along the tram route in another vehicle, the kerbline tends to protrude approximately half a metre into the road in front of the vehicle. The vehicle must then move towards the offside in order to manoeuvre around the tramstop. The tram tracks continue straight ahead so that the effect is that the tram pulls into the kerb, although actually the kerb is pulling out to the tram.

On implementation of this initial design a number of accidents occurred involving vehicles colliding with the overhanging edge of the tramstop. This problem was overcome by installing a tapered narrowing of the carriageway to take vehicles away from this protruding edge. It is now appreciated that this raises problems for cyclists. As previously mentioned cyclists tend to ride on the nearside of the carriageway between the kerb and the tramrail. At tramstops the width between the platform and rail is reduced to only about 350mm, a width that a cyclist cannot be expected to navigate safely, and as a result the cyclist is obliged to cross the tram track and ride on the section between the rails.

This is an often quoted problem that cyclists face on the tram network, that at regular intervals along a route they are forced to move out in front of other traffic whilst negotiating crossing the tram tracks.

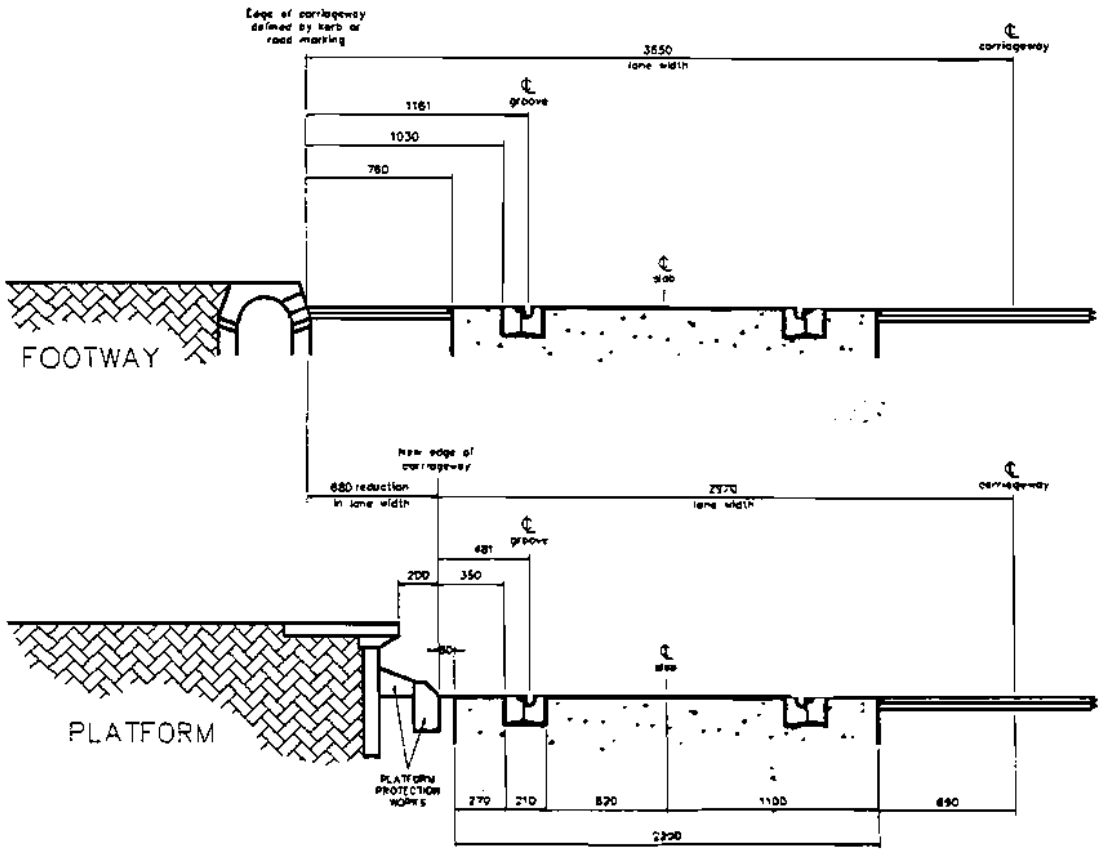


Figure 15: Typical section showing reduced lane width due to platform extending into the carriageway.

The change in the kerbline path, i.e. the tramstop extending into the road and the taper in advance of this, although within the parameters of relevant design guidelines, is not always very visible to drivers. If drivers are not aware they are approaching a tramstop, they may find a cyclist suddenly pulling out in front of them, apparently without reason. This problem is obviously heightened in the dark and times of low visibility, and renders the manoeuvre of even more concern to cyclists. Kerb extensions and traffic islands which protrude into the road tend to be highlighted by bollards with retroreflective bands or by traffic signs, so that they are more conspicuous to drivers in poor conditions. It may be appropriate to use similar measures at tramstops to give drivers more information about the lane alignment ahead.

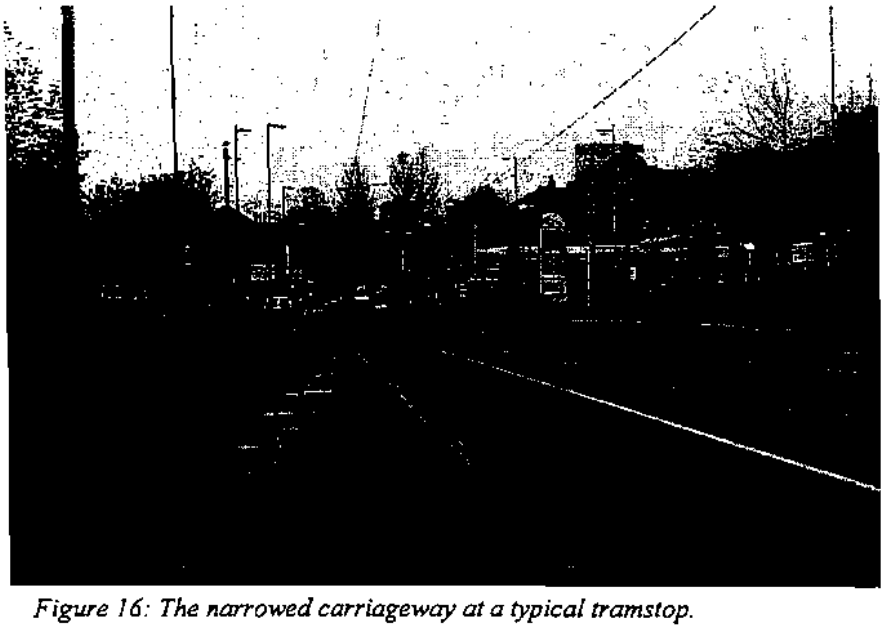


Figure 16: The narrowed carriageway at a typical tramstop.

4.6 Anti-Pedestrian Paving

An additional perceived problem at tramstops has been identified by the cycle lobby and relates to the anti-pedestrian paving located at tramstops. Where the taper has been lengthened at the lead in to the stop, the area is required to be kept free from pedestrian use due to the proximity of passing trams, and so is surfaced in an uneven fashion as a deterrent. This is a common solution to this type of problem and is in place in many cities. The deterrent paving chosen is however of a very aggressive design. Many styles of this paving are available, but the style chosen is more suitable for vehicle control applications than for discouraging pedestrian use[18].

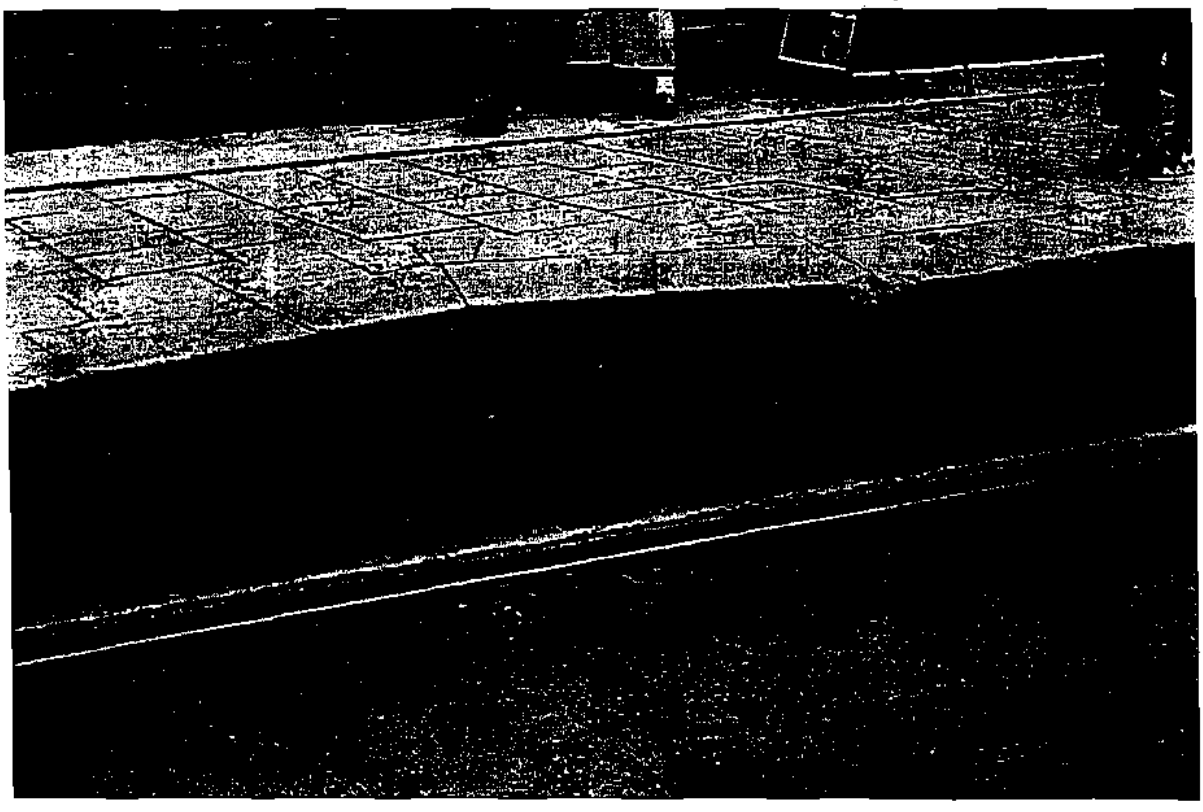


Figure 17: Deterrent Paving in place on a platform protection taper.

The jagged profile of the paving is intimidating to a cyclist when having to negotiate the tram track crossing whilst in the flow of traffic. Concerns have been raised that in this potentially hazardous area, the paving style could inflict serious injury to a cyclist falling onto it. No reports are however available to suggest that this type of incident has occurred.

5.0 Suggestions, Remedial Measures and Options For Improvement

It must be appreciated and accepted that the Supertram network has already been constructed and the complete system has been operational since Autum 1995. It is not therefore possible to redesign the system nor any of its principle components. It is not viable to reassess alignments, tramstop locations, rail sections, etc. Although some points made in this report may make suggestions towards good practice for future light rail schemes, the aim is to identify remedial measures that may be implemented to reduce the risk of injury to cyclists on the Supertram network in Sheffield.

It should be appreciated that wherever tram tracks, and thus grooves, are to be found set into the carriageway surface, then there is the potential for problems for cyclists riding on those streets. Perhaps the only absolute remedy therefore is to separate cyclists from these roads, this, however is not compatible with the Council's transport strategy.

The points raised below may relate to specific sections of the tram network but on the whole they are generalised. They may be suitable only when used in conjunction with other courses of action or perhaps appropriate to the whole tram system. In short, this section will aim to provide an armoury of measures for the benefit of cyclists that may be adopted to varying degrees along the tram route.

With this in mind, the following issues have been investigated further:

- Cyclist Education via Traffic Management
- Track Inserts
- Alternative and Parallel Routes for Cyclists
- Driver education

5.1 Cyclist Education Via Traffic Management

This section deals with proposals to allow and encourage cyclists to cycle along and across the tracks more safely. There has already been a considerable amount of media coverage to inform cyclists of the dangers of the track groove and to cross the tracks at a wide angle. If this were to be repeated with a wider coverage it could be assumed that the majority of cyclists and drivers would then be aware of the potential dangers. As previously stated, the problems come when trying to put these principles into practice amongst traffic.

The following proposals generally encourage cyclists to take up a position in the centre of a carriageway lane when riding at speeds similar to the adjacent traffic. They make the cyclists more obvious to drivers by enabling them to ride a bicycle in amongst the traffic as opposed to beside it.

- Advisory cycle lanes could identify a safer route for cyclists to take along the tram lines and skew across the tracks well in advance of tramstops to help cyclists pull out in front of other vehicles. Drivers would be more aware of when to expect cyclists to pull out and hence give them greater consideration. The white lines would highlight to drivers the need to allow cyclists more space to manoeuvre. Essentially, advisory cycle lanes would give more priority to cyclists, although some confusion may be experienced over who would have right of way in a particular situation.

- The cycle lanes would need to be signed adequately and regular white cycle road markings would enhance this. Mandatory cycle lanes are not feasible as traffic would need to overrun the lanes for significant distances all along the tram route and motor vehicles are prohibited from entering mandatory lanes.

- The standard advisory cycle lane markings are 4m line and 2m gap hazard markings at 100mm width. It may be beneficial to use the specific cycle facility markings known as *elephant's feet*. These are 400mm squares spaced by 400mm gaps and were introduced and used a little in the 1980's. The markings appear to be enjoying a resurgence in interest at present with reports of recent implementation within several schemes around the country. They do not prohibit motor vehicles but highlight to drivers areas where cyclists may be making unusual manoeuvres. The marking is unusual and bold and consequently drivers tend to take notice of them.

Figure 18: 'Elephant's Feet' markings recently installed in Sheffield.

- A coloured surface treatment would also identify to drivers the areas where cyclists may experience difficulties, as recommended in the National Cycle Network Guidelines and Practical Details[19]. If an advisory cycle lane is continuous for any reasonable length there may be benefit in continuing the colour throughout the length of the route. This gives cycle facilities a more uniform and recognisable identity.

- Advocating cycling on the section between the tram tracks would put cyclists in a much more prominent position and would allow them to deal with problems with more room to manoeuvre. Colouring the section between the tracks red and applying cycle symbol road markings would create an informal cycle lane along the centre of carriageways on the tram route. This would undoubtedly give cyclists an element of priority over other road users whilst increasing awareness of the cyclist in conjunction with safety benefits. Due to a lower relative average speed, cyclists taking up this position may help to reduce speeds of other vehicles on the tram route and so instil a form of traffic calming in the process. This would be too extreme a measure, for use on uphill stretches, where a cyclist slowly climbing a hill may unreasonably delay other traffic. It may also not be suitable on the busier, heavier trafficked roads on the Supertram network. The tram operators themselves may consider this approach unattractive due to the detrimental effect it would have on tram running times.

- Due to the repetition involved it would not be useful to position traffic signs in advance of every point a cyclist would need to cross the track. The large number of signs required would reduce the impact of each of them to a point where they would be virtually ignored. It may be considered however, that signs of this nature could still offer benefits at tramstops.

- It has been suggested that providing space on the nearside of the carriageway in advance of tramstops by widening the road into the footway slightly would allow cyclists additional room to manoeuvre across the tracks. This would have only a limited benefit to cyclists and would encroach on valuable pedestrian space in most cases.

- Now that most local motorists are more aware of the tramstop layouts, it would be useful to re-evaluate the necessity for the tramstop protection tapers. It may be found that local motorists are now familiar with the extended platforms and that tapers are no longer required. Alternatively a more suitable method for highlighting them may now be available. Instead of protecting the platform with something resistant to vehicles, making drivers more aware of the platforms may reduce conflicts and consequent damage. There are many materials available today specifically designed for situations where high conspicuity is required. Removal of these tapers would provide cyclists with a little more room to manoeuvre before the tramstop, but the benefits would need to be weighed up against the effort and expense of reconstruction.

- The HMRI suggest that cycle tracks adjacent to the footway are the optimum solution for cyclists. In most areas on the tram network this is not possible as the space necessary for Supertram operation and parking and loading requirements limit the widths of footways, such that it would not be acceptable to allow cyclists to share this space with pedestrians.

- Few footways on the tram network are greater than 3m wide and street furniture reduces available width significantly in many cases. Pedestrian flow would be required to be fairly low to allow sharing with cyclists, however areas would need to be analysed individually before a decision could be made. It may be feasible to allow cyclists off carriageway and *behind* tramstops in certain areas where more space is available, but this is unlikely to be possible in many areas.

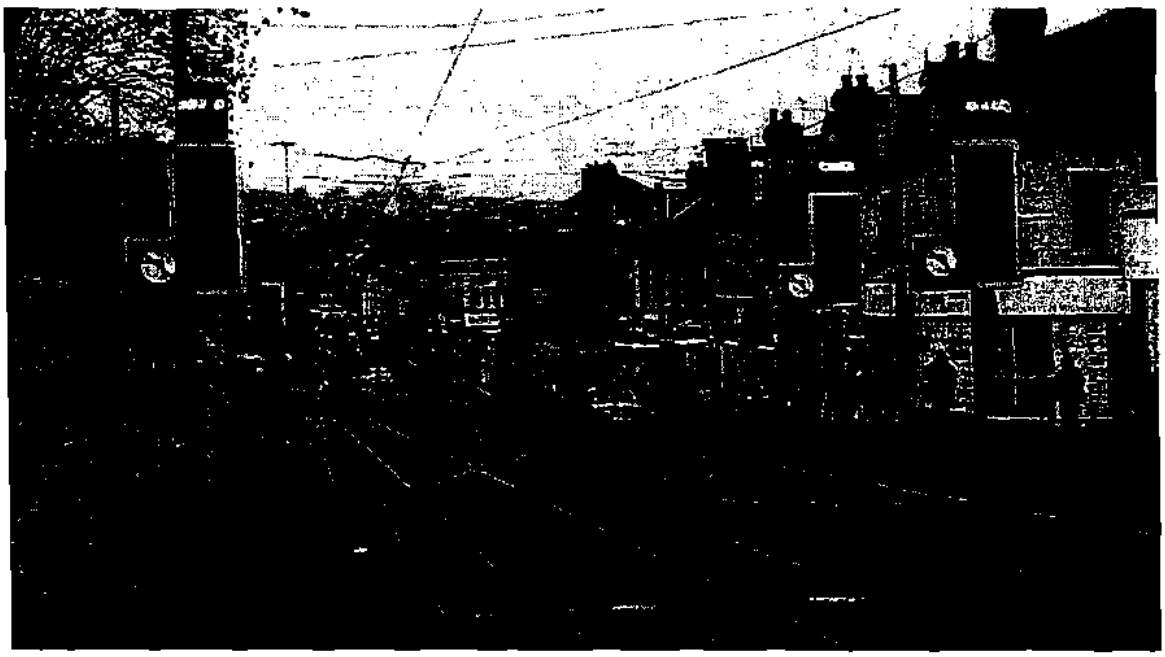


Figure 19: Footway widths are generally not suitable for sharing with cycles.

- A point that is often made in cycle route planning guidance is that the route should be direct and usable and if a detour is required to access a safe route then the more dangerous but more direct route can still be more popular.

5.2 Track Inserts

Since Cycle Friendly Infrastructure[7] first mentioned *rubber track fillers* were in use in the USA, a lot of interest has been generated in the principle. The theory of a compressible material filling the rail groove to allow cycles across the track safely is an attractive one, however with research it appears that this is not as simple as it sounds.

In Britain there does not appear to be anyone manufacturing a product suitable for use as a rubber track insert. Several companies supply level crossings made from a rubber material, but they do not provide a material to fill the groove in any way.

In Seattle, USA, two types of *flangeway filler* were installed four years ago, but on a system dissimilar to the light rapid transit system in place in Sheffield. The streetcar appears to run much less frequently and at a lower speed than that experienced in Sheffield. One of these products is considered to be a success but the tram speed is only 5 to 10mph and at higher speeds the rubber is ripped up. The product was originally designed for dock areas and in use in Seattle pedestrians apparently hardly notice the tram tracks at all. The system comprises a hollow rubber tube fitted into the flangeway, which compresses under the force of the flanged wheel and pops back into shape when the wheel has passed. The sections are very expensive at about US$700-900 per yard (approximately £500 per metre). Contact with the British branch of this international rubber products company revealed no knowledge of the product and suggested that the businesses in each country were fairly independent of each other. Nevertheless, it was understood that they may be able to help with further investigation if required and thus it may be beneficial to initiate research into the product via this company.

The second product is not considered to be so successful; it is made from recycled rubber and is about half the price of the former product. This tram system runs on standard I-section rails with no flangeway. The rubber panel that fits between the rails appears to have a more flexible section at its edges where it fits up against the rail. This section is pushed away horizontally by the flange and returns to its position after the tram has passed. In time however the rubber breaks up creating a groove 15-20mm wide. This product is considered only to be a temporary solution due to it tending to disintegrate with use.

In England a similar product is available for use with flangeless standard rails, but no reports of its success or otherwise were available. The relevant page from the company brochure is shown overleaf. The product has an elastic lip that rests against the rail and depresses when the tram passes. It is normally used in industrial yards where cycles cross tracks at oblique angles and is specifically marketed as a product for cycle safety. The tram speed is up to 15mph but the company has suggested it would be possible to increase this to 30mph with some product development. The frequency of the tram service was not mentioned. Using grooveless rail, a possible solution appears to be much closer, but whether this rail type is acceptable for use with street running trams has not been determined.

Alternatively, again perhaps more useful for future tram systems, if the rail groove could be deeper (say 60mm instead of 40mm) it may be possible to design a tougher filler that would not be required to be compressed to such an extreme and would thus have to deform less. This may enable a more resilient product to be produced.

without flange groove, for more safety and noise reduction

For level crossings with slow rail traffic and low frequency "[redacted] without flange groove", a special design, is recommendable. Especially in areas where crossings are skewed and there is a higher frequency of two wheeled vehicles "[redacted] without flange groove" offers increased safety. The flange groove, which is essential for the rail traffic, is covered by an elastic lip. This lip re-covers the flange groove after passage of the rail traffic. The closed flange groove makes for even less vibration for crossing road traffic and even more decrease in the level of noise development.

Figure 20: Extract from company brochure with product name deleted

Due to the potentially high cost of any suitable track filler it would probably be necessary to restrict its use to specific places where cyclists have to cross tram tracks at acute angles, e.g. before and after tram stops and at some junctions. It would be of much greater benefit however, if it could be used more extensively throughout the network, as experience shows that cyclist accidents on the tram tracks are not restricted to the particular areas where they have to cross the tracks.

To conclude this section, it appears that no rubber track filler is readily available at present to suit the rail type and tram speeds associated with Supertram in Sheffield. It is believed however, that if further research is undertaken a suitable system could be developed to stop cycle tyres from becoming stuck in the rail groove of some tram systems. This development may take some time and would presumably require a company to invest fairly heavily in the necessary research and development required.

It would be of great use to all involved in the cycle/tram safety issue, to test these products and any others that come to light, on certain sections of the tram system. Only then could durability, cost, safety benefits and reactions from cyclists be accurately assessed. This is an issue which could usefully be raised with promotors of other light rail systems in the United Kingdom.

5.3 Alternative And Parallel Routes For Cyclists

Cyclists need access to high amenity areas in a similar way that pedestrians do. The Supertram route often passes along the main road through these areas and thus alternative, useful routes are difficult to locate. Encouraging cyclists to use alternative routes is likely to take them away from the areas they wish to access and may therefore be of limited safety benefit.

Figure 21: Tram lines tend to run through the high amenity areas to which cycle access is required.

The last two sections have concentrated on making conditions safer for cyclists to use roads fitted with tram tracks. Before looking more closely at alternative routes, it is useful to identify on which sections cyclists may be able to ride in relative safety or may be able to do so with some of the remedial measures mentioned earlier also implemented.

In some of the cases described, a possible alternative route may be identified which links naturally into existing or proposed cycle routes. Others may serve only to remove cyclists from roads that are used by the tram and thus provide a discreet section of route perhaps away from any other identified cycle facilities.

If safe, direct and useful alternative routes are implemented it may be feasible to ban cycles from specific sections of the tram network thus removing the conflict altogether. This rather extreme solution would ultimately be the safest measure to implement for the benefit of cyclists but could restrict their access opportunities to many desirable high amenity areas and is thus contrary to City Council policy. Positive signing away from tram areas may therefore be more suitable than a Traffic Regulation Order prohibiting cyclists from using particular sections of road.

Each section of the tram route has different characteristics relating to traffic speed, traffic density, gradient and tram track and stop location within the highway. There is not enough time nor space to deal with every road on the tram network individually so some element of generalisation will be apparent here.

5.3.1 PHASE 8

The Hillsborough section, from Middlewood and Malin Bridge via Hillsborough Corner to Shalesmoor, is commonly referred to as Phase 8 of the tram network. The route runs through a busy district shopping centre and along a previously highly trafficked distributor road.

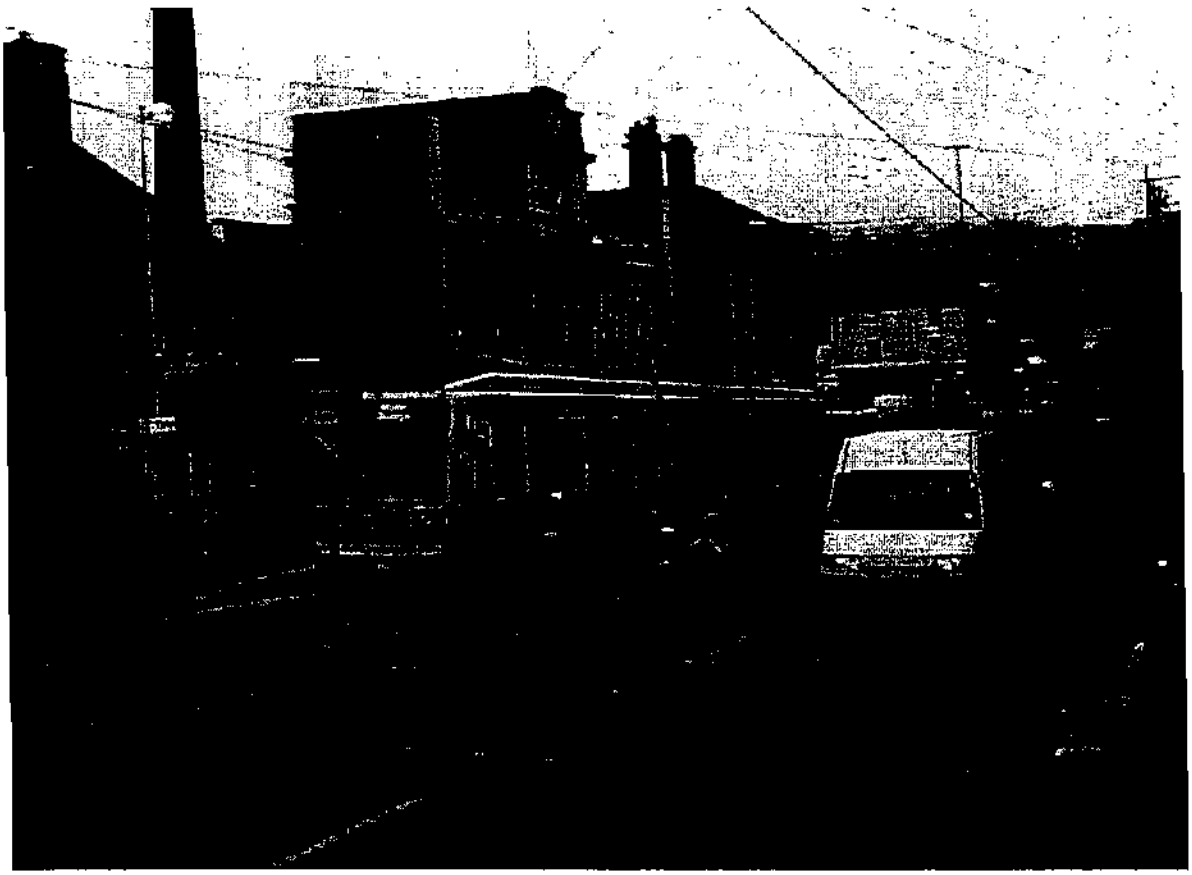


Figure 22: The modal split has been addressed at Hillsborough.

Penistone Road is a high quality dual carriageway road associated with and running parallel to the Phase 8 corridor. The traffic management measures installed in conjunction with the implementation of the tram system, have forced all through traffic onto Penistone Road, which copes adequately with the extra vehicles, leaving the Phase 8 corridor for public transport and local access journeys only.

Figure 23: Penistone Road - the dual carriageway route parallel to the phase 8 corridor.

This downgraded traffic route was also identified as a proposed cycle route, linking Hillsborough to the city centre. Traffic counts confirm that there has been a noticeable switch in cycle usage on the two parallel routes serving Hillsborough. Before the serious disruption of Langsett Road and Infirmary Road caused by the tramway construction, cycle flows were fairly evenly split between the two corridors, but now the tram is in service, the Phase 8 route carries only a quarter of the cycles whilst Penistone Road carries the other three quarters. Total numbers of cycles shared between the two routes remain similar.

Figure 24: The Infirmary Road corridor carries very little through traffic.

The Phase 8 corridor now carries relatively low traffic flows and, as planned, vehicular flow is dominated by buses, trams and local access traffic. It is believed then, that this corridor is still suitable as a cycle route, but that the traffic flows should be calmed further using the methods discussed elsewhere in this report, such as road markings and surface treatments, to identify areas where cyclists may need to cross the tracks. Due to the relatively low speeds and flows it may also be suitable to encourage cyclists to use the area between the tracks as a cycle lane, although this may be impractical in the generally uphill, to-Hillsborough direction. This measure may especially be suitable in the shopping area near the Middlewood shops.

Around the Phase 8 area alternative routes have been identified in the Cycle Route Strategy[6]. The route towards Walkley should be extended to reach further into the Walkley district, continuing to follow low flow residential roads, and so be of greater benefit to the local population.

Design is currently underway to implement advisory cycle lanes on the dual carriageway Penistone Road; this will benefit cyclists requiring a quick, direct route to the city centre. Two other routes are identified, approximately following the river and the old railway line. They are both longer term plans aimed towards the leisure cyclist.

During construction of the Penistone Road dual carriageway some adjacent land was made available and at present is landscaped. Investigations could be undertaken to determine if these areas can be of use in providing a rideable link in that area. Consideration should specifically be given to providing suitable cross links between Penistone Road and the Phase 8 route to complete a comprehensive and usable network in that area. Otherwise, as previously mentioned, the cycle routes will not serve the destinations required and will consequently remain unused.

5.3.2 West Street

The city centre section of the tram route runs west-east from Sheffield University, along West Street to Park Square. For the last third of this length the tram is separated from other vehicles as the space available is enough to fit the tram alongside the road, but a crucial length of this section is one way uphill for other vehicles. This one way section creates an obvious break in a cyclist desire line in the opposite direction and consequently is subject to a fair amount of abuse. Cyclists are known to ride down the cobbled surface where only pedestrians and trams are allowed, in order to reach the Castle Square and Park Square areas. A review is required to determine whether this movement could be permitted.

Figure 25: Cyclists illegally ride along this city centre tramway since the adjacent road was made one-way.

The West Street area is served by two parallel cycle routes chiefly on low flow roads. They were both implemented in the first tranche of cycle facilities almost fifteen years ago and have now severely deteriorated. Many signs are missing, surfaces are uneven and the routes are no longer easy to follow. In effect a cyclist not familiar with this part of Sheffield is unlikely to be aware of their existence. The routes have been greatly affected by Supertram construction and the new traffic routes adopted have also affected their operation.

An integral part of one of these routes was a signalised cycle crossing of the ring road. The crossing was heavily used by cyclists, but has had to be replaced by an offset aligned pedestrian only crossing. It is no longer practicable to allow cyclists to ride across the ring road at this point due to space constraints brought about by the proximity of the tram tracks. A number of large University buildings are situated either side of the ring road in this area and cyclists accessing them and the cycle route beyond currently tend to use the Glossop Road junction. This was partially due to the delayed construction of a proposed contraflow lane adjacent to the redesigned crossing. The contraflow lane has now been implementated, but cycling across the Inner Ring Road remains a problem here. Further work should be carried out to investigate whether a dedicated cycle crossing facility can be reinstated to serve the adjoining route.

The two existing routes, following Division Street and Portobello Street, form important cross city links into the existing city centre cycle network and have been well used in the past. There are significant shortcomings relating to the lack of completion of both routes at the east end. Although identified in the UDP[5], large scale construction and hence significant financial investment hold back early completion of the routes. One of these problem areas is currently being investigated within a bid to the Millennium Commission.

Both routes however, throughout their lengths, still need extensive rejuvenation and to be publicised effectively. It is necessary to investigate and re-evaluate them both and the redesign of particular sections may well be identified.

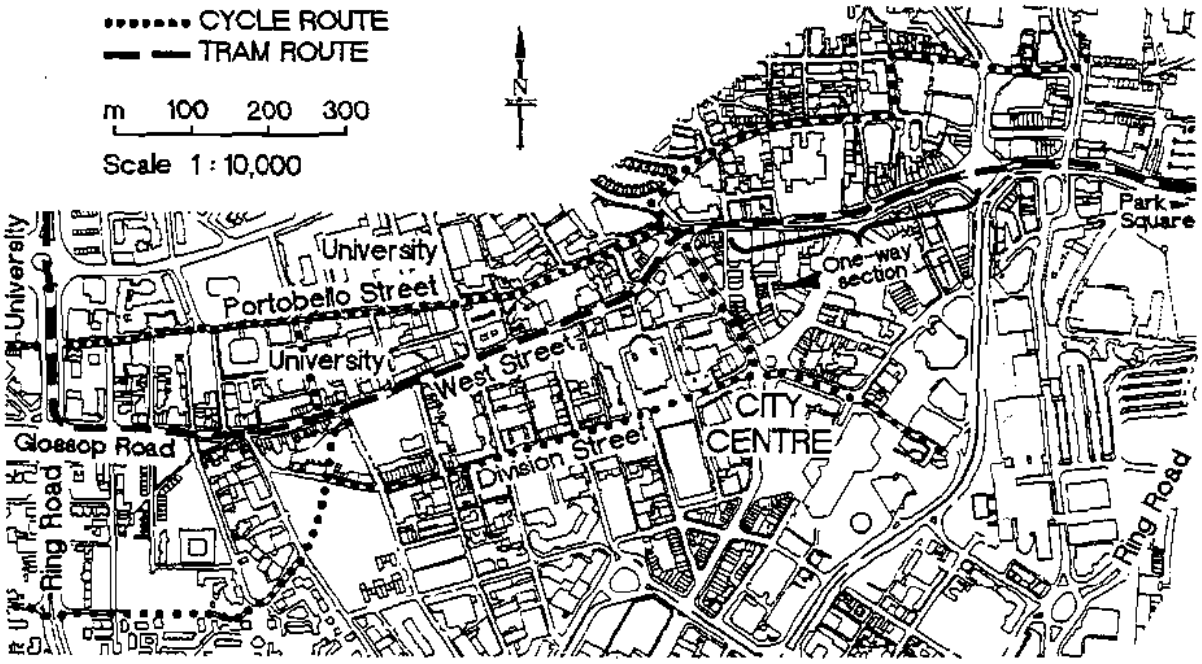


Figure 26: The city centre section of the tram route along West Street.

Notwithstanding the above, it is still considered that, like Phase 8, i.e. local access traffic only, the tram route along West Street itself offers a relatively safe route. Through traffic has been removed from West Street and the speeds of buses, trams and access traffic are comparatively low. This helps produce a traffic calmed environment and measures described earlier should be considered to encourage and allow cyclists to take up a commanding position on the carriageway.

5.3.3 Park Grange Road

Park Grange Road is a local distributor road to the Norfolk Park housing estate. The road winds continuously down a fairly steep hillside accessing many residential culs-de-sac and had a history of road safety problems prior to the implementation of Supertram works. The road has one lane in either direction with a wide central section that provides right turning lanes, traffic islands to prevent overtaking and ghost islands formed from hatched road markings.

There are options for taking cyclists off carriageway on this section of the tram route. With relatively low pedestrian flows in the area it may be considered acceptable to allow cyclists use of the footpaths which are often dissociated from the carriageway within grassed verges. Widening of these footpaths may be required, in which case resurfacing in a red colour may also be appropriate. Particular attention would need to be paid to the access points between carriageway and footpath and to the design of the crossings of the side roads.

Figure 27: Two views of Park Grange Road.

Again, encouraging cyclists to ride between the tram rails may be beneficial in this area, but this approach cannot be recommended in the uphill direction, as the obvious disbenefit to other traffic could not be considered acceptable. A two way route combining off-carriageway cyclepaths and on-street facilities would perhaps be most suitable on this hilly section of the tram route.

On-carriageway routes discrete from Park Grange Road itself should also be investigated. In figure 28 overleaf the Norfolk Park, City Road and Manor Top areas, discussed in the following sections, are shown. It would be possible to join a route here, and the extension described later, to the proposed city centre to Heeley/Meersbrook route which incorporates the recently installed Inner Ring Road crossing at Duchess Road. Norfolk Park Road provides an alternative route from the bottom of Park Grange Road and links via quieter residential roads to St. Aidan's Road and thus to the top of the hill near City Road. Promotion of St. Aidan's Road as a cycle route would also encourage cyclists away from the busy City Road. It may also be possible to provide a cycle route through Norfolk Park itself, which would create an off-street route to join Norfolk Park Road and St. Aidan's Road.

For this area then, several different styles of route need further research; on carriageway, on footway, on alternative low flow roads and also access through the park.

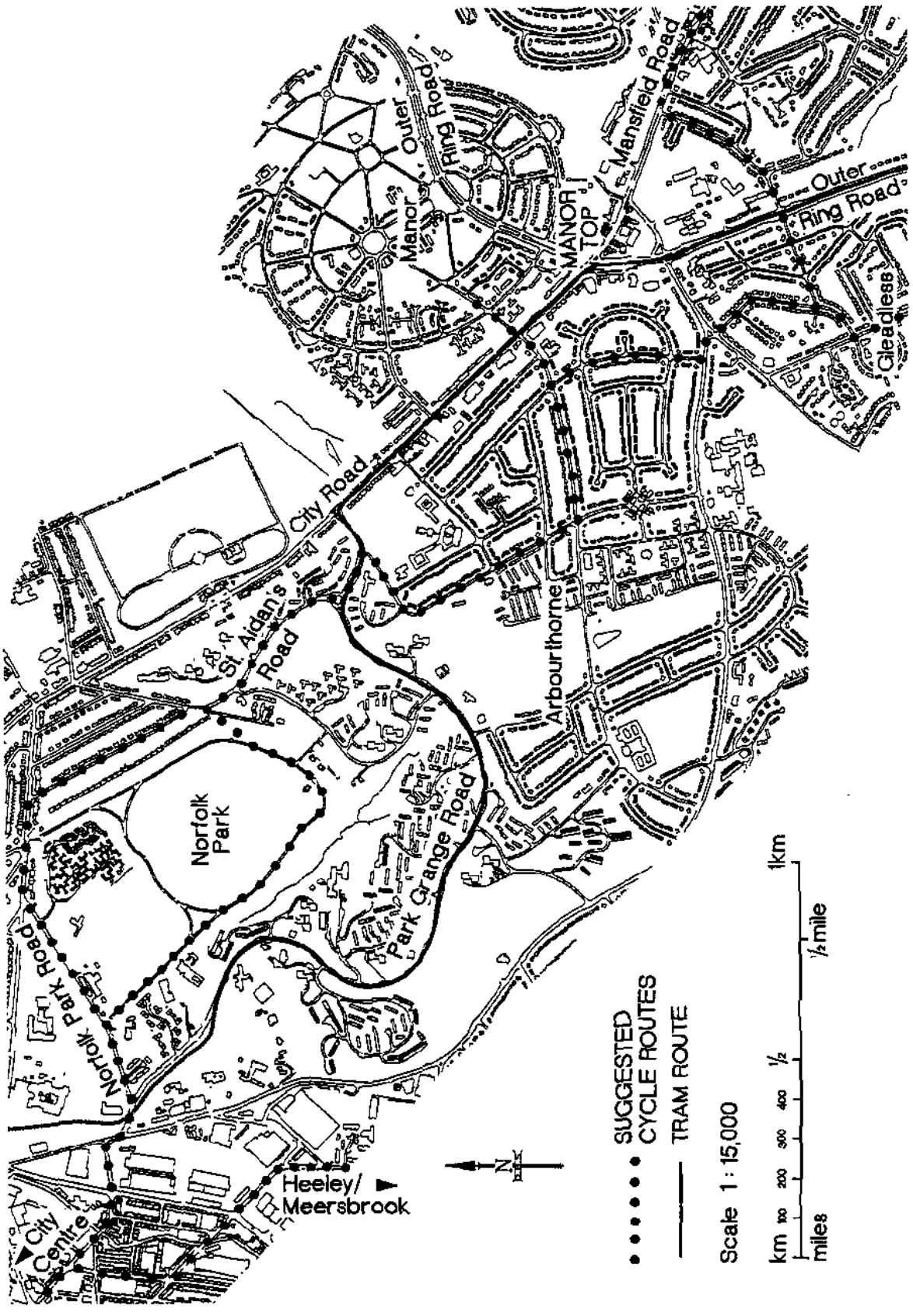


Figure 28: Alternative routes at Norfolk Park, City Road and Manor Top.

5.3.4 City Road

Figure 29: City Road looking towards Manor Top.

City Road is part of the A6135 Sheffield to Mansfield road; it is a typical arterial road surrounded by residential estates and fronted by houses, shops and businesses serving the local population. The road is busy with through traffic on top of local traffic and forms the major bus route through the area. The road is on a gradient and vehicle flows and speeds are fairly high. The whole environment in this area is very busy with several bus stops, accesses and service and parking lay-bys on the half mile stretch of road.

There is no opportunity to allow cyclists use of the City Road footways owing to insufficient available widths and potential conflicts with pedestrians. The conditions on carriageway are fairly hostile to cyclists and so the only solution in this area appears to be to promote alternative routes on nearby residential streets.

Research into origin and destination of cyclists in this area is required, as access to the Manor estate may perhaps be achieved via upgraded footpaths, whereas access to the Arbourthorne and Gleadless residential areas may benefit from an on carriageway cycle route through them on low flow roads. To continue up Mansfield Road cyclists would need to rejoin City Road near its junction at Manor Top or continue on the parallel residential route and use a modified pedestrian crossing to cross the Outer Ring Road and return to the through route.

5.3.5 Outer Ring Road - Ridgeway Road

Figure 30: The tram runs in the central reserve and the offside lane of the Outer Ring Road.

On Ridgeway Road, part of Sheffield's dual carriageway, 40mph speed limit Outer Ring Road, the tram runs in the offside lane and the central reserve and so has a less detrimental effect on cyclists. The trams do not run in the nearside lane where cyclists tend to ride, but there is a short section having a restricted lane width. The standard 3.65m lane width is reduced down to 3.0m, this however is not uncommon in urban situations.

The junctions at either end of this section of route are known as Manor Top and Gleadless Townend. They are both multi-lane, one way, signalised gyratory systems installed within the Supertram works to control the heavy flows and turning manoeuvres prevalent at these ring road junctions.

Figure 31: Manor Top is a busy gyratory system on Sheffield's Outer Ring Road.

At Manor Top bus and tram lanes enable public transport (as well as taxis and cycles, as mentioned previously) to make simplified right turns that other vehicles cannot. This facility provides greater access for them and thus a form of priority. For cyclists on the general carriageway however, this means that tram tracks cross traffic lanes at acute angles and that for certain manoeuvres cyclists must cross tram tracks running parallel to their direction of travel. The junction is extremely busy at most times of the day and vehicle speeds are high. Similarly to City Road, Manor Top is a bustling district centre and there is no opportunity to allow cyclists use of footways due to the high pedestrian flows. Alternative routes through this area were described in the last section and depend on final destination, but tend to follow residential roads and may require upgrading of a pedestrian crossing of the ring road.

Figure 32: Gleadless Road looking towards White Lane, where all traffic is obliged to move into the offside lane and hence cyclists must cross the tram tracks whilst riding in the same direction as them.

Trams at Gleadless Townend travel in the central reserve of the dual carriageway or the off-side lane when following the ring road and vehicle turning manoeuvres across the tracks are at near 90 degrees. When the tram turns into and out of White Lane however, the tracks run on sections of carriageway on which traffic is required to change lanes, and crossing the tracks at acute angles is required. Again footways are unlikely to be suitable for cycling due to width constraints and pedestrian flows, but there are limited low flow roads joining the required destinations. On the Gleadless Road section it may be possible to keep cyclists away from the tracks by utilising wide areas of footway/ forecourt before joining White Lane. There are however, potential problems here over available widths and land ownership.

Neither of these busy junctions are conducive to cycling though, and it is suggested that longer term, more significant solutions to the problems of crossing or joining the ring road at Manor Top and Gleadless Townend would reap greater benefits for cyclist safety.

5.3.6 White Lane

White Lane near Gleadless has more reported cycle incidents related to the tram tracks than any other area in Sheffield. The tram runs on a straight carriageway for about one kilometre with a service road to the facing houses running parallel on the north side of the road for all of this length. At either end of the service road large areas are available for turning and parking cars.

Figure 33: The access road to the houses on White Lane runs parallel to the main traffic and tram route.

This access road could be connected to the main road and promoted for legitimate use by cyclists. Some of the land at either end of the access road would be required to enable cycle movement to and from White Lane, and negotiations may therefore be required if the necessary areas are not within Highway Authority ownership. At the Gleadless end cyclists can join and exit the access road and signing would be required here to promote use of the parallel route.

At the Fox Lane end it may be possible to convert the overgrown verge on the south side of the road to a hard surfaced cycleway. This would allow the access road on that side to be used similarly to the one on the north side. Again, land ownership issues may present a stumbling block.

There is less room available at the Fox Lane junction and further design work would be required to enable cyclists to cross through the junction without having to cross the tracks at an acute angle. It appears possible however, that cyclists could access the north side service road from both directions whilst only encountering the tram tracks for a short distance.

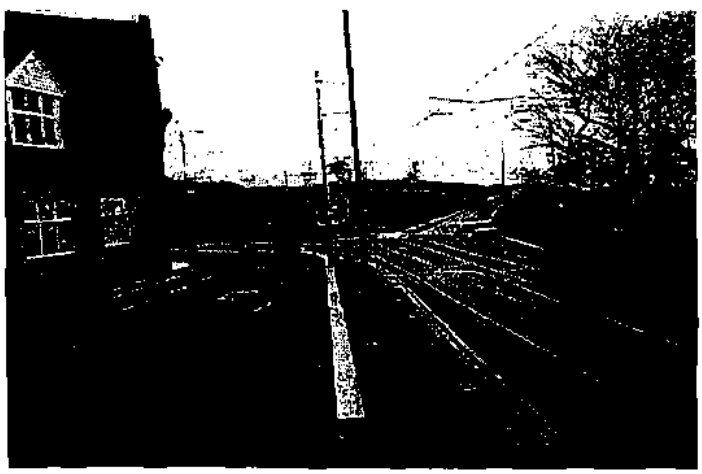


Figure 34: The Fox Lane junction at the end of White Lane.

5.3.7 Mosborough Townships

Beyond White Lane the nature of the road becomes more rural and the tram route switches between on and off street running several times. From Owlthorpe to Halfway the tram lines cross roads at right angles, generally fairly safe for cyclists. In keeping with the design theories behind the township residential developments, it is suggested that cyclists, where possible, would be better placed on the internal roads than on the major, higher speed distributor roads. That said, at off street tramstops similar to that shown in Figure 35, it may be possible to implement a similar solution to that used at Aytoun Street, Manchester (shown on page 60), to enable cyclists to use the distributor roads in more safety.

Figure 35: Typically from the townships area, Hackenthorpe tramstop is segregated from the carriageway.

Through Owlthorpe it appears feasible to implement a cycle route mainly on existing residential roads. This measure would allow cyclists to bypass the tram route on the busy Sheffield Road.

Between here and Halfway, cyclists encounter fewer problems with tram tracks as the route is generally off street, only occasionally crossing roads and then at angles approaching 90 degrees.

5.4 Driver Education

As previously identified the combination of tracks and traffic is a major problem. If drivers were more aware of the situation cyclists were in, then perhaps more consideration would be given to their needs. This applies not only to car drivers but to bus, lorry and tram drivers alike. The message to put across is the need to give cyclists more time and more space to make the manoeuvres that they are required to make. It is therefore necessary for drivers to understand more about riding a bicycle on the road. It is necessary to appreciate when and why a specific manoeuvre is made and be able to anticipate when a cyclist will need to make that manoeuvre.

As shown below the cyclist is approaching a tramstop (note the anti-pedestrian paving) and thus needs to cross the tram groove as, out of shot, the platform extends into the road. The bus driver however, still considered this a suitable time to overtake the cyclist.

Figure 36: A bus overtakes a cyclist on the approach to West Street tramstop, where the cyclist needs to cross the rail to pull in between the tracks, in order to avoid the projecting platform.

If the intended changes to the modal split come about in Sheffield, and transport becomes more sustainable as is planned, then drivers will need to learn to give more time to other road users.

A number of measures could be implemented to encourage greater understanding and awareness of other road users actions and limitations:

a) Widespread distribution of information leaflets. This does not mean a pile in a library or other public buildings, but extensive delivery to every residential address in Sheffield. The format should be punchy, short, sharp and to the point, one side of A5 with a catchy slogan may be suitable. A basic illustration and relevant statements should be enough to jog people's minds when necessary. To augment the leafleting, advertisements could be shown on the backs of local buses, for example, the well known "*Please let the bus go first*" catchphrase.

b) This advertising should be partnered by a media launch, it would be important to have support of local television, radio and newspapers for interviews, coverage and publicity. After reaction to the initial *blitz* is judged, it may be worthwhile following up with a secondary campaign to reinforce the statement.

c) Relevant traffic signs may help to make drivers more aware of cyclist manoeuvres. At present the DETR do not specify a suitable traffic sign and so authorisation may be required for a new design. The inherent problem with signs of this type, i.e. warning or information signs at recurring hazards, is that *familiarity breeds contempt*, consequently the more a sign is repeated the less effect it has, to the point where for example, drivers ignore a sign because they have already seen two similar signs in the last kilometre. Fluorescent yellow sign background material has been used in some circumstances to give particular signs greater impact, but again there is concern regarding its overuse devaluing its significance.

Figure 37: Yellow backed signs have been used extensively in some areas.

It may therefore be appropriate to identify specific sites or roads where problems are known to have occurred and to position highly visible signs at entrances to these areas, as opposed to repeating the signs throughout.

d) Road markings may be suitable to inform drivers of where cyclists may be moving into the middle of the road. This was dealt with further in section 5.1.

e) 20mph zones reduce traffic speed and make drivers more aware of other road users. The physical measures available to achieve speed reductions are not really suitable for use on a tram network as speed humps or cushions could not be used in conjunction with trams. Additionally, many of the roads on the tram route are district distributors and thus perhaps not appropriate for this type of treatment, which is primarily intended for residential streets.

f) As identified in section 4.4, the tram operators should be informed that they do not have a right to expect cyclists to give way to trams approaching from the rear. This is contrary to the instructions understood to have initially been given to tram drivers and so they would need to be instructed otherwise. This may reduce the antagonism sometimes shown between cyclists and tram drivers.

6.0 Conclusion / Recommendations

The previous section identified a wide variety of possible measures that may be usefully implemented to increase cyclist safety on the Supertram network. Some of the measures are very onerous to other carriageway users and thus may not be suitable for immediate introduction or may not be suitable for use at all, without other mitigating measures. There are a number of ideas however, that could be designed in detail and installed experimentally to assess suitability and perhaps reap immediate safety benefits. These, perhaps initially temporary, measures would enable comments to be sought from users, cycle representatives and other interested parties regarding their suitability.

Accordingly, it is recommended that :

- Cyclists be encouraged to take up a position between the tram tracks on appropriate stretches of route, by the use of coloured surface treatment, traffic signs, road markings and publicity.

- Road markings and surface colouring be tested for highlighting areas where cyclists need to cross tram tracks at less than desirable angles.

- Trials of road marking and surfacing types should be considered, to determine which may be best used to inform drivers of where cyclists may make unexpected manoeuvres.

- Contact should be made with relevant interested companies to assess the viability of design and production of a suitable rubber insert for use in conjunction with the rail section used by South Yorkshire Supertram.

- Design of suitable signs should be investigated to inform drivers of hazardous areas for cyclists.

- Further research should be undertaken into where incidents are occurring and the nature of those incidents, so that remedial measures can be tailored to suit problems individually. This might also throw up concentrations of incidents or other relevant anomalies where special consideration may be required.

- Feasibility and preliminary design work should be undertaken on the alternative routes identified in the text.

- The relevant existing cycle routes in Sheffield should be renewed and/or brought up to current standards and publicised adequately, so that all cyclists are aware of alternative routes away from tram lines.

- Public awareness should be raised of the danger of driving close to cyclists, and thus restricting room for manoeuvre particularly (but not exclusively) when on tram routes.

- A review of the way hazardous cycle incidents are recorded should be undertaken, with a view to identifying best practice and encouraging co-operation from all parties concerned. This would help to provide useful, standardised, more comprehensive information.

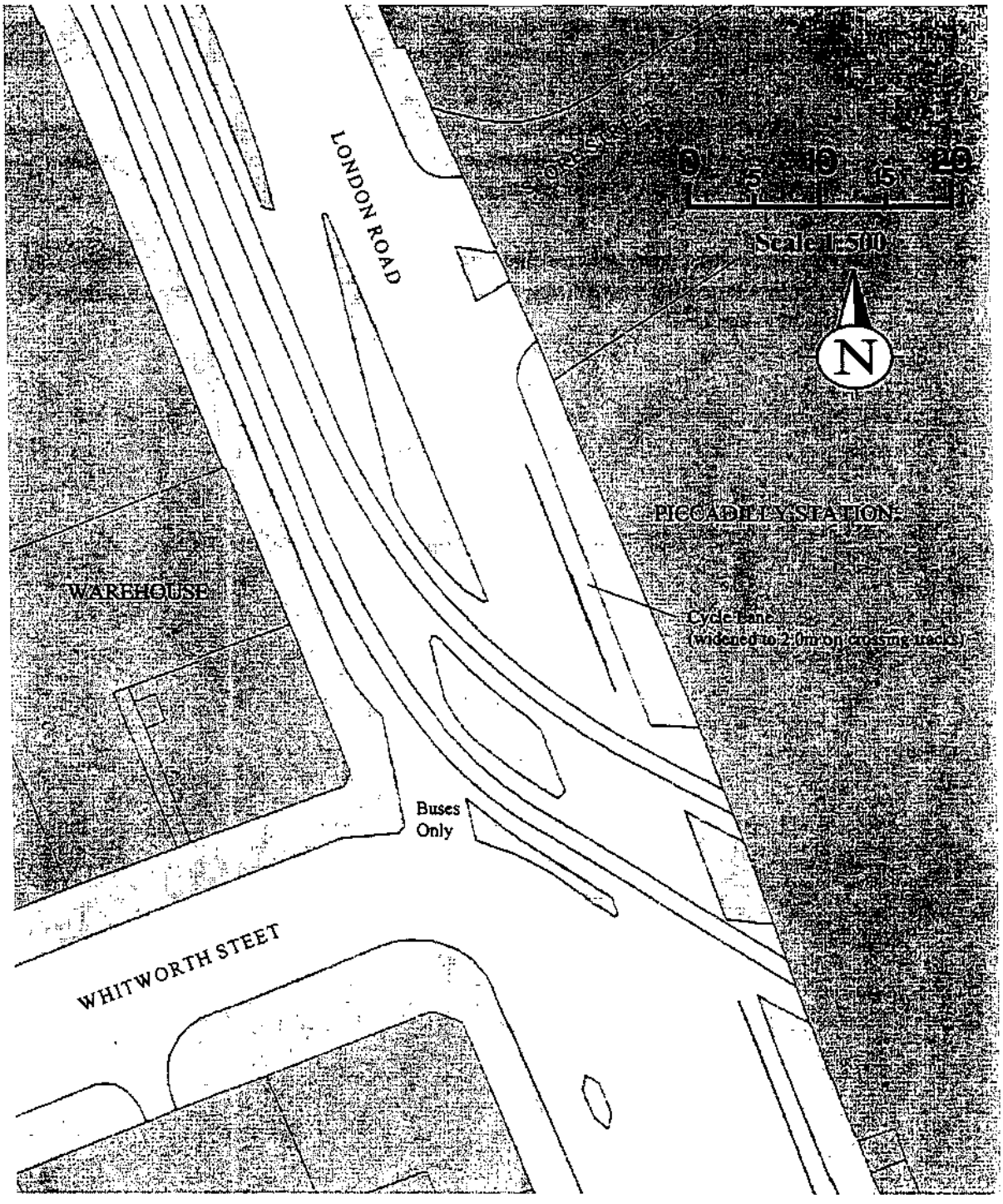
- Future light rapid transit systems in the UK should investigate the feasibility of the use of flangeless rails alongside further development of the associated rubber panel to fit between the rails.

- Developers of new on street tram systems should be encouraged to investigate solutions to the problems highlighted in this report, e.g. other interested parties may be willing to contribute to the cost of researching a suitable track insert.

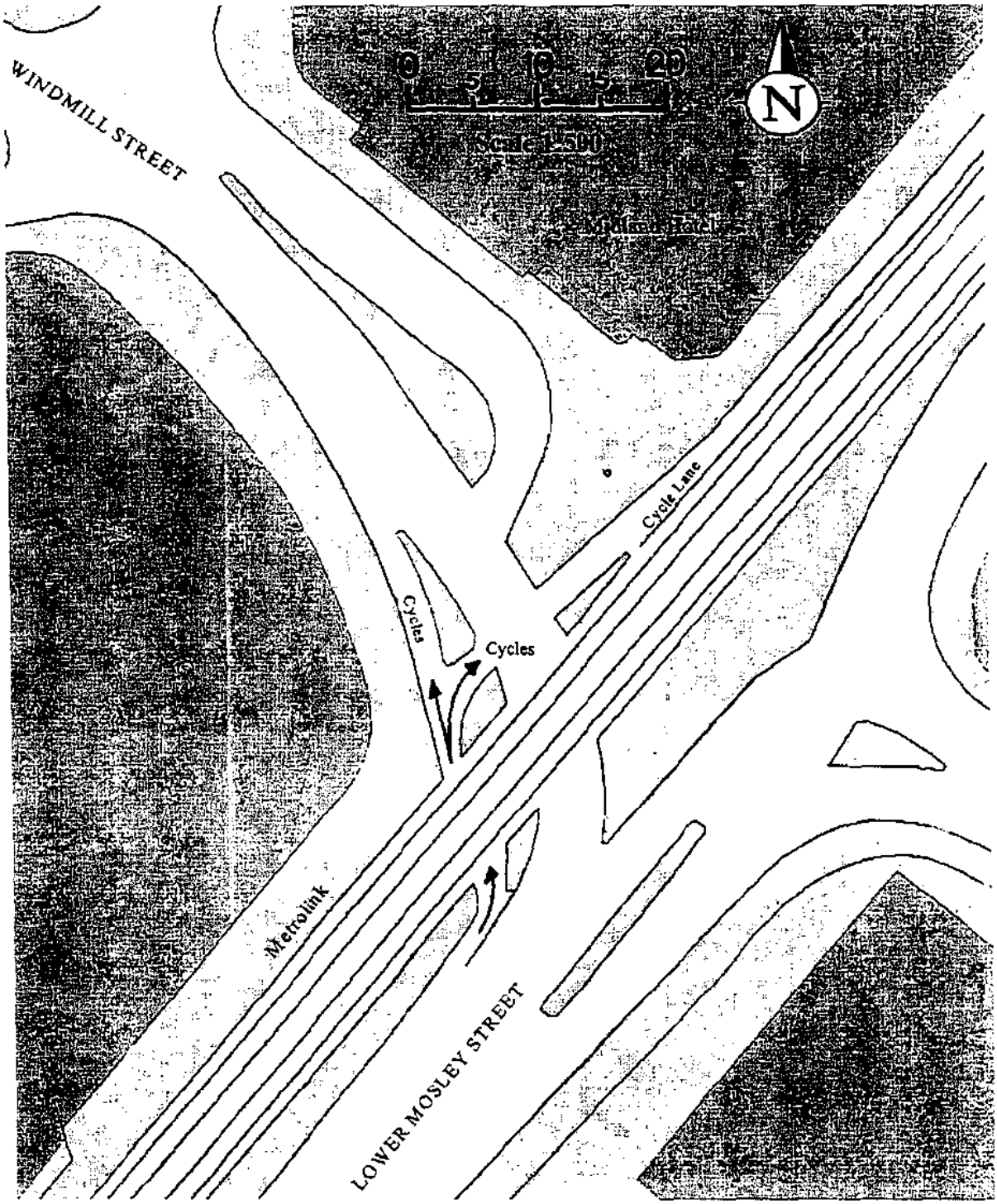
Finally, it should be remembered that there may not be one correct solution to the problems identified and that experimentation with combinations of several measures may be required before a suitable situation is reached.

7.0 APPENDICES

7.1 APPENDIX 1: TRAM RAIL CROSSINGS IN MANCHESTER

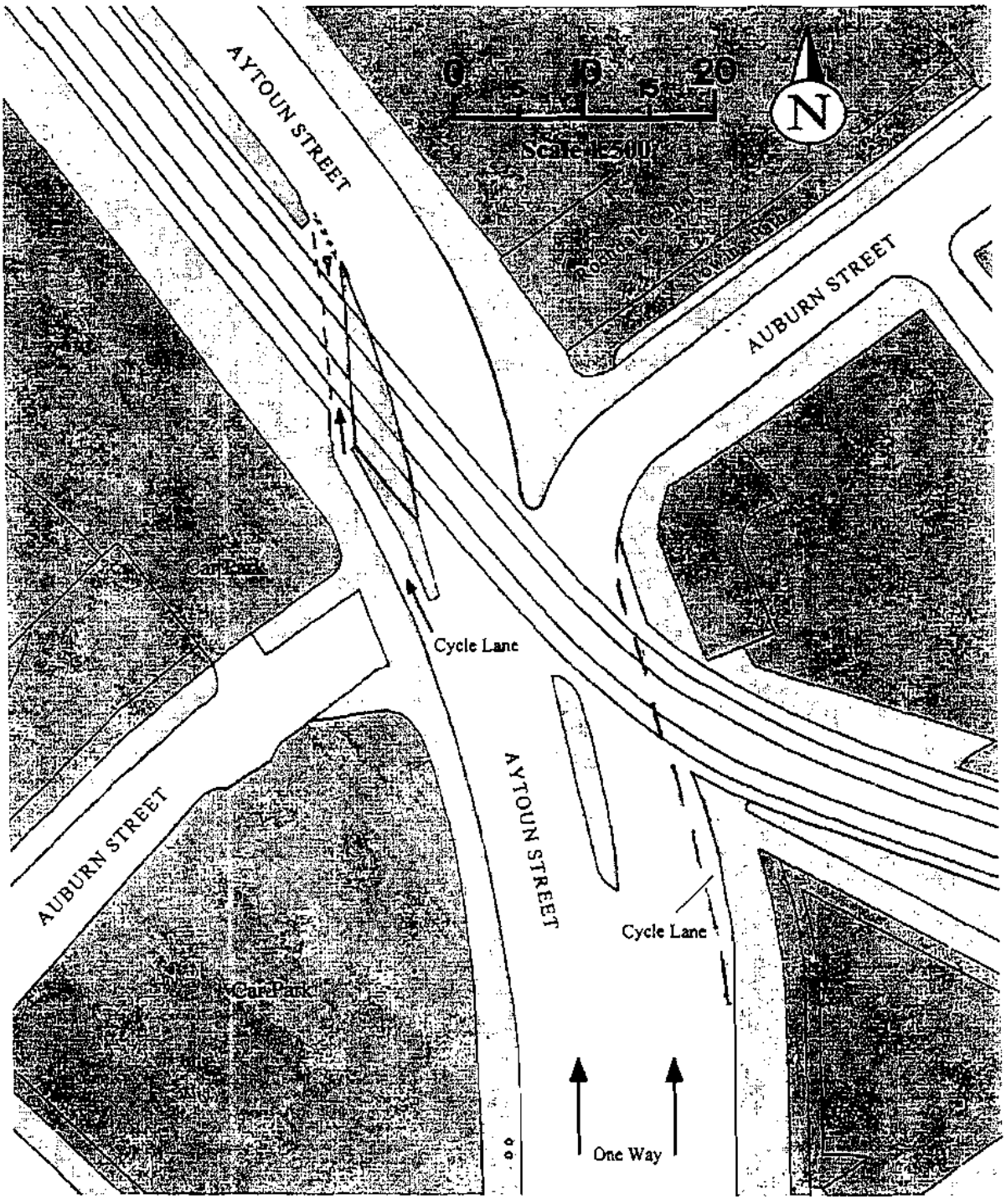


London Road, Manchester
A cycle lane has been implemented specifically and widened to 2m to allow cyclists room to negotiate the tracks.



Lower Mosley Street, Manchester

Cyclists are separated from general traffic to enable them to cross the tram tracks at a steeper angle. They can then rejoin the traffic or cross the carriageway to access a cycle lane.



Aytoun Street, Manchester

A cycle lane separates cyclists from the traffic lane to enable them to cross the tram tracks apart from other vehicles, and then rejoin the main carriageway and continue along Aytoun Street. A cycle lane also provides space to cross the tracks when turning into Auburn Street.

7.2 Appendix 2: Catalogue Of Accident Data

LOSS OF CONTROL PEDAL CYCLE ACCIDENTS ON THE SUPERTRAM NETWORK, SHEFFIELD, 01 JANUARY 1994 TO 08 AUGUST 1996

SOURCE	DATE	TIME	LOCATION	DESCRIPTION	REFERENCE
Press	Before 17 Mar 94	?	White Lane	Wheel got caught in tram lines? "Escaped serious injury" Male 50 "slight" (JDW)	Sheffield Star 17/03/94
Press	Before 17 Mar 94	am?	Park Grange Road	Wheel got caught in tram lines Cyclist landed on his arm, shattered bones, 3½ hour operation Male 30 "serious"	Sheffield Star 17/03/94
Press	Before 17 Mar 94	pm?	Donetsk Way	Wheel got caught in tram lines Cyclist landed on grass verge, helmet "saved him from serious injury" Male 23 "slight" (JDW)	Eckington Leader 19/05/94
STATS19	04 May 94	1945	White Lane @ Fox Lane	Pcycle wheel caught in tram track Rider fell off Male 30 slight	94E00695
Press	Mid May 94	am?	City Road	Cycle "slipped off edge of concrete strip between kerb & track and was thrown onto the road" Broken hand bones, serious grazing to knees, thigh & shoulder Male 61 "serious"	Sheffield Telegraph 04/06/94
Supertram	01 Dec 94	1230	White Lane / Fox Lane	Cyclist falls on track Serious injury - SY Police involved	Supertram record 14
Press	Before 30 Jan 95	?	Outer Ring Road near Gleadless Town End	Wheel got caught in tram lines Cyclist thrown off Shoulder, back & leg tendon injuries "now on crutches" Male 44 "serious"	Sheffield Star 30/01/95
Press	Mar 95	?	White Lane	Wheel got caught in tram lines Cyclist fell to the road, cyclist also carrying child in safety seat Dislocated thumb, damaged hand ligaments, leg injuries. Visited hospital six times. Child suffered facial grazes. Female 55 "serious" & female 1 "slight"	Sheffield Star 19/05/95
STATS19	13 Jun 95	1250	City Road, 150yds city side of Eastern Avenue	Pcycle wheel caught in tram track Rider fell off Male 32 slight	95H02184

SOURCE	DATE	TIME	LOCATION	DESCRIPTION	REFERENCE
STATS19	10 Aug 95	1250	Park Grange Road, 10m from Park Grange Crescent	Pcycle...brakes on bend Wheel catches tram track, causes skidding Male 25 slight	95I02263
STATS19	08 Oct 95	1610	Middlewood Road near Wadsley Lane	Pcycle gets caught in tram tracks Following car collides Male 12 slight	95J02732
STATS19	05 Aug 96	?	White Lane, 30yds Gleadless side of Carterhall Road	Pcycle gets caught in tram tracks Cyclist goes over handlebars Following tram collides with bike Male 25 slight	96H00779
Press & Phone from SY Police Civ.	23 Mar 96	0946	Gleadless Road near Seagrave Road	Cyclist caught front wheel in tram track, fell and banged head Male 36 fatal. Died in Royal Hallamshire Hospital	Phone from Snig Hill 28/03/96, Sheffield Star 28/03/96 and 03/07/96
Supertram	29 Jul 95	1648	"Arbourthorne" Park Grange Road?	Cyclist fails to observe Give Way sign. Ambulance attended - "serious" (JDW) SY Police attended, accident ref. 977?	Supertram record 61
Supertram	28 Jun 96	0820	White Lane	Cyclist fell from bike, wheel caught in rail. Ambulance attended, cyclist concussed & leg injuries - serious	Supertram record 263
Supertram	05 Aug 96	1724	White Lane	Cyclist fell from bike, wheel caught in rail. Cyclist ended up under the tram "Cyclist unhurt" slight injuries (JDW)	Supertram record 285
Letter	Before 12 May 96	?	West Street	Pcycle crossing tracks, wheel caught in tracks. Cyclist thrown over handlebars. Bruised, therefore "slight" (JDW)	Letter to RHH 11/05/95
Letter	21 Feb 96	1630	West Street	Cycle wheels wedged in tracks Detained in Royal Hallamshire Hospital Concussion and bad bruising - serious	Letter to SCC 03/03/96
Internal memo	29 Apr 96	0840	Glossop Road	Cycle crossing tracks and cyclist fell to ground Given the Medical Report would suggest "serious"	Internal memo & correspondence

8.0 References

1. South Yorkshire Supertram Limited (1993) *Super NEWS Issue 1*, SYSL, Sheffield

2. Department of Transport (1989) *Provisional Guidance Note on the Highway and Vehicle Engineering Aspects of Street-Running Light Rapid Transit Systems*, DOT, London

3. Transportation Policy Unit (1996) *Transport Matters Leaflet*, Sheffield City Council

4. Wood C (1996) *A Railway Revolution...*, LRTA/Chris Wood, Norwich

5. Directorate of Planning and Economic Development (1993) *Sheffield A City For People, The Unitary Development Plan, Deposit Version*, Sheffield City Council

6. Transportation Policy Unit (1994) *Cycle Routes Strategy Consultation Draft*, Sheffield City Council

7. Department Of Transport, Bicycle Association, Cyclists' Touring Club, Institution of Highways and Transportation (1996) *Cycle-Friendly Infrastructure Guidelines for Planning and Design*, CTC, Godalming

8. Department of Transport (1996) *The National Cycling Strategy*, DOT, London

9. Directorate of Planning and Economic Development (1996) *Sheffield Transport Policies and Programme*, Sheffield City Council

10. *Highways Act 1980*, HMSO

11. Orlik M (1993) *An Introduction to Highway Law*, Shaw & Sons, Crayford, Kent

12. Pratt & Mackenzie (1932) *Law of Highways Eighteenth Edition*, Butterworth & Co., London

13. Riddall J & Trevelyan J (1992) *Rights of Way A Guide to Law and Practice*, Charlesworth & Co., Huddersfield

14. Wood C (1995) *Trams and Bikes: Friends or Foes?*, Light Rail and Modern Tramway 58 (695) (November 1995) pp372-5

15. C.R.O.W. Institute (1994) *Sign Up for the Bike: Design Manual for a Cycle Friendly Infrastructure*, The Netherlands

16. Directorate of Planning and Economic Development (1996) *South Yorkshire Package Bid 1996*, Sheffield City Council p133

17. Cyclists' Touring Club (1992) *Cyclists and Major Roads*, Godalming

18. CAMAS Building Materials (1994) *Charcon Paving Specifier's Guide*, CAMAS, Ashbourne

19. Ove Arup & Partners (1996) *National Cycle Network Guidelines and Practical Details*, Sustrans, Bristol

Danish Transport Council (1995) *Light Rail Impact on Bicycle Safety*, Denmark

HMRI (1992) *Technical Note on the Highway and Vehicle Engineering Aspects of Street-Running Light Rapid Transit Systems*, HMRI, London

South Yorkshire Supertram Limited (1994) *Super NEWS Issue 2*, SYSL, Sheffield

South Yorkshire Supertram Limited (1994) *Super NEWS Issue 4*, SYSL, Sheffield

South Yorkshire Supertram Limited (1995) *Super NEWS Issue 5*, SYSL, Sheffield

Wood C (1996) *Integrating Cycling and Public transport*, TransPlan, Norwich