

NATIONAL CYCLE MANUAL

www.cyclemanual.ie

The Basics

Legislation and Policy

Planning for the Bicycle

Designing for the Bicycle

Getting the Details Right

Maintenance

Tools and Checklists



Withdrawn

National Cycle Manual

Cycling is for Everyone

The “cycling offer” within urban areas must be improved to encourage more people to cycle, including those who are risk-averse.

The goal is now to “raise the bar” and to aim to provide for two-abreast cycling in a stress free and safe environment.

The National Cycle Manual

This Manual embraces the Principles of Sustainable Safety as this will offer a safe traffic environment for all road users including cyclists. It offers guidance on integrating the bike in the design of urban areas.

The Manual challenges planners and engineers to incorporate cycling within transport networks more proactively than before.

Withdrawn

June 2011

The National Transport Authority invites you to make use of the material in this manual as published, including the images and graphics. All material, unless otherwise acknowledged, is the property of the National Transport Authority, and any re-use should acknowledge the National Transport Authority. The material must not be edited or amended without the permission of the National Transport Authority.

CONTENTS

PAGE

1.0 THE BASICS

1

1.1 Sustainable Safety

3

1.1.1 Functionality

3

1.1.2 Homogeneity

4

1.1.3 Legibility

4

1.1.4 Forgivingness

5

1.1.5 Self-Awareness

5

1.2 Five Needs of a Cyclist

6

1.2.1 Road Safety

6

1.2.2 Coherence

6

1.2.3 Directness

7

1.2.4 Attractiveness

7

1.2.5 Comfort

7

1.3 Conflict and Risks

8

1.3.1 STEP 1 - Identify the Potential Conflict

8

1.3.2 STEP 2 - Assess the Potential Conflict

8

1.3.3 STEP 3 - Address the Potential Conflict

9

1.3.4 STEP 4 - Monitor the Outcome

9

1.4 Quality of Service

10

1.5 Width

11

1.5.1 Determining Width

11

1.5.2 Width Calculator

12

1.5.3 Tips for Additional Effective Width

12

1.6 Link Types

13

1.7 Integration and Segregation

14

1.7.1 Integration - Cycling in Traffic

14

1.7.1.1 How the Principles of Sustainable Safety Apply

15

1.7.1.2 How Quality of Service Applies

15

1.7.2 Segregation

16

1.7.2.1 How the Principles of Sustainable Safety Apply

17

1.7.2.2 Important Design Issues regarding Segregation

17

1.7.2.3 How Quality of Service Applies

18

1.7.3 Hierarchy of Provision

18

1.7.4 Guidance Graph

19

1.8 Right of Way

22

1.9 Pedestrians & Cyclists

22

1.9.1 Pedestrians are Unpredictable Road Users

22

1.9.2 Principles of Sustainable Safety

23

1.9.3 Shared Facilities

23

1.9.4 Bridges

24

2.0 LEGISLATION AND POLICY	25
2.1 Current Legislation and Guidance	27
2.1.1 Legislative Reference for Specific Traffic Management Measures	28
2.1.2 Key Legislative Points regarding Cycling	29
2.2 Irish Cycling Policy	30
2.2.1 Smarter Travel, A Sustainable Transport Future	30
2.2.2 National Cycle Policy Framework	31
2.2.3 NTA Transport Strategy for The Greater Dublin Area (2010)	31
2.2.4 National Spatial Strategy	31
2.2.5 Regional Planning Guidelines	31
2.2.6 A Strategy for Development of Irish Cycle Tourism	32
2.2.7 Road Safety Strategy, 2007 - 2012	32
2.2.8 Policy Regarding Bicycles in Quality Bus Corridor	32
2.3 Road Signs and Markings	34
3.0 PLANNING FOR THE BICYCLE	35
3.1 What is a Cycle Network?	37
3.2 Components of a Network	38
3.2.1 Three Level Urban Network	38
3.2.2 Connections to National Cycle Routes and Green Routes	38
3.2.3 Local Streets	38
3.3 Networks and Quality of Service	39
3.3.1 Network Planning and the Needs of Cyclists	39
3.3.2 Network Planning and Importance of Directness	39
3.3.3 Quality of Service Map	39
3.4 Seven Steps to planning a Network	40
4.0 DESIGNING FOR THE BICYCLE	47
4.1 Tips for A Good Design	49
4.1.1 TIP 1: Ride the Route	49
4.1.2 TIP 2: Sense Check	49
4.1.3 TIP 3: Design Envelope - Clear Design Objectives and Constraints	49
4.1.4 TIP 4: Cycle Design Integrated in Traffic Planning	50
4.1.5 TIP 5: The Need to Confer Advantage on the Bicycle	51
4.1.6 TIP 6: Design - A Combination of Elements to deliver Consistent QOS	51
4.2 Links Introduction	52
4.2.1 Choice of Link Type	52
4.3 Link Types	53
4.3.1 Mixed / Shared Street	53
4.3.2 Standard Cycle Lanes	56
4.3.2.1 Mandatory Cycle Lane	56
4.3.2.2 Advisory Cycle Lane	56
4.3.2.3 Raised Cycle Lane	56
4.3.3 Cycling in and beside Bus Lanes	60
4.3.4 Standard Cycle Tracks	64
4.3.5 Contra Flow Cycle Lanes and Tracks	69
4.3.6 Cycle Trails	71
4.3.7 Cycle Ways	71

4.4	Junction Introduction	72
4.4.1	Cycling Principles at Junctions	72
4.4.1.1	Critical Cycling Issues at Junctions	72
4.4.1.2	Principles of Sustainable Safety	73
4.4.1.3	Understanding Bicycle Operation at Junctions	74
4.4.1.4	Meeting the Cyclist's Need	75
4.4.1.5	Junction Capacity and Cycling	76
4.4.2	ASLs - Advance Stacking Locations	76
4.4.3	Weaving Cyclists	76
4.4.4	Junction Approaches	80
4.5	Left Turns	84
4.5.1	Re-Establishing Cyclist Position On-Road	84
4.5.2	Designing for Opposing Traffic Turning Right	87
4.5.3	Left Hand Pockets and Dedicated Left-Turning Lanes	88
4.5.4	Late Release Left Hand Turns	93
4.5.5	Left turning Large Vehicles	94
4.5.6	Existing Left Pockets	97
4.6	Right Turns	99
4.6.1	Single Lane Approaches	99
4.6.2	Multi-Lane Approaches to Junctions	102
4.6.3	Box Turns or "Stay Left-To-Go-Right"	102
4.6.4	Jug Turns	106
4.6.5	Utilising the All-Pedestrian Stage	110
4.7	Crossings	111
4.7.1	Uncontrolled Crossings	111
4.7.2	Controlled Crossings	116
4.8	Roundabouts	121
4.8.1	Cycle Friendly Roundabouts	121
4.8.2	Integration or Segregation and Roundabout Capacity	121
4.8.3	Geometry and Urban Roundabouts	122
4.8.4	Types of Roundabouts	122
4.8.4.1	Mini-Roundabouts	122
4.8.4.2	Shared Roundabouts	122
4.8.4.3	Segregated Cycle Track on Roundabout	123
4.8.4.4	Fully Segregated Roundabouts	123
4.8.4.5	Multi-Lane Roundabouts	123
4.8.5	Improving Existing Roundabouts	128
4.8.6	Signage and Markings	128
4.8.7	Overrun Areas	128
4.9	Side Roads and T-Junctions	129
4.9.1	General Arrangement of Side Roads	129
4.9.1.1	Single Lane Side Roads only	129
4.9.1.2	Set back Stop and Yield Lines	129
4.9.1.3	Tight Kerb Radius	129
4.9.1.4	Cycle Facility on Side Roads	129
4.9.2	Examples of Side Road Junctions	129

4.10 Transitions	145
4.10.1 Principles of Sustainable Safety	145
4.10.2 Vertical Transitions	146
4.10.3 Horizontal Transitions	146
4.10.4 Combination Transitions	146
4.11 Design and Construction Flowchart	150

5.0 GETTING THE DETAILS RIGHT 153

5.1 Bus Stops	155
5.1.1 Traffic Management Guidelines	155
5.1.2 Disability Act, 2005	155
5.1.3 Conflicts	155
5.1.4 Design Checklist	156
5.1.5 Design Options for Bus Stops	156
5.2 Drainage	166
5.2.1 Overview of Drainage for Cycling	166
5.2.2 Design Objective	166
5.2.3 Key Issues to be Considered	167
5.2.3.1 Choice of Cycle Facility	167
5.2.3.2 Pavement and Surface Construction	167
5.2.3.3 Ironmongery	167
5.2.3.4 Surface Geometry	168
5.2.3.5 Road Markings and Coloured Surfacing	168
5.2.3.6 Segregated Cycle Facilities and Independent Drainage	168
5.2.3.7 Impacts of Hard Surfaces on Drainage Infrastructure	168
5.2.3.8 Unbound Surfaces	169
5.3 Cycling and Public Lighting	170
5.3.1 Design Objectives	170
5.3.2 Codes of Practice and Reference Guidelines	170
5.3.3 Key Issues to be Considered	171
5.3.3.1 Road / Street Category	171
5.3.3.2 Design Speed of Cyclists	171
5.3.3.3 Locating Lighting Columns	171
5.3.3.4 Strength and Uniformity of Lighting	172
5.3.3.5 Dependence on Carriageway Lighting	173
5.3.3.6 Lighting and Safety at Isolated Locations	173
5.4 Entrances and Driveways	174
5.4.1 Design Principles	174
5.4.2 Main Design Elements	174
5.4.3 Short Ramps	175
5.4.4 Frequent Entrances	176
5.5 Bicycle Parking	181
5.5.1 Strategic Approach to Bicycle Parking	181
5.5.2 The Need for Different Cycle Parking Solutions	181
5.5.3 Balancing Convenience, Cost and Quality	182
5.5.4 Location Specific Characteristics	182
5.5.5 Developing and Implementing a Local Bicycle Parking Plan	183
5.5.6 On-street Parking as a Central Element in a Cycle Parking Plan	185

5.5.7	How much Parking - Cycle Parking Guidance	187
5.5.8	Basic Requirements of Bicycle Parking Facilities	188
5.5.9	Choosing an Appropriate Design of Rack or Stand	190
5.5.10	Cycle Parking Area	190
5.5.11	More Information	191
5.6	Surface Construction Details	192

6.0 MAINTENANCE

195

6.1	Principles	197
6.1.1	Principle of Sustainable Safety: Functionality	197
6.1.2	Meeting Cyclist's Needs	197
6.1.3	Maintenance Orientated Design - Designing out the Problem	197
6.1.4	Common Design Problems	197
6.2	Preventative Maintenance	198
6.2.1	Basic Maintenance Programme	198
6.2.2	Preventative Programmes	198
6.2.2.1	Inspection	199
6.2.2.2	Logging	199
6.2.2.3	Risk Management and Resource Allocation	199
6.3	Common Maintenance Issues Affecting Cyclists	200
6.3.1	Autumn Leaves	200
6.3.2	Broken Glass	200
6.3.3	Debris (e.g. grit)	201
6.3.4	Rutting and Joint Maintenance (in Bus Lanes and Elsewhere)	201
6.3.5	Defective or Uneven Surfaces	202
6.3.6	Ironmongery	202
6.3.7	Ponding	203
6.3.8	Roots and Weeds	203
6.3.9	Wear and Tear of Markings and Linings	204
6.3.10	Lighting	204

7.0 TOOLS AND CHECKLISTS

205

7.1	Mixed or Separated	207
7.2	Width Calculator	210
7.3	Quality of Service Evaluation	211
7.4	Checklist: Function / Form / Usage	212
7.5	Six Way Check	212
7.6	No Room for the Bicycle	213
7.7	Design and Construction Flowchart	214
7.8	Junction Key Design Issues and Checklist	217

GLOSSARY

219

Acknowledgements

225

Withdrawn



The Basics

This section covers the basic building blocks required for any cycling (or traffic) scheme from inception and planning through to route choice and appropriate type of facility.

The principles of Sustainable Safety underpin this entire manual. They provide a common sense baseline from which any design must start.

This section gives a quick reference to topics such as types of cycle facilities and appropriate cycle lane widths. It also gives non-cyclists an understanding of the basic needs of cyclists and describes what distinguishes a good and enjoyable cycle facility from a bad one.

It is strongly recommended that all users of this manual become familiar with these basics of cycling, and also that designers get out on a bicycle and get first hand experience of what they are designing for.

Withdrawn

1.1 SUSTAINABLE SAFETY

Cycling is a vulnerable mode in traffic terms. Safety is at the heart of all good design. The designer should ensure that the Principles of Sustainable Safety have been applied to all schemes.

The principles of Sustainable Safety were developed in the Netherlands in 1992 and the following years. They underpin all road design and the adherence to those principles has contributed to the Netherlands leading record in road safety.

This manual subscribes to the principles of Sustainable Safety and has used them in the determination of content.

There are five principles as follows:

1.1.1 Functionality

The principle of functionality is that the design which is fit for purpose is safer. Urban streets, roads and spaces are always multi-functional.

The functions are either movement or place related. It is important therefore that the designer understands and accommodates the functions applicable to the particular scheme.

The lists below offer an aide-memoire to typical functions encountered in urban areas. Bear in mind that functions can vary at different times of the day or week, e.g. bus lanes, parking weekends etc.

Movement Related Functions (inter alia)

- Pedestrians – walking, crossing
- Cycling
- Vehicular traffic (all modes)
- see *Road Classification Section 1.6, Traffic Management Guidelines*
http://www.dto.ie/traffic_manual.pdf
- Drop-offs and pick-ups
- Access to property
- Turning
- Abnormal vehicle manoeuvres
- Parking of vehicles and bicycles
- Bus stops – waiting and crossing to and from the bus
- Loading and delivery
- Refuse collection

Place Related Functions (inter-alia)

- Housing and access
- Parks and open space
- Communication and information points
- ATMs and postal services
- Meeting and gathering
- Play and recreation
- Shops including window display
- Social and community services
- Shelter and public convenience
- Heritage and architectural value
- Services (gas, water, sewerage etc.)



1.1.2 Homogeneity

The principle of Homogeneity is that reducing the relative speed, mass and directional differences of different road users sharing the same space increases safety. This has a beneficial impact on the level and severity of accidents that might otherwise occur.

Where the relative speed, mass or direction is not homogenous, different road users may need to be segregated.

Relative Speed: As average cyclist speeds are 15 to 20km/h, designers should pay particular attention to vehicular traffic exceeding 50km/h.

Relative Mass: In general, bicycles should not be positioned close to large vehicles. Bicycles are however frequently permitted within bus lanes where there is generally consistency in speed and direction, and the bus driver has been trained in relation to driving with cyclists.

Relative Direction: The most common directional issues occur where drivers turn left across cyclists or right across opposing cyclists, and when cyclists weave across traffic lanes. While these movements cannot be precluded, they must be accommodated in a controlled, low speed and legible manner.

In summary, consider the following:

- The current or proposed mix of transport modes
- The relative speed profile across the transport modes
- The likely changes of direction or crossing movements to be catered for



1.1.3 Legibility

The principle of Legibility is that a road environment that all road users can read and understand is safer. A legible design will be self-evident, self-explanatory, and self-enforcing. Legibility is equally necessary in both mixed and segregated cycling environments, and is not therefore simply about lane markings and streaming traffic.

A legible road environment is such that:

- all potential conflicts are obvious and the resolution of the conflict is mutually understood by all road users
- all road users know where to position themselves, e.g. cyclists "taking the traffic lane" or using a dedicated lane or track
- all road users are instinctively aware of the expected position and likely behaviour of all other road users
- potential hazards can be identified in advance
- road users can communicate visually with each other
- road users can understand in advance the route they have to negotiate

Design considerations

- Ensure that each mode is properly positioned
- Ensure that the urban design and layout communicates the desired behaviour to all road users
- Ensure there are no contradictory messages within the layout
- Ensure the legibility is effective at night and in poor weather



1.1.4 Forgivingness

The principle of Forgivingness (Passive Safety) is that environments that contribute to benign outcomes of accidents are safer.

Consider in particular:

- **Falling:** Should a cyclist lose balance or tumble, nearby traffic should have sufficient time and space to stop
- **Evasion room:** Non traffic areas could be used for evasion, e.g. grass verges
- **Cross falls:** Slope cycle tracks away from the traffic
- **Physical hazards:** Remove guardrails, protruding street furniture, gullies etc.
- **Lighting:** Higher level of illumination where cyclists are positioned

Design Considerations

- What are the risks to vulnerable road users?
- How forgiving are the principal conflict points?
- Does the accident database support this view?
- What information / training do road users need?



1.1.5 Self-Awareness

The principle of Self-Awareness is that where road users are aware of their own abilities and limitations to negotiate a road environment, the environment is safer.

Consider in particular:

- Provide a higher Quality of Service close to locations where cyclists are less experienced or more limited, e.g. school children, parents with cycling trailers, tourists with panniers etc.
- Alternative routes within the vicinity that match reduced ability
- Site specific information and signage
- Training for inexperienced users
- Peak and Off-Peak – is the cycling challenge more difficult at different times of day or week?



1.2 FIVE NEEDS OF A CYCLIST

The designer must understand cycling as a mode of transport. In this manual, it is strongly recommended that designers should cycle and be fully familiar with the cycling environment and needs.

These needs can be summarised under five requirements:

1.2.1 Road Safety

Designers of transport infrastructure must seek to maximise road safety for all road users, including cyclists.

All networks should include measures that are proven to be safe and that the cyclist believes to be safe. Any perception of a lack of safety could be a deterrent to cycling.

Consider in particular:

- **Quality of Cycling Surface:** Cyclists are safer when focusing solely on road traffic and not distracted by sub-standard cycling surfaces
- **Junction Design:** Most collisions involving cyclists occur at junctions
- **Evening and Night Time Cycling:** Poor lighting and personal security concerns will deter certain cyclists
- **Drainage:** Blocked drains, poorly located gullies and manholes
- **Debris:** Broken glass, grit build up, wet leaves



1.2.2 Coherence

The cycling network should link all main origin and destination zones / centres for cyclists. A well-targeted cycle network should carry the majority of cycle traffic (in cycle-km terms).

Cycling routes within the network should be logical and continuous. Delays, detours, gaps or interruptions should be avoided. Markings and signage should be clear and consistent.

Consider in particular:

- **Continuity of Route:** It is illogical to discontinue cycling provision near busy destinations to accommodate or maintain other traffic flow
- **Junctions:** Cycling routes approaching, going through and exiting junctions should be obvious
- **Time Plating:** Discontinuity can occur by virtue of loading, parking or when general traffic is allowed in a bus lane



1.2.3 Directness

Cycling infrastructure should be as direct as possible, minimising any delays or detours. A well designed urban cycle network should confer an advantage in terms of average distance or journey time when compared with other transport networks.

Consider in particular:

- **Filtered Permeability:** Positive advantage to cycling by providing short-cuts etc.
- **Traffic Signals:** Sequencing of signals to minimise waiting time at junctions and crossings for cyclists
- **Detours:** Short detours to maintain momentum and avoid local conflicts. Long detours are unlikely to be used



1.2.4 Attractiveness

The cycling environment along a route should be pleasant and interesting. This is particularly important for beginners, tourists and recreational cyclists.

Monotony and exposure to the elements are unattractive to cyclists, as are litter, uncontrolled animals and poorly maintained environments.

Consider in particular:

- **Shelter:** Planting wind breaks - this can also provide visual interest
- **Maintenance:** Keep cycling surface in good condition and clear of debris
- **Lighting:** Ensure that cycle routes are adequately lit so as not to deter evening and night time use



1.2.5 Comfort

Cycling infrastructure should be designed, built and maintained for ease of use and for comfort. This is particularly important for beginners, tourists and recreational cyclists.

Anything that causes discomfort or delay, or requires a disproportionate amount of effort, is likely to result in the cycling facility not being used.

Improved cycling comfort can be achieved through providing effective width for cycling links; well-drained high-quality surfacing; improving shelter; minimising stopping, delays, detours etc.

Consider in particular:

- **Width:** Provide adequate width to avoid conflict
- **Gradients:** Ensure gradients are not excessive
- **Stopping and Delays:** Minimise the number of obstructions or detours that impact on the cycling momentum
- **Surface Quality:** Ensure cycling surface is smooth and continuous
- **Shelter:** Minimise exposure to inclement weather

1.3 CONFLICT AND RISKS

Conflicts will arise where different modes of transport share the same space. Junctions by their nature are particularly susceptible to conflict.

The relative speed, direction and mass of cyclists, pedestrians or vehicles will determine the severity of the outcome of an actual conflict.

Awareness of potential conflict and addressing it through a legible design is fundamental in providing cycling facilities. Through legible design, all conflicts will then be obvious to all road users in advance, and the resolution of each conflict will be mutually understood by all road users.

Conflict Management is a form of Risk Management.

The four steps below are adapted from the standard approach to Risk Management. Some or all of these steps will also form part of the Road Safety Audit process.



1.3.1 STEP 1 - Identify the Potential Conflict

Review the junction or situation to identify possible conflict areas for all different modes of transport.

Consider in particular:

- What is the “actual” usage pattern of the road as opposed to its Function and Design – especially regarding inappropriate speed, position and direction?
- The individual movements of different modes of transport and how they interact
- Standard hazards such as horizontal and vertical clearances, street furniture etc.
- Possible errors of judgement by cyclists and other vulnerable users
- Database of accidents
- Available traffic information (e.g. An Garda Síochána, traffic wardens, control centre operators, etc.)
- Cycleability Audit undertaken jointly with cycle users and stakeholders (e.g. CRISP, Cycle Route Implementation and Stakeholder Plan, from the UK)



Abrupt transition increases risk of conflict

1.3.2 STEP 2 - Assess the Potential Conflict

Where potential conflicts are identified, determine how likely they are to occur and how severe the outcome might be.

Consider in particular:

- The level of risk, where Risk = Likelihood of occurrence x Severity of outcome
- Are previous accidents likely to recur?
- Locality: Are there particularly vulnerable users present? (i.e. children, elderly, school groups, etc.)
- What is the likely worst outcome?



Cyclists exposed to side swipe

1.3.3 STEP 3 - Address the Potential Conflict

Potential conflict can be addressed by Removing, Reducing or Accepting, but also by Management.

Removing – potential conflicts

- Remove potential conflict through design, e.g. smoother transitions, wider facilities, signal sequencing etc.
- Divert or segregate conflicting road users
- Curtail particular network usage, e.g. truck ban, relocate bus stops, ban particular turns etc.
- Remove the hazard, e.g. street furniture, vegetation, unsuitable roundabout etc.

Reducing – potential contributing factors

- Speed differentials between road users
- Drainage detailing, surface quality, lighting, etc.
- Traffic capacity, e.g. lane reductions, traffic calming etc.

Accepting – that the level of risk is reasonable

- Investigate previous accident history
- Satisfy that no design weakness contributes to a potential accident
- Assure that the likelihood of repetition is remote

Management – transferring the responsibility to users (after all reasonable design steps have been taken)

- Address behaviours of users and raise awareness of the conflict, e.g. bus drivers, passengers and cyclists around bus stops
- Appropriate signage and guidance at potential conflict
- Education / training of school children and other vulnerable road users
- Education / training of other road users, e.g. HGV drivers and learner drivers
- Provide on-site instruction to users
- Undertake publicity campaigns

1.3.4 STEP 4 - Monitor the Outcome

The final step in the conflict management process is to monitor the effectiveness of the design measures implemented.

Consider in particular:

- Review any subsequent accidents and identify if causes relate to conflicts already identified in Step 1.
- Provide a feed-back arrangement for user to comment / complain
- Review available accident data, including:
 - RSA Accident database
 - Site-specific information
 - Conflict trends and details
 - Hospital A & E data



1.4 QUALITY OF SERVICE

Quality of Service is a measurement of the degree to which the attributes and needs of the cyclist are met. In other words it describes the quality of the cycling environment – a high Quality of Service will better meet the 5 Needs of the Cyclist.

The appropriate Quality of Service is influenced by the characteristics of vehicular, cycle and pedestrian traffic and by network characteristics. As such, it is not solely determined by the physical quality of the cycling infrastructure or the cycling capacity.

Quality of Service is measured by considering five criteria:

- Pavement Condition Index (PCI) is a measure of the physical integrity of the cycling surface. It is determined by comprehensive visual inspection as set down by the Department of Transport. In the absence of a formal PCI score, use a locally derived marking system out of 100
- Number of adjacent cyclists describes the capacity for cycling two abreast and/or overtaking. "2+1" accommodates two abreast plus one overtaking
- Number of conflicts is a measure of the potential interruptions to a cyclist per 100m and may include bus stops, side-roads, driveways, entrances, junctions, pedestrian crossings, parking and loading etc.
- Junction time delay is a measure of the actual time delay at junctions as a percentage of the overall journey time, assuming an average journey speed of 15km/h
- HGV influence is a measure of the number of HGVs and buses adjacent to cyclist as a percentage of the total traffic during peak hours



Quality of Service	Pavement condition (PCI range)	Number of adjacent cyclists	Number of conflicts per 100m of route	Journey time delay (% of total travel time)	HGV influence (% of total traffic volume)
Level A+	86 – 100	2 + 1	0 – 1	0 – 5%	0-1%
Level A	66 – 85	1 + 1	0 – 1	6 – 10%	0-1%
Level B	51 – 65	1 + 1	1 – 3	11 – 25%	2 – 5%
Level C	41 – 50	1 + 0	4 – 10	26 – 50%	6 – 10%
Level D	20 – 40	1 + 0	>10	>50%	>10%

Quality of Service (QOS) is ranked from Level A+ (highest) to Level D (lowest). To achieve any particular QOS, at least 4 of the 5 criteria must be achieved. The fifth may be no more than one level lower, e.g., a route meeting four criteria at Level B and one at Level C has an overall QOS Level B.

1.5 WIDTH

In this manual, there are only two possible positions for cycling along roads and streets:

Mixed Traffic

Cyclists are in front or behind vehicles in a controlled speed environment.

Cycling Lanes or Tracks

Cyclists are beside vehicles in their own space.

In either situation:

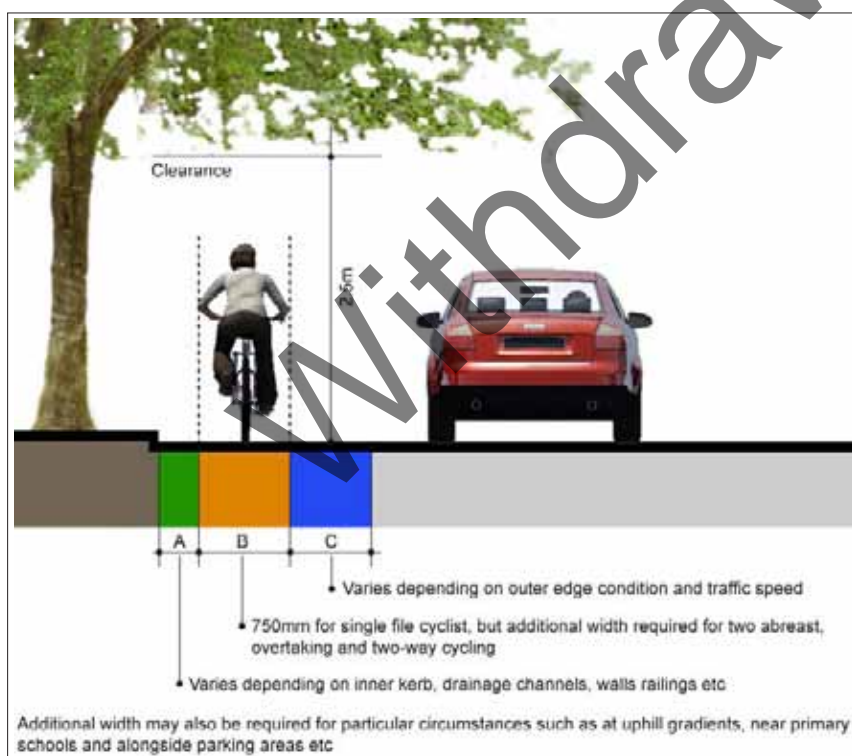
- The expected position of the cyclist should be legible to all road users
- There must be sufficient width for cycling

If there is not sufficient space for a functional cycle lane as set out below, then a Mixed Traffic solution should be considered with an appropriate traffic regime. In other words, a substandard cycle lane is never recommended.



1.5.1 Determining Width

The designed width of a cycle facility is comprised of the effective width, i.e. the space that is "usable" by cyclists, as well as the clearances that will be required in different circumstances.



Not enough space

How wide is a Cyclist?

An individual adult cyclist on a conventional bicycle is approximately 750mm wide. A further 250mm will normally permit the use of accessories such as child trailers, panniers etc.

Wobble Room

Cyclists always wobble or wander from side to side in order to keep balance, particularly at lower speeds. A provision of 250mm wobble room is normally sufficient.

Additional width should be considered where cyclists will be slower and wobbling more, e.g. approaching junctions, at bends, or on uphill sections.

1.5.2 Width Calculator

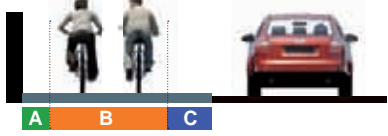
There are three basic elements that determine the width of a cycle lane or track, A, B, and C below.

- The space to the left of the cyclist
- The space required to support the cycling regime (two-abreast, single file, overtaking etc.)
- The space to the right of the cyclist

There may also be additional width required depending on topography, traffic, locality etc.

The table below provides a simplified means of determining the actual width required for cycle lanes and tracks. Standard wobble room is already built into the values in the table.

Where a cycle lane exceeds 3.0m in width, there may be some confusion with traffic lanes and a cycle track may be a better solution.



A Inside Edge	B Cycling Regime	C Outside Edge	D Additional Features
Kerb 0.25m	Single File 0.75m	30kph, 3.0m wide lane 0.50m	Uphill 0.25m Sharp bends 0.25m
Channel Gully 0.25m	Single File + Overtaking, Partially using next lane 1.25m	50kph, 3.0m wide lane 0.75m	Cyclist stacking, Stopping and starting 0.50m
Wall, Fence or Crash Barrier 0.65m	Basic Two-Way 1.75m	Raised kerb, dropped Kerb or physical barrier 0.50m	Around primary schools, Interchanges, or for larger tourist bikes 0.25m
Poles or Bollards 0.50m	Single File + Overtaking, Partially using next lane 2.00m	Kerb to vegetation etc. (ie. cycleway) 0.25m	Taxi ranks, loading, line of parked cars 1.00m (min 0.8m)
	2 Abreast + overtaking (tracks and cycleways) 2.50m		Turning pocket cyclists 0.50m

Example:
To determine required cycle width, select the appropriate Inside Edge, Cycling Regime, Outside Edge and any Additional Features

Channel Gully 0.25m	Single File + Overtaking, Partially using next lane 1.25m	50kph, 3.0m wide lane 0.75m	Around primary schools, Interchanges, or for larger tourist bikes 0.25m
---------------------	---	-----------------------------	---

0.25m
+ 1.25m
+ 0.75m
+ 0.25m

Required width = 2.50m

Note: This is the maximum width for an on road cycle lane. Cycle tracks can be wider.



Space limited to single file only



1.5.3 Tips for Additional Effective Width

Reduced Kerb Heights between the cycle lane and footpath or verge, 50mm or lower, will not catch the underside of the pedal of the bicycle, and cyclists can cycle closer to the kerb.

Side Draining Gullies with a uniform camber provide more effective width for cycling than surface gullies / drainage channels.

1.6 LINK TYPES

There are several types of link options available to the designer depending on the adjoining traffic regime, the need for segregation and the target Quality of Service. The various options are indicated in the table below and further detailed discussion on their application and typical characteristics are included in *Section 4. Designing for the Bicycle*.

Mixed / Shared Street



Narrow Shared Street



Wide Shared Street



Mixed Street

Standard Cycle Lanes



Mandatory Cycle Lane



Advisory Cycle Lane



Raised Cycle Lane



Advisory Cycle Lane

Bus Lanes



Cycling in Bus Lane



Cycling beside Bus Lane



Retro-Fit Bus Lane

Contra-Flow



Contra-Flow Cycle Lane



Contra-Flow Cycle Track



Cycle Way

Standard Cycle Tracks



At Grade Cycle Track



Raised Cycle Track



Cycle Track behind Verge



Two-Way Cycle Track

Cycle Trails and Ways



Cycle Trail



Cycle Way

1.7 INTEGRATION AND SEGREGATION

Integrated Cycling is cycling with the general traffic, with or without marked cycle lanes.

Segregated Cycling is cycling on dedicated cycle tracks or cycle ways that are separated from the general traffic by a physical barrier.

This section considers how the appropriate cycle facility (mixed, lane, track) on cycle links might be chosen using the Guidance Graph.

The choice will be influenced by:

- The overall vision for the route itself and the surrounding area in the context of delivering sustainable travel patterns
- Principles of Sustainable Safety
- The target Quality of Service

Along a cycle route, there may be different options chosen for different links. Junctions are primarily designed as integrated facilities unless there are special circumstances, e.g. specific left hand turn issues, HGV movements, etc.



Space available for a wider mandatory cycle lane

1.7.1 Integration – Cycling in Traffic

The designer has two basic options for an integrated scheme:

- Mixed: Where the cyclist is directly in front or behind vehicles
- Lanes: Where the cyclist is side-by-side with traffic

Integrated facilities include:

- Narrow streets with no markings
- Streets with only basic traffic lane markings
- Streets with cycle lanes
- Cycle and bus lanes

Benefits of integrated design include:

- Increased driver awareness of cyclists
- Freedom of movement for cyclists regarding access and egress
- Environmentally passive
- Space efficiency
- Cost effectiveness, i.e. cheaper to provide and maintain



1.7.1.1 How the Principles of Sustainable Safety Apply

The three principles of sustainable safety relevant to integration are functionality, homogeneity and legibility.

Functionality

In an integrated environment, pedestrian and cycle movements, loading and public transport facilities etc, are prominent functions. Integrated cycling is appropriate in these cases as the through traffic function is subordinate to, equal to, or limited by, other road and street functions. Environmental and amenity objectives etc. may also apply.

Homogeneity

The graph below recommends the traffic volumes and speeds at which integrated cycling is the optimal solution. The design should include controls such that the appropriate speeds and volumes are met, thereby creating an attractive and safe integrated cycling environment.

Legibility

It is important that the low speed environment is self-evident, self-enforcing and self-explanatory, regardless of the number of cyclists, time of day etc.

Notes on Distributor Roads

- Integrated cycling is generally not recommended for primary distributor roads whose function is the optimal movement of through vehicular traffic
- It is recognised that integration, e.g. cycling in bus lanes, may feature on certain distributor roads, particularly in locations where there is no possibility of providing segregated facilities. Careful attention is required to the traffic speed, mix and turning movements in these locations



Consider interaction points



A shared bus and cycle lane would be a better solution

1.7.1.2 How Quality of Service Applies

A high Quality of Service can be achieved in a well designed integrated environment.

Many residential and access streets already offer a high quality of service to cycling. Cycling two-abreast on quiet, interesting, well-surfaced streets and roads can be attractive to cyclists. In many cases there is no physical infrastructure involved, other than the self-evident and self-enforcing nature of the environment.

Heavy congestion and high traffic volumes will limit Quality of Service.



1.7.2 Segregation

Segregation refers to the physical separation of cyclists from motorised traffic, and can be provided by the following:

- Kerbs
- Kerbed plinths
- Bollards
- Soft margins or verges
- Crash barriers (National distributor roads only)

Segregated facilities include:

- Cycle tracks
- Cycle trails
- Cycle ways

Benefits of well designed segregated facilities include:

- Protection from motorised traffic
- Independence of vehicular congestion
- Improved reliability of journey times

However, cyclists using a segregated route will be confined to the cycle track and this will restrict their access and freedom of movement. Therefore, careful attention is required to detailed design of:

- access and egress arrangements from the track
- any significant cycling desire lines that cross at right angles to segregated facilities

Segregated facilities are recommended:

- Where the traffic regime cannot be rendered suitable for integrated cycling
- To preclude traffic from queuing or parking on the facility
- To confer an advantage on cyclists

Segregated facilities are generally NOT recommended:

- Where there are obstacles, frequent entrances or junctions that will impair cycling momentum
- Where there is a strong demand for frequent local access and egress by cyclists
- At junctions, unless there are specific issues such as turning HGVs etc.
- Where integrated facilities would provide a better solution
- Where there is no commitment to track maintenance and monitoring



Cycling past an island bus stop (Denmark)

1.7.2.1 How the Principles of Sustainable Safety Apply

The three principles of sustainable safety relevant to segregation are functionality, homogeneity and legibility.

Functionality

If the primary function of a road in a Sustainable Urban Traffic Plan is for motorised traffic, (e.g. urban distributor road, high volume / mass transit sustainable travel routes such as QBC and BRT) this function may be compromised or undermined through the introduction of an integrated cycling facility and, in turn, discourage users from adopting sustainable travel modes.

See also, *Principles Underpinning Development of the Quality Bus Network and Cycling*, October 2009, Department of Transport.

Smarter Travel – The existence of current heavy traffic volumes does not automatically presume that cyclists should be segregated. It may be that such volumes are not in keeping with a Sustainable Urban Traffic Plan, and reductions in traffic speed and volume is required in any case.

Homogeneity

The graph below recommends the traffic volumes and speeds at which segregated cycling is the optimal solution.

Legibility

It is important that the environment is self-evident, self-enforcing and self-explanatory. In order for this to be achieved segregated tracks should:

- Discourage obstruction e.g. wheelie bins etc.
- Clearly identify access, egress, priority and direction of cycling
- Commence and terminate with smooth transitions



1.7.2.2 Important Design Issues regarding Segregation

- **Drainage:** Additional drainage may be required for segregated facilities
- **Maintenance:** It is imperative that segregated facilities are kept free of debris and litter, and have robust, high quality surfaces
- **Frequency of Junctions:** Frequent side roads will interrupt the benefit of a dedicated facility. In such cases, traffic speed and volume control in conjunction with integrated cycling may be a better option
- **Minor junctions (access streets, entrances etc.):** It is important that traffic turning across off road segregated facilities is made fully aware of the possibility of cyclists on the facility, have adequate sight lines, and turn at an appropriate slow speed
- **Road Works:** If cycle track is closed due to road works, a segregated alternative should be considered
- **Enforcement:** Should be considered if intended design is compromised by other road users
- **Driveways:** See entrances for detailing of cycle priority past entrances and driveways
- **Pedestrians:** It is important to assess the likely pedestrian activity and conflict points at key points along the route, the consequential requirement for cyclists to yield priority, and the potential impact on cycling QOS if priority is frequently lost to pedestrians



1.7.2.3 How Quality of Service Applies

Subject to a quality design and maintenance programme, segregation can offer:

- Improved reliability and predictability of the route
- High levels of comfort, including noise levels, air quality and stress factors
- Encouragement to novice, risk-averse and prospective cyclists to cycle more regularly – an overriding ambition of the National Cycle Policy Framework

1.7.3 Hierarchy of Provision

Irish transport policy seeks to reduce private car dependence from 65% to 45% for commuting by 2020. It is essential that designers actively consider reducing traffic speed and volumes for all new traffic management schemes.

When determining the appropriate cycle facility required, consider the possibility of providing for cyclists in a mixed traffic environment first. The *National Cycle Policy Framework*, Department of Transport, summarises this approach.

It recommends that designers consider the following steps in hierarchical order:

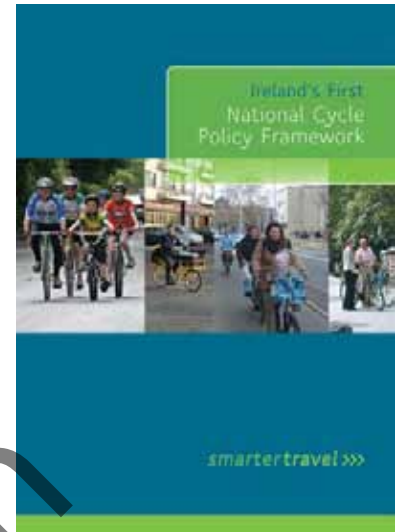
- 1 Traffic reduction
- 2 Traffic Calming
- 3 Junction treatment and traffic management
- 4 Redistribution of carriageway
- 5 Cycle lanes and cycle tracks
- 6 Cycleway (public roads for the exclusive use of cyclists and pedestrians)

This approach requires the cycle designer to fundamentally (re)assess the degree to which the existing traffic is a 'given'.

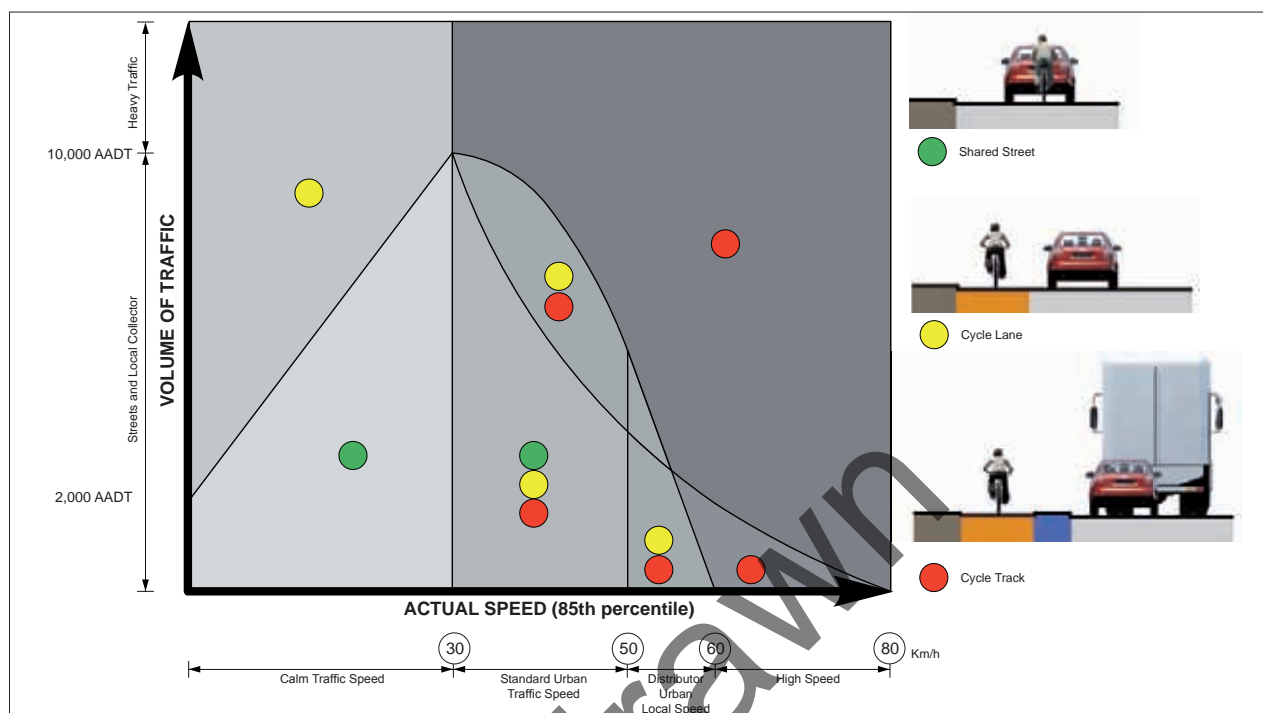
While it is acknowledged that solutions at the upper tiers of the hierarchy will not always be viable, under no circumstances should designers dismiss them out of hand at the outset.

Consider the following prior to deciding what kind of facility to provide:

- What opportunities exist to reduce the volume and speed of motorised traffic, reduce the impact of traffic on the road / street, and provide an attractive quiet environment suitable for cycling?
- Are traffic queues occurring or anticipated approaching junctions, even after addressing the overall traffic impacts, and how are cyclists offered priority past the queue?
- Is the target Quality of Service achievable without segregation?
- What is the maximum actual traffic speed? Inter-peak and off-peak traffic speeds are often higher



1.7.4 Guidance Graph



NOTES ON USING THE GUIDANCE GRAPH

Note 1 – There are two ways to use this graph

A. Choose your preferred cycle environment

Choose the type of facility you would like to have (e.g. mixed streets), and then reduce the speeds and volumes of traffic to an appropriate level. This approach is appropriate when the designer's intention is to emphasise an informal, calmed, relaxed town or village centre, or perhaps where the road is so narrow that there is no possibility of dedicating space to cycling.

B. Plan your traffic speeds and volumes

Determine the design speeds and volumes of traffic according to the regional and/or local sustainable traffic plan, and provide the appropriate cycling facility for that regime.

Note 2 – Threshold Values

The guiding thresholds in this graphic represent the most widely internationally-accepted values of traffic speed and volume for various cycle provision options. They are approximate values in their scope, to give designers a sense of the appropriateness of their design solutions.

It beholds the designer to ensure that the Principles of Sustainable Safety, especially, Functionality, Homogeneity and Legibility, are applied to each design, regardless of the solution(s) offered in this graphic.

Note 3 – Traffic Volumes - some rules of thumb

The graph's Y-axis is the total two-way vehicular flow per day based on AADT. Some useful rules of thumb:

- 1 Peak hour traffic volumes = approximately 10% of 24-hour AADT
- 2 Peak hour traffic splits 66% inbound 33% outbound
- 3 A bus or HGV is equivalent to 3 PCUs (passenger car units). A busy bus lane (e.g. a bus every minute, and regular taxis) could have as high a traffic flow (in PCUs) as the next traffic lane
- 4 A busy inbound urban traffic lane within a signalised system carries between 650 – 850 PCUs per hour

Note 4 – Actual speeds of motorised traffic

In cycle design, it is not the theoretical speed of traffic, or the posted traffic speed limit – it is the actual 85%ile traffic speed that counts

The actual speed of traffic can be quite different to the signed speed limit for the road, especially off-peak. In some cases, the roadscape may need to be re-configured to ensure that speeds of traffic are no higher than the designer intends within the design.

Traffic lane widths are an important consideration. With the exception of primary distributor roads, traffic lane widths should not exceed 3m in general. (see *Traffic Management Guidelines*, Table 9.2: "Typical Lane Widths".).

Further guidance on Speed and Traffic Calming can be found in the *Traffic Management Guidelines*, Chapter 6, Table 6.1(b) "Traffic Calming on Existing Roads".

Note 5 – Relative speed of traffic

Average urban commuter cycling speeds are up to 20km/h. Where weaving occurs, the Dutch advice (CROW) is to limit the speed differential between bicycle and traffic to 10km/h, in order that bicycles can weave in front of vehicles with relative comfort and safety etc.

For this reason, the 30km/h speed limit (ensuring it is observed) becomes central to the concept of mixed traffic.

Beyond 50km/h actual speed, the relative speed of vehicles to cyclist is getting high (30km/h or higher). In relative terms, cyclists travelling at 20km/h in a 50km/h zone are equivalent to pedestrians walking along the road with their backs to traffic, within a 30km/h zone.

For this reason segregation is generally appropriate for urban roads where:

- actual motorised speeds are above 50km/h or
- on such roads where the speed limit is set at 60km/h or higher

Note 6 – Critical Thresholds – 10,000 AADT and 5,500 AADT

In reviewing the graph, the threshold of 10,000 AADT is important. At 30km/h actual traffic speed, this represents the maximum level of traffic flow at which mixed cycling is likely to be the most appropriate choice. 10,000 AADT is roughly equivalent to 1000 PCUs in the peak hour, or 666 PCUs inbound in the morning peak hour.

At 50km/h actual speed (the standard urban speed limit) the maximum traffic flow is 5,500 AADT if mixed cycling is preferred. This is equivalent to 360 PCUs inbound in the peak hour – a relatively low volume of traffic.

Note 7 – Multi-Lane Roads

In general, and under the Principle of Legibility, this manual does not recommend designs that intend cyclists to slew across multiple lanes of traffic for right turns.

While some experienced cyclists may negotiate such manoeuvres, where possible, the designer should provide an appropriate crossing arrangement in accordance with the Principles of sustainable safety.

If the street or road in question has more than one general lane per direction (between junctions), the designer should re-assess the layout:

- 1 If the road is genuinely and necessarily a higher order collector / distributor road with a strong vehicular traffic function, cycle lanes or tracks are likely to be required
- 2 If the road has low amounts of through traffic, the roadspace should be re-configured in favour of the bike

Note 8 – Limiting Right Hand Turn Pockets

In many situations, right hand turn pockets are introduced simply because the space exists. Right hand turn pockets should only be included on roads where traffic delay is a real concern (i.e. on higher order collector, or distributor roads).

Careful attention is required to the provision for cycling in the vicinity of right hand pockets, where there may be local traffic weaving and turbulence.

Note 9 – Feasibility of widescale segregation

It may not be feasible to re-engineer much of the existing urban space to provide for segregated facilities.

Integrated cycling solutions, based on the hierarchy of provision, are likely to be more effective in terms of cost and delivery. However, integrated facilities are likely to require significant changes to the traffic regime.

The transport implications of significant reductions in speed and volume of traffic on key arteries to and through cities and towns needs to be fully understood and planned for, within the sustainable urban traffic plan, before embarking on such changes.

1.8 RIGHT OF WAY

Road users frequently ask “Who has right of way?” in particular circumstances.

Under Irish law, all road users have equal right of way. Rather, the question is “Who is expected to yield their right of way?”, as opposed to “Who has right of way?”.

All road users, including emergency vehicles and cyclists alike, are expected to proceed with due care and consideration for other road users in all cases, irrespective of who has right of way.

For example:

- At priority junctions, all main road traffic may generally expect traffic turning on or off the main road to yield. This expectation is tempered by the obligation to exercise due care and attention
- Buses and taxis are entitled to use bus lanes, but this does not confer absolute right of passage. For instance, if cyclists are in the bus lane, due care and consideration may require drivers to remain at a non intimidation distance behind the cyclist
- Cyclists are also bound to exercise due care and attention to other road users and themselves. Erratic, unpredictable or inconsiderate behaviour may cause accidents

The solutions offered in this manual have been developed based on the above.



1.9 PEDESTRIANS AND CYCLISTS

Sustainable urban environments are for people who are living in, working in, moving through or just visiting the area. Pedestrians are the most vulnerable of all road users, as they include children, blind and disabled people and the elderly, as well as able bodied people.

Urban design of town and city centres should aim for the optimum pedestrian Quality of Service consistent with the overall traffic plan. Shared facilities between pedestrians and cyclists generally result in reduced Quality of Service for both modes and should not be considered as a first option.

1.9.1 Pedestrians are Unpredictable Road Users

Streets can be busy places, and include pedestrians, cyclists and other vehicles.

The nature of pedestrians is that they are much less predictable than cyclists and other road users who are generally moving from A to B. Pedestrians can stop at any stage along the way to meet, talk, stand, wait and observe.



Shared cycle and pedestrian bridge (Copenhagen)



Cycle track inside parked cars (Copenhagen)
Drivers door opens in traffic, not cyclist

1.9.2 Principles of Sustainable Safety

The Principles of Sustainable Safety, when applied to cyclists and pedestrians, would suggest that both modes should be segregated whenever possible.

Functionality

Pedestrian areas accommodate a wide variety of activity apart from walking, including standing, waiting, meeting, talking, watching etc. Cycling in proximity to people, gates, entrances, doorways, etc. is not recommended as it is generally incompatible with the pedestrian activity.

Legibility

The unpredictable nature of people and pedestrians makes it very difficult to provide clear cycle routes or zones through pedestrian areas without increasing the risk of collision. It is better to provide an alternative cycle route.

Homogeneity

Bicycle speed is usually much greater than that of pedestrians. Pedestrians should always have priority and signage should reinforce this. Cycling speeds should be reduced to allow for sudden stopping if necessary.

Forgivingness

Handlebars, pedals and other protruding elements of bicycles are most likely to result in injury to pedestrians in the event of a collision. An alternative route or segregation is preferable.

1.9.3 Shared Facilities

Shared facilities are disliked by both pedestrians and cyclists and result in reduced Quality of Service for both modes. With the exception of purpose-designed shared streets, shared facilities should be avoided in urban areas as far as possible.

Where shared facilities cannot be avoided, there are a number of considerations as follows that will help both cyclists and pedestrians to be aware of the other's presence.

- Pedestrians should always have priority, reinforced by signage
- Cyclists should consider themselves as 'cycling on the footpath'
- Segregate pedestrians and cyclists vertically and/or horizontally
- Delineation markings should not be used as they give cyclists an incorrect sense of a dedicated cycle space
- Sufficient width of footpath and cycle track will help both modes to travel in comfort
- Sufficient width to facilitate evasive action and/or avoidance of potential conflict
- Shared facilities next to vehicular traffic should have a minimum combined width 3.0m
- Cycling alignment and speed reduction measures should be considered

Shared facilities might be appropriate at locations where footpaths are wide and the volume of pedestrians and cyclists is low, e.g. in low-density towns and cities, and suburban or recreational areas. They may also be necessary at particular infrastructure features as described below in *Section 1.9.4*.

Visually Impaired

Visually impaired pedestrians rely on having a longitudinal kerb to demarcate the edge of the footpath. The kerb provides a tapping edge to help them negotiate their way along the footpath. Importantly, the level change tells them which surface is the footpath and which is the road, cycle facility or other surface. The principle of "**Up = Safe**" is of fundamental importance to the visually impaired.



Shared facility should be much wider

Do Not Use Painted White Lines

Painted white lines separating the 'walking side' from the 'cycling side' are not recommended. Even with good signage, pedestrians frequently disregard these lines and will walk or stand on the cycling side.

There is a legacy of such markings and signs already in place along existing shared facilities. It is not expected that they be removed or replaced immediately, and can be left in situ pending eventual replacement as part of a network retrofitting programme.

Shared Crossings

Toucan crossings allow pedestrians and cyclists to cross together without the need for the cyclist to dismount. They are recommended for crossing District Distributors and other main roads. The approaches to the crossing should be designed so as to minimise conflicts between cyclists and pedestrians.

1.9.4 Bridges

The key determinant of whether to mix cyclists and pedestrians on bridges is the speed of the bike. This is influenced by the length and slope of the bridge.

Non-traffic short flat bridges are suitable for shared use with pedestrian priority. However, longer bridges where cyclists are likely to build up higher speeds, should segregate both modes.

Where new bridges are intended for cyclist usage, it is recommended that they meet the following requirements.

Feature	Design Requirement
External parapet	1.2 to 1.4m height
Clearance to parapet	See <i>Section 1.5.1</i>
Surface	Suitable for bicycle wheels and braking
Lighting	Sufficient for social security
Landing points (each end)	Bridge deck gradient < 1:20, to keep cycle speeds low
Priority	Design to reinforce pedestrian priority in mixed area at bridge access/egress aprons



Wide shared pedestrian priority area (N4, Dublin)

Legislation and Policy

This section lists the main statutory and non-statutory provisions governing cycling and the provision of cycle facilities in Ireland. It also sets out the policy framework regarding the bicycle.

Withdrawn

2.1 CURRENT LEGISLATION AND GUIDANCE

Currently, the primary legislative requirements are found in:

Road Traffic Act, 1961

The base legislation for the regulation of road traffic and vehicles.

Road Traffic Act, 1994

Amended that allows for traffic calming measures to be introduced.

Road Traffic Act 2004

Introduction of the metric speed limits and special speed limits.

Roads Act, 1993

The base legislation for the regulation of the construction and maintenance of public roads.

Furthermore, the following Statutory Instruments are relevant to the provision of cycling facilities:

S.I. 181 of 1997, Road Traffic (Signs) Regulations, 1997

S.I. 182 of 1997, Road Traffic (Traffic and Parking) Regulations, 1997

S.I. 273 of 1998, Road Traffic (Signs) (Amendment) Regulations, 1998

S.I. 274 of 1998, Road Traffic (Traffic and Parking) (Amendment) Regulations, 1998

Additional legislation is in preparation associated with the following:

Traffic Signs Manual, 2010 (pending)

Road Traffic (Signs) (Amendment) Regulations, 2010 (pending)

Guidance Documents

The Traffic Management Guidelines, 2003 provides guidance on traffic management including some guidance regarding cycling.

The forthcoming *Irish Manual for Streets* will also provide relevant advice on cycling.

The National Cycle Manual, 2010, superseded *Provision of Cycle Facilities – National Manual for Urban Areas, 1998*.



2.1.1 Legislative Reference for Specific Traffic Management Measures

Location	Minimum number of bicycle parking spaces
Traffic Calming / Management Measures	Road Traffic Acts 1961, 1968, 1994 & 2002 Road Traffic (Traffic and Parking) Regulations, 1997 (S.I. No. 182 of 1997) & Amendment Regulations, 1998 (SI 274 of 1998) Road Traffic (Signs) Regulations, 1997 (S.I. No. 181 of 1997) & Amendment Regulations, 1998 (SI 273 of 1998)
Apply a Weight Restriction	Article 17 of S.I. No. 182 of 1997 makes provision for prohibiting vehicles above a specified weight from entering a road. Sign Number RUS 015 from S.I. No. 181 of 1997 is an example of the type of sign which must be used.
Apply a Height Restriction	Article 34 of S.I. No. 182 of 1997 makes provision for prohibiting vehicles above a specified height from proceeding past traffic sign number RUS 016. The Second Schedule of S.I. No. 181 of 1997 gives details of RUS 016.
Direction to Proceed along a Particular Route	Article 22 of S.I. No. 182 of 1997; Article 5 of S.I. No. 181 of 1997
Prohibit straight ahead or right or left turn movements	Article 23 of S.I. No. 182 of 1997; Article 6 of S.I. No. 181 of 1997
Apply Parking Restrictions	Articles 36 to 45 of S.I. No. 182 of 1997 Article 36 - Prohibitions on Parking; Article 37 - Restrictions on Parking; Article 38 - Restrictions on Parking Heavy Goods Vehicles; Article 39 - Parking in Bus Lanes; Article 40 - Clearways; Article 41 - Prohibitions on Parking at School Entrances; Article 42 - Parking in Loading Bays; Article 43 - Disabled Persons' Permits; Article 44 - Disabled Persons' Parking Bays; Article 45 - Pedestrianised Streets Articles 14 to 20 of S.I. No. 181 of 1997 Article 14 - Single Yellow Lines; Article 15 - Double Yellow Lines; Article 16 - Loading Bay; Article 17 - School Entrance; Article 18 - Parking Bays; Article 19 - Disabled Persons Parking Bay; Article 20 - Disc Parking Area
Apply Parking Charges	Sections 36 of the Road Traffic Act, 1994
Bus Lanes & Bus only street	Article 32 of S.I. 182 of 1997; Article 27 of S.I. 181 of 1997 Sign RUS 021 (Pedestrian only street) is used in association with an information plate to indicate a bus only street
Bus Stop	Under Sections 85 & 86 of the Road Traffic Act, 1961 the Garda Commissioner may specify stopping places and stands for buses and may make bye-laws in respect of same. When commenced, Section 16 of the Road Traffic Act, 2002 will devolve this function to Road Authorities. No date has yet been fixed for devolving this function. Articles 41 & 42 of S.I. 181 of 1997
Taxi Stand	From 1st February 2003, Road Authorities may make bye-laws for Taxi Stands under Section 15 of the Road Traffic Act, 2002 Article 32 of S.I. 181 of 1997
Cycle Tracks	S.I. 273 of 1998; S.I. 274 of 1998
Cycleway	Section 68 of Roads Act, 1993
Traffic Lights	Article 30 of S.I. 182 of 1997; Articles 33, 34, 35, 36 of S.I. 181 of 1997
Pedestrian Crossing (Zebra) & Crossing Complex	Article 46 of S.I. 182 of 1997; Articles 38 & 39 of S.I. 181 of 1997
Pedestrian Crossing Signals	Article 30 of S.I. 182 of 1997; Article 40 of S.I. 181 of 1997
Cycle Crossing Signals	Article 10 of S.I. 273 of 1998; Article 9 of S.I. 274 of 1998
No Entry	Article 28 of S.I. 182 of 1997; Article 23 of S.I. 181 of 1997
Speed Limits	Road Traffic Act, 1961, Road Traffic Act, 1968 & Sections 30 to 34 of the Road Traffic Act, 1994
Traffic Calming Measures	Section 38 of the Road Traffic Act, 1994

2.1.2 Key Legislative Points regarding Cycling

Obligation on Cyclists to use Cycle Facilities

The current Regulations place an obligation on cyclists to use a cycle track or lane where one has been provided.

The only exceptions are:

- when changing direction
- when overtaking a stopped bus, or
- where the cycle track is blocked by a vehicle parked for the purpose of loading or unloading

Cycling in Bus Lanes

Current Regulations permit cyclists to cycle in a bus lane unless specifically excluded from doing so. At present, such exclusions include cyclists using contra-flow bus lanes.



Advisory cycle lane should be mandatory

2.2 IRISH CYCLING POLICY

The Irish Government, the NTA and various State Agencies and bodies are committed to ensuring that the cycling mode is supported, enhanced and exploited, in order to achieve strategic objectives and reach national goals.

The two leading documents regarding cycle policy are from the Department of Transport:

- Smarter Travel, A Sustainable Transport Future
- National Cycle Policy Framework

These are supported by, informed by, or paralleled by other key policy documents, inter alia:

- NTA Transport Strategy for The Greater Dublin Area (2010)
- National Spatial Strategy
- Regional Planning Guidelines
- A Strategy for the Development of Irish Cycle Tourism
- RSA Road Safety Strategy
- Policy regarding Bicycles in Quality Bus Corridors

2.2.1 Smarter Travel, A Sustainable Transport Future

This is the transport policy for Ireland for the period 2009-2020.

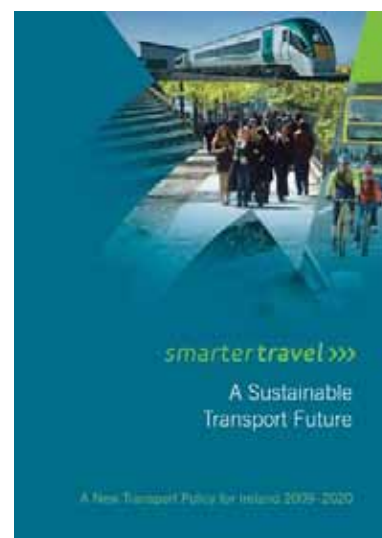
The policy recognises the vital importance of continued investment in transport to ensure an efficient economy and continued social development, but it also sets out the necessary steps to ensure that people choose more sustainable transport modes such as walking, cycling and public transport.

In Smarter Travel, the Government reaffirms its vision for sustainability in transport and sets out five key goals:

1. to reduce overall travel demand
2. to maximise the efficiency of the transport network
3. to reduce reliance on fossil fuels
4. to reduce transport emissions and
5. to improve accessibility to transport

To achieve these goals and to ensure that Ireland has sustainable travel and transport by 2020, the Government sets the following key targets:

- Future population and employment growth will predominantly take place in sustainable compact forms, which reduce the need to travel for employment and services
- 500,000 more people will take alternative means to commute to work to the extent that the total share of car commuting will drop from 65% to 45%
- Alternatives such as walking, cycling and public transport will be supported and provided to the extent that these will rise to 55% of total commuter journeys to work
- The total kilometres travelled by the car fleet in 2020 will not increase significantly from current levels
- A reduction will be achieved on the 2005 figure for greenhouse gas emissions from the transport sector

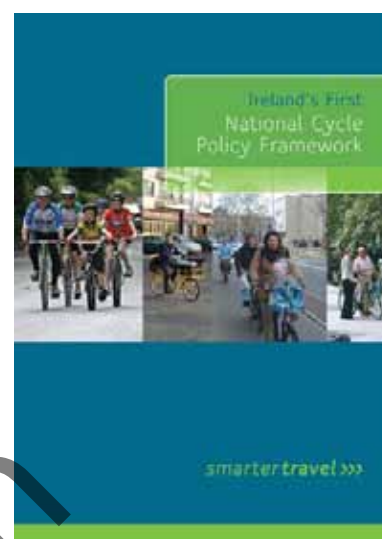


2.2.2 National Cycle Policy Framework

Ireland's first *National Cycle Policy Framework* was launched in April 2009. It outlines 19 specific objectives, and details the 109 individual but integrated actions, aimed at ensuring that a cycling culture is developed in Ireland to the extent that, by 2020, 10% of all journeys will be by bike.

It proposes a comprehensive package of planning/infrastructure and communication/education measures, and emphasises the need for stakeholder participation and adequate funding of the required initiatives.

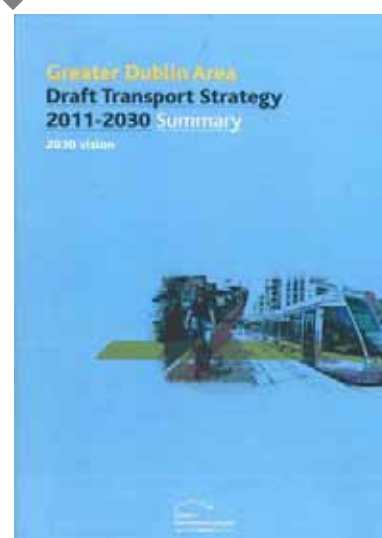
The *NCPF* requires that cycle-friendly planning principles be incorporated in all national, regional, local and sub-local plans.



2.2.3 NTA Transport Strategy for The Greater Dublin Area (2010)

Work is well underway on completing a new transport strategy for the Greater Dublin Area (Dublin, Kildare, Meath and Wicklow) for the period up to 2030 ("2030 Vision"). The Strategy will be inextricably linked to sustainable land use planning and will be directed by the economic, social, cultural and environmental needs of the people of the Greater Dublin Area.

The *NTA Transport Strategy for the GDA* will include a regional policy paper on Cycling, as well as specific measures and objectives for the cycling mode.



2.2.4 National Spatial Strategy

The *National Spatial Strategy (NSS)* is a coherent national planning framework for Ireland for the next 20 years. The NSS aims to achieve a better balance of social, economic and physical development across Ireland, supported by more effective planning.

It promotes sustainable development by encouraging physical compactness, and minimising urban sprawl. The resulting shorter travel distances should help to make public transport more efficient, while increasing the attractiveness of the cycling and walking modes.

Implementation of the *NSS* is a fundamental component of the *2007 National Development Plan*.



2.2.5 Regional Planning Guidelines

The *Regional Planning Guidelines (RPGs)* aim to give regional effect to the *National Spatial Strategy* and to guide the development plans for each county. The *RPGs* inform the Development Plans in each Council area and have effect for six years.

Transportation is one of the issues to be addressed by the Guidelines in accordance with the principles of proper planning and sustainable development.



2.2.6 A Strategy for the Development of Irish Cycle Tourism

The “Strategy for the Development of Irish Cycle Tourism” was developed to determine:

- how best to renew the popularity of cycling in Ireland
- how to encourage visitors to come to cycle in Ireland, and
- how to ensure that cycle tourism can generate visitor spend in rural areas

This strategy forms a subset of the *Fáilte Ireland Tourism Product Development Strategy* within the *NDP*. It focuses on a number of areas within the destination with particularly high potential for holiday cycling, and describes various measures to make them attractive to both domestic and overseas visitors.

It also suggests the development of some longer more challenging routes and sketches out the framework for a *National Cycle Network*.



2.2.7 Road Safety Strategy, 2007-2012

The primary aim of this Strategy is to reduce collisions, deaths and injuries on Irish roads. In terms of fatalities this is an average of 21 per month (2007). The Road Safety Authority has identified a number of key behaviours to be changed by the actions set out in this Strategy:

- Inappropriate speeding
- Impaired driving through alcohol, drugs (prescription or non-prescription), or fatigue
- Not using seat belts and child safety restraints
- Unsafe behaviour towards / by vulnerable road users (pedestrians, motorcyclists, cyclists, young children and older people)

The document includes a proposal to:

“Research, develop and publish a national cycling safety strategy incorporating best practice engineering, education and enforcement issues.”



2.2.8 Policy regarding Bicycles in Quality Bus Corridors

Principles Underpinning Development of the Quality Bus Network and Cycling

Under the Government's Smarter Travel policy there is strong commitment to encourage alternatives to the car, particularly for urban commuting, with very ambitious targets set for modal shift.

The bus is seen as a key player in offering an alternative to the car and the Government commits to a new level of service for buses, including infrastructural improvements. In relation to bus corridors the new policy explicitly states:

“We will implement more radical bus priority and traffic management measures...This may involve making some urban streets car-free, creating tram-like priorities in others and making greater use of roads/hard shoulders by buses”

The same policy seeks to create a culture of cycling in Ireland aiming for significant increases in the levels of cycling in urban areas by 2020 to the extent that in cities such as Dublin, 25% of commutes in 2020 could be by bike. Flowing from this the Government has published a National Cycle Policy Framework to give effect to this ambition. It explicitly deals with networks for urban areas:

“...the design philosophy will be based on the “hierarchy of measures”...with the focus being on the reduction of vehicular speeds...We will ensure that designs are created with the principal aim of preserving cyclist momentum. We will also ensure that designs will provide for a safe passing distance of 1.5 metres between motorised vehicles and bicycles”

To give practical effect to the above approach in urban areas a combination of measures need to be taken not just new approaches in relation to design. One such measure is a reduction in general speed limits to 30km/h.

In summary, in seeking to deliver on the objective of ensuring greater use of public transport, cycling and walking, the Government, particularly in the metropolitan environment, is seeking to pursue complementary strategies in relation to bus and cycling, namely the provision of high quality bus priority and cycling infrastructure.

The purpose of this document is to offer some interim guidance to local authorities and executive agencies/offices tasked with implementing bus priority measures in urban areas so that full cognisance is given to the need to meet the Government's ambition for cycle provision as well as bus priority in urban areas.

Key Principles

The aim is to create opportunities for the better movement of both bikes and buses in urban areas in accordance with the new Government policy framework for Smarter Travel.

Pending the development of regional or local transport plans and supporting policy guidance, the Department of Transport as funding authority for physical infrastructure for bus priority, requires the following principles to be adhered to:

- The Level of Service intended for each part of the Bus Network and the Bicycle Network need to be set down at the planning stage, as this will have significant bearing on the detailed design to follow for each mode
- If the bus and cycle networks overlap on a particular corridor, the design of the bus and cycling spaces should be done in accordance with best practice
- Where the provision for cyclists along a section of bus priority space is of a low quality of service, an alternative cycle route in the vicinity of the space should be provided
- Where no alternative cycle route is possible, and a low level of cycling is proposed (or retained) as part of any traffic scheme (Bus priority or any other), clearly stated reasons need to be submitted to the funding authority / agency as part of the application, and
- Where the only option is shared road space, the infrastructure should be designed and delivered as being for both modes (and other permitted vehicles) with primacy being given to the safety of cyclists

Practical Steps to Support These Principles

The Department of Transport (or the relevant delegated funding agency) will require evidence of adherence to the above principles prior to approval of funding of a bus priority route or other road improvement or traffic scheme. In this respect the relevant Officer in the Local Authority should be consulted on options for freeing up road space and his/her report included in the funding proposal for the measure.

Where shared space is being provided the primacy of the safety of cyclists needs to be supported by speed management for bus services and other vehicles, safety training for drivers, and other measures. A prior commitment to such will be required from the bus operators as part of the funding of the scheme.



2.3 ROAD SIGNS AND MARKINGS

Advice in relation to signage and road markings will be provided pending publication of the Traffic Signs Manual by the Department of Transport.

In the meantime, please refer to www.transport.ie for the latest updates.





Planning for the Bicycle

Against the policy background for the bicycle, there are a variety of action areas to promote and deliver for the bicycle mode. The overall objective is to plan for and encourage many more people to choose and use the bicycle in Irish towns and cities.

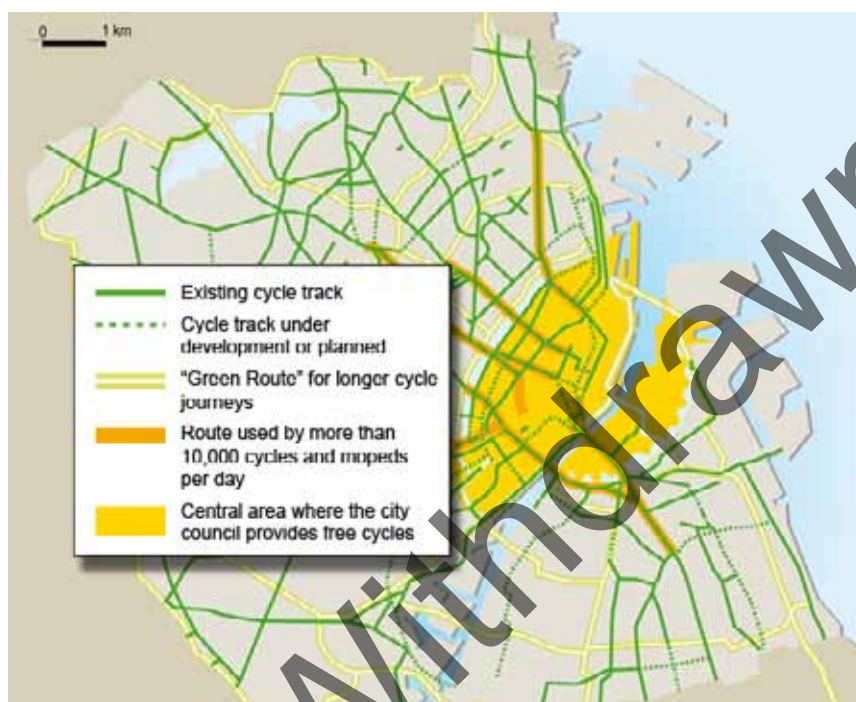
In this section, we limit our focus on the urban design, traffic management, and facilities development issues. Pivotal to all of these is cycle network planning, in the context of an overall traffic management plan, and an overarching county development plan.

Withdrawn

3.1 WHAT IS A CYCLE NETWORK?

For the purposes of this manual, a Cycle Network is a defined collection of connected routes. Routes are a set of connected links and junctions that follow logical corridors between zones or urban centres. Links are individual sections between junctions. Routes may be up to 6km long and Quality of Service is normally determined at route level.

The purpose of the cycle network is to connect the main zones of origin and destination within an urban area and should provide effective through-movement for cyclists. A well-planned cycle network will carry the vast majority of cycle journeys, in cycle-km terms.



Advisory cycle lane should be mandatory, and wider if possible

3.2 COMPONENTS OF A NETWORK

Cycle networks provide a mesh or grid throughout the city to facilitate cyclists. A well designed cycle network will include a hierarchy of corridors that provide for different levels of cycling traffic and also offer cyclist route choices. This section discusses the components of an urban hierarchy and how urban networks relate to the National or Inter Urban cycle routes.

3.2.1 Three Level Urban Network

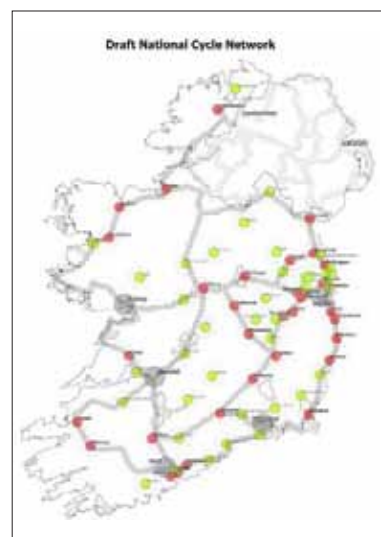
The urban cycling network can have up to three levels:

- **Primary Network:** Main cycle arteries that cross the urban area, and carry most cycle traffic
- **Secondary Network:** Links between the principal cycle routes and local zones
- **Feeder:** Cycle routes within local zones, and/or connections from zones to the network levels above



3.2.2 Connections to National Cycle Routes and Green Routes

The National Cycle Network needs to be connected to the Urban Cycle Network, and should be recognisable and legible within the urban area.



Green Routes are provided specifically for tourist, recreational and leisure purposes, but can also address everyday trip demand. Green Routes should be connected to the Cycle Network, so that they are accessible to cyclists from across the urban area.

3.2.3 Local Streets

Local streets are generally not included in the Network (unless they are part of a route), but local areas should be connected to the overall Cycle Network.

Cycling by its nature is local and most cycling is of 6km or less. Significant daily trips tend to be less than 4km, i.e. within the local neighbourhood. It is therefore important that streets in the locality are "cycleable", i.e., meet the Five Needs of Cycling. If this does not happen, then cycling from the local area to the network and/or the main destinations is precluded.



3.3 NETWORKS AND QUALITY OF SERVICE

In order to have a high level of take up of any transport mode, there must be a high level of provision, i.e. a high Quality of Service

Therefore, the cycle network must be user focused, addressing the 5 Needs of the Cyclist and providing a sufficiently high Quality of Service.

3.3.1 Network Planning and the Needs of Cyclists

The Cycle Network should address the 5 Needs of the Cyclist. The first three needs, namely Safety, Coherence and Directness are considered central to network planning. Comfort and Attractiveness are not considered as significant factors in network planning, but remain important requirements at route and link level.

Cyclist Need	Implications for Cycle Network Planning
Directness	Offer as direct a route as possible, keeping detours or delays to a minimum. Provide a shorter average distance (or journey time) over short distances as compared to other modes.
Safety	Provide for the safe passage of cyclists and other road users. Provide socially safe route choices at night-time
Coherence	Link all main origin zones and destinations. Aim to carry the majority of cycle traffic (in cycle-km terms). Offer route choice, with at least one risk-averse option for key journeys



Cycle track on bridge (Copenhagen)

3.3.2 Network Planning and Importance of Directness

Directness is the most important requirement for network planning. Because of the effort and time involved, cyclists are highly intolerant of detours and additional journey length, etc. Major trip patterns should be as close to "as the crow flies" as possible.

3.3.3 Quality of Service Map

It is recommended that the designer prepare a Map of the Quality of Service (QOS) for the cycle network. Ideally, for routes serving primary destinations, the QOS should increase closer to the destination. The highest QOS should be in the immediate vicinity of the primary destination itself. Typical primary destinations are:

- City and town centres
- Public transport hubs – railway, metro, tram and bus stations
- Employment zones
- Second-level schools and higher education institutions
- Leisure and sports facilities (football fields, parks, cinema, etc.)
- Tourism and recreational centres (hub towns and villages, scenic amenities, cycle trails, etc.)



Advisory cycle lane should be mandatory

3.4 SEVEN STEPS TO PLANNING A NETWORK

For larger towns and cities, it is important that detailed analysis is used in network planning so that subsequent cycling investment is justified. For smaller towns, there may be insufficient scope for detailed analysis and route options may be limited in any case.

There are 7 steps to planning, budgeting and programming a cycle network. The appropriate level of input at each step will be determined by the amount of data available, the scope for improvements and the scale of investment proposed.

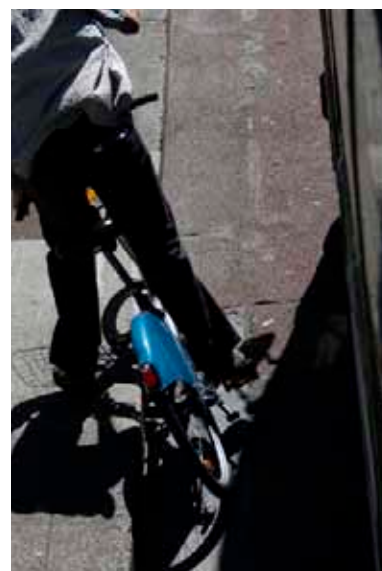
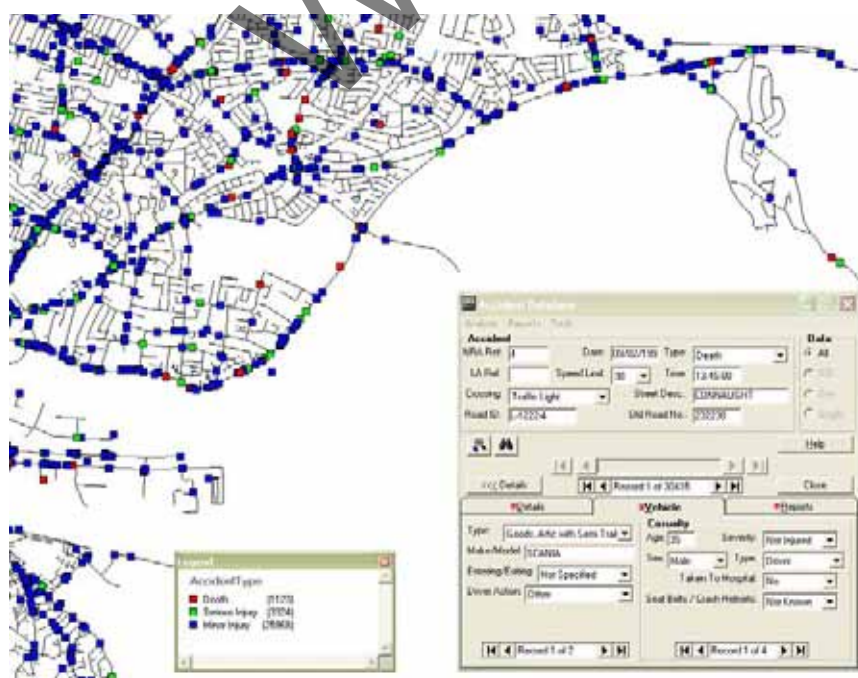
STEP 1: Inventory of Existing Cycling Regime

The existing cycle network and wider urban area should be mapped and an inventory prepared, even if this is at informal level. The inventory will include:

- All roads where cycling is permitted
- All roads where cycling currently occurs
- Unofficial routes, through parks, on footpaths, through building complexes, through breaks in fences etc.
- Any links or connection points from residential areas to the network
- Any barriers, limitations or bottlenecks that could affect route choice (e.g. one way streets, bridges, major junction delays or dangers, night-time closures, level crossings, etc.)
- Quality of Service rating (if available)
- Cycle parking locations
- Other relevant physical infrastructure
- For maintenance reasons, record segregated facilities
- Record which cycling directions are provided for

Mapping Accidents

It is critical to map all reported cycling accidents. In network planning or improvement existing accident locations need to be included and addressed through the 4-step process for Conflict Management.



Insufficient space

Inventory Mapping

The inventory should generate a comprehensive map including:

- Main trip attractors or generators in the urban area
- Quality of Service ratings (A+ - D) for the routes within the network
- Length, type and direction of infrastructure provided throughout the network
- Location of bicycle parking
- Other as appropriate



Mapping Cyclist Accessibility to the Network and Key Zones

Development densities within an urban area, together with its physical layout will influence the cycle network.

A well-developed cycle network will have a mesh of routes running at 250m "squares". This density of routes allows for a feasible choice of routes close to any location that will not impose significant detours for urban cyclists.

Modern GIS tools will allow for mapping of cycling accessibility to the cycling network and to the major centres. This will also identify gaps or sections of poor accessibility.

Residential streets should not be included if the streets are:

- for access only, or
- not part of a through cycle route

Dealing with Barriers and Severance Locations

All breaks or severance in the continuity of a route should be clearly identified.

Large roundabouts, major junctions or road crossings, valleys, network pinch points, can all have a fundamental impact on the network. In particular, the confluence of cycle routes as they approach and exit from bridges and pinch points should be specifically detailed.

At such locations cyclists may experience unacceptable detours or delays that would reduce the overall Quality of Service for the route.

If there is no solution to a key point of discontinuity or severance, or if unacceptable detours and delays cannot be avoided, the cycle network should not be planned around these locations.

STEP 2: Understanding Trip Demand and the Potential for Cycling Trips

Trip Demand

An efficient and effective Cycle Network will target the greatest quantity of existing and potential cycle traffic. This requires a knowledge of overall trip demand within the urban area (all trips by all modes), and an understanding of existing and potential cycling demand.

The main sources of information on trip demand are:

- Census data (CSO last census analyses 2006)
- Origin surveys: Household / Area
- Destination surveys: Key employers, shopping / commercial centres, educational centres, surveys associated with mobility management plans, etc.
- Use of transport Models: Saturn, OmniTrans, etc.
- Other datasets: Traffic counts, roadside surveys, etc.
- Trip generation rates: use of standard / typical trip rates for certain types of land use developments

Using this information, the existing trip demand, together with the potential for cycling short trips (i.e. 6km or less) can be estimated and located.

Useful outputs can include:

- Trip Length profile to key destination centres, and numbers of short trips
- Zone-to-zone trip movements (employment-based)
- Educational Trip demand

Potential Cycling Demand: New Users

Within the overall trip matrix, potential cycling trips are those journeys (or part of a multi-modal journey) that are 6km or less in length, and which generally do not involve significant movements of goods or other passengers.

All Day Trip Profile

While peak hour trips such as those to work or education are significant, off-peak trips are equally important potential bike trips. The 2006 Household Survey (Central Statistics Office) for the Greater Dublin Area revealed significant trip volumes outside of the two peak periods:

Examples include trips to:

- recreation, sport fields and leisure centres
- community based services and centres, places of worship, etc.

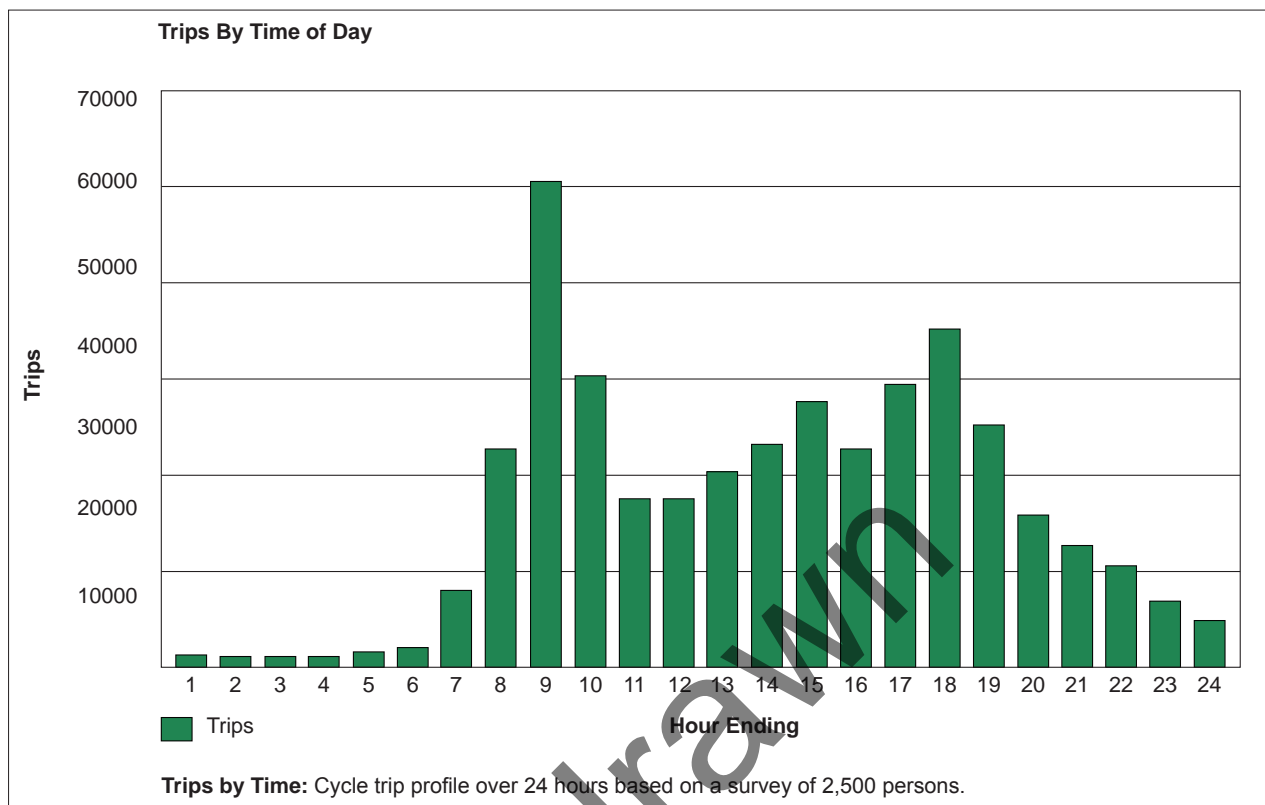
Factors that increase Trip Rates – Children, Employment

The survey also showed that households with children made 25 to 33% more trips than those without children and the trip rate did not drop-off during the summer. In addition those in employment had a 25% higher trip rate as compared to those not in employment.

Therefore, network planning should consider how it serves areas with younger families and/or higher levels of employment.



Residential streets should be cycle friendly to avoid cycling on the footpath



STEP 3: Trip Assignment to the Network

All existing and potential cycle trips need to be assigned to the Cycle Network so as to indicate where the greatest pressure for cycling is currently and will be in the future. This will allow for prioritisation of network improvements.

In the absence of a dedicated cycling assignment model, trips can be assigned manually. The assignment process should reflect the key route choice factors, which cyclists use:

- Directness i.e. best cycle journey time / distance
- Safety
- Quality of Service

Gradient also needs to be considered as steep gradients can deter cycling on particular routes and cyclist may choose flatter, if slightly longer alternatives that require less effort.

Compare to existing trip-patterns

Existing cycling patterns, if known should reflect the post-assignment pattern although the overall numbers would be higher.



STEP 4: Trip Forecast

The cycle network must cater for future needs as well as for existing latent demand. As such network planning should consider the likely growth in demand arising from:

- Future trends, expected policy outcomes, target mode shifts, etc.
- Development Plan projections for countywide and local areas

Smarter Travel and the National Cycling Policy Framework set out clear targets for reducing car use and increasing cycle usage together with the means for achieving these at a national level. Smarter Travel states that the future network should be planned to cater for cycle policy measures including:

- public transport / cycle opportunities
- increased cycling as part of school and employment mobility management plans

These additional trips and zones should be mapped onto the network and future trips quantified and assigned as in Step 3.



STEP 5: Urban and Transport Planning

Cycling does not operate in isolation from the other modes in transport planning. As such in cycle network planning it is also necessary to consider future proposals (both short and long-term) for the other transport modes. Early identification will ensure that potential conflicts can be avoided or reconciled.

Map out other strategic proposals that could affect the cycling network, for example:

- Bus network plans
- Traffic and signalling plans
- Pedestrianisation schemes
- Rail Interchange proposals
- Town centre masterplans, Strategic Development Zones (SDZs) etc.
- Others as appropriate

Opportunities that exist within the development plan should also be reviewed, e.g. capitalising on infrastructure and maintenance projects to provide new or improved cycle links:

- Urban or town street improvement schemes
- road maintenance
- renewal of sub-surface utilities
- Others as appropriate

Strategic Traffic Management Plan

Within the Greater Dublin Area, the cycle network will be an integral part of the Strategic Traffic Management Plan for the region.



STEP 6: Prioritising Improvements

Steps 1 to 5 provide a view of existing cycle trips, future potential cycle trips, important zones and centres, forecast growth etc., mapped against the existing cycle provision.

Step 6 maps and prioritises the key improvements required on routes within the cycle network and will normally identify:

- connections to key destinations
- routes where there is high trip demand and low QOS
- accident locations requiring remedial or improvement works
- gaps, detours, or deficiencies in network
- barriers, bottlenecks, limitations or lack of permeability

For each of the improvements identified above, it is important to consider:

- alternative design solutions to determine the best solution for the local circumstance
- what is the effect of doing nothing, i.e. how critical is the proposed improvement?
- potential conflicts with other infrastructure or development programmes
- opportunities for cycle network improvement within other infrastructural or maintenance programmes

The improvements will form the basis of the cycling infrastructure programme considered in Step 7.

STEP 7: Programme, Consultation, Budgets

The programme should include all the improvements and their delivery timeframe. Ideally, proposals should be mapped and tabulated according to:

- Priority
- Urgency (safety)
- Cost
- Hierarchy level within the cycle network (principal, feeder, access)
- QOS improvement

A detailed programme for the cycle network should also identify:

- Contingencies, dependencies or risks to delivery
- Land acquisitions, enabling works, e.g. utility diversions etc.

The *Department of Finance Capital Appraisal Guidelines* set out a solid method for assessing schemes and programmes. The principles within these guidelines should be followed as good practice, even where the cycle network programme may fall below certain thresholds.



Withdrawn

Withdrawn

Designing for the Bicycle

It is important to design correctly for the bicycle at all levels of the network, including the strategic level, the route planning level and at design level.

Strategic Planning Level – the cycle network planning is embedded and consistent with all other plans, including the traffic management plan and the development plan. See *Section 3. Planning for the Bicycle*.

Route Planning Level– the cycle routes are properly aligned, are wide enough, offer the appropriate QOS, and choose the optimum balance between the various modes and road functions. See *Section 1. The Basics* and *Section 7. Tools and Checklists*.

Specific detailing advice on topics such as drainage, lighting, entrances etc is included in *Section 5. Getting the Details Right*.

Withdrawn

4.1 TIPS FOR A GOOD DESIGN

The design process is set out in *Section 4.11 Design and Construction Flowchart*. In addition, it is worth considering the six tips below in terms of good practice.

4.1.1 TIP 1: Ride the Route

It is difficult to design for cycling without an experience of the mode. The National Cycle Manual website will include video footage taken of cycling, both from the cyclist's perspective and from the point of view of other road users.

However, this should not be considered a replacement for actual personal experience of cycling in urban areas. It is strongly recommended that designers cycle (and walk) along the routes that are to be designed / upgraded, and observe the conflicts and deficiencies at first hand.



Advisory cycle lane should be mandatory

4.1.2 TIP 2: Sense Check

The Principles of Sustainable Safety remain central to all road and street design. At their core, they provide an excellent platform for conducting a "sense check" on designs of any type, but of cycling in particular.

The common-sense questions include:

- Is the design fit for purpose, i.e. does it work for the bicycle, does it deliver the target QOS?
- Is it legible, i.e. is the position and behaviour of all modes clear, logical and understood? Are all conflicts obvious, and is the resolution of those conflicts understood by all?
- Is it as homogenous as possible? Does the design place like-with-like, or are there significant differences in mass, speed and direction between the bike and other traffic?
- Is it forgiving? What are the main risks and what does the design do to lessen the severity of the outcome of those risks?
- How self-aware are the users? Is the design only for certain categories of road user / cyclist? How are the others to manage to get through the design?



4.1.3 TIP 3: Design Envelope – Clear Design Objectives and Constraints

An efficient design is one that achieves its objectives within the constraints imposed from the start. It is therefore essential that the brief for the design is clear regarding constraints and objectives.

Design Constraints will typically include:

- Kerbside activity (loading, parking) and the degree to which it can be changed or removed
- Requirements of other traffic / modes (e.g. vehicular capacity, bus priority, pedestrian requirements etc.)
- Road envelope, and the likelihood (or otherwise) of land acquisition
- Prior statutory planning context – SDZ or LAP specificity, conditions attaching to developments etc.



- Budget
- Timeframe
- Human resources and competencies
- Public / political support (or otherwise)
- Fixed / protected infrastructure (trees, services, heritage etc.)

Design Objectives can be broken into Performance and Method based objectives:

Performance Based Objectives presume that there are fewer constraints, and that a suite of design options is possible, within which there are optimal designs.

- Typical Performance (or Outcome) Objectives
- Increase the numbers of cyclists by x%
- Improve the bicycle QOS for the route from (say) QOS D to QOS B
- Improve the cycle journey time reliability by y%
- Provide a route that is attractive to certain target groups (elderly, children, tourists etc.)
- Provide a Cycle Parking Scheme to cater for the next 5 years, with a maximum of (say) z% reported bicycle theft during that period

Method Based Objectives are usually appropriate to schemes where the network planning is complete, where the constraints are fully understood and quite limiting in their nature, and where the design scope for alternatives is therefore curtailed.

Typical Method (or Output) Objectives

- Provide an off-road two-way cycle route between points A and B
- Design a traffic calming scheme for Area "F" that will deliver QOS C or higher for marked routes within the area
- Design a Signal Plan to reduce average cycle and bus journey times by (say) 20% along routes A and B

Design Objectives and constraints need to be as clear as possible from the start. Otherwise, the degree to which the design contract has been satisfied will not be understood.

Performance and Method Objectives should not be mixed. For instance, the planned QOS must be clearly stated and achieved in the Performance design, whereas the Method approach will have already satisfied the client as to delivering the required QOS.



Traffic lane is much too wide



Photo courtesy Sustrans

4.1.4 TIP 4: Cycle Design Integrated in Traffic Planning

Recent Irish experience points to the provision of dedicated cycling facilities "where there was space" (e.g. hard shoulders) at the farther extents of a route, with a cessation of provision for the bike (either in reductions in traffic intensity or through provision of space) approaching key destinations.

It is essential that the bicycle mode be planned in conjunction with the other traffic modes in an overall traffic management plan. Otherwise, the cycle network will be disjointed and located where there is space, not necessarily where it is needed or can contribute to a significant mode shift.

At a detailed design level, the bicycle needs to be integrated into the overall traffic management for a route.

In other words, the bicycle should influence and have a bearing on current traffic management practice. If it does not relate to car parking, turning, signalling, etc..., there is a strong risk that the cycle design is isolated, may not deal properly with conflicts, and will not be successful.



4.1.5 TIP 5: The Need to Confer Advantage on the Bicycle

In most Irish towns and cities, there are other modes choices for urban trips besides the bike (e.g. car, bus, taxi etc.). In the case of the private car, it is important to remember that:

- it is normally convenient to the trip maker (outside the front door)
- it is warm and dry and comfortable
- it is connected (radio, satnav, hands-free phone)
- it is relatively safe from collision
- it can offer reliable journey times (e.g. outside peak hours)

It is essential that cycle design not only meets the 5 Needs of the Cyclists, but also actively confers an advantage on the bicycle mode, in the context of the reality of private car ownership and usage.

Key advantages that can be conferred include:

Route:	Shorter and more direct routes than by car
Journey time:	Signal-free routes, priority at junctions, etc.
Parking Convenience:	Proximity and prominence of secure cycle parking to front door
Social and Healthy:	Pleasant and popular routes to encounter / talk to other cyclists, cycle two-abreast, take exercise

A cycle route with a high QOS (e.g. B or above) will inherently confer these advantages. It is unlikely that a significant increase in cycling will be achieved, if the Quality of Service offered to the bicycle is low.



4.1.6 TIP 6: Design – A Combination of Elements to deliver Consistent QOS

Irish roads and streets tend not be uniform in terms of width, appearance, traffic layout etc. Therefore it would be exceptional that the cycle facility would remain constant along the entire length of a road.

The key challenge for the detailed design of a cycle route is to offer a consistent QOS, despite the fact that the link layouts, traffic regime, roadside activity etc. will change along the route. The best designs will select, assemble and combine the various components to deliver an overall cycle facility that:

- is embedded within the traffic and transport plan for the area
- recognises the interaction between the road users, and
- provides the target QOS for cyclists consistently along the route



Advisory cycle lane should be mandatory

4.2 LINKS INTRODUCTION

Links are the physical cycling infrastructure that join origins to destinations. They can take a variety of forms depending on particular conditions and these are described below in *Section 4.3 Link Types*.

This Manual recommends providing for cyclists in a manner that supports and promotes a more sustainable approach to travel. The concepts and details are based on both national and international evidence and feedback.

The key objectives include:

1. Providing for two abreast where possible – this makes cycling more enjoyable, but the wider cycle facility also makes it safer, more visible and more attractive.
2. Providing consistently for cyclists – minimising the need to make transitions from one type of link to another, and making the overall facility predictable and legible.
3. Designing junctions where cyclists are safely integrated with the main traffic flow – ensuring better bicycle provision and reducing bicycle / pedestrian conflicts.



4.2.1 Choice of Link Type

Factors influencing the appropriate choice of link type include:

Space Required

This Manual recommends calculating the optimum width required for any given situation using the **Width Calculator**, and then seeking to establish how it can be accommodated.

It is not acceptable to simply provide whatever space is left over after traffic has been catered for – this approach often results in facilities that are substandard and unsafe for cyclists. Substandard facilities have been shown to be dangerous, increasing the likelihood and severity of conflict. It would be better not to provide any cycling facility at all, and to review the overall cycle network.

Solutions may include reducing the number of traffic lanes, reducing the design speed of adjoining traffic, or introducing a segregated or off-road cycle facility.

Traffic Speed and Volume

The design speed of the adjoining vehicular traffic will inform the choice of link type. Where traffic is low in speed, the speed differential between bicycles and vehicles is small, and cyclists can be safely integrated with the main traffic.

As traffic speed increases, the speed differential also increases, and greater degrees of separation and segregation are required.

Equally, where traffic volumes are low, such as in residential areas or side streets, cyclists can be integrated with vehicular traffic as long as motorists are aware of the presence of cyclists and will yield to them. In such circumstances, vehicular traffic is not unduly impeded by the presence of cyclists.

Where traffic volumes are higher, separate or segregated facilities will be required to ensure that cyclists do not cause traffic queues.

See *Section 1.7.4* for further information on the appropriate choice of link type for different traffic volumes and speeds.

Budget

Whether providing a new facility or upgrading an existing one, a realistic budget needs to be made available. Identifying the correct solution in advance is essential. In some cases, the correct solution may in fact be cheaper than a substandard one. An example of this might be a good cycle lane alongside a single traffic lane, as opposed to a narrow cycle lane squeezed in beside two lanes of traffic.



Lack of clarity for all road users

4.3 LINK TYPES

There are several types of link options available to the designer. The purpose of this section is simply to summarise the basic characteristics and principal design considerations of each option.

It is important this section is read in conjunction with the other advice offered in this manual. The appropriate link option will be primarily guided by the advice on Segregation and Integration.

In most cases, regardless of the choice of link option, the cyclist will be brought through junctions integrated with the traffic using transitions if required. The reason for this is that the alternative gives rise to significant cycling-pedestrian conflicts which are currently inappropriate to Irish urban town centres.



4.3.1 Mixed/Shared Street

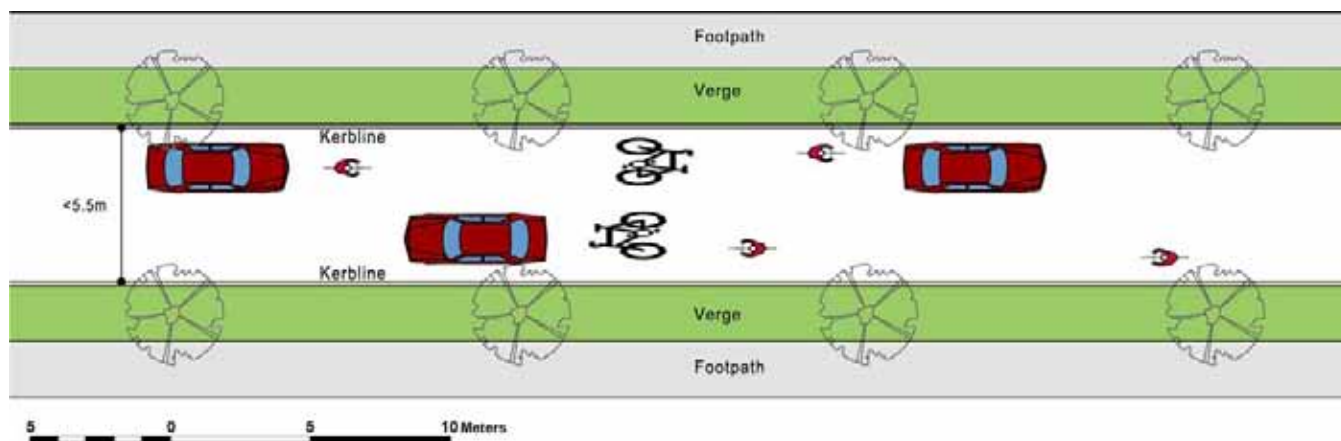
Mixed or shared streets are suitable in low traffic single lane environments where cyclists and pedestrians take precedence over vehicular traffic. The key feature from a cycling perspective is that cyclists “take the lane” in line with vehicles.

Where such streets are less than 5.5m in width, there should be no central lane marking, thereby ensuring all road users in either direction yield to each other.

For widths between 5.5 and 7.0m, a central lane marking should be provided to separate opposing traffic.



Narrow Shared Street



Typical Road Environments:

- Residential areas, access roads and streets, environmental traffic cells and shopping streets
- Little or no through traffic, except perhaps public transport
- Traffic function is subordinate to vulnerable road user requirements
- Low traffic speeds and volumes
- Not appropriate for multi-lane roads

Characteristics:

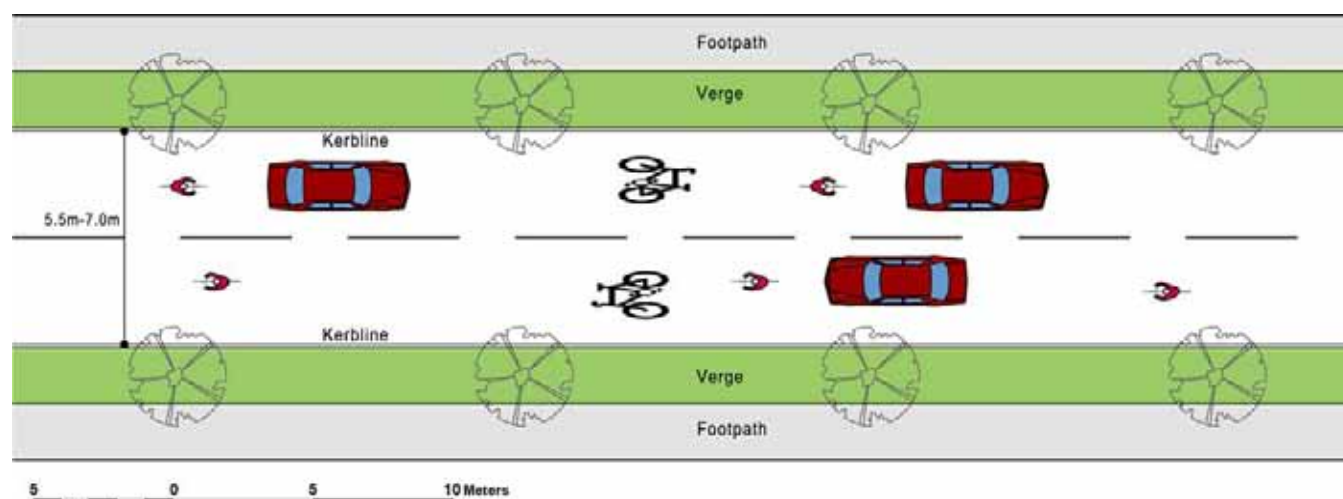
- Street less than 5.5m in width
- No central line between opposing lanes
- Quiet, low traffic and low speed environments
- High QOS possible
- Unconstrained accessibility for cyclists

Key Issues to be Considered:

- Essential that cyclists "take the lane" and traffic follows
- Cycle logos in centre of lane to emphasise correct cyclist position
- Overtaking cyclists only in opposing lane and at low speed
- Two way cycling should be the norm
- Entry and exit treatments to reinforce legibility
- Cycle lane if exit queuing occurs
- Loading and parking



Wide Shared Street



Typical Road Environments

- Residential areas, access roads and streets, environmental traffic cells and shopping streets
- Little or no through traffic, except perhaps public transport
- Traffic function is subordinate to vulnerable road user requirements
- Low traffic speeds and volumes
- Not appropriate for multi-lane roads

Key Issues to be Considered:

- Essential that cyclists "take the lane" and traffic follows
- Cycle logos in centre of lane to emphasise correct cyclist position
- Overtaking cyclists only in opposing lane and at low speed
- Two way cycling should be the norm
- Entry and exit treatments to reinforce legibility
- Cycle lane if exit queuing occurs
- Loading and parking

Characteristics:

- Street between 5.5 and 7.0m in width
- Central line between opposing lanes
- Quiet, low traffic and low speed environments
- High QOS possible
- Unconstrained accessibility for cyclists



4.3.2 Standard Cycle Lanes

Cycle lanes are lanes on the carriageway that are reserved either exclusively or primarily for the passage of cyclists. They are normally located on the left or kerb side of the road and benefit from being included within the normal road maintenance programme.

Because they are part of the main carriageway;

- the design of cycle lanes requires careful attention to turning movements of both cyclists and other traffic
- cyclists are not physically protected, and it is important that the traffic regime is appropriate to the presence of cyclists on the road
- they are only effective when unhindered by parking and loading activity. Careful attention to this design issue is required especially in town centres and around schools

Standard cycle lanes include Mandatory Cycle Lanes, Advisory Cycle Lanes and Raised Cycle Lanes. In this manual, if cycle lanes are to be provided, the preferred option is the Mandatory Cycle Lane wherever possible.



Cycle lane should be wider and mandatory

4.3.2.1 Mandatory Cycle Lane

Mandatory Cycle Lanes are marked by a continuous white line which prohibits motorised traffic from entering the lane, except for access. Parking is not permitted on mandatory cycle lanes. Mandatory Cycle Lanes are 24 hour unless time plated in which case they are no longer cycle lanes.

4.3.2.2 Advisory Cycle Lane

Advisory Cycle Lanes are marked by a broken white line which allows motorised traffic to enter or cross the lane. They are used where a Mandatory Cycle Lane leaves insufficient residual road space for traffic, and at junctions where traffic needs to turn across the cycle lane.

Parking is not permitted on advisory cycle lanes other than for set down and loading. Advisory cycle lanes are 24 hour unless time plated.



Cycle lane should be wider

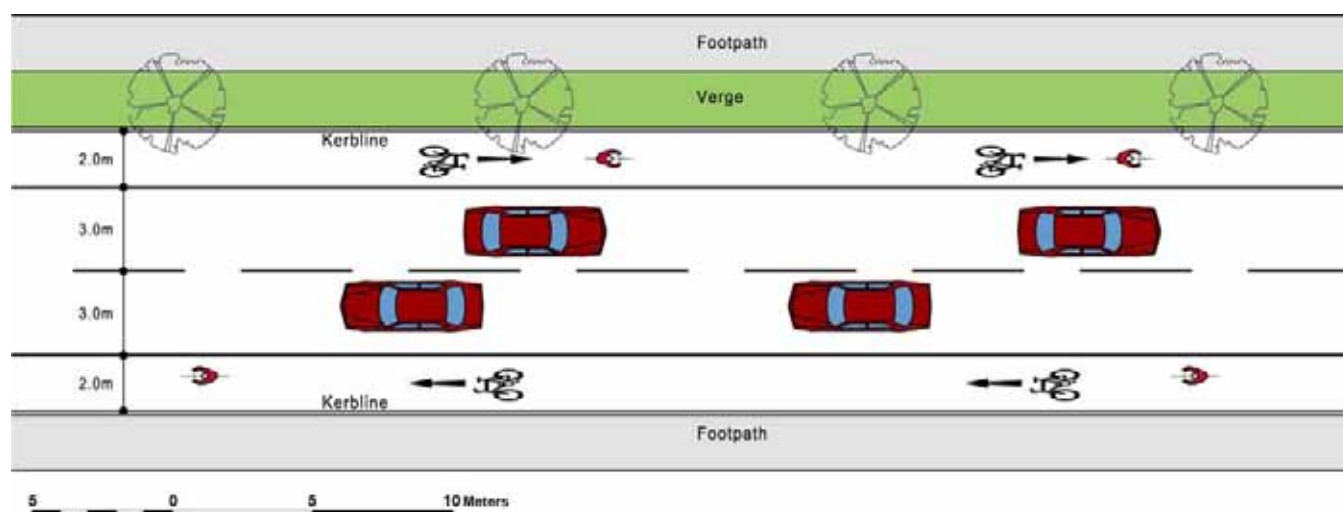
4.3.2.3 Raised Cycle Lane

Raised Cycle Lanes are Mandatory Cycle Lanes that are raised by 25 to 50 mm from the main carriageway surface. They are always 24 hour operation and parking is never permitted. Their primary use is two-fold:

- Along collector roads with frequent entrances and driveways where in a shelf arrangement the cyclist is slightly lower than the footpath and slightly higher than road
- Where the cycle lane is adjacent to a bus lane and the position of the cyclist is reinforced at particular location, e.g. approaching junctions



Mandatory Cycle Lane



Typical Road Environments

- Access streets with exit queues
- Collector roads with speeds up to 50km/h – see Guidance Graph
- Adjacent to bus lanes – see below

Characteristics

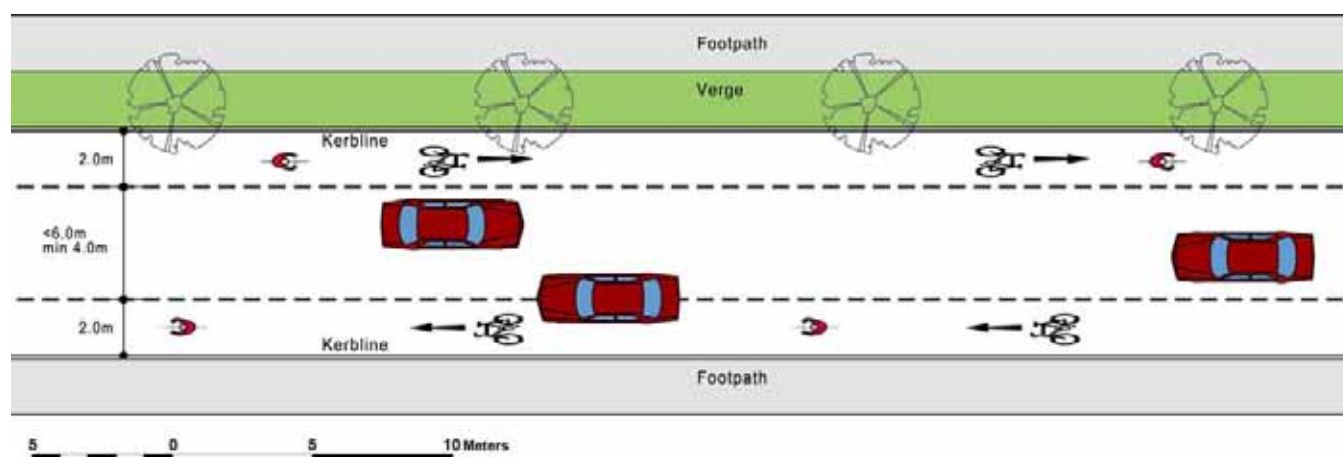
- Highlights presence of on-road cyclists to other road users
- May change to advisory lane on approach to junctions and at bus stops
- Red surfacing only at the beginning and end of mandatory sections of the cycle lane

Key Issues to be Considered

- Parking and loading not permitted in cycle lane, and must be provided elsewhere if required
- Consistent quality essential, no changes in lane width, no “gaps”
- Sufficient road width must be available to cater for other road users outside the cycle lane
- Smooth, flat, well-drained and well-maintained surface
- Gullies preferably located in kerb and not on the cycle lane
- 24-hour operation preferred, but time plating possible
- If traffic consistently tracks into mandatory cycle lanes, then segregation or enforcement may be required



Advisory Cycle Lane



Typical Road Environments

- Collector roads with single lane in each direction and maximum speed of 50km/h – see Guidance Graph
- Multi-lane junctions for streaming cyclists and turning traffic movements

Characteristics

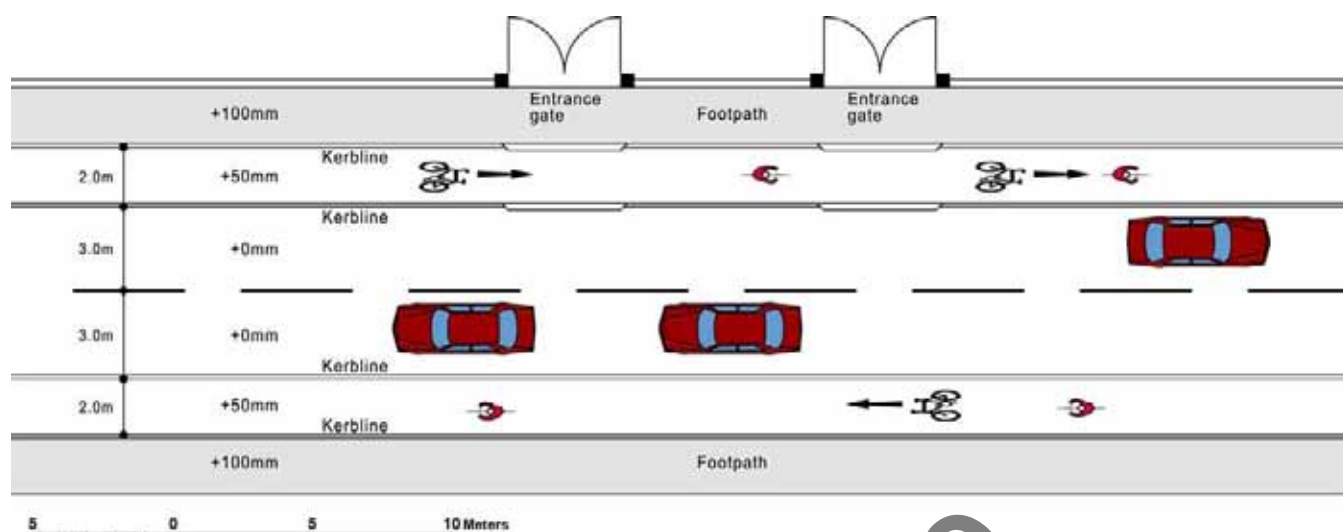
- Motorised traffic can enter cycle lane when safe and necessary to do so
- Most effective where there is no demand for kerbside parking or loading
- Red surfacing only required at conflict points or where area might be confused with on-street parking

Key Issues to be Considered

- Only to be used in exception circumstances where Mandatory Cycle Lane is inappropriate
- Not recommended in the vicinity of schools etc where drop off and pick up may undermine the cycling function
- Road centre line should not be used when the residual space for traffic is less than 6.0m. In this situation, low traffic speed is important and traffic calming may be required
- Consistent quality essential, no changes in lane width, no "gaps"/ breaks in continuity
- Smooth, flat, well-drained and well-maintained surface
- Gullies preferably located in kerb and not on the cycle lane



Raised Cycle Lane



Typical Road Environments

- Collector roads with frequent entrances and driveways
- Adjacent to bus lanes – also see below

Characteristics

- Cycle lane, minimal separation from carriageway by low-level kerb
- Visually and legally part of carriageway, but improved safety
- Easier to provide than segregated cycle track

Key Issues to be Considered

- Lanes should be wide enough to allow overtaking – otherwise the step down presents a hazard to cyclists falling into traffic
- Smooth, flat, well-drained and well-maintained surface
- Gullies preferably located in kerb and not on the cycle lane
- Poles, public lighting columns, etc should be located off road, i.e. not on the raised cycle lane



4.3.3 Cycling in and beside Bus Lanes

There are two options for cycling with buses. Cyclists can cycle with the buses in the bus lane, or a Mandatory Cycle Lane can be provided alongside the bus lane. Advisory Cycle Lanes with a bus lane are not recommended other than in the vicinity of bus stops.

Some bus lanes are extremely busy traffic terms and the designer should consult the Guidance Graph before presuming on the suitability or otherwise of cycling in the bus lane.

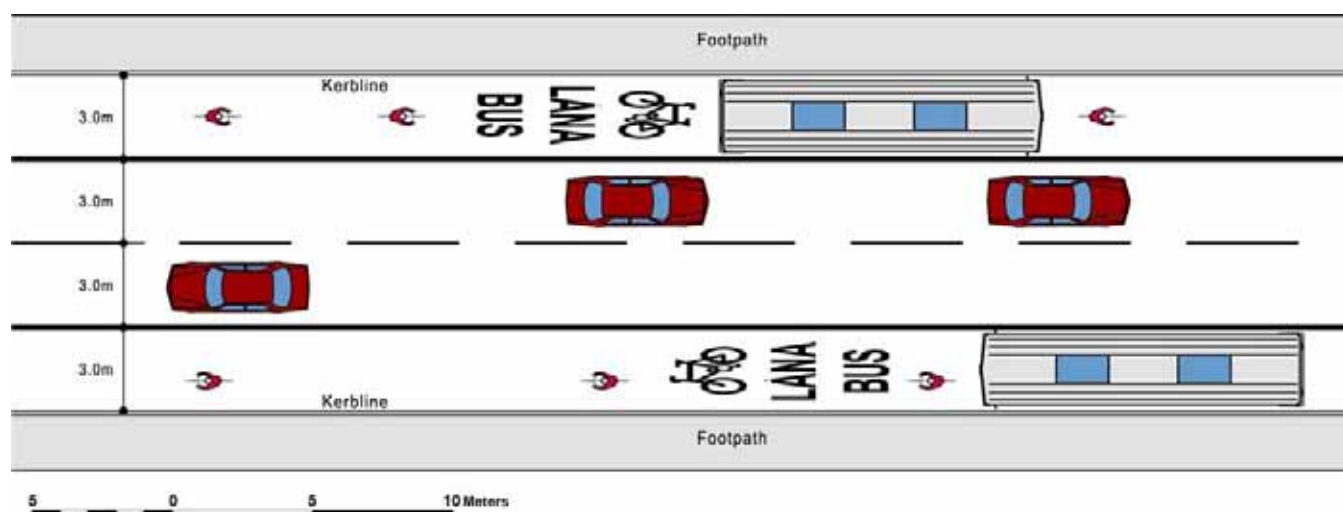
Careful consideration is required when bus lanes are time plated, as the traffic regime outside of bus operation may be less cycle friendly.

Guidance on bus stops is provided elsewhere in this manual.

For overall policy on cycling and buses, consult *Principles Underpinning Development of the Quality Bus Network and Cycling*, October 2009, Department of Transport.



Combined Cycle and Bus Lane



Typical Road Environments

- Collector or low-speed Distributor Road, max. 50km/h

Characteristics

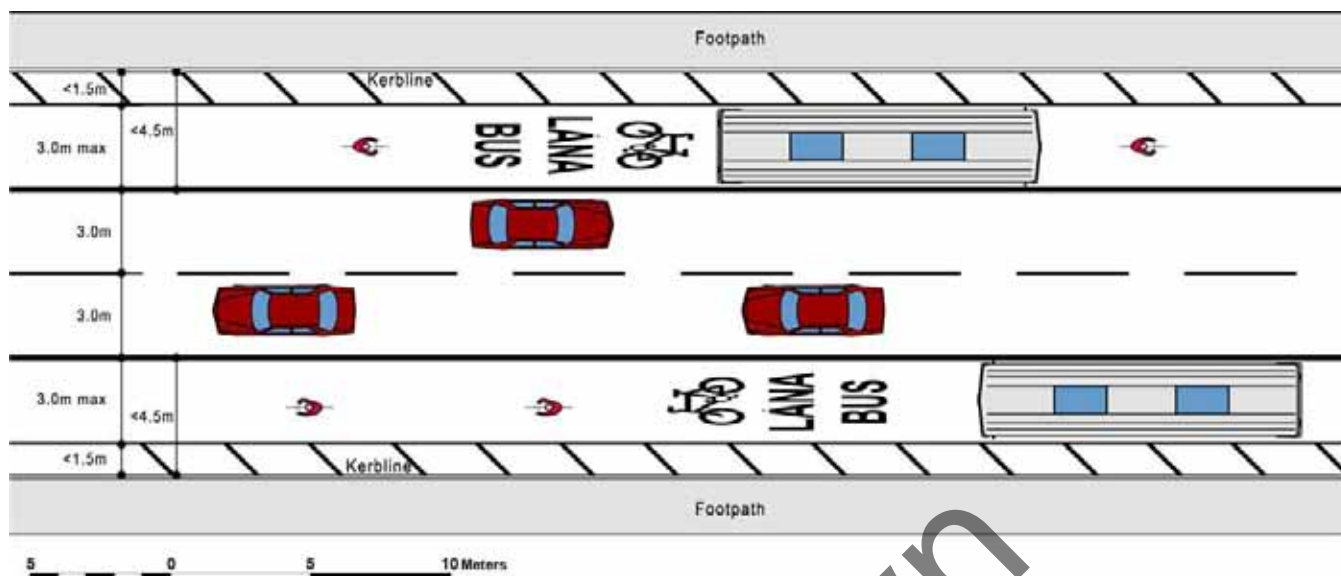
- Cyclists share space with buses, coaches and taxis
- Bus lane 3.0 metre wide. Any surplus width to be marked off or re-assigned to footpath, verge or other road function

Key Issues to be Considered

- Bus lane surface (rutting, drainage details) especially around bus stops
- Time-plated bus lanes require separate assessment of cycling provision out-of-hours
- Only suitable for short lengths of road, to avoid frustration
- Poor QOS for cycling if buses are stacked at stops and junctions
- Limited QOS for buses with significant volumes of cyclists



Retro-Fitting Cycling into Bus Lanes



Typical Road Environments

- Collector or low-speed Distributor Road, max. 50km/h

Characteristics

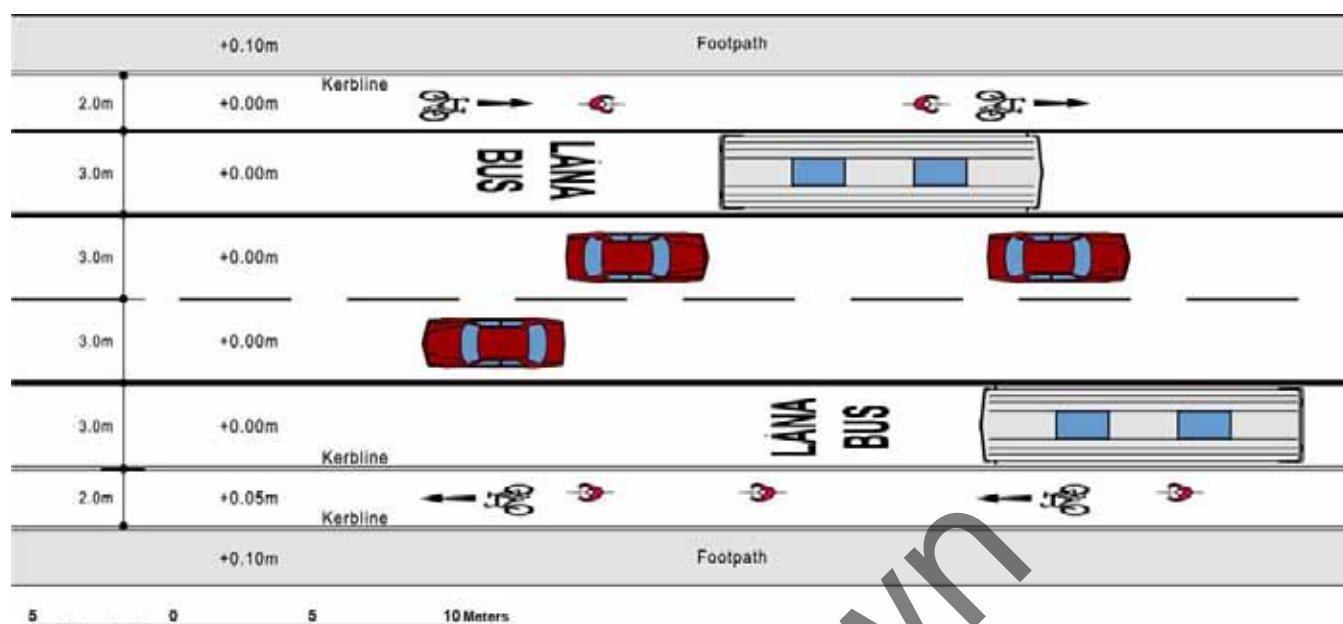
- Existing bus lane is wider than 3.0m, but less than 4.5m wide and consequently not wide enough for a parallel cycle lane
- Any surplus bus lane width is hatched off to reduce the bus lane to 3.0m.
- Cyclists share space with buses, coaches and taxis

Key Issues to be Considered

- Bus lane surface (rutting, drainage details) especially around bus stops
- Time-plated bus lanes require separate assessment of cycling provision out-of-hours
- Only suitable for short lengths of road, to avoid frustration
- Conflict between left turning buses at junctions where the cyclist might approach alongside the bus on the hatching
- Limited QOS for buses with significant volumes of cyclists



Cycle Lane alongside Bus Lanes



Typical Road Environments

- Collector or District Distributor, max. speed 60km/h

Characteristics

- Dedicated cycle lane adjacent to bus lane
- Reduced frustration, higher QOS for both bus and bicycle modes
- Bus lane acts as buffer space between cyclists and general traffic

Key Issues to be Considered

- Mandatory cycle lane, except around bus stops
- Bus lane surface (rutting, drainage details) especially around bus stops
- Minimum total width for buses and cyclists is 4.5m – see Width Calculator
- Time-plated bus lanes require separate assessment of cycling provision out-of-hours



4.3.4 Standard Cycle Tracks

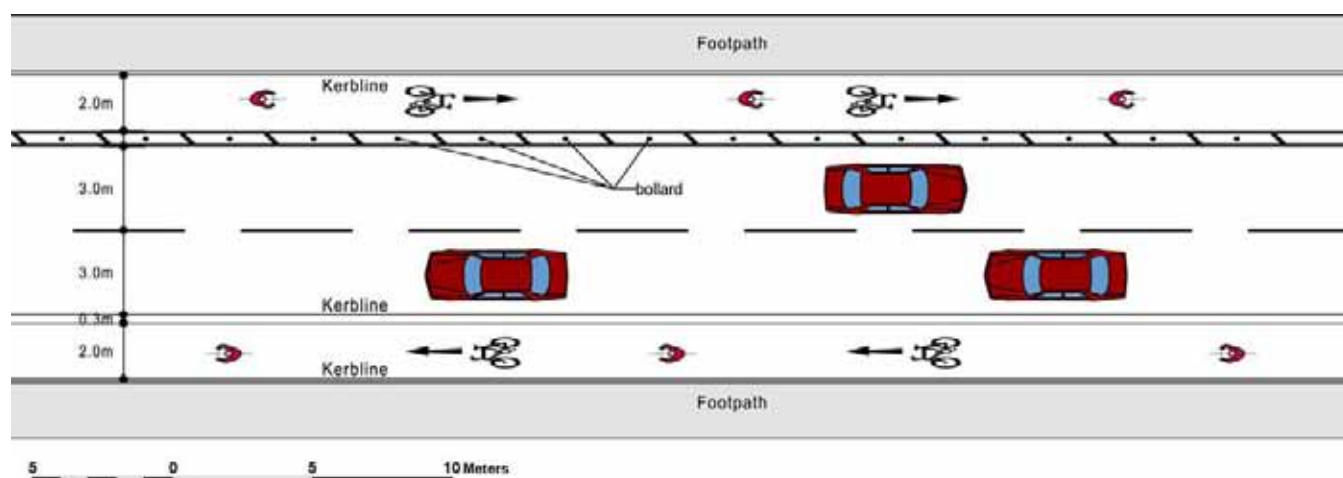
Cycle Tracks are different from Cycle Lanes in that they are physically segregated from motorised traffic. This is achieved by either a kerb with a level change, bollards etc. They have limited points of access and egress and therefore these locations need to be carefully detailed.

Cycle tracks are generally for situations where the traffic regime is unsuitable for cycling and cannot be otherwise mitigated. For this reason, it is important that cycle tracks retain their function at all times – otherwise cyclists may be forced into an unsuitable traffic regime.

The transitions from cycle track to cycle lane and vice versa are central to the success of cycle tracks.



At Grade Cycle Tracks



Typical Road Environments

- Collector roads, speeds up to 50km/h
- Roundabouts – see Hedgehog Design

Characteristics

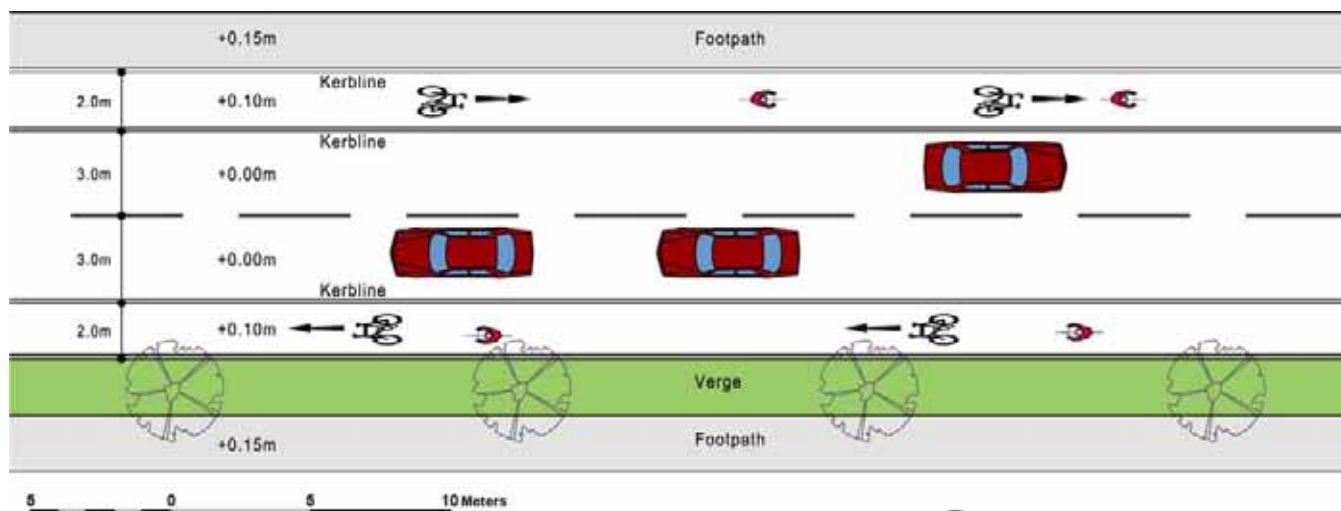
- Physical segregation between cyclist and motorised vehicles
- 24 hour and no parking or loading
- Bollards or continuous upstand

Key Issues to be Considered

- Ensure continuity of segregation with no “gaps”
- Sufficient width of cycle track
- Poles, public lighting columns, etc should be located off road, i.e. not on the cycle track
- Transition to cycle lanes at junctions and their approaches
- Access for maintenance
- Drainage requirements will inform choice of segregation method – bollards or continuous upstand
- Provide sufficient and logical access and egress points for cyclists
- Pedestrian conflicts



Raised Cycle Track



Typical Road Environments

- Collector roads, speeds up to 80km/h
- Distributor roads if there is 24-hour bus lane in both directions

Characteristics

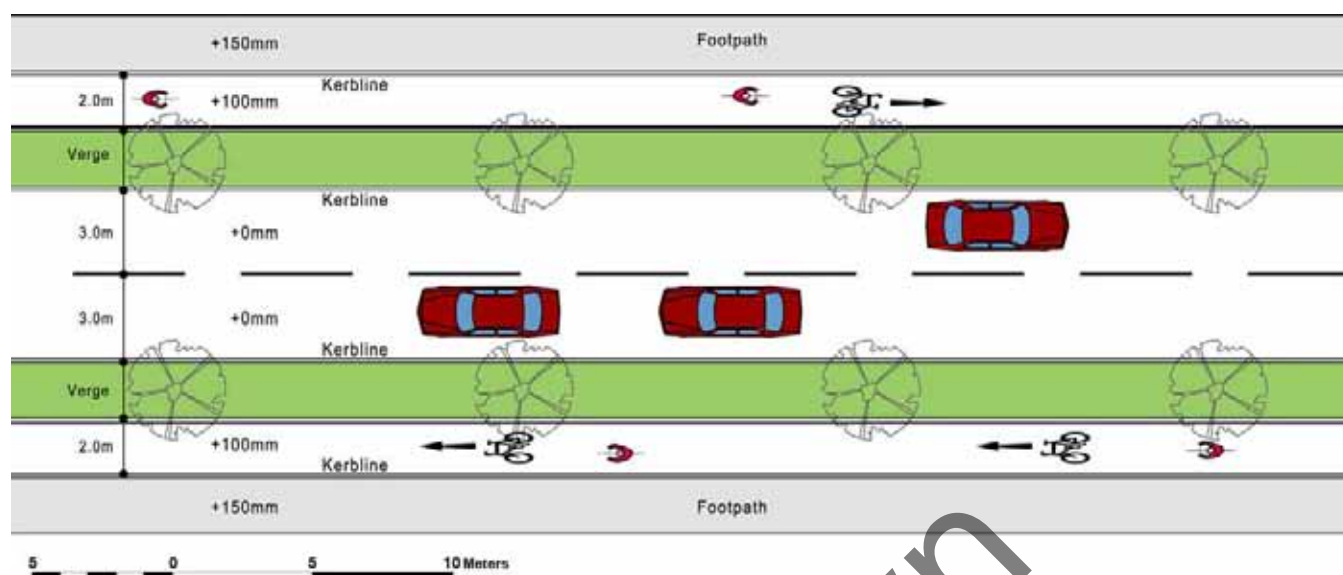
- Physical segregation by full kerb height between cyclist and motorised vehicles
- 24 hour and no parking or loading

Key Issues to be Considered

- Bollards or delineators may be used if persistent parking or loading is an issue
- Additional hard surface may require increased drainage capacity
- Cross fall away from traffic is more comfortable but requires additional drainage
- Specific attention to detail at entrances to avoid dishing the cycle track
- Outside kerb of cycle track needs to be legible to traffic and cyclists at all times, including night time
- Poles, public lighting columns, etc should be located off road, i.e. not on the cycle track



Cycle Track Behind Verge



Typical Road Environments

- Distributor and collector roads with speeds greater than 60km/h

Characteristics

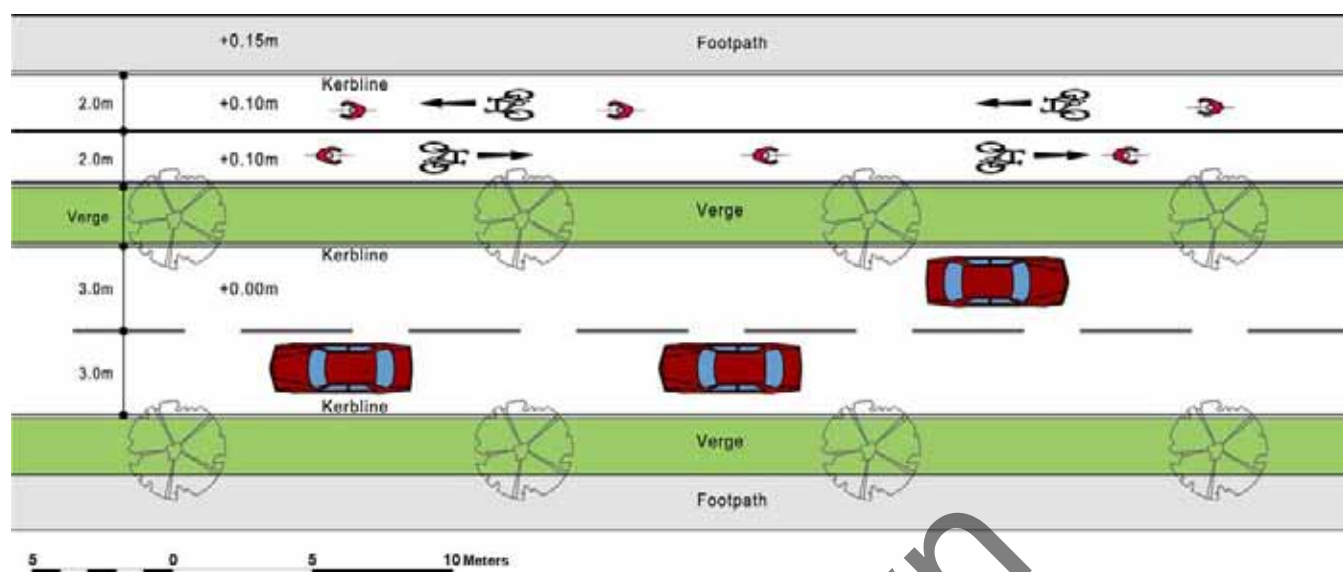
- Grass or paved verge separating cycle track from carriageway
- Trees, shrubs & street furniture can be placed within the verge

Key Issues to be Considered

- Use paved verge in vicinity of pedestrian crossing points
- Trees, street furniture, etc. should not obstruct clear passage
- Tracks should be wide enough to allow overtaking
- Tracks should be smooth, flat, well-drained and well-maintained
- Access for maintenance



Two-Way Cycle Track



Typical Road Environments

- Multi-lane district distributor and collector roads with infrequent crossing points
- Roads with significant crossing delays for cyclists
- Roads where the urban development is on one side of the road only

Characteristics

- Must be segregated by level change from carriageway and/or verge
- The contra-flow cyclist should always be on the inside and furthest from the traffic and yields priority at junctions
- The with-flow cyclist is positioned closest to the traffic. This ensures lower relative speed between cyclist and traffic (Forgiveness Principle) and facilitates transitions from cycle track to cycle lane at junctions
- Physical separation from carriageway by dividing verge

- Physical separation from footpath by verge or height difference
- Cyclists need not cross road when using two-way track
- Wider track allows more comfort and easier overtaking for cyclist

Key Issues to be Considered

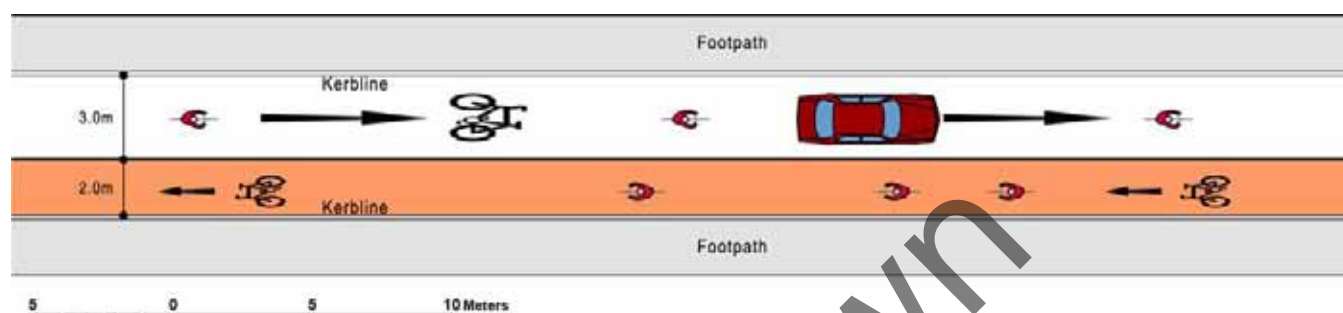
- Careful treatment required in design of junctions and crossings and their approaches
- Legibility – it should be readily apparent to all road users that track is two-way
- The positions of the cyclists need to be clearly marked
- Ensure continuity with no "gaps"
- Wider track required for two-way
- Poles, public lighting columns, etc should be located in the verge or the footpath
- Maintenance



4.3.5 Contra Flow Cycle Lanes and Tracks

The introduction of contra-flow cycle facilities within an urban one way system can significantly improve in directness and the attraction of cycling. This manual proposes contra-flow cycle lanes and tracks, depending on the volume and speed of the one way traffic.

Contra Flow Cycle Lanes



Typical Road Environments

- Access roads, quiet streets in town centres, speed 30km/h or less

Characteristics

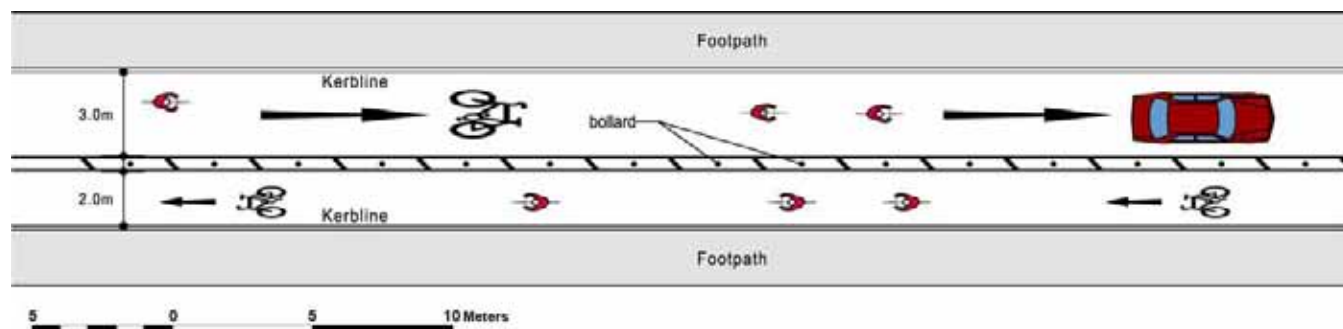
- Short streets
- Low parking and loading demand on the contra-flow side of the street
- 24 hour by nature
- Mandatory

Key Issues to be Considered

- Legibility and signage – other users can read and respect the cycle facility
- Detail design of junctions
- Ensure continuity and coherence, no gaps
- Not suitable for areas with kerbside loading and parking



Contra Flow Cycle Tracks



Typical Road Environments

- Access roads
- Low volume collector roads
- Town Centres with no direct parking or loading demand on the contra-flow side of the street

Characteristics

- Physically segregated
- Short streets
- No parking and loading demand on the contra-flow side of the street
- 24 hour by nature
- Mandatory

Key Issues to be Considered

- Legibility and signage – other users can read and respect the cycle facility
- Detail design of junctions
- Ensure continuity and coherence, no gaps
- Not suitable for areas with kerbside loading and parking
- Segregation needs to take account of pedestrian crossing demands



4.3.6 Cycle Trails

Typical Road Environments

- Access roads, quiet streets in town centres, speed 30km/h or less

Characteristics

- Short streets
- Low parking and loading demand on the contra-flow side of the street
- 24 hour by nature
- Mandatory

Key Issues to be Considered

- Legibility and signage – other users can read and respect the cycle facility
- Detail design of junctions
- Ensure continuity and coherence, no gaps
- Not suitable for areas with kerbside loading and parking



Photo courtesy Sustrans

4.3.7 Cycle Ways

Typical Road Environments

- Roads for cyclists through parks
- Off-road short cuts

Characteristics

- Few intersections with roadways
- High comfort levels due to absence of motorised traffic
- Crossings rather than junctions
- Combined utilitarian and leisure uses

Key Issues to be Considered

- Need for compliance with Section 68 of Roads Act, 1993
- Need for good visibility and lighting
- Where frequent use by pedestrians is likely, consider raised adjacent footpath and/or reducing speed differential through cycle calming
- Consistent quality with dedicated cycle signposting
- Crossing points and intersections



4.4 JUNCTION INTRODUCTION

This section discusses junction design from a cyclist's perspective. It explains how cycling can be best accommodated in different circumstances, and how the proper design of a junction can greatly increase safety for cyclists. It also sets out cycling features that are common to many junctions and explains why they are necessary.

4.4.1 Cycling Principles at Junctions

Junctions are critical components of cycling networks, and cycle-friendly junctions facilitate the safe and efficient passage of all modes of transport.

In urban areas, the majority of cycling accidents occur at or close to junctions. This is primarily due to the inherently complex nature of mixed mode movements at junctions. Better consideration and application of the Principles of Sustainable Safety should result in improved safety and efficiency at junctions.

The section highlights the particular challenges that junctions present to cyclists, and identifies ways in which designers can cater for cyclists.



Consider all road users

4.4.1.1 Critical Cycling Issues at Junctions

Merging and splitting

Merging and splitting facilities that are located close to junctions increase the junction's complexity. They can generate turbulence within the traffic system, and may increase the risk of accidents. While merges and splits are standard design on primary distributor networks, they should generally be avoided in urban areas intended for bicycles.

Side Swipe

Side swipe can occur with weaving vehicular traffic. Examples include left hand slip lanes, multi-lane one-way systems, merges and splitting, as well as dual entry and dual circulating roundabouts, and can also include poorly designed bus stops and loading facilities.

At low speed, side swipe can result in oblique collisions, generally involving material damage only to the vehicles. However, side swipe may be far more consequential if cyclists are involved in weaving traffic.

Inherently, the appropriate or expected cycle position may not be clear to cyclists or to drivers, resulting in unpredictable, illegible and potentially hazardous situations.

Eye Contact

Eye contact between cyclists and drivers is essential for the safety of cyclists at junctions. Proper eye contact between cyclists and drivers allows them to communicate their intentions to each other.

Junction layout that preclude or reduce the opportunities for proper eye contact should be avoided. The most common failure is at two-lane entry from side road or roundabouts where the desired line of sight is inevitably obstructed by the vehicle in the outer emerging lane. Equally, at oblique or Y-junctions, the oblique angle will make it very difficult for drivers to see the approaching cyclist.



Cyclists vulnerable to side swipe

4.4.1.2 Principles of Sustainable Safety

One of the biggest challenges facing road designers is ensuring the safety of road users at junctions. The section deals with the Principles of Sustainable Safety as they relate to junctions, and highlights the issues that must be considered in providing for cyclists.

Functionality

Properly designed junctions cater for all road user movements and are fit for purpose. Accidents will occur at junctions where normal movements are not catered for.

At the design stage of junctions, each approach and exit must be assessed for each mode using the 6-way check, see *Section 7.5*. If particular movements cannot be incorporated, (e.g. a particular right hand turn, etc.) they should be specifically precluded and an alternative provided, but only as a last resort.

Homogeneity

Low traffic speeds through junctions will allow more time to react. Within urban areas, where pedestrian crossings are commonplace, traffic speeds should ideally be limited to 30km/h. At mixed mode junctions, including cyclists typically travelling between 15 and 20km/h, traffic speed should be no more than 40 to 50km/h.

Narrow traffic lanes passively reduce traffic speed. Traffic lane widths in urban areas should not exceed the widths specified in the *Traffic Management Guidelines*, and this manual recommends that through traffic lane widths should not generally exceed 3.0m in any case.

Legibility

A legible junction is one where road users can understand the layout, and understand what is expected of them and other road users. In legible junctions, it is obvious where other road users should be positioned within the junction. Sharp or unexpected changes in direction or speed may be indications of poor junction legibility.

If junctions are clearly defined and legible, potential conflicts will be obvious and predictable. It is important that designers incorporate junction controls (yield priority, signal control, gap acceptance etc) that are clear, universally understood and manageable by all road users.

Forgivingness

A forgiving environment is one where the outcome of any unforeseen circumstance or road user error is mitigated to the greatest extent. The focus on delivering forgiving environments must be on pedestrians, cyclists and other vulnerable road users who are most at risk of injury in the event of an accident.

The number of potential conflicts should be minimised by:

- Reducing the number of approaches and simplifying junction layouts, and/or
- Reducing the amount of time (or crossing distance) that the vulnerable user is exposed to conflict

Relative speed differentials between different road users should be reduced by:

- Reducing vehicular approach speed, and/or
- Ensuring that junction entrance and exit lanes are properly aligned

The severity and number of accidents can be reduced by:

- Providing evasion space for cyclists
- Removing guardrails and other entrapment risks, as recommended in the *Traffic Management Guidelines, 2003*



4.4.1.3 Understanding Bicycle Operation at Junctions

In order to provide cycle-friendly junctions, designers should fully understand the preferences, needs and expectations of cyclists.

Loss of Momentum

The physical nature of cycling is such that cyclists try to maintain their momentum wherever possible (to reduce physical effort).

Where cyclists are travelling straight ahead, they expect to have main road priority. Frequently this priority is compromised by traffic turning left. In this manual, various approaches to managing the left turn conflict have been set out, with the intention of maintaining cycling momentum and priority wherever possible.

One key advantage of cycling (over private cars) is the ability to continue past queuing traffic to the top of junctions. Failure to provide space to do so will render the junction cycling un-friendly, with cyclists prone to the same congestion as general traffic.

Loss of Stability

Kerb side pedestrian guardrails and poles can catch the handlebars of bicycles. At junctions in particular, cyclists are likely to 'wobble' more due to stopping, slowing down and starting up. Consistent with previous advice in the *Traffic Management Guidelines*, guardrails are not recommended at junctions. Furthermore, the width of cycle lanes at junctions should be increased by 0.5m where possible.

Impact of Delay

Bicycle trips are generally short (e.g. 6km/20 minutes or less). Any time spent waiting at junctions will represent a higher proportion of the overall trip time compared to that for vehicular traffic. This will act as a deterrent to cyclists. Such delay can occur where signalised junctions are set up to maximise vehicular capacity and minimise vehicular delay.

Delay in poor weather is much less acceptable to cyclists than to drivers of vehicles.

The importance of shorter signal cycle times cannot be emphasised enough in relation to cycling (and walking).

Cycling Skill Level

As many cycling accidents occur at junctions, care must be taken by designers to ensure they are safe for use by those normally capable of independent travel, e.g. those between 8 and 80 years of age. Cycling should be open to a broad range of people, including those who are more risk-averse, and those who like to travel in company.

Designers should consider adopting the 8 to 80 approach detailed at <http://www.8-80cities.org>



4.4.1.4 Meeting the Cyclist's Need

The *Five Needs of the Cyclists* are discussed in *Section 1 The Basics* of this manual. At junctions, there are particular specific needs under the five different headings.

Road Safety

Junctions are potentially the most dangerous parts of the cycling journey. By applying the Principles of Sustainable Safety to their design and management, junctions can be made safer and the potential for collisions will be reduced.

It is important that junctions have good surfaces so that cyclist can look ahead and around to observe traffic instead of having to look down to avoid potholes etc.

Coherence

Quality of Service should also be continuous. Cycle facilities should continue through junctions and be clearly evident to all road users. Cycle signage should be clear and logical at the approaches and exits from junctions.

Directness

Direct, obvious and short connections through junctions are essential so as not to cause any delay.

In the past, solutions that required cyclists to deviate from the main route sometimes involved tight radius bends, multiple ramps, mixing with pedestrians and negotiating between pedestrian guardrails. Such facilities are often a waste of resource, as cyclists frequently take the more direct route and mix with traffic.

Comfort

Cyclists always appreciate adequate stacking space at junctions as it allows them to wait comfortably without losing balance. Stop times for cyclists should be minimised so as to reduce exposure to inclement weather.

Cyclists who are familiar with particular junctions will also appreciate good sightlines on the approach to traffic signals. This allows them to gauge their speed to arrive at a green signal and minimise any loss of momentum.



Poor width and no ASL
(Advance Stacking Location)

4.4.1.5 Junction Capacity and Cycling

Traditional urban junctions, designed primarily for vehicular movements, may have tended to subordinate the role of cycling and walking. Indeed, the practice of traffic signal staging has developed on the basis of dealing with vehicular traffic volumes first, and attending to pedestrian crossing movements at the end of the process.

A new approach to junction layout and signal staging is required, to reflect the changing priorities in traffic policy. To achieve high Quality of Service for cyclists, junctions should be able to cater for the projected cycling volumes and all bicycle turning movements, as well as minimise cyclists' delay as much as possible.

Cycle route design is likely to require a fundamental re-appraisal of existing junctions. It is likely that vehicular volumes, particularly in urban areas, will have to be reduced in order to cater more appropriately for cyclists and pedestrians.

The *Traffic Management Guidelines, DTO 2003, Section 8.3* are of particular interest in this respect.

Cyclists and Pedestrians:

The needs of cyclists and pedestrians should be considered as a fundamental part of the design process rather than as an afterthought once vehicular traffic has been catered for.

Capacity:

At congested locations extra capacity should not be provided to the detriment of road safety or facilities for vulnerable road users.



Left traffic lane too long – cyclists over exposed to weaving traffic

4.4.2 ASLs - Advance Stacking Locations

ASLs are used at signalised junctions to facilitate stacking of higher volumes of straight ahead cycle movements, and also to accommodate right-turning cycle movements. They permit cyclists to stop and wait in a forward position, ahead of stopped vehicular traffic.

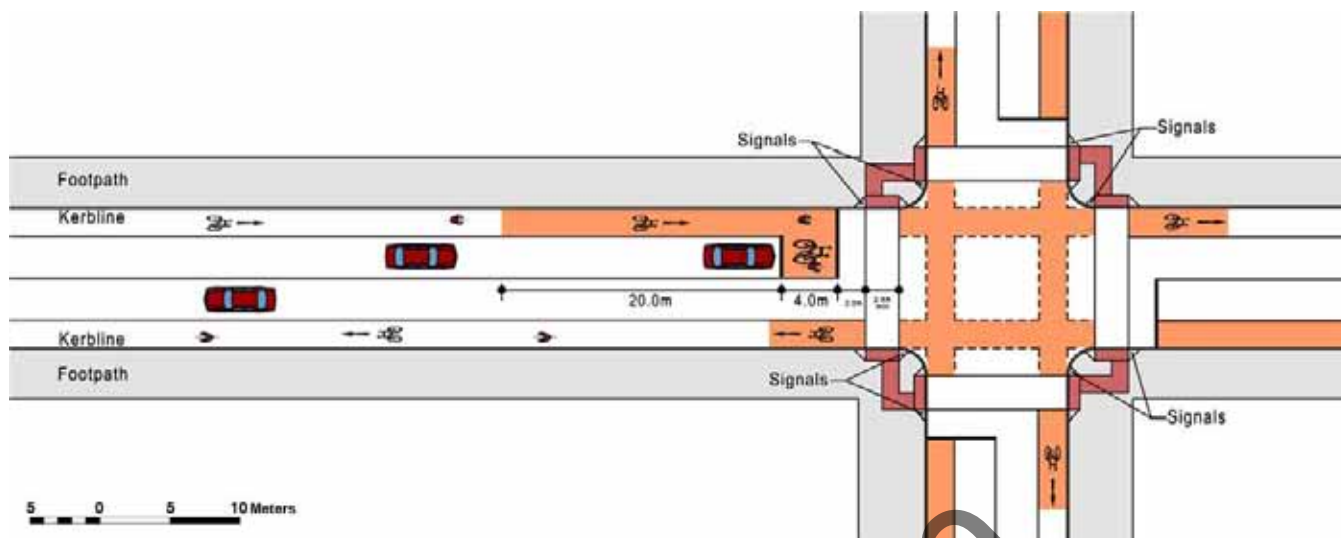
ASLs allow cyclists to commence the straight ahead or right turning movement before the other traffic. Their prominent location and coloured surface increases driver awareness of the presence of cyclists.

ASLs should follow specific design rules as follows:

- They should be 4-5 metres in length to allow enough space for cyclists to manoeuvre into the correct position
- They should have a coloured surface for legibility
- ASLs have a stacking purpose when traffic at a junction is stationary
- If ASLs are intended to assist right-hand turning cyclists, they should only be deployed at junctions where it is safe for cyclists to weave to the right through traffic
- In heavier or faster traffic, use the Box Turn (Left-To-Go-Right), see Section 4.6.3, solution instead of ASLs
- ASLs must always be “fed” by a cycle lane to ensure that cyclists can pass stationary traffic and get to them. If no feeder cycle lane can be provided, do not introduce an ASL on its own, as this will only frustrate cyclists and encourage them to mount the footpath etc. to access the ASL
- Each traffic lane should have its own ASL as in many instances, traffic lane movements are separately signalised. In cases where two traffic lanes have separate cycle lanes, it may be appropriate to provide an ASL at the head of each lane. In the second example below, the kerbside lane provides for straight ahead movements, and the outer lane caters for right turning cyclists. Note that the ASLs are not joined together
- ASLs must never face opposing traffic, unless they are separately signalised – this is because cyclists are inconspicuous and vulnerable when opposing tight turning traffic turn at the same time. A better solution is the Box Turn (Left-To-Go-Right)
- Never provide an ASL on a traffic lane with significant HGVs, as truck driver may not be able to see the bicycle in front of the cab. In such cases, consider Set Back Stop Lines, signalised cycle tracks and box turns



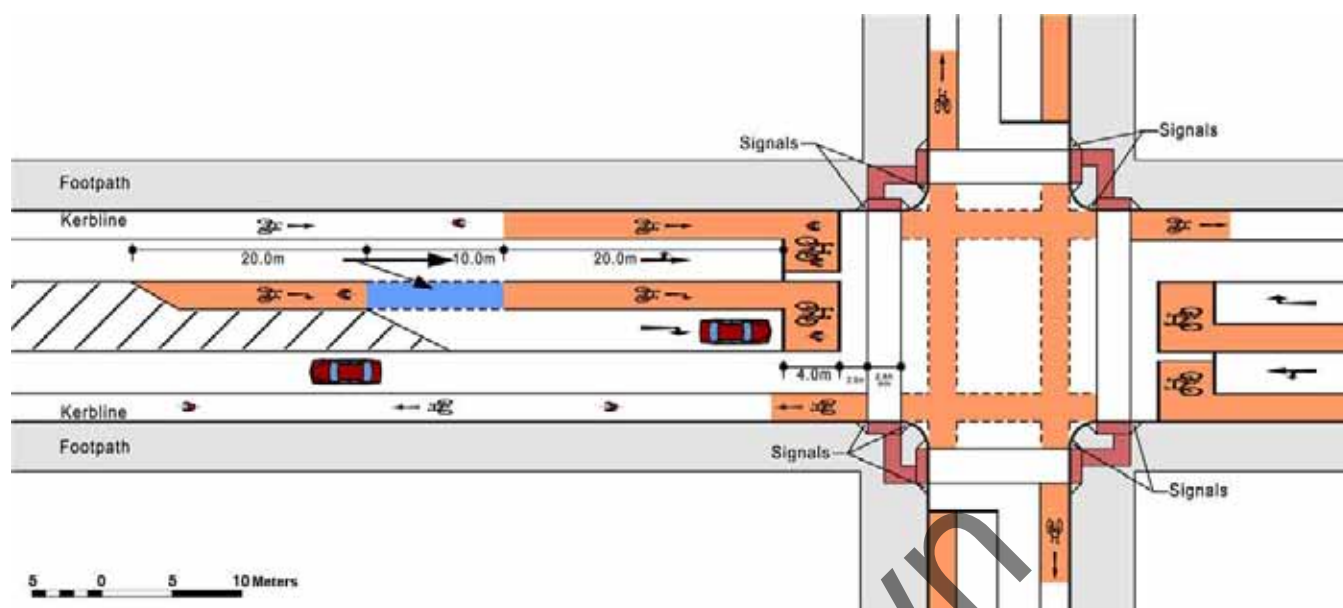
Advance Stacking Location: Single Lane



- ASL fed by mandatory cycle lane - do not provide ASL if not fed by cycle lane
- Arrangement suitable for local junctions only, as cyclists are expected to position themselves between opposing traffic flows awaiting gaps in oncoming traffic
- For high demand for cyclists turning right, consider early start for cyclists / traffic on ASL approach
- If there is persistent encroachment of traffic into ASL, consider shifting primary traffic signal closer to traffic stop line at rear of ASL – however, additional small cycle aspect primary signals will be required for cyclists waiting in ASL, probably mounted off pedestrian crossing signal pole
- Consider ASL for all single leg approaches (only one shown)
- Consider box turn facility in addition to ASL, for more cautious cyclists



Advance Stacking Location: Double Lane



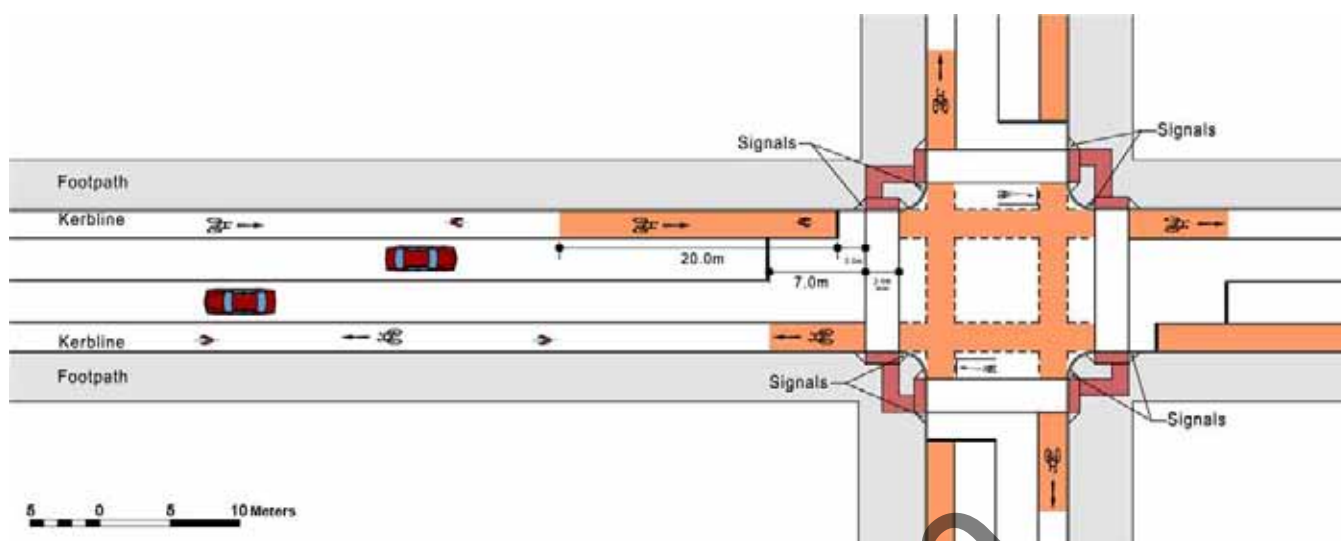
Principle of design

Right turning cyclists can weave across a single traffic lane to a feeder cycle lane before traffic starts to split into separate traffic streams.

- Not suitable where cyclists must weave across two lanes (e.g. bus lane and traffic lane) to enter RH cycle lane / ASL
- If there is no cycle feeder lane to right hand ASL, do not put in ASL – install box turn facility only
- Requires RH ASL / traffic stream to be separately signalised (e.g. kerbed from straight ahead traffic or gantry mounted signals, for separate signal staging)
- Consider box turn facility in addition to Right Turn ASL, for more cautious cyclists
- Keep right hand pocket short (max 30m) to reduce likelihood of cyclists being between two lanes of moving traffic



Set Back Vehicular Stop Line



Principle of design

At tight junctions, larger vehicles may need to track well into the junction to turn left, and a set back vehicular stop line may be necessary.

- No ASL provided, so that cyclists are not stacked where vehicles need to track
- Box turns should be provided instead
- Mandatory cycle lane is sufficient for local junctions, where there are low speed tracking turns
- Where there are HGVs, cycle track should be segregated up to the stop line, and separately signalised. See 4.5.5 *Left Turning Large Vehicles: Functionality*



4.4.3 Weaving Cyclists

Weaving is a mechanism by which cyclists wishing to turn right will move across traffic while approaching a junction so as to get into the correct road position or lane.

Mixed Traffic

In mixed traffic, cyclists should be in a central position within the traffic lane already, and a simple hand signal coupled with a gap in the oncoming traffic will facilitate the right turn.

Cycle Lanes

Where cycle lanes are provided, the cyclist must signal with one hand, look over the shoulder for gaps in the traffic, move to the centre of the general traffic lane or to the dedicated cycle lane, wait for a gap in the oncoming traffic and complete the turn.

Balance

Weaving involves a combination of actions which can all affect balance. Good quality road surfaces are essential to allow cyclists to focus their attention on other road users. Lighting is important for cyclists to give them greater confidence that they themselves are visible. Predictable traffic behaviour will greatly assist cyclists preparing to weave.

Speed

Motorists are familiar with weaving at on and off ramps and on dual carriageways, and are keenly aware of the importance merging at a similar speed to the main traffic flow in order to merge smoothly and avoid collision.

For the same reason, cyclists should weave only in a low vehicular speed environment. As cyclists generally travel at around 20km/h, the actual speed of traffic should not exceed 35km/h.

Multi Lane Roads

Multi lane roads are higher speed environments by their nature and cyclist weaving is not appropriate. In multi lane roads, there is a risk of side swipe (see earlier). The higher speed differential and added complexity of looking for two or more simultaneous gaps presents too high a risk for cyclists. For this reason, cyclists wishing to turn right should be accommodated using Box Turns (Left-To-Go-Right), *Section 4.6.3 solutions or Crossings, Section 4.7.*



4.4.4 Junction Approaches

A well designed approach will ensure that the junction is legible and predictable for all road users. Cyclists must be considered at the outset of the design process and fully integrated within the overall junction solution.

This section discusses some of the key design issues that should be considered at junction approaches.

Flares

The introduction of flares and merging either side of a junction generally represents an attempt to increase vehicular capacity. However this may impair legibility and the provision for cyclists. It is frequently impossible to properly align entry and exit lanes, particularly where two entry lanes become a single lane on the far side of the junction.

Flares tend to result in faster, less predictable and less legible junctions, with sub-standard provision for cyclists and pedestrians. The second lane or flare introduces vehicular weaving and may increase vehicular speed.

For the above reasons, flares are not recommended for cycling environments. If junctions need to accommodate occasional larger vehicles, consider using roll-over areas instead of widening the entire junction.

Extra Cycle Lane Width at Junctions

The standard minimum width for a cycle lane is 1.75m in any case. This manual recommends that cycle lanes should widen by up to 0.5m for the last 20-30m approaching junctions when appropriate.

The additional width will allow for:

- wobbling at slow cycle speeds (< 12km/h), stopping and starting up
- space for stacking cyclists
- passing another waiting cyclist

Streaming

Streaming lanes are cycle lanes located between a through traffic lane and a turning pocket (e.g. a cycle lane located between a left turn pocket and a straight ahead / right turn traffic lane).

The streaming cycle lane should be 2.0m wide to take account of moving traffic on both sides of the cyclist.

In such arrangements, the straight ahead cycle movement takes priority, and the left turning vehicular traffic must be required to cross left over the cycle lane.

The following points should be noted:

- Streaming cycle lanes can only be used in low traffic speed environments where there is minimal speed differential between cyclists and adjacent traffic
- Streaming is not suitable along HGV routes
- The permitted weaving area for traffic to cross the cycle lane must be clearly indicated and limited to no more than 10.0m long so as to reduce vehicular speed, and profiled line markings should be considered for the solid white line beyond the weaving area
- Streaming cycle lanes should only be used beside right or left hand pockets (i.e. distinct lanes dedicated to turning movements) and should not exceed 30.0m in length
- Cycle lanes should be clearly visible in all conditions, including night time and poor weather

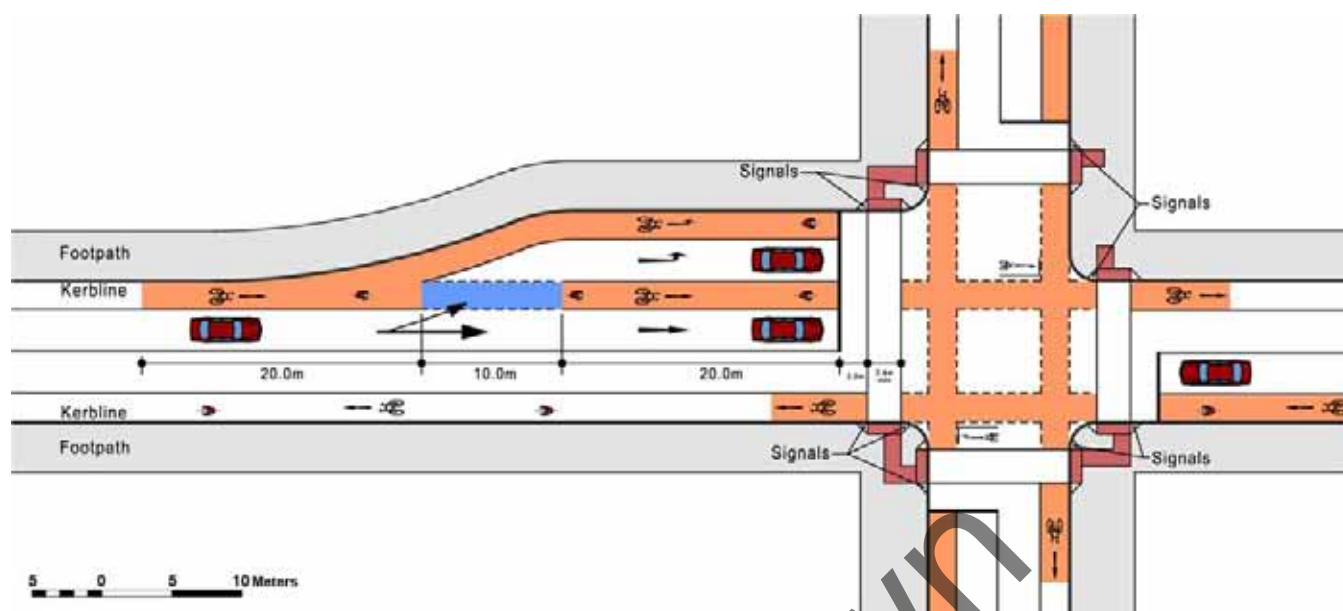


Cyclists need more space at junctions



Good layout, but guardrails not recommended

Streaming Cyclists



- Put in left hand traffic pocket only if required (e.g. to run as a separately staged traffic movement, facilitate pedestrian crossing of side road, etc.)
- No ASLs - include box turns for right hand turning cyclists, as left hand pockets will (should) feature only at significant traffic junctions
- Keep signal cycle time short
- Limit pocket length to dimensions shown – otherwise cyclists in central cycle lane are overexposed between two lanes of moving traffic, and there is increased potential for faster traffic weaves into the left hand pocket
- Use reverse curves on footpath kerbs, reflecting more closely traffic movements, and improving drainage and litter management



Kerb-side Hatching

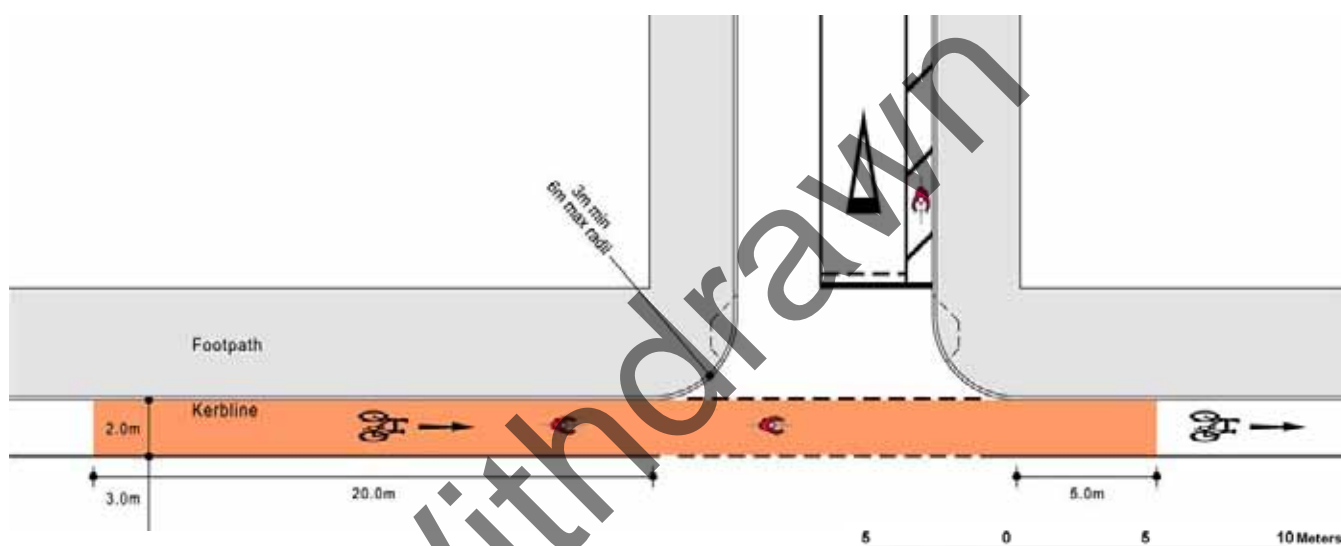
Where there is insufficient room for a cycle lane, kerb-side hatching can be used in low speed and low volume mixed street environments. The purpose of the hatching is to keep traffic away from the kerb and provide cyclists with some limited passage to a junction when traffic is stationary.

Cycle logos in the traffic lane should always accompany kerbside hatching.

As kerb-side hatching is narrower than cycle lanes, cyclists should “take the traffic lane” once traffic starts moving, as the clearance between the traffic and the kerb is not sufficient.

Kerb-side hatching should never be longer than 30.0m so that cyclists can travel the full length during the red signal phase.

Side Roads: Kerb-side Hatching



- Hatching prevents traffic from loading or parking near the junction, or from doubling up close to the junction
- Provides some opportunity for cyclists to push past traffic to the junction
- Only provide where there is insufficient room for a cycle lane



4.5 LEFT TURNS

This section deals with one of the principal cycling hazards – the conflict between cyclists travelling straight ahead on the main road and traffic cutting across them to turn left.

For left turns from a side road onto a main road, see *Section 4.9 Side Roads*.

4.5.1 Re-Establishing Cyclist Position On-Road

This manual recommends that cycle facilities are re-established as on-road cycle lanes for the last 20 to 30m in advance of a significant left turn. The re-establishment zone provides time for vehicles and cyclists to observe each other and accommodate each other's movements at the conflict point. This is as much to do with ensuring the safety of straight ahead cyclists as left turning cyclists.

Depending on the nature of the cycle facility along the main carriageway, a Vertical Transition will be required in the case of a cycle track to bring the facility to the main carriageway level. Equally, a Horizontal Transition, shifting cyclists to the right, may be required for an off-road cycle track or if there is kerbside parking or loading facilities in advance of a dedicated left lane or pocket.

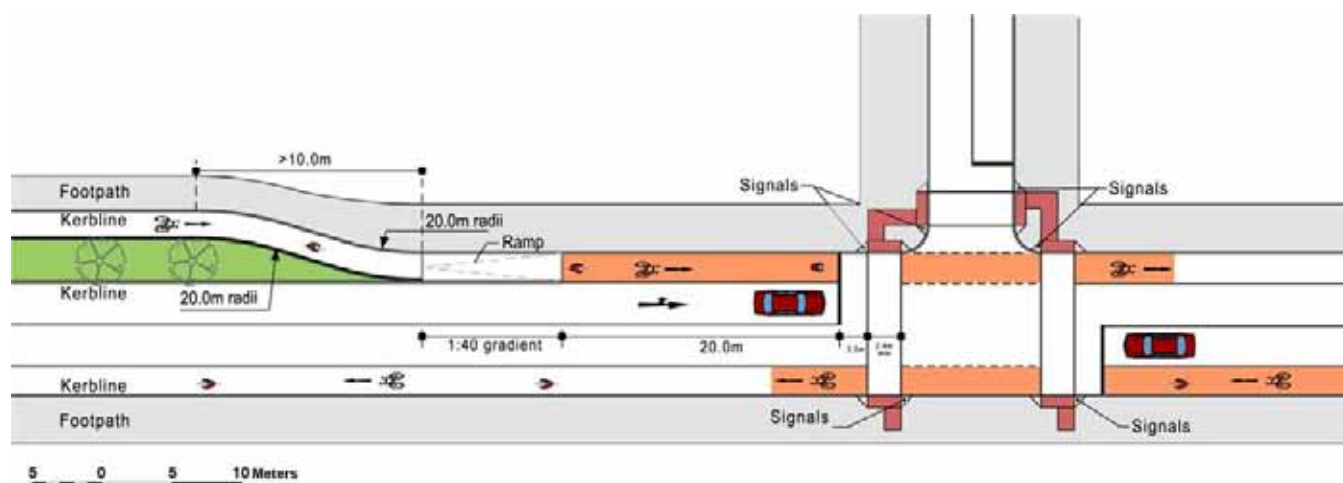
The re-established cycle-lane must be continuous, clearly marked and legible so that vehicles weaving left across it know they must yield to cyclists who may be continuing straight ahead.

Re-establishment requires that sufficient length is available and that the traffic environment is safe for cyclists, particularly in the case of Collector and Distributor roads.

Where the traffic environment precludes the use of a cycle lane, re-establishment can be achieved by means of a raised or similarly segregated cycle track.



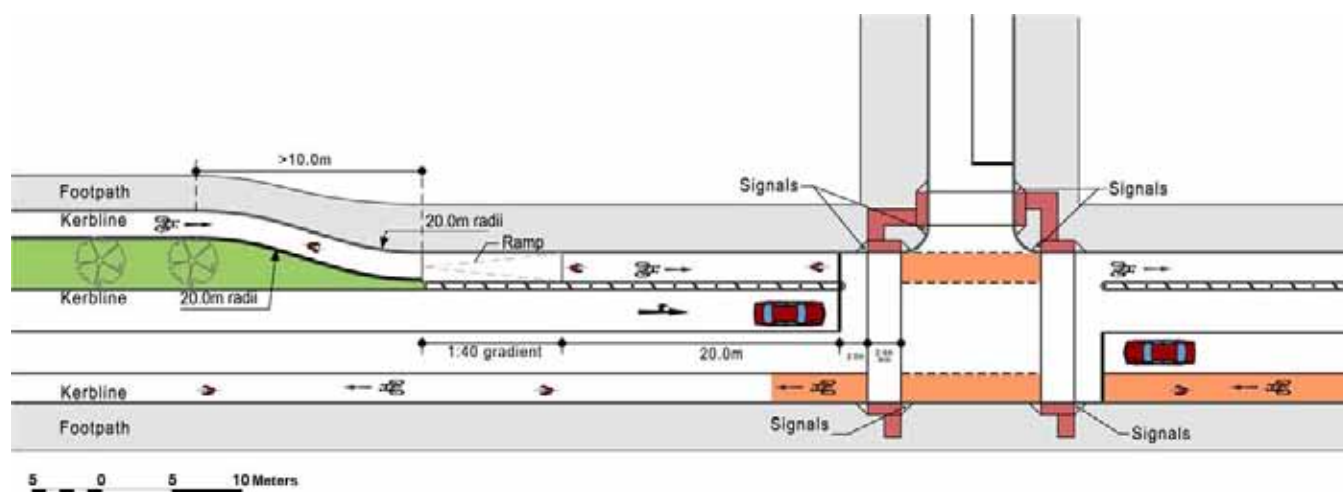
Re-Establishing from Off-Road Cycle Track to Cycle Lane



- Off road cyclists are re-established on the road well in advance of a junction
- Cyclists aligned so that they do not pop out in front of vehicles
- Transition curve radii allows cyclists to maintain speed
- Mandatory cycle lane, to prevent traffic encroachment
- Maximum on road exposure of cyclists = 30m in advance of junction
- Consider ASL (and / or box turn) to assist right hand turning cyclists (not shown)



Re-Establishing from Off-Road Cycle Track to Segregated Cycle Track



- Used in vicinity of HGVs turning left
- Design re-establishes off road cyclists back on road in advance of junction
- Cyclists aligned so that they do not mix with vehicles
- Transition curve radii allows cyclists to maintain speed
- Segregated at grade cycle lane, to preclude traffic encroachment
- Design may require separate cycle signal stage (e.g. where turning HGVs are present), although not generally required
- Box turn required to assist right hand turning cyclists (not shown)

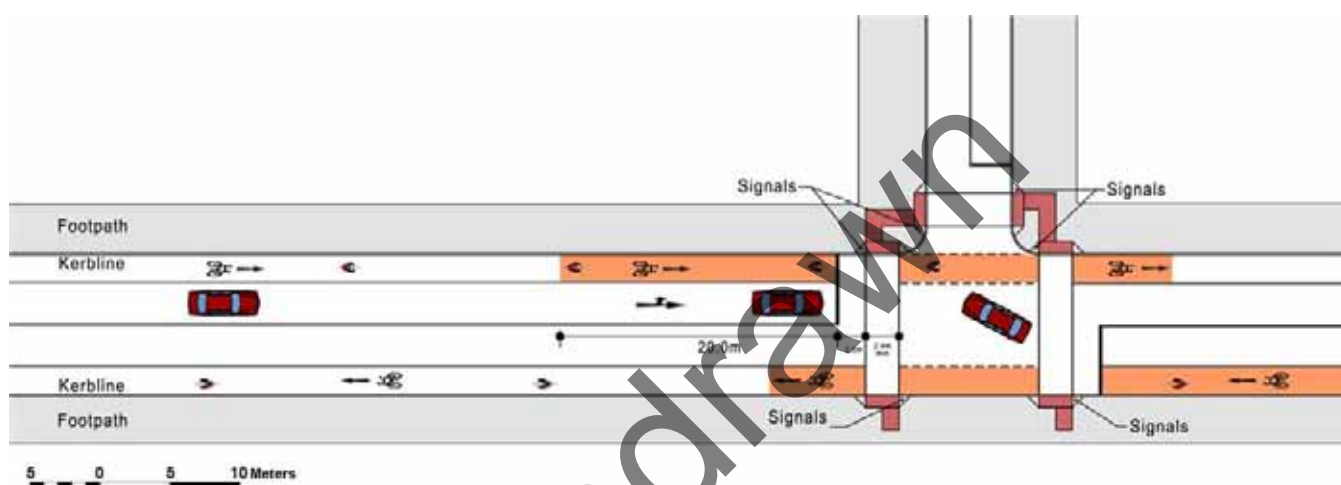


4.5.2 Designing for Opposing Traffic Turning Right

Cyclists passing on the inside of a traffic queue can frequently find themselves in conflict with right turning traffic coming from the opposing direction to turn into a side road.

This manual recommends that the cycle lane approaching the junction should be a minimum of 2.0m wide and that the cycle lane is continued through the junction and clearly marked. This will raise driver awareness of the potential for cyclists, improve the visibility of approaching cyclists and maximise the cyclist's lateral evasion space in the event of a conflict.

Cyclists and Opposing Right Turning Traffic



- Wide (1.75 to 2.0m) red coloured cycle lanes provide additional legibility to all traffic (vehicles, cyclists) in congested junctions
- Wide cycle lanes provide some evasion space in circumstances of opposing traffic movements



4.5.3 Left-hand Pockets and Dedicated Left-turning Lanes

On busier roads with higher vehicular capacity, multiple and/or dedicated lanes may be required for different movements.

This section looks at left-hand pockets (30.0m or less) and dedicated left-turning lanes (greater than 30.0m) in conjunction with the straight ahead movement. Dedicated right-turning lanes are dealt with in Right Turns, *Section 4.6*.

Where a single traffic lane with a kerbside cycle lane approaches a left turn, the straight ahead cycle lane should be continuous through the junction. Left turning motorists are expected to yield to any straight ahead cyclists before turning left.

For left pockets and lanes, it is important that cyclists going straight ahead are re-established in their own intended alignment before introducing the turning pocket. Traffic can then turn into the left hand pocket across the cycle lane.

Streaming of cyclists between the left turning and straight ahead traffic lanes is not recommended for distances greater than 30.0m. Where the left turning traffic longer than this is required, the cyclist should be brought to the junction on a kerbside cycle track. The junction should be signalised and cyclists provided with their own stage.

Bus Lanes and Left-hand Pockets and Dedicated Left-turning Lanes

Where a bus lane exists, with a shared or adjacent cycle lane, there is a need to safeguard priority for both buses and cyclists travelling straight through the junction.

The layout in *Left Hand Pocket and Bus Lanes* provides for cyclists and buses to continue straight ahead in a shared lane, but traffic moving from the general traffic lane must cross the bus/cycle lane to access the left-turn pocket.

Shifting the Cyclist Right

Where a dedicated left-turn lane is to be provided or where there is kerbside parking or loading in advance of the junction, the challenge is to shift cyclists (who are going straight ahead) to the right of the left-turning traffic, without being hit by traffic from behind.

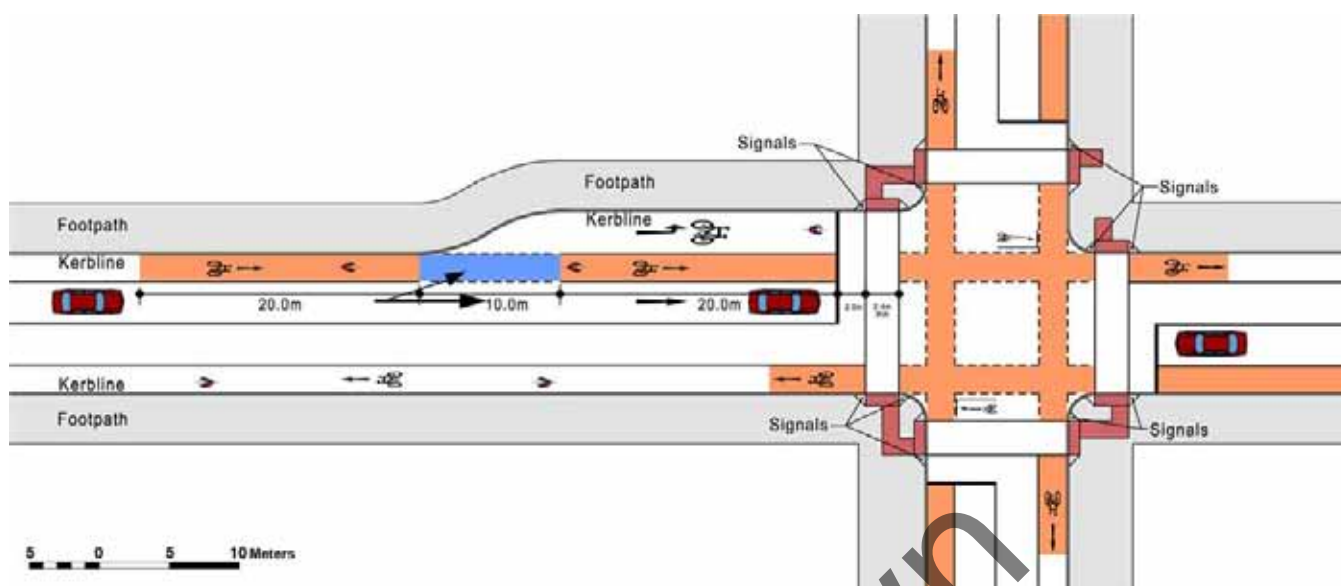
Cyclists should be shifted to the right only under the protection of a physical island. The left turn pocket can be introduced downstream of the island. The geometry of the entrance to the left turn pocket should require "turning" rather than "veering" in order to ensure slow vehicular speed.



For long left hand lanes, consider segregated cycle track with signalisation



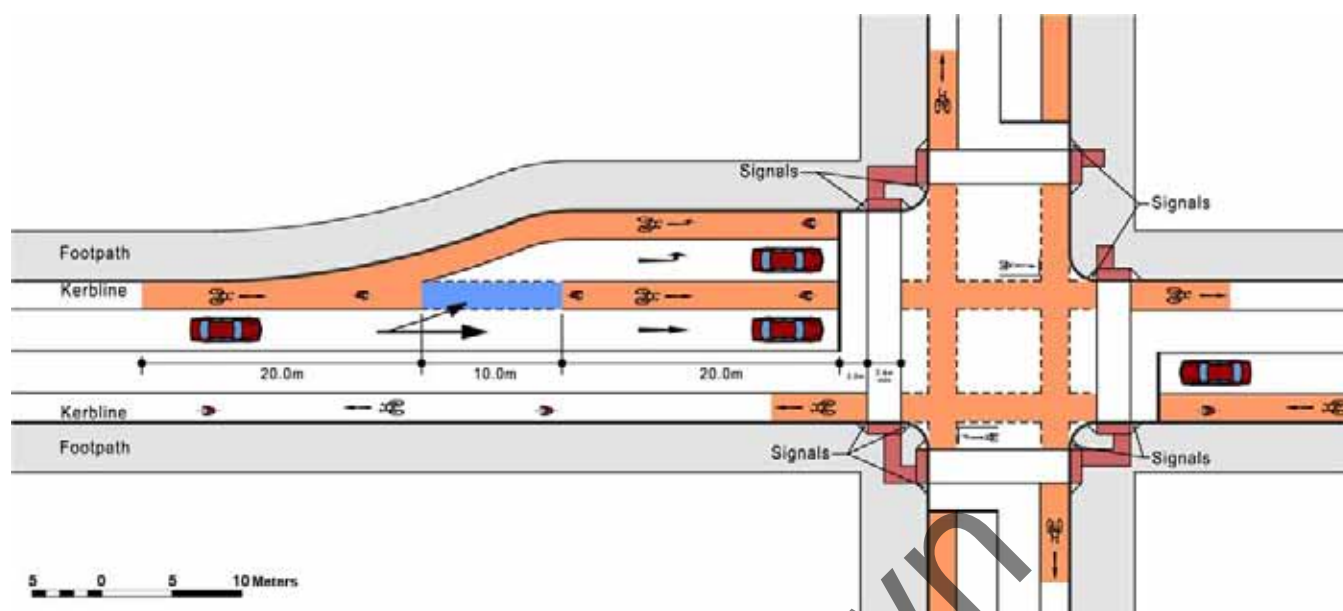
Left Hand Pocket



- Put in left hand traffic pocket only if required (e.g. to run as a separately staged traffic movement, facilitate pedestrian crossing of side road, etc.)
- No ASLs - include box turns for right hand turning cyclists as left hand pockets will (should) feature only at significant traffic junctions
- Keep signal cycle time short
- Limit pocket length to dimensions shown – otherwise cyclists in central cycle lane are overexposed between two lanes of moving traffic, and there is increased potential for faster traffic weaves into the left hand pocket
- Left hand pocket has no cycle lane – ensure pocket lane is suitable for cycling mixed with traffic, by keeping pocket length short, lane width tight (3m plus whatever needed for vehicle tracking)
- Not suitable where HGVs use left hand pocket
- Use reverse curves on footpath kerbs, reflecting more closely traffic movements, and improving drainage and litter management



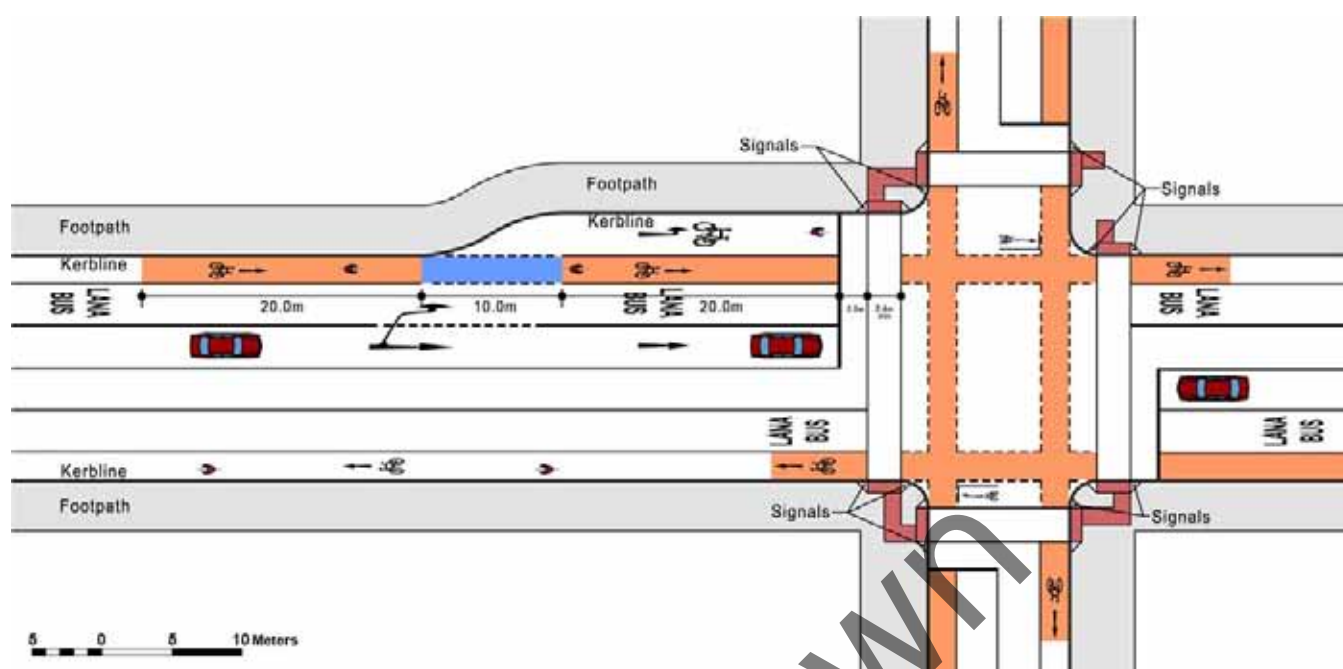
Left Hand Pocket with Left Turning Cycle Lane



- Put in left hand traffic pocket only if required (e.g. to run as a separately staged traffic movement, facilitate pedestrian crossing of side road, etc.)
- No ASLs - include box turns for right hand turning cyclists, as left hand pockets will (should) feature only at significant traffic junctions
- Keep signal cycle time short
- Limit pocket length to dimensions shown – otherwise cyclists in central cycle lane are overexposed between two lanes of moving traffic, and there is increased potential for faster traffic weaves into the left hand pocket
- Use reverse curves on footpath kerbs, reflecting more closely traffic movements, and improving drainage and litter management



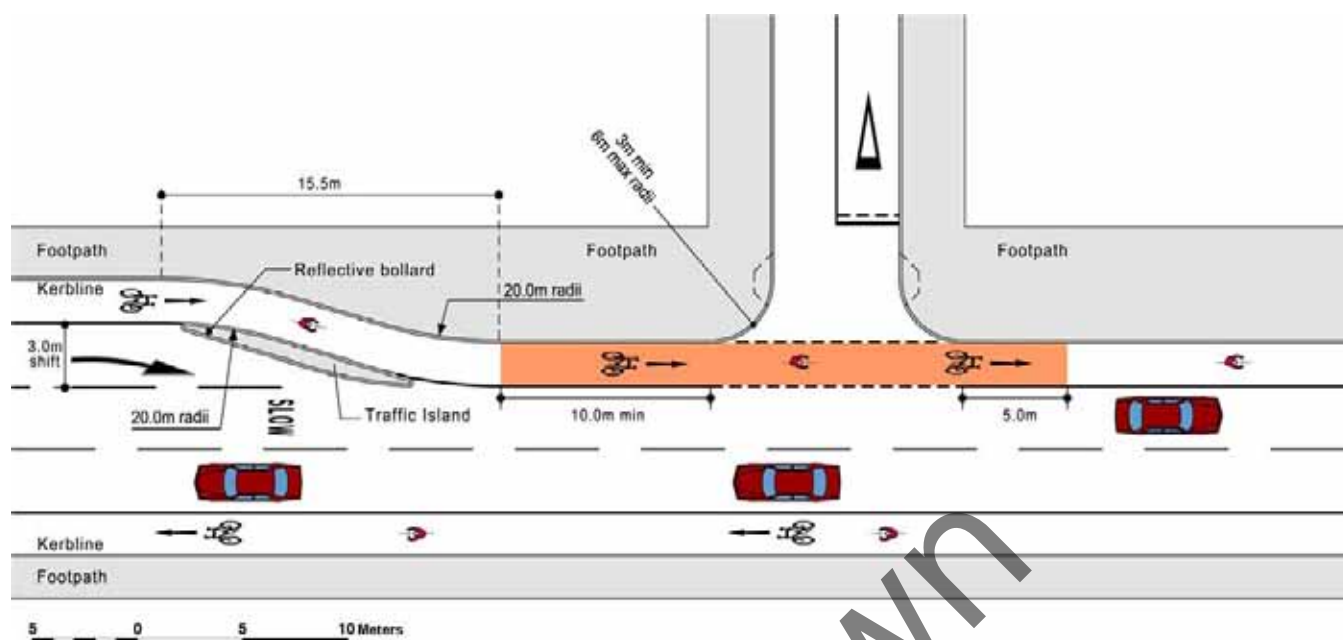
Left Hand Pocket and Bus Lanes



- Bus lane and cycle lane brought to stop line
- Left turn vehicles required to cross bus lane and cycle lane to enter left hand pocket
- Put in left hand traffic pocket only if required (e.g. to run as a separately staged traffic movement, facilitate pedestrian crossing of side road, etc.)
- No ASLs - include box turns for right hand turning cyclists, as left hand pockets will (should) feature only at significant traffic junctions
- Keep signal cycle time short
- Limit pocket length to dimensions shown – otherwise there is increased potential for faster traffic weaves into the left hand pocket
- Use reverse curves on footpath kerbs, reflecting more closely traffic movements, and improving drainage and litter management



Shifting Cyclists to the Right



- Used to re-establish off road cyclists back on road in advance of minor junction
- Cyclists aligned so that they do not pop out in front of vehicles
- Transition curve radii maintain cyclists speed
- Mandatory cycle lane, to prevent traffic encroachment
- Maximum on road exposure of cyclists = 30m in advance of junction
- Keep footpath build out clear, to improve legibility



4.5.4 Late Release Left Hand Turns

Subject to Department Approval – Refer to Traffic Signs Manual

There can be a conflict between pedestrians crossing side roads and significant volumes of left turning traffic. In some urban situations, the solution has been to simply omit the pedestrian crossing.

This manual proposes a solution as follows, subject to Department approval, whereby the pedestrian facility can be provided. This will not be suitable where large vehicles (trucks / buses) are turning left.

Late Release Signalisation

Stage 1 Pedestrian Crossing Stage

Side Road: Green man

Main road: Red left turn traffic filter and green straight-ahead filter

Stage 2 Early Transition Stage

Side Road: Green man so those crossing may continue to do so

Main road: Flashing amber filter for left turning traffic commences and green straight-ahead filter

Stage 3 Transition Stage

Side Road: Amber man

Main Road: Flashing amber for left turning traffic and green straight-ahead filter

Stage 4 Left Turning Traffic Stage

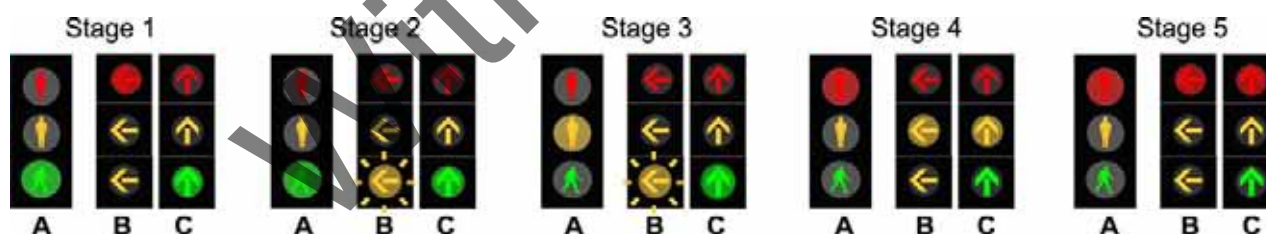
Side Road: Red man

Main road: Amber left filter and green straight-ahead filter

Stage 5 All Red Stage

Side Road: Red man

Main road: Red left filter and red straight-ahead filter



4.5.5 Left turning Large Vehicles

The problem of kerbside cyclists being cut out by a turning vehicle is universal. When that vehicle is a large vehicle, the issue becomes critical.

Difficulties with Dedicated Slip Lanes

Conflicts between the large turning vehicles and cyclists / pedestrians on left slip lanes present a significant risk. Slip lanes often give drivers an unreasonable sense of priority, and by virtue of their oblique geometry, they restrict views of cyclists and pedestrians. They should be removed wherever possible.

A segregated cycle lane along the main road that clearly continues across the mouth of the side road is a much safer solution for cyclists.



If a slip lane must be maintained, the arrangement shown in *Modifying Existing Left Hand Pockets*.

How The Principles of Sustainable Safety Apply

The most relevant principles of Sustainable Safety are Legibility, Homogeneity, Functionality, and Forgivingness. Designers should consider these principles in generating junction solutions. Considering each in turn:

Legibility

Are drivers aware of the cyclists?

Are cyclists aware of turning vehicles?

Is there an accident history?

Consider

- Red surfacing for cycle lane / track, to raise awareness
- Reducing the width of the junction mouth, obliging a wider swing and slower turn for vehicles (perhaps incorporating an overrun area for vehicle tracking purposes)
- Locally widen the cycle track
- Information / warning signs for cyclists advising of turning vehicles
- Additional signage for vehicles, to check for cyclists
- Possible use of pole-mounted mirrors, to facilitate checking the cycle lane before turning
- Turn bans, to preclude the conflict; and
- Segregating the on-road cycle lane approach (as above), to limit the location of turning to the vicinity of the junction mouth



Left curve radius too generous

Homogeneity

In addition to a difference in direction, there is a difference in size, but there may also be a difference in speed (e.g. is the cyclist going faster up the inside than the general traffic).

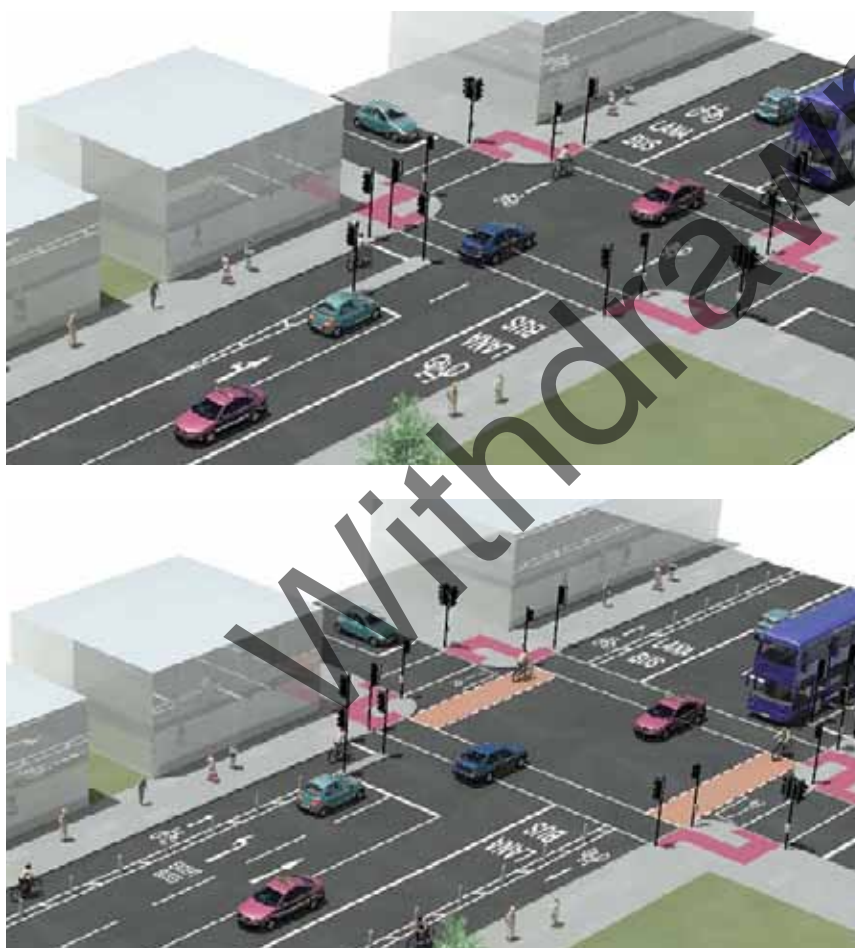
Consider

- rumble markings across the cycle lane, to slow cyclists, and alert them to conflict
- cyclist – oriented speed-activated alert signs, to advise “turning vehicles ahead”

Functionality

Is the junction one where trucks frequently turn in and out, and needs to be designed with this function in mind?

Consider the designs below:



Signalisation – segregated cyclist facilities

- Set back stop line for traffic, to increase visibility of cyclists from truck cab
- No ASL
- Stage kerbside cyclists to run with pedestrians and main traffic, with the red left-hand filter
- Stage the phase for traffic turning left (flashing amber filter only, no green filter) to follow closure (red) of cyclists and pedestrians phase

Cyclist Deflection, in truck-intensive areas

Where there is likely to be higher volumes of larger vehicle movements, the following solution, while not as convenient for cyclists, may be safer.

- cyclists lose all priority – this option is not appropriate for main cycle routes
- cyclists segregated (by virtue of traffic regime) and brought to side road crossing at least 5m away from main road



Forgivingness

What design aspects can reduce the severity of an incident?

- No guardrail in vicinity of junction – this removes the risk of cyclist entrapment
- Ensure there are no parked or loading vehicles, or bus stops approaching the junction – kerbside stationary vehicles may reduce visibility, and can present an entrapment risk
- Set back poles etc from vicinity of cyclists
- Provide verge / other evasion space

4.5.6 Existing Left Pockets

Left hand pockets should be removed wherever possible. A simple solution is to re-assign the existing pocket as footpath, verge or parking so that the cyclist has the correct alignment.

Where a left turning pocket cannot be removed, the layout can be modified to either shift cyclists to the right in advance of the pocket, or to enhance the level of protection for cyclists.

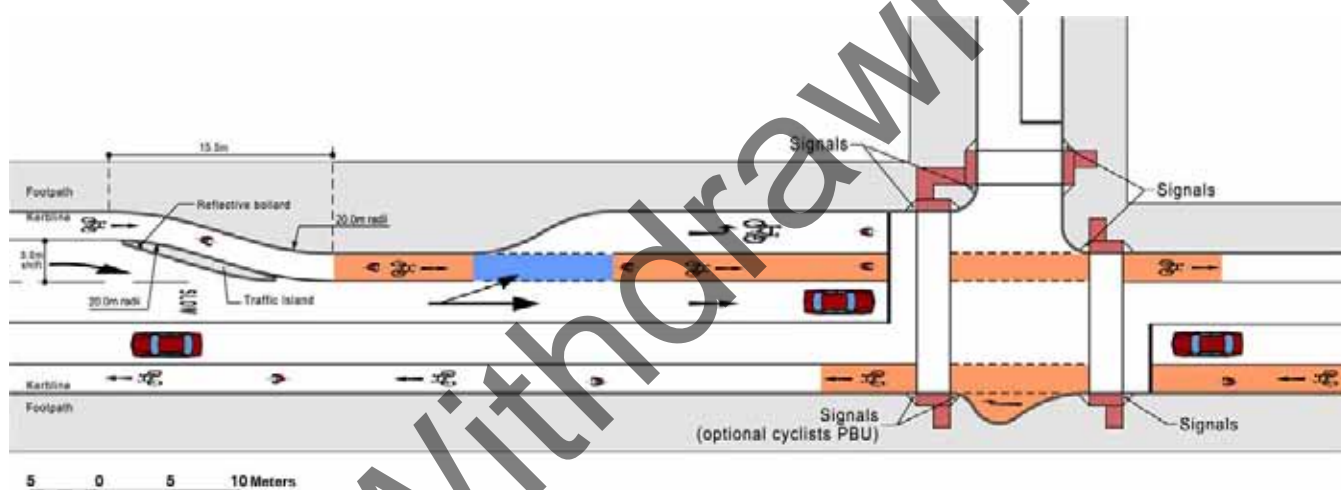
Shifting Cyclists to the Right

If significant volumes of left-turning traffic preclude the removal of an existing left turning pocket, the kerb should be re-aligned to shift cyclists to the right as shown.

Enhanced Protection at Existing Left Hand Pockets

Where an existing left hand pocket needs to be retained, cyclist safety can be improved by adopting the details shown on Modifying Existing Left Hand Pockets.

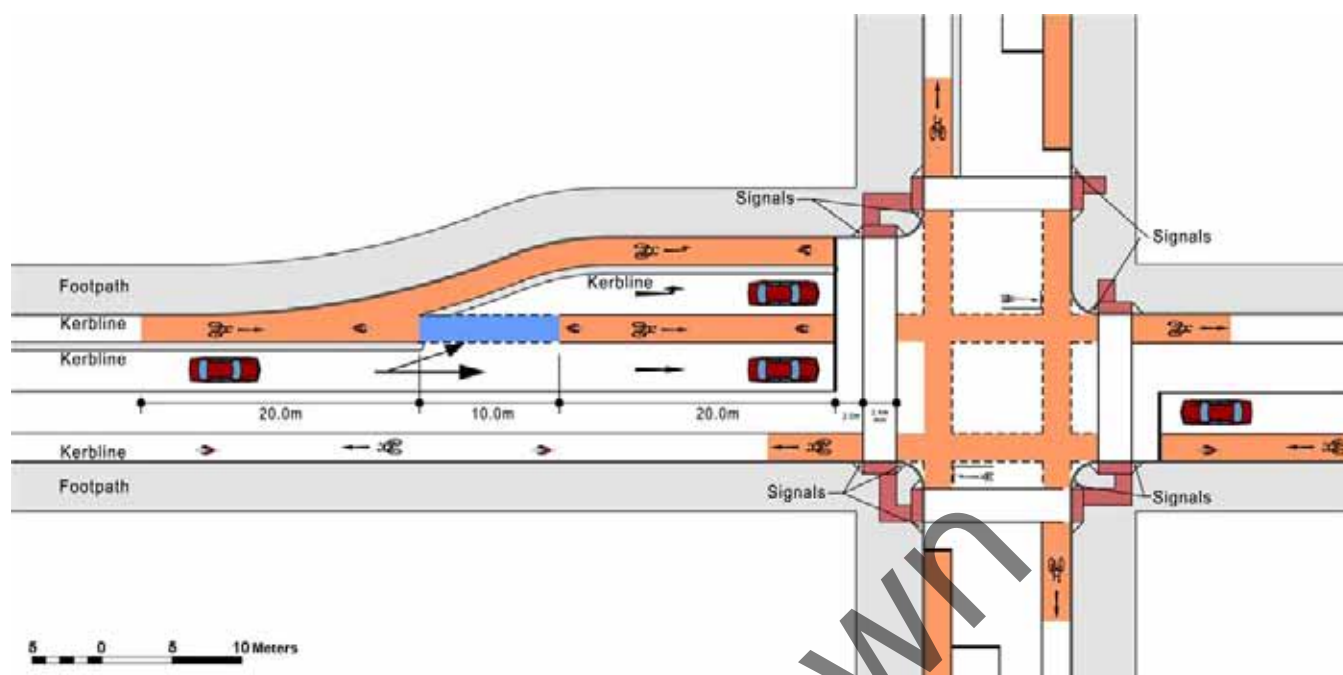
Shifting Cyclists to the Right



- Cyclist is brought to the correct alignment in advance of the pocket with a physical build out
- Short section, 30m max, of existing left pocket retained in advance of junction



Modifying Existing Left Hand Pockets



- Segregating the cyclist as close as possible to the (blue) conflict point, to prevent large vehicles from cutting across
- Providing a cycle track (as opposed to lane) in the left turn pocket
- Increasing the left turn radius to allow for tracking of large vehicles
- Including raised bollards etc. at the end of the left hand cycle track, and at the start of side road cycle track, to keep vehicle from encroaching on cyclist's space while turning left



4.6 RIGHT TURNS

This section deals with cyclists making right turns from a main road onto an adjoining side road. See also *Section 4.4.1 Cycling Principles at Junctions* and *Section 4.4.2 Features Common to Junctions*.

For right turns from a side road onto a main road, see *Section 4.9 Side Roads*.

The appropriate solution to accommodate a right turning cyclist will be determined by a combination of the following:

- The volume and speed of traffic
- The number of traffic lanes in each direction
- The degree of traffic control (priority, signals etc.)

4.6.1 Single Lane Approaches

On single carriageway roads and street where there is a low speed traffic regime, it is possible to facilitate cyclists weaving in order to make a right-hand turn into a side street or private entrance.

Mixed Street

In a mixed street environment, the cyclist should already occupy the centre of the traffic lane and can simply indicate to go right, stop and wait for a gap in any opposing traffic, and make the right turn. The vehicular speed regime for this solution should be no more than 30km/h.

Cycle Lane

Where a cycle lanes is provided, the cyclist must signal with one hand and look over the shoulder for a gap in the traffic behind. Once in the main traffic lane, they can stop at the turn to wait for a gap in the opposing traffic and complete the turn when safe to do so. The vehicular speed regime for this solution should not exceed 50km/h.

Where space permits and there is strong demand, central hatching can provide a useful informal waiting area for cyclists turning right in two stages.

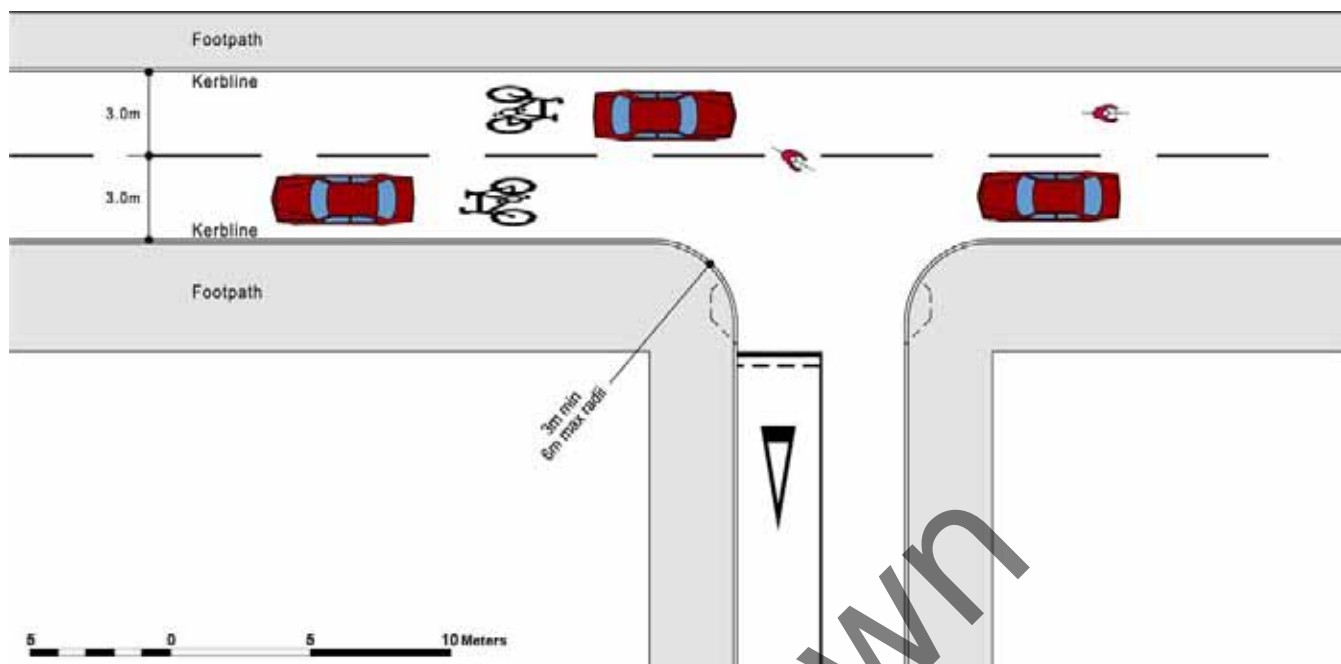
Higher Volume Vehicular Traffic

Where traffic volumes are high, weaving is not recommended. In such locations, it may be preferable to provide dedicated crossing facilities and these are dealt with below in *Section 4.7 Crossings*.

Combined Traffic Speed Control and Crossing Point

Where vehicular traffic speeds are high, as may be the case on an existing road, it may be appropriate to introduce a pinch point to passively reduce the speed of vehicular traffic and provide a safer crossing facility as part of a traffic calming scheme. See *Cycle lane and Pinch Point* in *Section 4.7.1*.

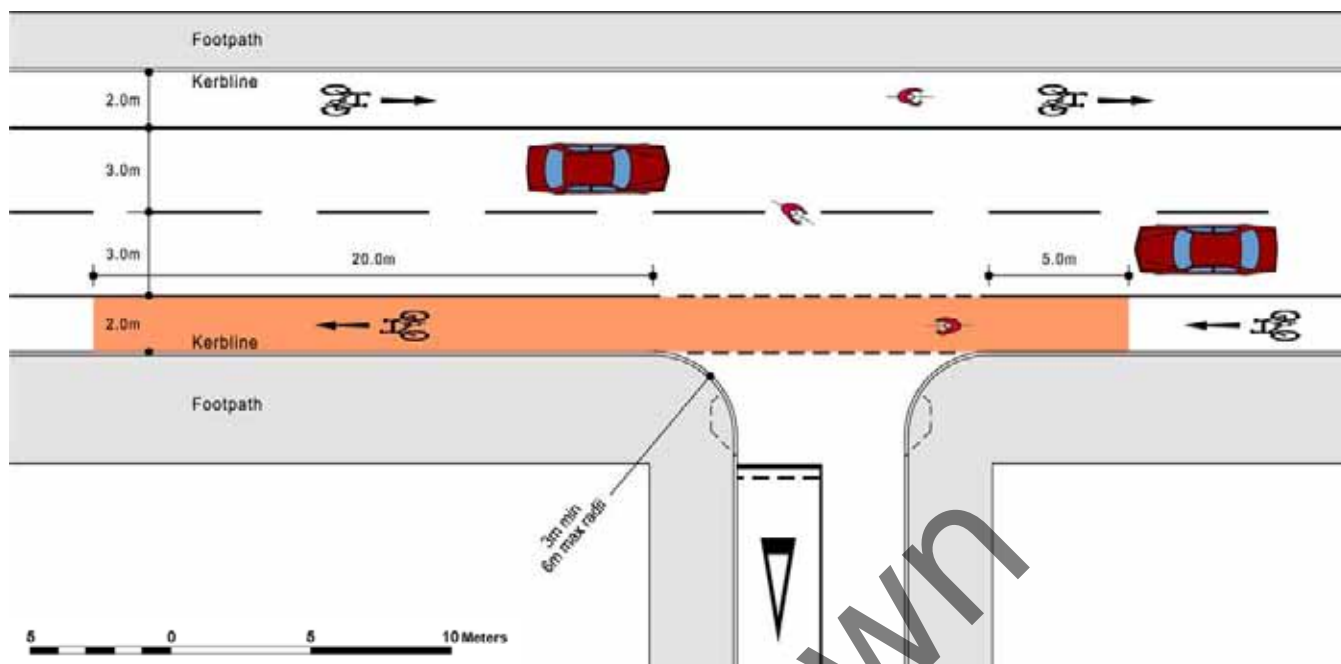
Basic Right Turn from Mixed Street



- For urban centres, with low traffic speeds and volumes – cyclists in mixed traffic
- Stop or yield line at / behind rear of footpath
- Pole for stop / yield (not shown) located at rear of footpath, away from desire line for pedestrians
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Kerb radii tight (3-5m)
- Side road junction mouth narrow (6-7m, plus cycle lanes, if any)
- Cyclists take central position in traffic lanes



Basic Right Turn from Cycle Lane



- For urban centres, stop or yield line at / behind rear of footpath
- Pole for stop / yield (not shown) located at rear of footpath, away from desire line for pedestrians
- Mandatory cycle lane approaching junction, to provide cycle space, preclude parking
- Red coloured surface in cycle lane in vicinity of junction (only) to improve legibility
- Cycle lane brought across mouth of junction
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Kerb radii tight (3-5m)
- Side road junction mouth narrow (6-7m, plus cycle lanes, if any)
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



4.6.2 Multi-Lane Approaches to Junctions

Right turning cycle facilities at junctions, entrances and private properties along multi lane roads approaches is generally not recommended. Cyclists would have to weave across at least two lanes of traffic with a much greater risk of being hit from behind.

Dedicated Right Turning Facilities

At certain junctions where traffic speeds are less than 50km/h, it may be possible to use a dedicated right turning cycle lane. This is described in the drawing *Dedicated Right with ASL*.



4.6.3 Box Turns or "Stay Left-To-Go-Right"

Box Turns should be used on larger signalised junction to facilitate right turning cyclists.

Cyclists stay to the left of the approach, move into a stacking area at the mouth of the side or cross road, and wait for the green phase. This arrangement avoids right turning cyclists having to weave across busy traffic lanes, or getting stuck between opposing streams of traffic in a junction. It also permits straight ahead cyclists to continue along the main road unobstructed.

Box turns are recommended in any or all of the following circumstances:

- Where the speed and volume of traffic requires segregated cycle facilities
- Where there are more than one traffic lane in the same direction
- Where weaving or uncontrolled crossings are unsuitable
- To provide a right hand turn for cyclists at junctions where vehicular traffic is not permitted to turn right

It will generally be necessary to set back the pedestrian crossing of the side road by 2.5m to 3.0m to create an advance stacking area in front of the pedestrian crossing line. The stacking area must be clearly visible and should not obstruct crossing pedestrians or straight ahead cyclists.

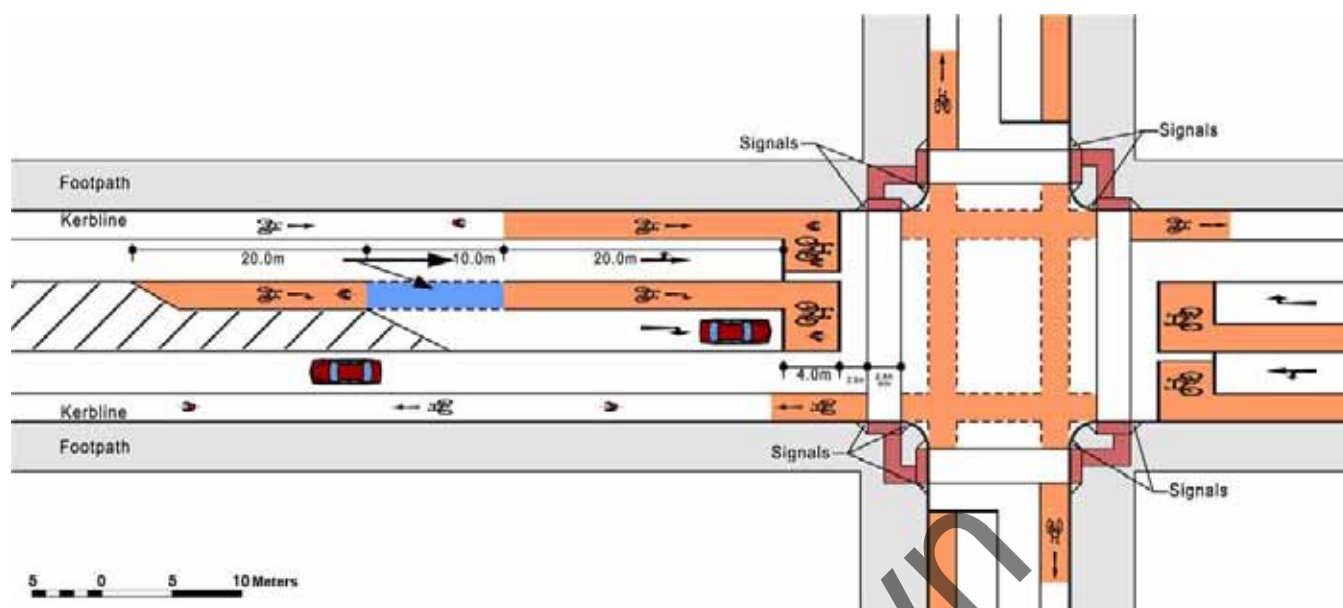
Box Turns require the presence of secondary signals for side road traffic control. Otherwise, stacking cyclists will not know when to cross.

At multi-lane side or cross roads, where separate streams on the main and side roads are signalled to run concurrently (e.g. RH in, LH out), the position of the cyclists' stacking box is important.

Box turn arrangements are shown in the drawings *Standard Box Turn* and *Box Turn with Dedicated Left on Cross Road* overleaf.



Dedicated Right with ASL

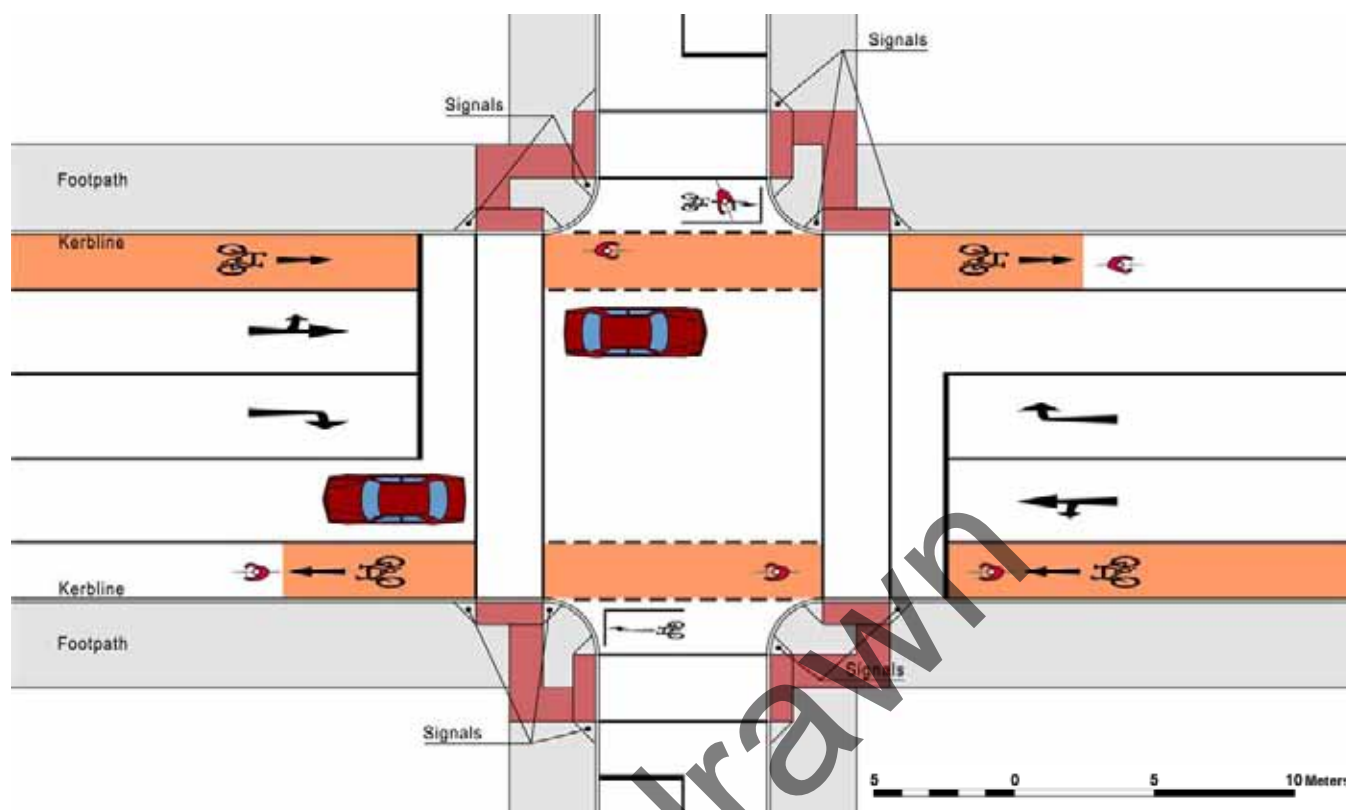


Principle of design

- Not suitable where cyclists must weave across two lanes (e.g. bus lane and traffic lane) to enter RH cycle lane / ASL
- If there is no cycle feeder lane to right hand ASL, do not put in ASL – install box turn facility only
- Requires RH ASL / traffic stream to be separately signalised (e.g. kerbed from straight ahead traffic, or gantry mounted signals, for separate signal staging)
- Consider box turn facility in addition to Right Turn ASL, for more cautious cyclists
- Keep right hand pocket short (max 30m) to reduce likelihood of cyclists being between two lanes of moving traffic



Standard Box Turn

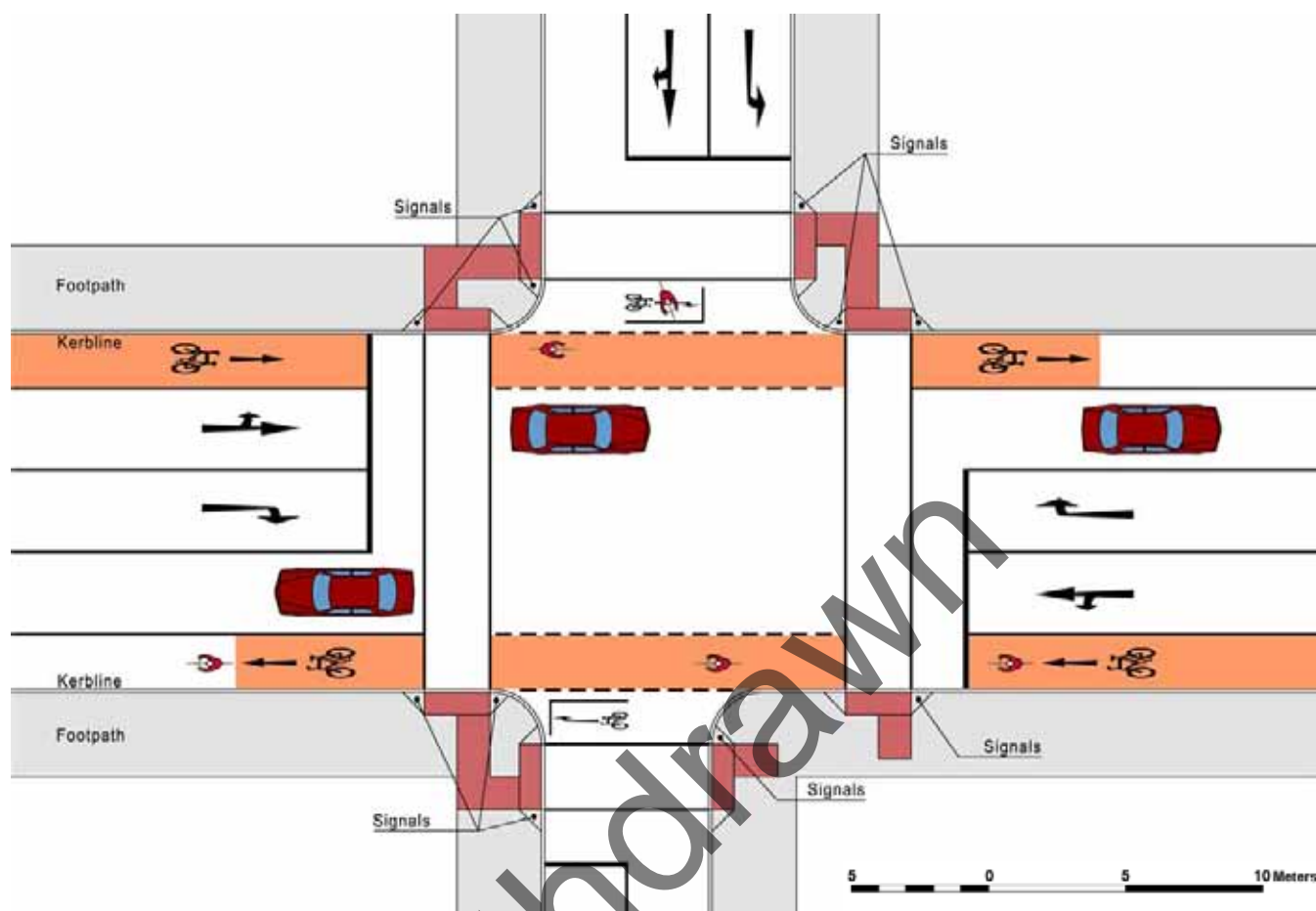


Design Issues:

- No ASL for right turning cyclists
- Short traffic signal cycle time essential (90 seconds maximum)
- Pedestrian crossing line displaced to accommodate cyclists on the side road
- Secondary signals on side road (or dedicated cycle aspects) to guide turning cyclists
- Ensure "box" on side road is located correctly i.e. is located away from the swept path of turning traffic on main road



Box Turn with Dedicated Left on Cross Road



Design Issues:

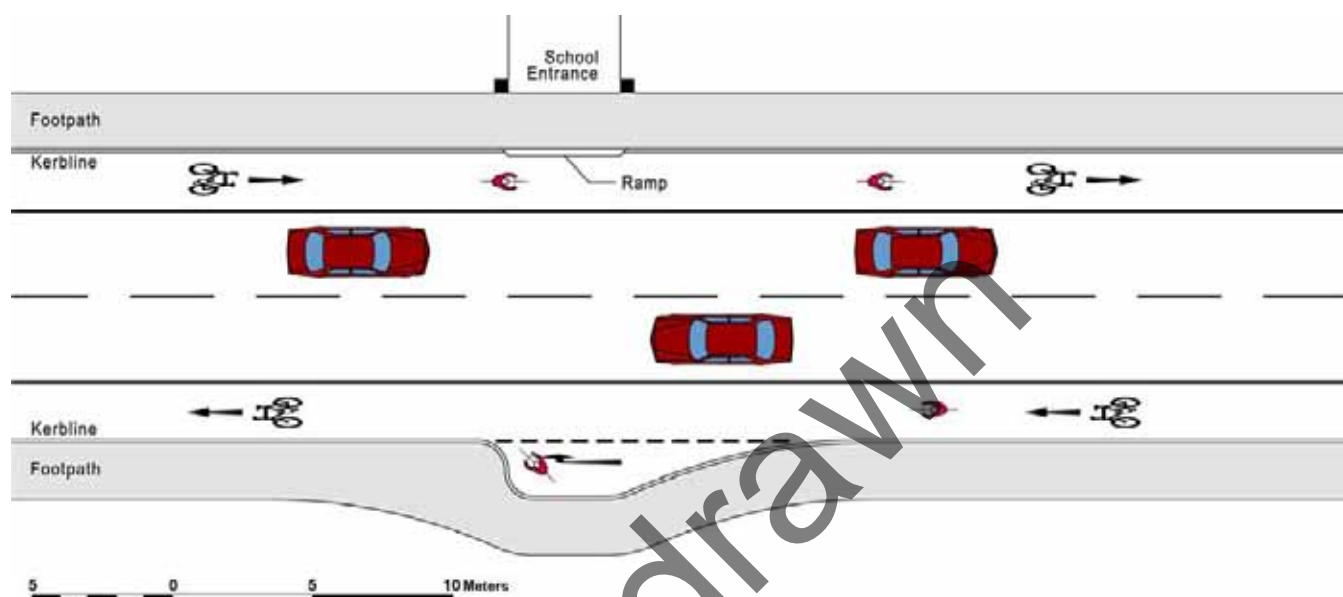
- As Per Standard Box Turn Above
- Box Turn must not be located in front dedicated left lane



4.6.4 Jug Turns

On links where there may be high volumes of cyclists turning right, such as at a school entrance, Jug Turns can accommodate stacking cyclists while permitting straight ahead cyclists to continue through.

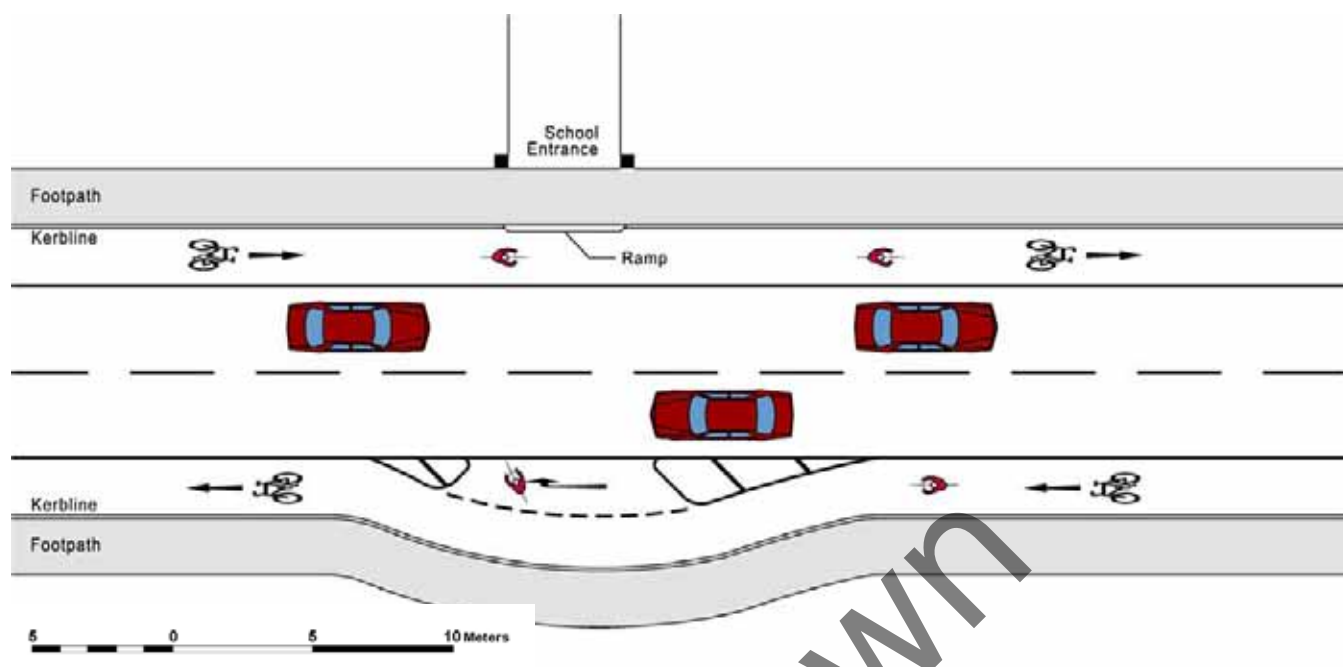
Basic Jug Turn and Cycle Lane



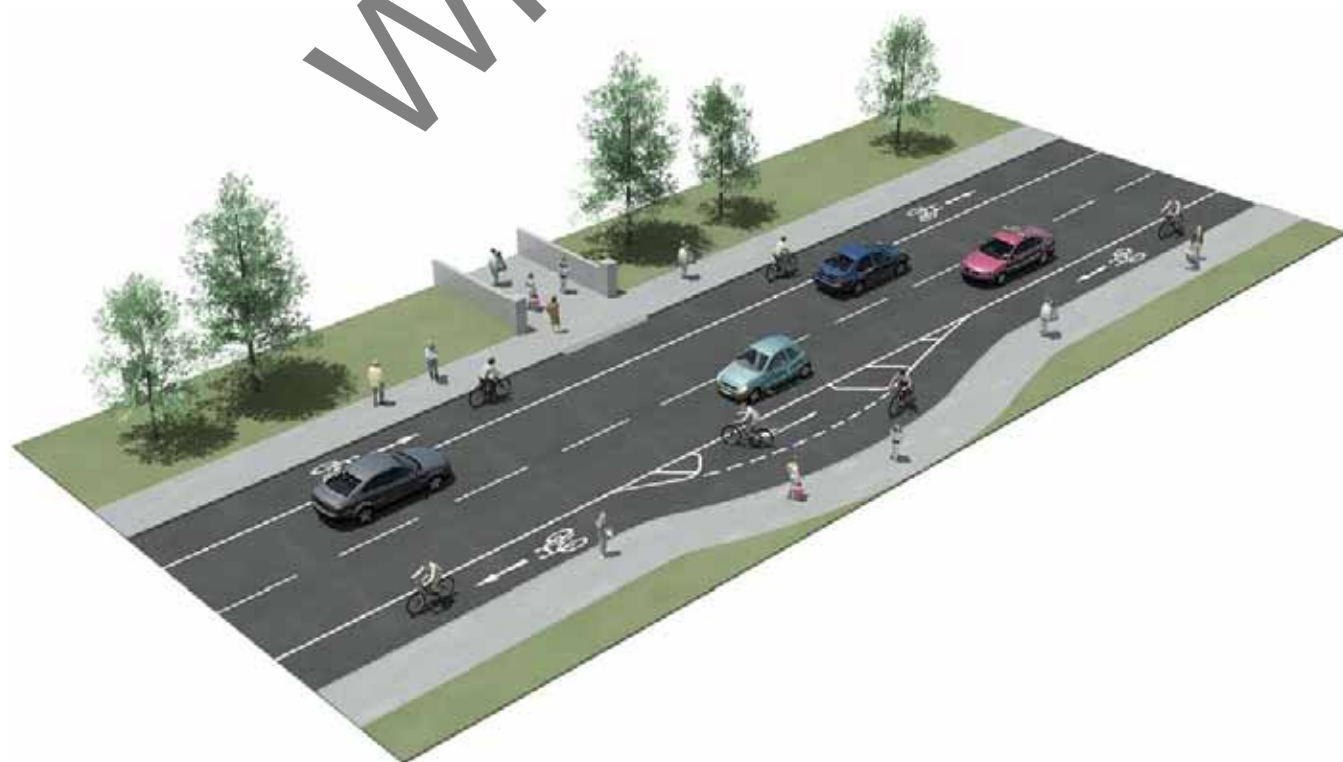
- Jug-handle crossing
- Right hand uncontrolled crossing – waiting cyclist on inside of passing cyclists and traffic
- Pedestrians displaced
- If unacceptable delays for cyclists to cross road, consider signalised toucan crossing



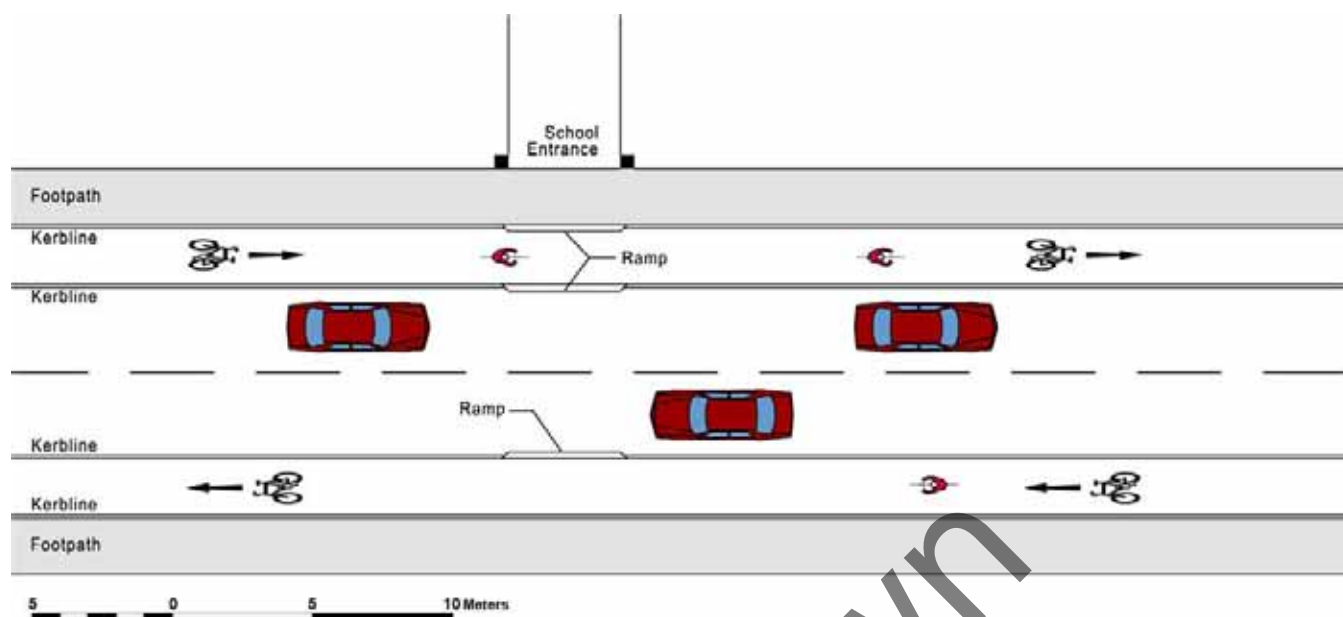
High Capacity Jug Turn and Cycle Lane



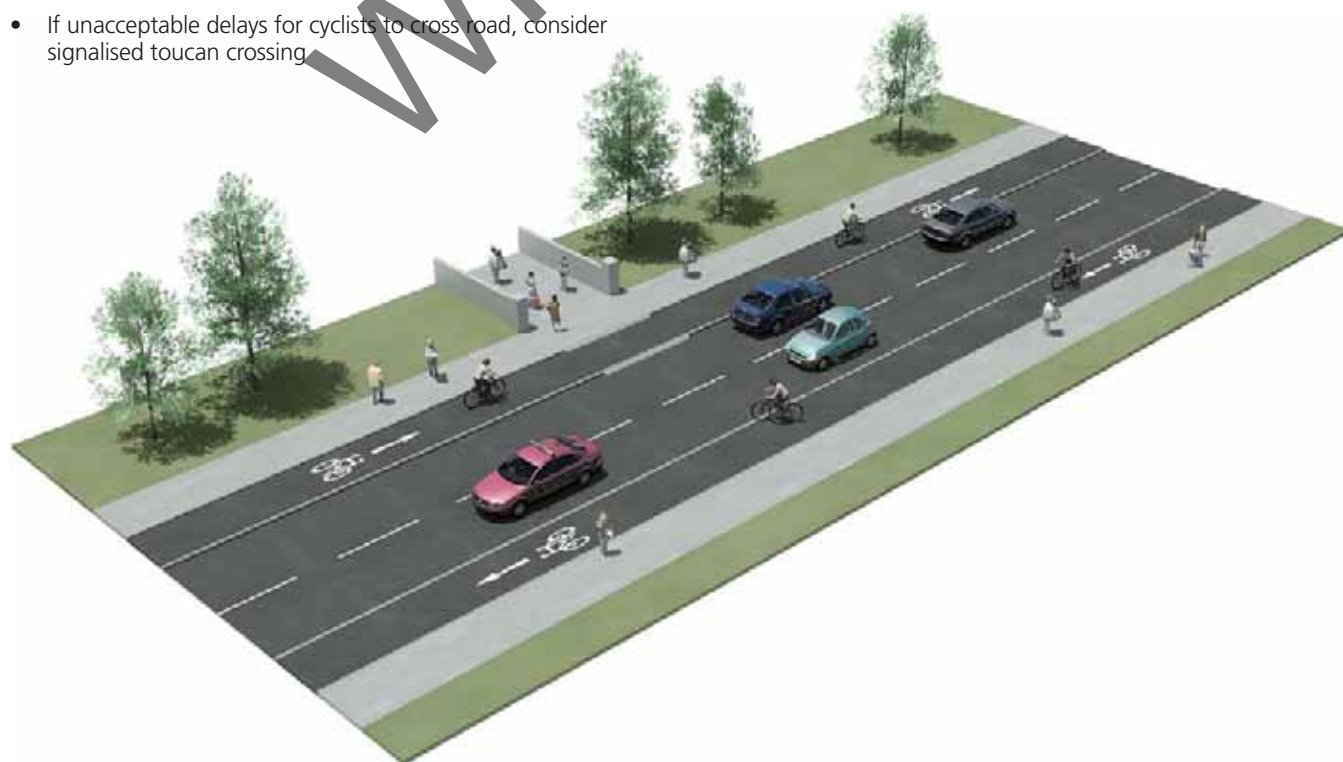
- Jug handle crossing, with cycle lanes
- Right hand uncontrolled crossing – waiting cyclist on outside of passing cyclists
- If necessary, consider kerbing of jug handle cycle waiting area, for greater legibility for approaching cyclists
- Pedestrians displaced
- If unacceptable delays for cyclists to cross road, consider signalised toucan crossing



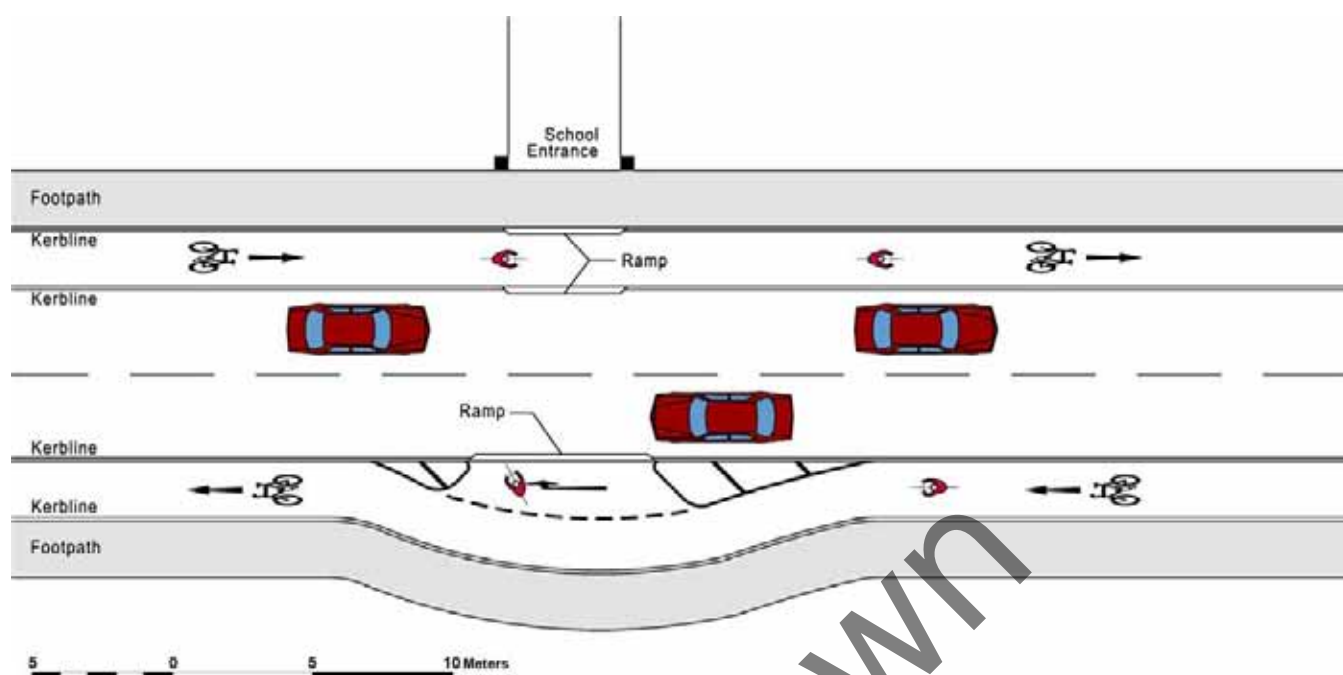
Jug Turn and Cycle Track



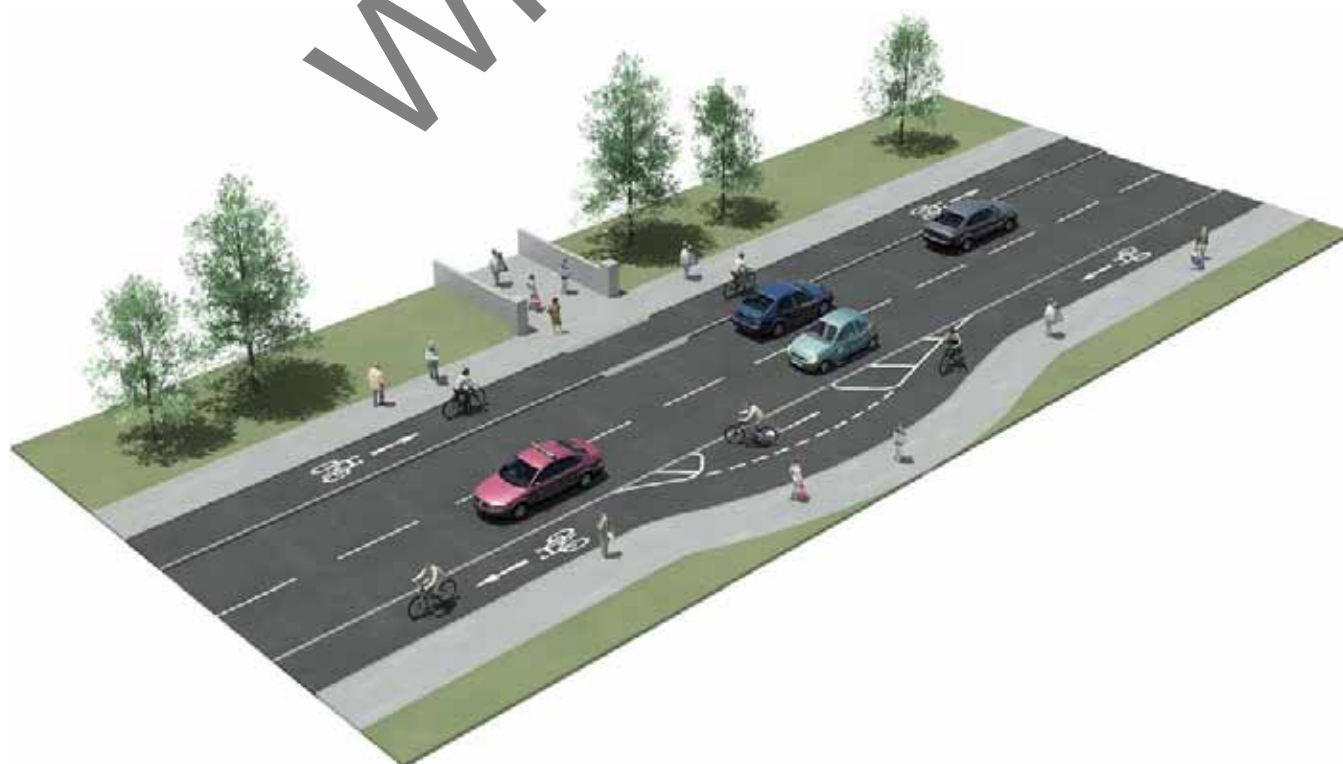
- Informal jug handle crossing, with cycle tracks
- Ensure cycle track wide enough to provide for cyclists to pass on inside – minimum cycle track width based on one cyclist and one passing (see width calculator)
- Right hand uncontrolled crossing – waiting cyclist on outside of passing cyclists
- Pedestrians not displaced
- Provide bevelled kerbs / ramps to assist cyclists cross from tracks to road level etc.
- If unacceptable delays for cyclists to cross road, consider signalised toucan crossing



High Capacity Jug Turn and Cycle Track



- Jug handle crossing, with cycle tracks
- Right hand uncontrolled crossing – waiting cyclist on outside of passing cyclists
- Provide kerb ramps to facilitate smooth cycle crossing of road and across cycle tracks (and across footpaths to key destinations, if necessary)
- Pedestrians displaced
- If unacceptable delays for cyclists to cross road, consider signalised toucan crossing



4.6.5 Utilising the All-Pedestrian Stage

Subject to Department Approval – See Traffic Signs Manual

At toucan crossings, pedestrians and cyclists share the road space under a combined green-man and green bike signal stage, but pedestrians retain priority.

Toucans are currently limited to mid-block locations.

The principles governing toucan crossings may be extended to the all pedestrian phase at a junction, subject to Department approval.

During the all-red traffic stage, both pedestrians and cyclists could utilise the wrap around green man pedestrian phase, subject to a number of considerations:

- only suitable for tight confined junctions, with short cycle times and short pedestrian crossing distances
- ideally, cycle stacking space /box turn facilities should be included on all legs
- use a green cycle aspect in association with green man



4.7 CROSSINGS

Crossings are intended for cyclists to cross the road at right angles to the traffic flow. They are used where the combination of traffic speed and volume makes it unsafe for cyclists to mix and weave with traffic.

A range of different crossing types are possible depending on circumstances, and afford cyclists and pedestrians the option of stopping traffic in order to cross the main road.

In all cases, the most cycle-friendly choice is the one that provides for safe crossing and minimal delay to the cyclist.

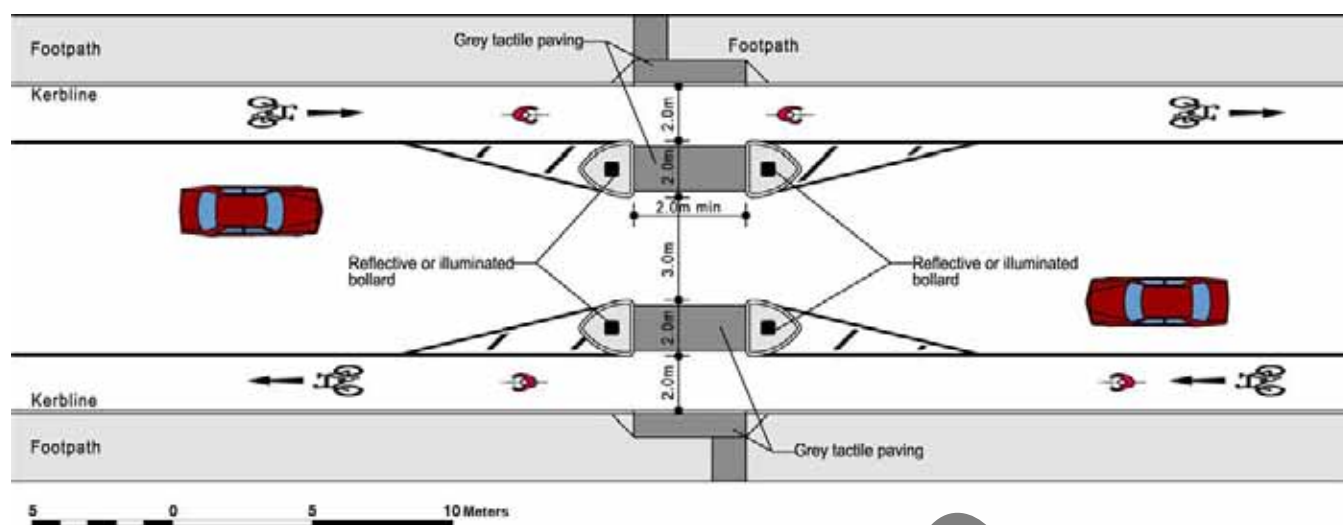
4.7.1 Uncontrolled Crossings

A variety of uncontrolled crossings can allow cyclists and pedestrians to stop and cross the main traffic safely. These include solutions that passively reduce traffic speeds and/or address the crossing as a two-stage process. Cyclists and pedestrians must wait for a suitable gap in the traffic before crossing.

The volume and speed of traffic on the main road will influence the choice of these solutions. Heavier traffic and higher speeds will generally require controlled crossings.



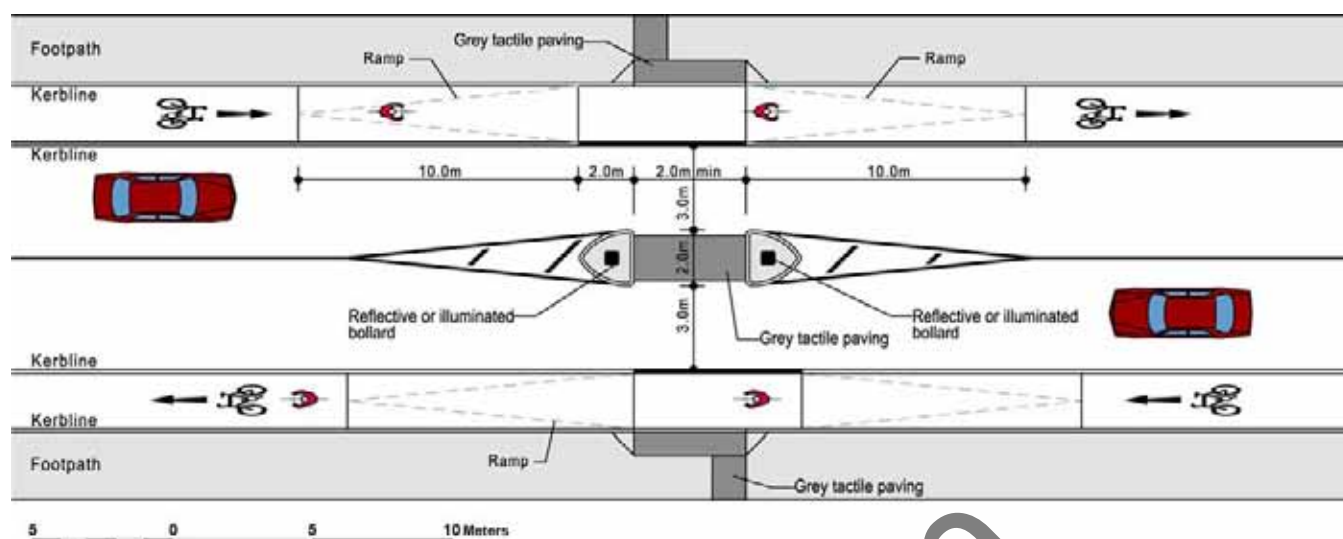
Cycle Lane and Pinch Point



- Gateway treatment / traffic calming
- May be appropriate to sensitive local destinations (schools, libraries etc.)
- Consider also shuttle-working treatment (see *Traffic Management Guidelines*)
- Cyclist segregated and unimpeded
- Minimum cycle lane width to assist maintenance



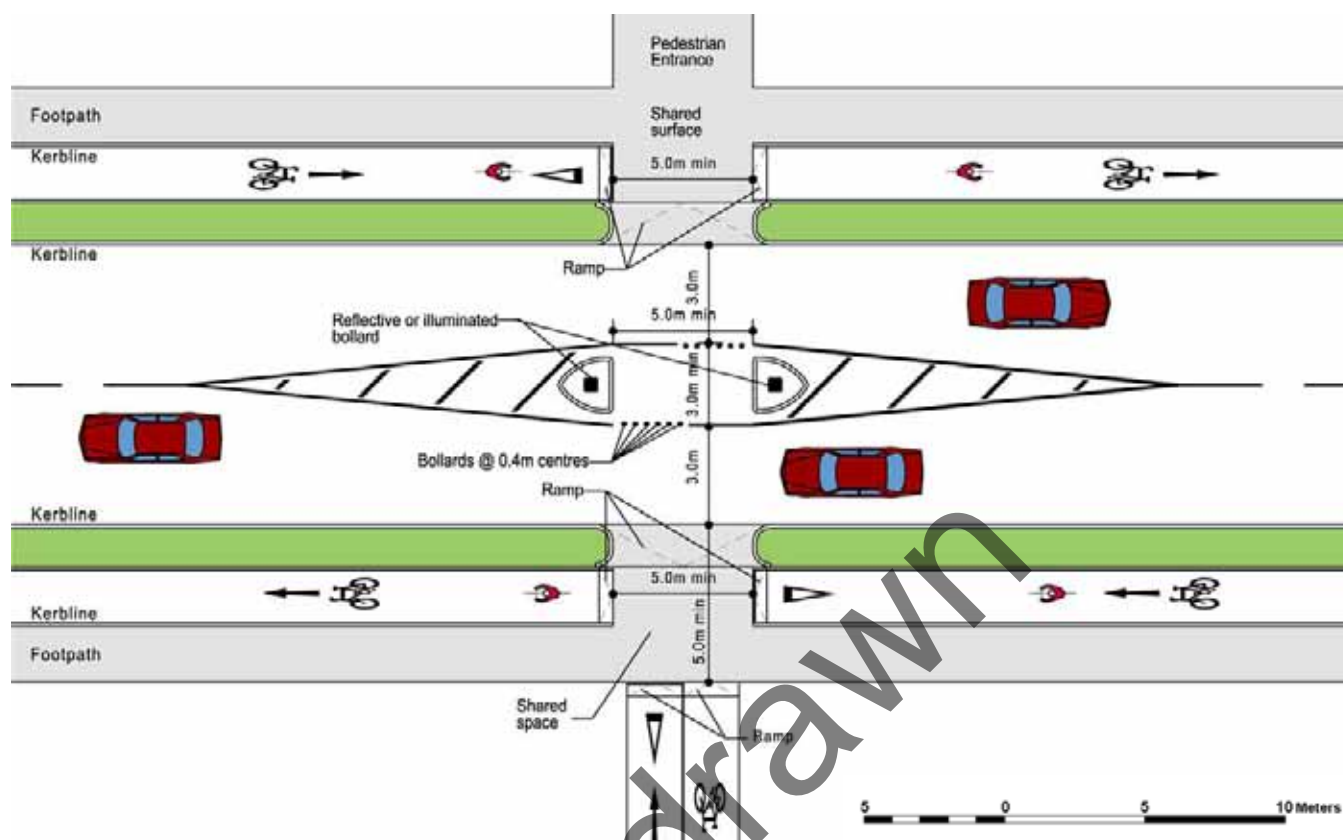
Cycle Track and Two-Stage Crossing



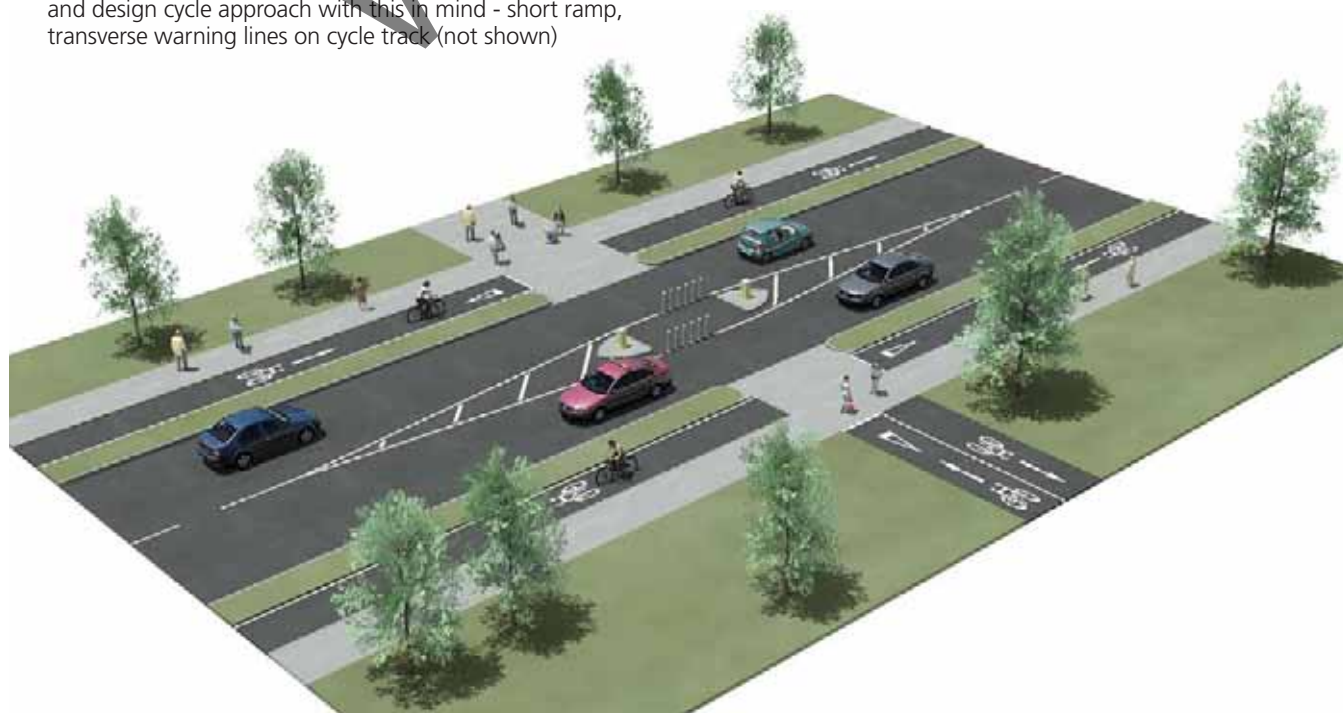
- Uncontrolled Pedestrian crossing
- Not particularly good as gateway, since carriageway each side of central island is 5m wide
- Cyclists ramped back to road level, to assist pedestrian crossing
- Sufficient width so that cyclists not squeezed by central pedestrian island



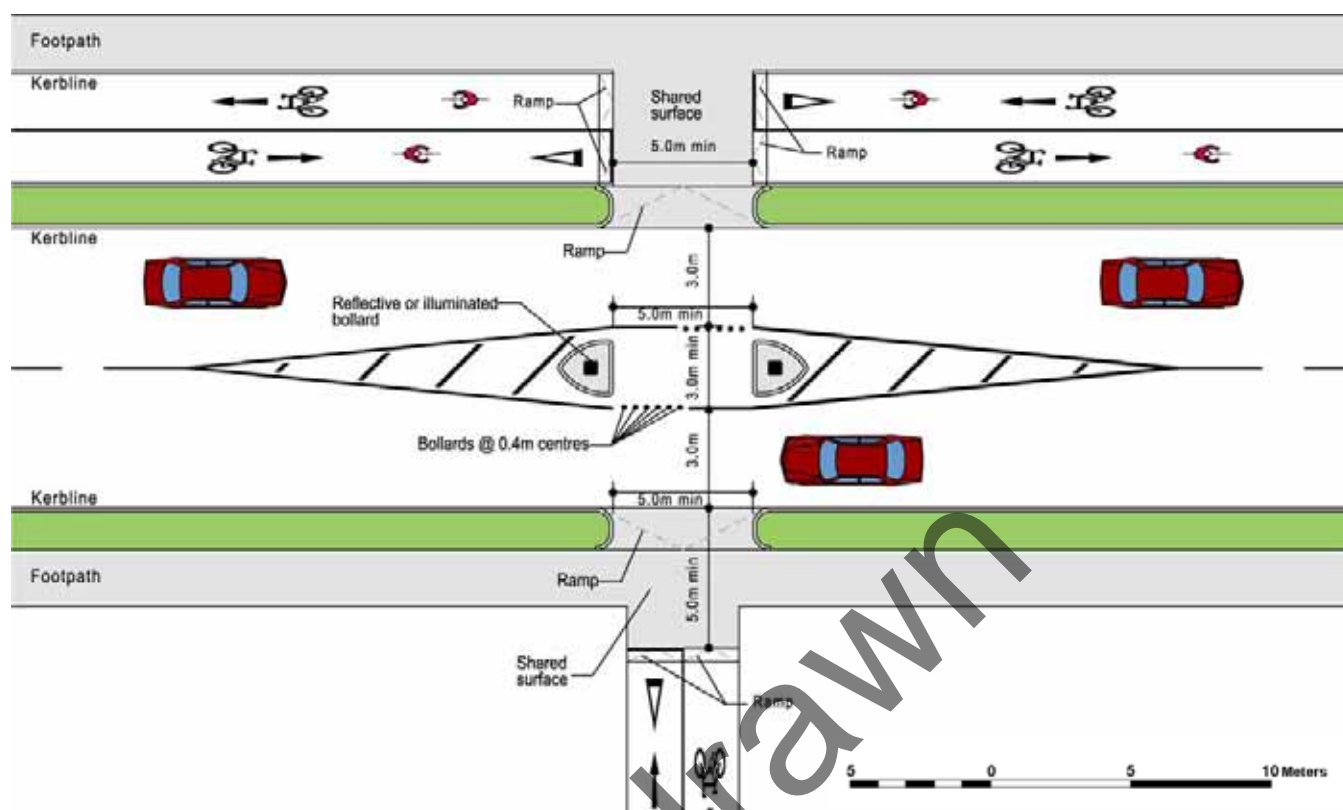
Off-Road Cycle Track and Two-Stage Crossing



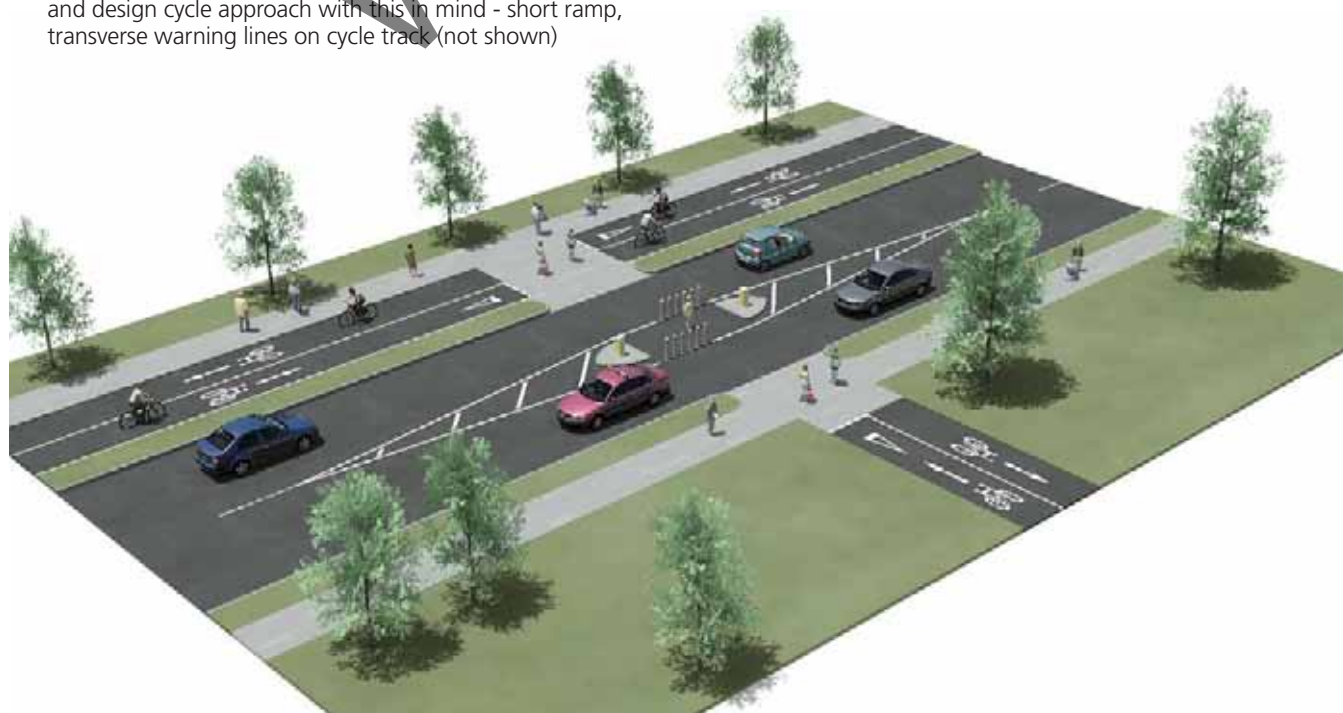
- Two-stage uncontrolled pedestrian & cycle crossing
- Not suitable near signalised junctions
- Important that central island does not facilitate direct (one-stage) cycle crossing attempts
- Dimensions of island are minimum – where there is higher cycle crossing demand, consider larger central island (for stacking, movement) or signalised Toucan crossing (no island)
- Clearly sign pedestrian priority area across cycle tracks, and design cycle approach with this in mind - short ramp, transverse warning lines on cycle track (not shown)



Two-Way Off-Road Cycle Track and Two-Stage Crossing



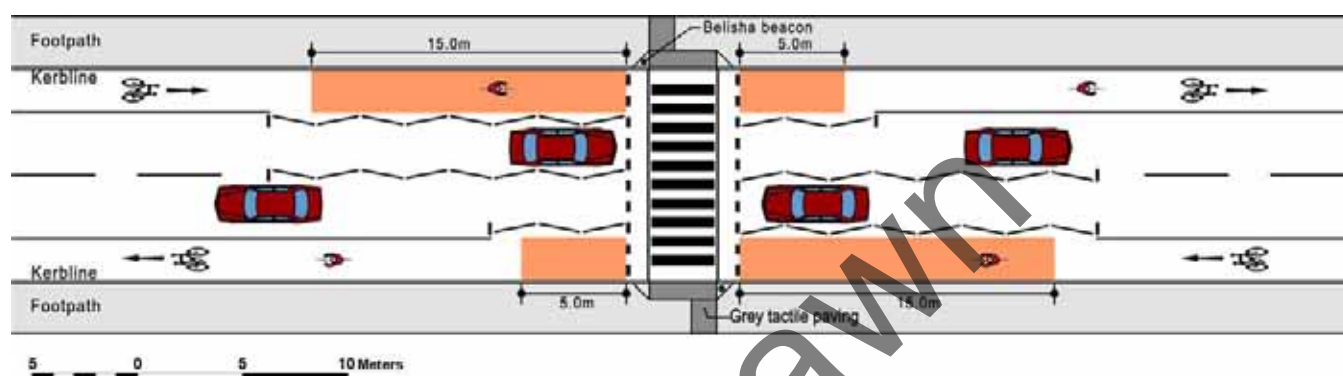
- Two-stage uncontrolled pedestrian & cycle crossing
- Not suitable near signalised junctions
- Important that central island does not facilitate direct (one-stage) cycle crossing attempts
- Dimensions of island are minimum – where there is higher cycle crossing demand, consider larger central island (for stacking, movement) or signalised Toucan crossing (no island)
- Clearly sign pedestrian priority area across cycle tracks, and design cycle approach with this in mind - short ramp, transverse warning lines on cycle track (not shown)



4.7.2 Controlled Crossings

Controlled crossings facilitate cyclists and pedestrians by allowing them to stop traffic on the main road. Signals, activated automatically or by push button units will stop the traffic and give cyclists and pedestrians sufficient time to cross the road safely.

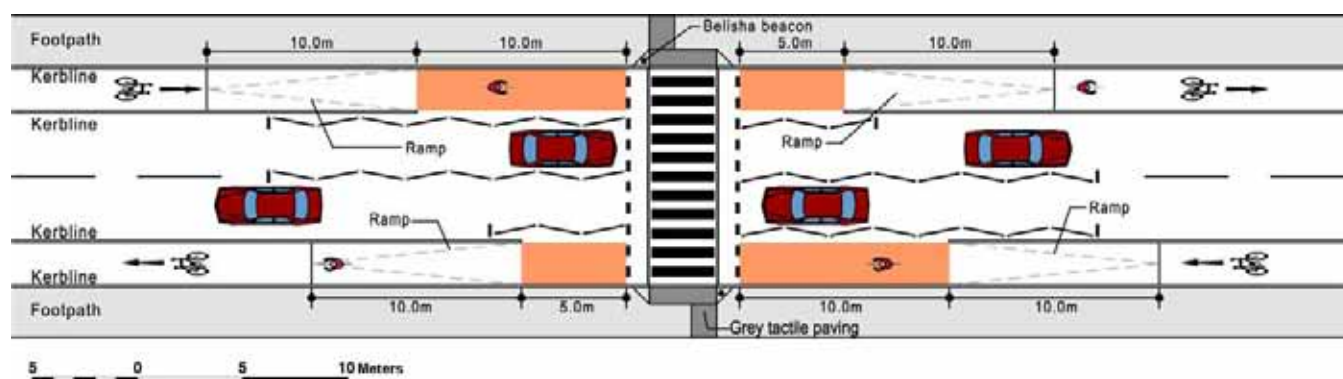
Cycle Lane with Pelican Crossing



- Cycle lane approach to zebra crossing
- Solid line on cycle lane replaced with zig-zag
- Maintain red surface, for legibility (so as not to confuse with car parking)



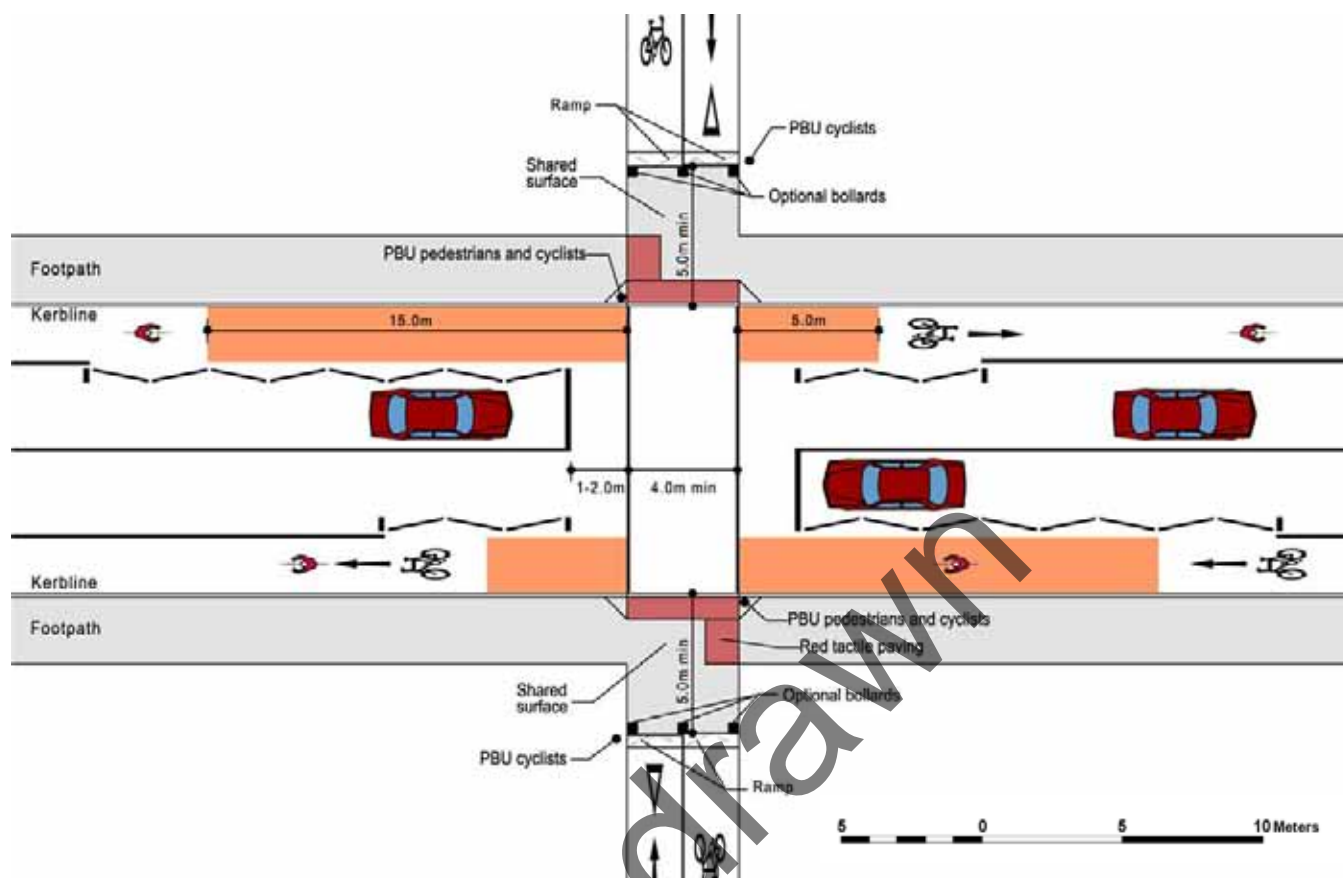
Cycle Track with Pelican Crossing



- Cycle track approach to zebra crossing
- Re-establish cycles at road level in advance of zebra crossing, to facilitate smooth pedestrian crossing
- Solid line on cycle track replaced with zig-zag
- Maintain red surface, for legibility (so as not to confuse with car parking)



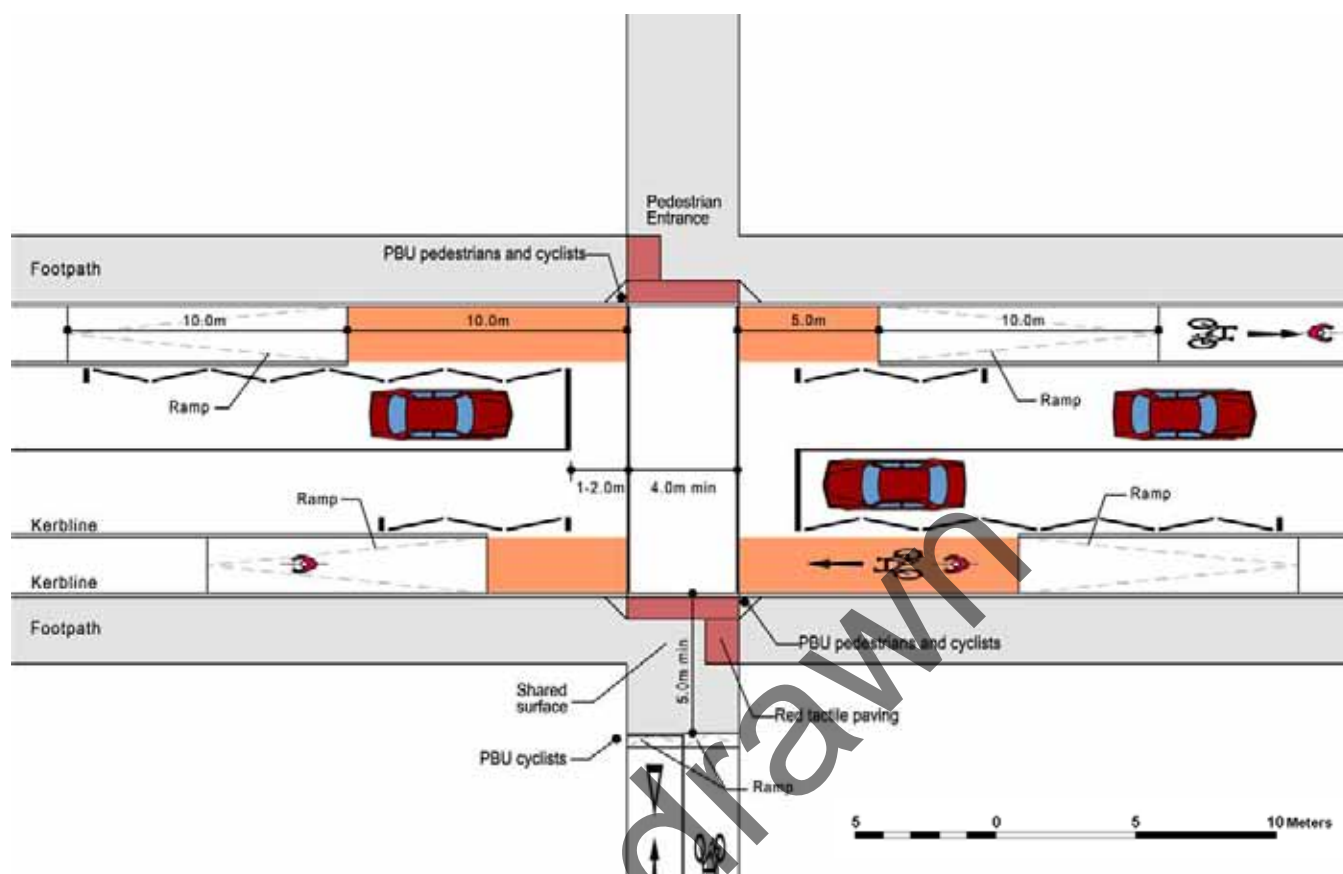
Cycle Lane with Toucan Crossing



- Crossing shared by cyclists and pedestrians – pedestrians retain priority over cyclists
- Appropriate where cycle track / cycle way / cycle trail crosses road at isolated location away from junctions
- Push button units located for pedestrians as standard
- Additional push buttons located for cyclists convenience - bicycle detection (loops, passive IR etc.) may be more appropriate
- Clear signage required on cycle track of approaching crossing
- Shared pedestrian priority area should be minimum of 5m wide from end of cycle track to edge of road, with sufficient sight triangles, to give time for traffic and cyclists to see each other
- Spaced bollards may be required at end of cycle track on entry to shared cycle pedestrian area, to slow cyclists, for additional legibility
- Signal clusters as per Traffic Signs Manual



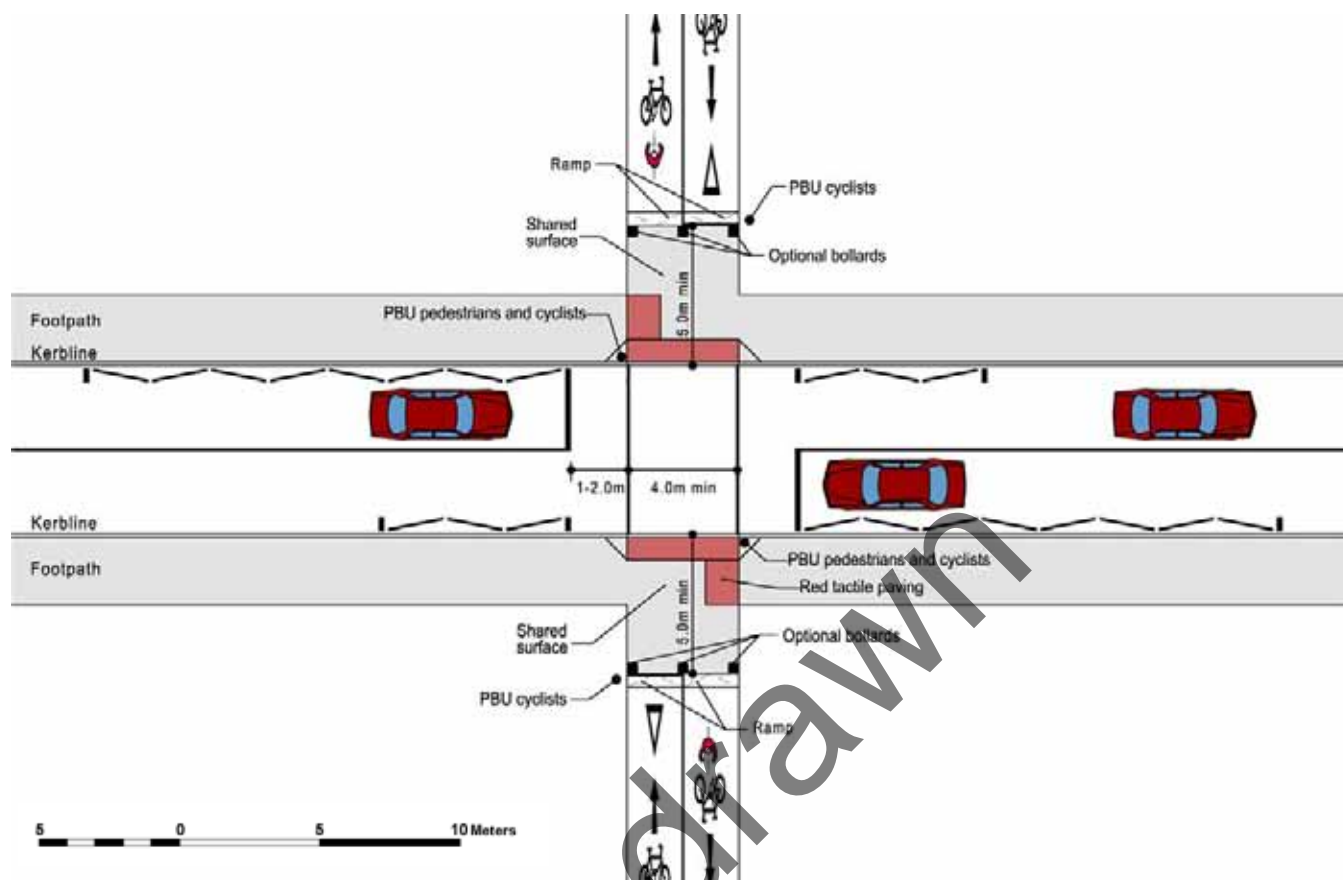
Cycle Track with Toucan Crossing



- Crossing shared by cyclists and pedestrians – pedestrians retain priority over cyclists
- Cycle track brought to road level to facilitate smooth pedestrian crossing
- Appropriate where cycle track / cycle way / cycle trail crosses road at isolated location away from junctions
- Push button units located for pedestrians as standard
- Additional push buttons located for cyclists convenience - bicycle detection (loops, passive IR etc.) may be more appropriate
- Clear signage required on cycle track of approaching crossing
- Shared pedestrian priority area should be minimum of 5m wide from end of cycle track to edge of road, with sufficient sight triangles, to give time for traffic and cyclists to see each other
- Spaced bollards may be required at end of cycle track on entry to shared cycle pedestrian area, to slow cyclists, for additional legibility
- Signal clusters as per Traffic Signs Manual



Cycle Way with Toucan Crossing



- Toucan (shared cycle and pedestrian) crossing of minor road (mixed cycling with traffic – no cycle lanes) – pedestrians retain priority over cyclists
- Appropriate where cycle track / cycle way / cycle trail crossed road at isolated location away from junctions
- Push button units located for pedestrians as standard
- Additional push buttons located for cyclists convenience - bicycle detection (loops, passive IR etc.) may be more appropriate
- Clear signage required on cycle track of approaching crossing
- Shared pedestrian priority area should be minimum of 5m wide from end of cycle track to edge of road, with sufficient sight triangles, to give time for traffic and cyclists to see each other
- Spaced bollards may be required at end of cycle track on entry to shared cycle pedestrian area, to slow cyclists, for additional legibility
- Signal clusters as per Traffic Signs Manual



4.8 ROUNDABOUTS

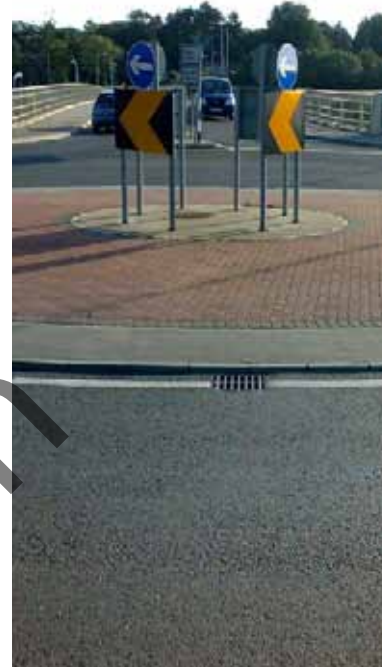
Roundabouts can facilitate the interchange of relatively high volumes of traffic with shorter delays than might be experienced at other types of junctions. They are priority junctions, in effect a series of “T-junctions” arranged in a ring, and operate on the basis of gap acceptance. Roundabouts work as long as the circulating area and the exits do not back up.

Roundabouts can work well for cyclists and pedestrians but only if designed to specifically address their needs and expectations. Safety, and not capacity, is the over-riding principle for good roundabout design.

4.8.1 Cycle Friendly Roundabouts

The design principles are very similar to those for Side Roads of T-junctions.

- Approaching traffic should be slowed (to stopping speed). This provides better gap acceptance, greater legibility for drivers and a safer cycling environment
- Traffic speed on the roundabout should also be controlled by means of a narrow gyratory lane
- Approach arms should be aligned towards the centre point of the island and not deflected to the left
- Traffic lanes should approach roundabouts at right angles rather than obliquely, and without any flares. This makes it easier to see cyclists and traffic on the roundabout. It is easier for pedestrians to cross the mouth of the side road
- Multi-lane approaches are not recommended, as vehicles in the outer approach lane preclude eye contact between traffic on the inner approach lane and cyclists on the roundabout
- Double or multiple gyratory lanes are not cycle friendly due to traffic weaving and the risk of side swipe



4.8.2 Integration or Segregation and Roundabout Capacity

No Cycle Lanes on Roundabouts

Cycle lanes should not be included in the circulating section of roundabouts. Cyclists should be either mixed with traffic on roundabouts in a single circulating lane (i.e. cycle logos in the traffic lane, no cycle lane) or else segregated from traffic by physical means.

Roundabout Capacity

Depending on the traffic balance between arms, single lane roundabouts can accommodate up to 20,000 – 25,000 vehicles per day. It is important to remember that the capacity of a roundabout is the total number of vehicles using, and not the number approaching it from any one arm.

Cyclists can mix with traffic at roundabouts with traffic volumes of less than 6,000 vehicles per day. These are cost effective and space efficient.

Segregation is necessary above 6,000 vehicles per day, and specific design features must be introduced to ensure the safety of cyclists.

4.8.3 Geometry and Urban Roundabouts

Roundabouts in urban areas typically should have an external radius "R1" of between 5.0m and 16.0m.

In order to minimise vehicular speeds, the width of the circulating lane "A" should not exceed 3.5m to 4.0m. Additional over-run areas can be provided at the central island, if required to cater for occasional oversized vehicles.

The internal radius "R2" can be as small as 0.5m to 2.0m in the case of mini-roundabouts, but otherwise ranges from 2.0m up to as much as 12.0m.

In principle, approaches should be perpendicular, and the central island should be wide enough to deflect the path of "straight through" traffic and ensure that approach traffic speed is slow enough to stop if necessary.

It is important that the roundabout is legible and well signed in advance.



Cycle lane on roundabout not recommended – should be shared

4.8.4 Types of Roundabouts

There are four types of roundabouts that can be used in urban areas for cyclists depending on the traffic speed and the design capacity of the junction. These are detailed below.

Multi-lane roundabouts are not safe for cyclists. With one or more circulating lanes and/or multiple approach and exit lanes, the risk of collision is too great. Where these are required for vehicular traffic, fully segregated grade separated or alternative cycle alignment solutions should be considered to ensure a safe cycling environment.

4.8.4.1 Mini-Roundabouts

Mini-Roundabouts are characterised by a painted central island, 0.5m to 2.0m in radius, domed to a maximum height of 75mm (25mm on bus routes) and with very visible painted arrows indicating the gyratory direction. Mini-roundabouts have narrow single traffic lane approaches and a shared circulating area with a 'tight' geometry to ensure minimal traffic speed.

Mini-Roundabouts can be used in mixed street environments at junctions with design capacities of up to 2,000 vehicles per day, and where the vehicular speed on the approach roads is less than 30km/h. Larger vehicles can negotiate the tight geometry by over-running the central island.

4.8.4.2 Shared Roundabouts

Shared Roundabouts are characterised by a built central island clearly defined by a solid kerb, minimum 150mm high, and with a radius of 2.0m or larger. An overrun can be provided to facilitate larger vehicles if required. Shared roundabouts have single traffic lane approaches and a shared single circulating lane no wider than 4.0m.

Shared roundabouts can be used in mixed street environments at junctions with design capacities of up to 6,000 vehicles per day, and where the vehicular speed on the approach roads is less than 50km/h.



4.8.4.3 Segregated Cycle Track on Roundabouts

These are characterised by a dedicated circulating cycle track that is highly visible and segregated from the main vehicular circulating lane by kerbs. They will also have a built central island clearly defined by a solid kerb and with a radius between 4.0m and 12.0m. Shared roundabouts have single traffic and cycle lane approaches and a single traffic circulating lane with a separate segregated cycle track.

For use on roundabouts with design capacities of 6,000 – 10,000 vehicles per day, this solution provides dedicated space for cyclists both on the roundabout and at the entry and exit points that prevent the cyclist from being “squeezed”.



4.8.4.4 Fully Segregated Roundabouts

Fully segregated roundabouts are required for higher traffic volumes. Junction approaches have segregated cycle tracks and the roundabout itself has a single traffic circulating lane and a segregated circulating cycle track. They have a built central island clearly defined by a solid kerb and with a radius between 4.0m and 12.0m.

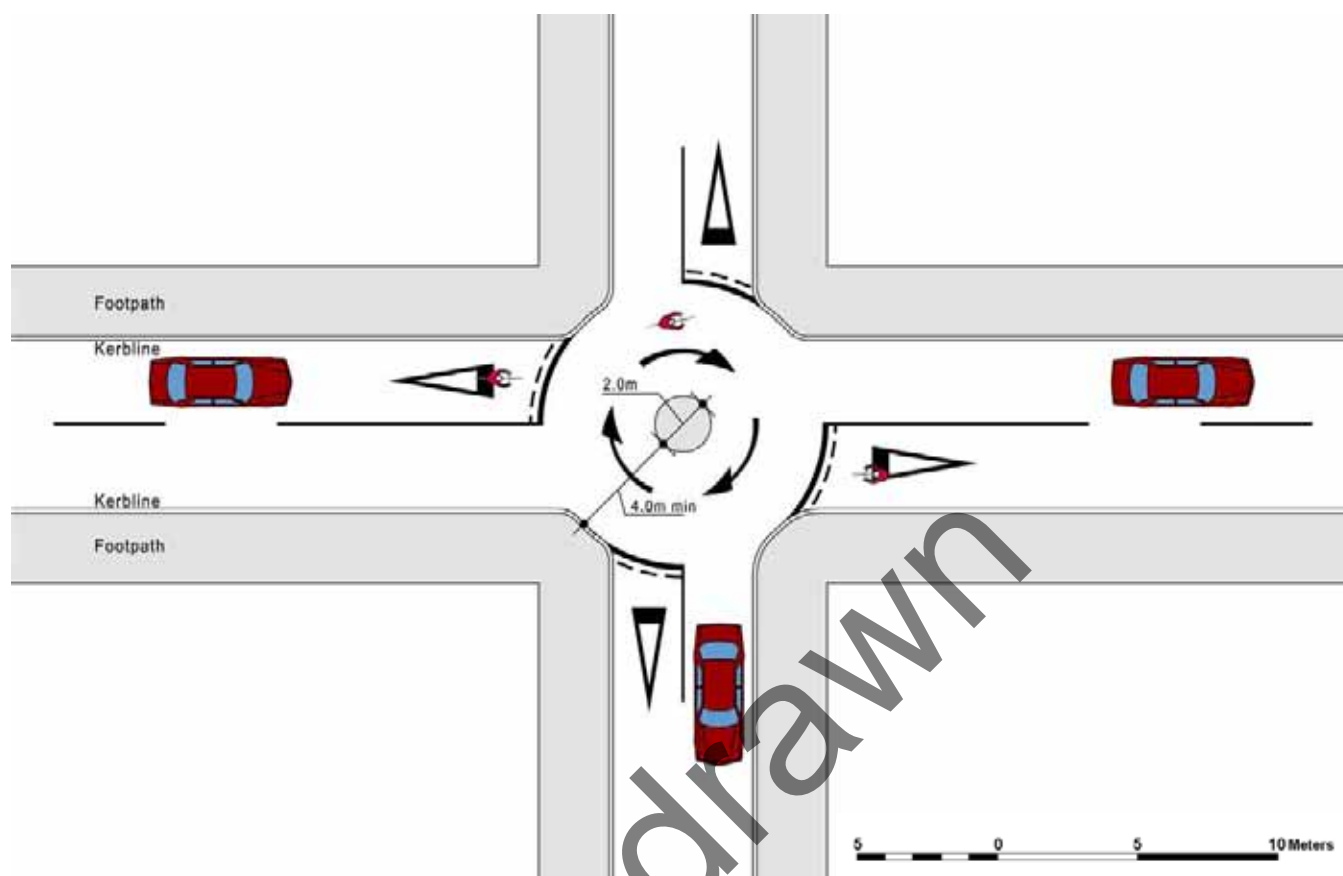
Fully segregated roundabouts are required where design capacities are greater than 10,000 vehicles per day.

4.8.4.5 Multi-Lane Roundabouts

Multi-lane roundabouts, with one or more circulating lanes and/or multiple approach and exit lanes, are not suitable for cyclists. Fully segregated grade separated or alternative cycle alignment solutions should be considered to ensure safe cycling continuity.



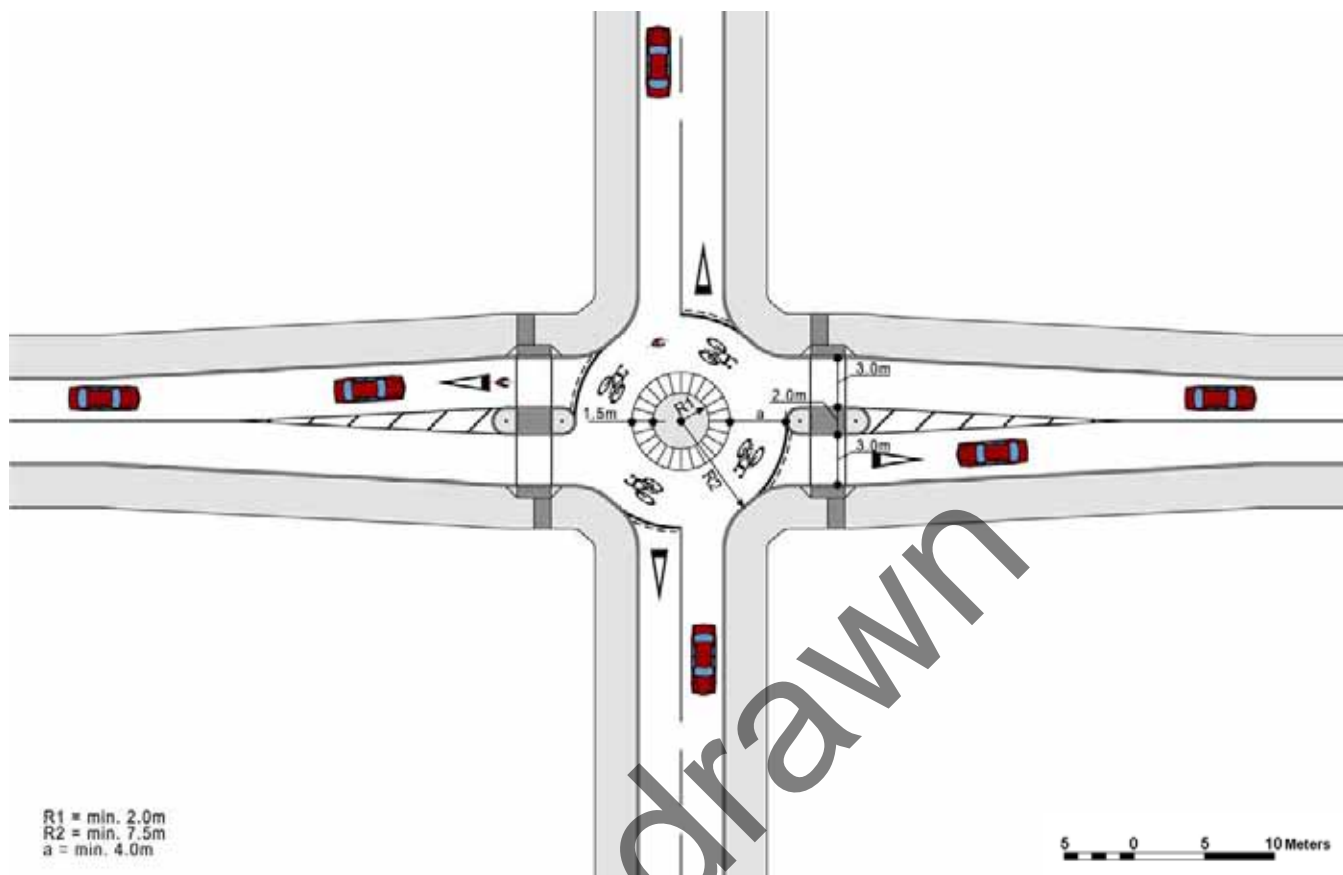
Mini Roundabout



- Cyclists mixed with traffic
- Low volume, low speed environments
- Suitable for narrow single lane approaches
- Central island is painted, domed to 75mm at centre



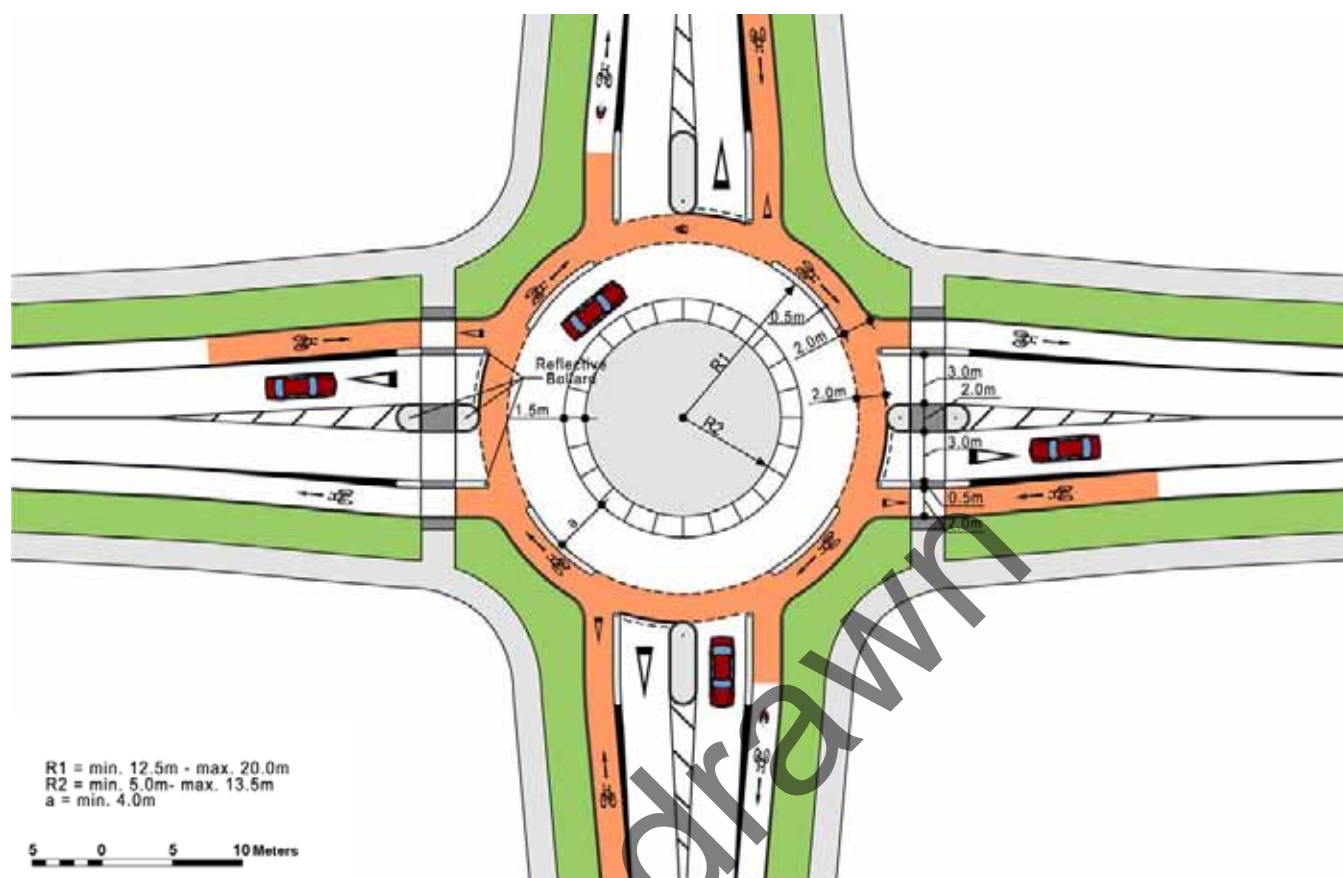
Shared Roundabout



- Cyclists mixed with traffic on single circulating lane
- Not suitable where high cycle numbers anticipated
- May be appropriate to consider plateaux on each approach to roundabout
- Safety assessment measured against local control data (safety record, local accident data)



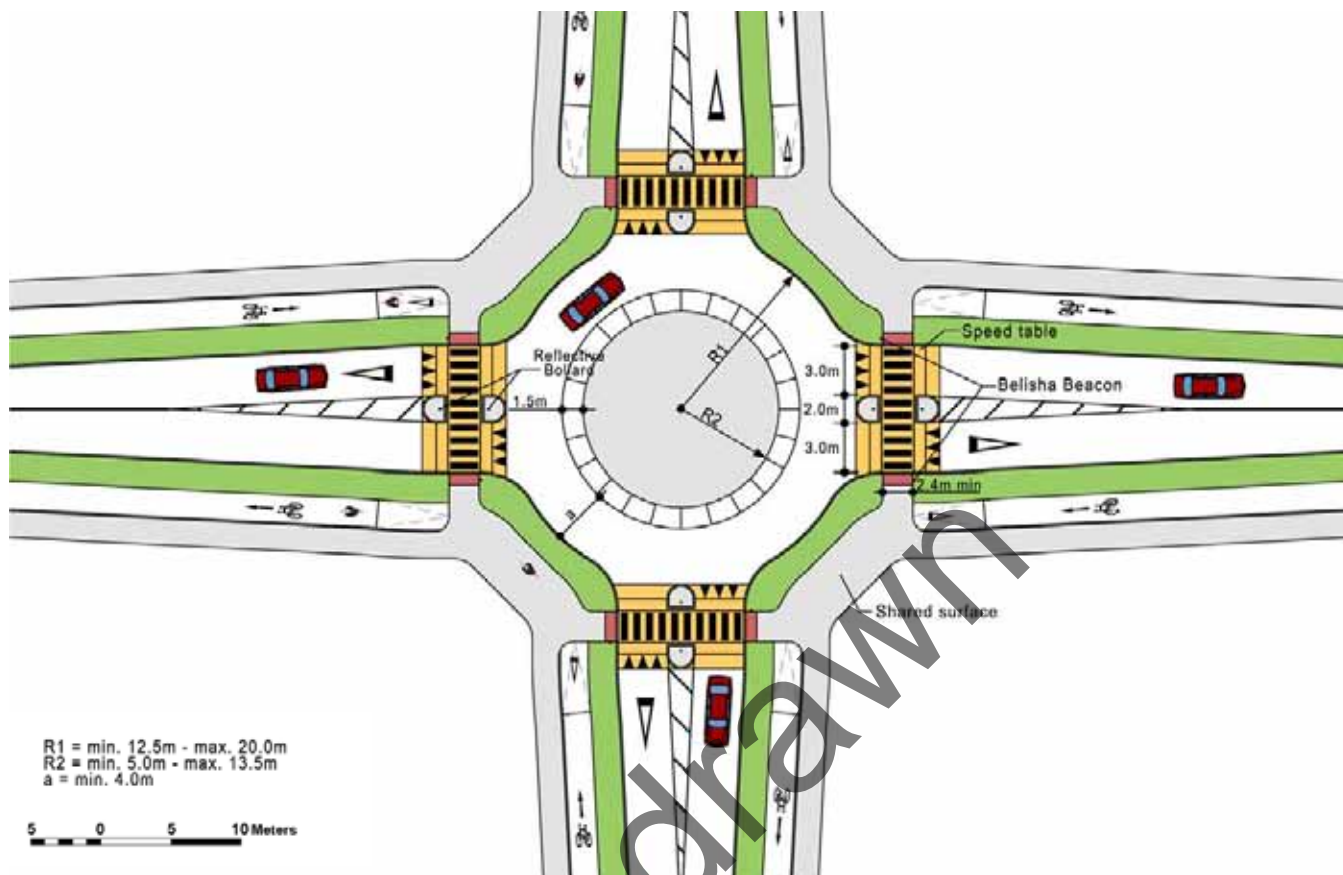
Segregated Track on Roundabout



- Priority for cyclists at entry and exit roads must be clearly established
- Roundabout arms should have narrow entries and exits, aligned to the centre of the roundabout, and minimum flare (sufficient for standard vehicle tracking)
- Hedgehog kerbs on the roundabout should have a width of 0.50 to 1.00m, and must be highly visible and obvious to motorists
- Most suitable for use on Collector Roads or low-volume District Distributor Roads



Fully Segregated Roundabout



- Cyclists are required to stop
- Intended priority at entry and exit roads must be obvious
- Points of conflict must be obvious to cyclists and motorists
- Vehicular approaches to cycle crossing must be at right angles for optimum eye contact
- Cycle track fully segregated off-roundabout
- Safety buffer between track and roundabout



4.8.5 Improving Existing Roundabouts

Many existing urban roundabouts were designed primarily from a motorist or capacity perspective, and are not conducive to safe pedestrian and cycling movements.

Flared multi-lane approaches can be converted to single lane right-angled approach lanes as shown below. The benefits include a safer cyclist and pedestrian environment, slower speeds and reduced risk, greater legibility for drivers and better gap acceptance.



Traffic queuing may increase slightly in the peak periods. This should be considered in the context of the traffic plan for the area.

4.8.6 Signage and Markings

All approaches should have direction and "roundabout ahead" signs

Central island should have "turn left" and "sharp change of direction" signs facing each entry, as well as appropriate lane and yield markings

Cycle facilities, whether on the roundabout (continental style) or segregated, should be clearly signed and delineated for both cyclists and motorists

Priority and yield requirements should be clearly signed at all conflict points

4.8.7 Overrun Areas

Overrun Areas can be provided on any of the roundabout types above in order to accommodate occasional larger vehicles.

The overrun area is separate to the circulating lane and forms part of the internal central island.

A 50mm kerb should be provided to between the circulating lane and the overrun area.

The preferred width of the overrun area is 1.5m to 2m.



4.9 SIDE ROADS AND T-JUNCTIONS

Side roads present either as T-junctions, left turns or right turns depending on the approach direction. This section considers non-signalised junctions at side roads along main cycle routes.

4.9.1 General Arrangement of Side Roads

The objective is to control traffic movements and speed, and to ensure legibility for all road users. Key items to consider in making side roads more legible and cyclist-friendly are covered below.

4.9.1.1 Single Lane Side Roads Only

Side roads should use a single 3.0m wide lane approach. A single approach facilitates clearer visibility between motorists and cyclists on both roads.

In contrast, double approach lanes obstruct visibility. Emerging left-turning motorists may not see cyclists approaching along the main road due to vehicles in the outer lane of the side road.

Furthermore, if there are two lanes, there is no obvious way for a cyclist to turn right from the side road onto the main road.

4.9.1.1.1 Set Back Stop and Yield Lines

In built up areas, set back stop signs, yield signs and road markings should be located such that they are highly visible, to increase junction legibility, and reinforce the expectation of main road priority.

Stop and yield lines should be located at the first point of conflict with pedestrians, i.e., the back of the footpath, (or the building line or the fence line depending on context). Under this design, emerging vehicles make a two stage approach to the junction.

In the first stage, motorists stop or yield at the set back location, to allow pedestrians cross the side road with greater comfort and security. In the second stage, motorists proceed to the actual junction at a slow speed giving them time to see cyclists approaching the junction along the main road.

4.9.1.1.1 Tight Kerb Radius

Where cyclists share the road space, either in a mixed street environment or with cycle lanes, a tight kerb radius of 1.0m to 3.0m at the mouth of side streets restricts the speed of turning vehicles.

Where side roads have cycle tracks, it is important to ensure the cycle track radius is at least 5.0m to ensure cyclists do not swing out into the path of turning vehicular traffic.

4.9.1.1.1 Cycle Facility on Side Road

Where possible, a mandatory cycle lane on the side road should be provided to ensure cyclists have access to the stop line. This confers an advantage on cyclists in situations where there may be periodic queues on side streets.

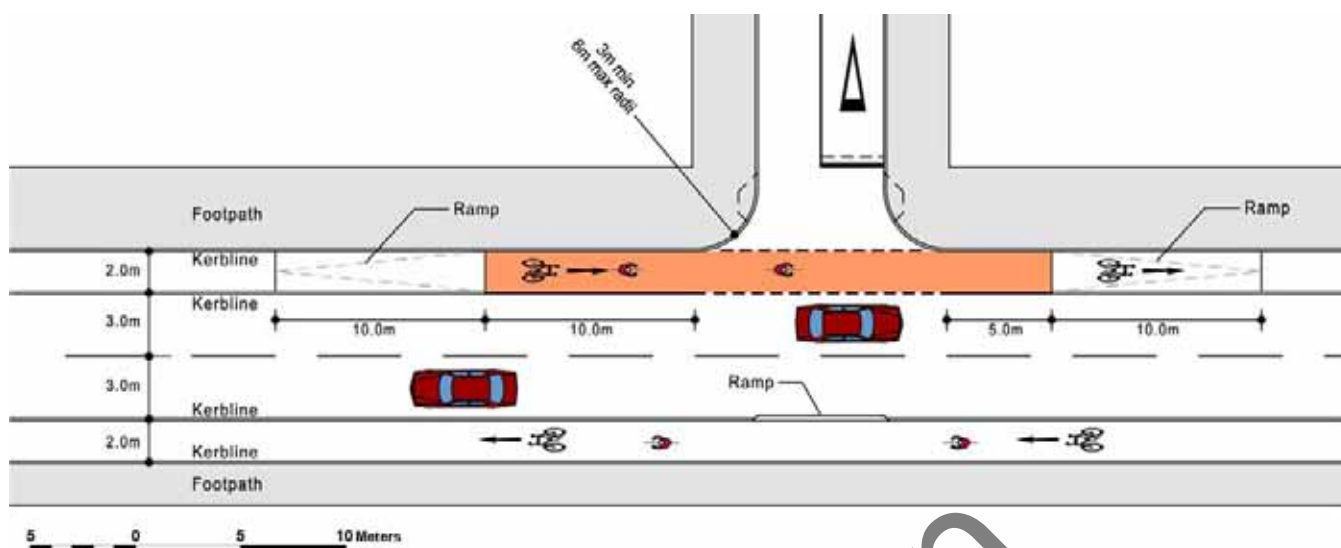
4.9.2 Examples of Side Road Junctions

The following drawings illustrate how different main road traffic regimes interface with the unsignalised side road.



Left curve radius too generous

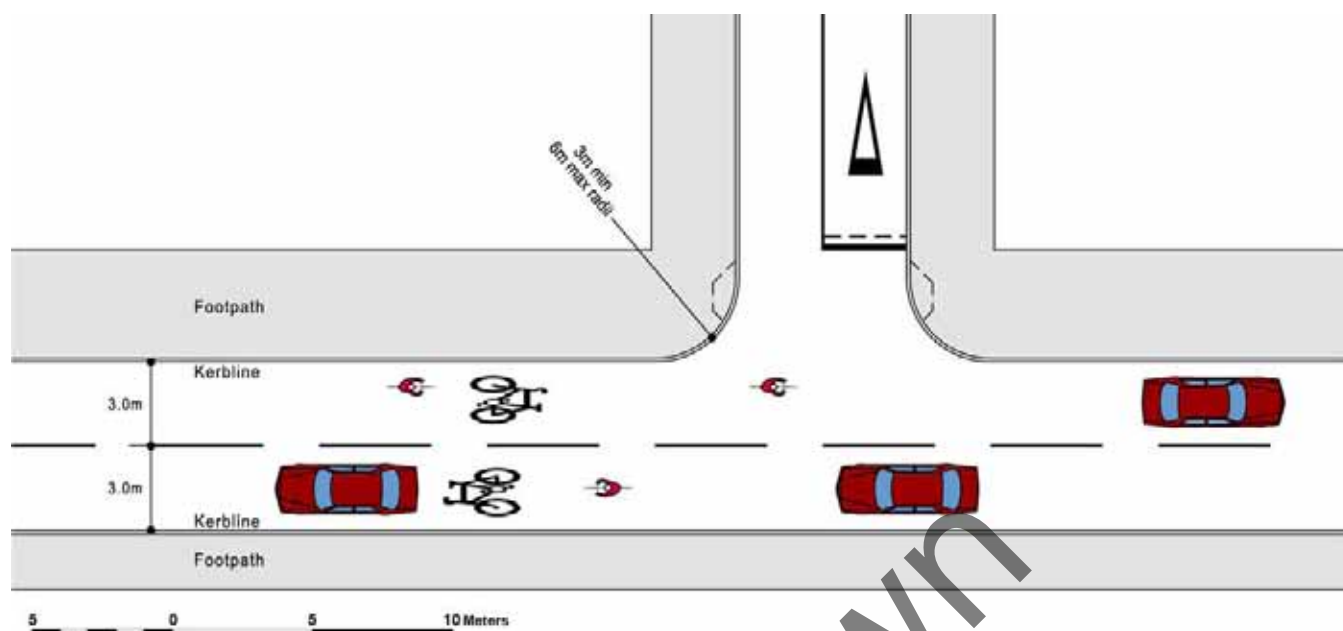
General Arrangement for Side Roads



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



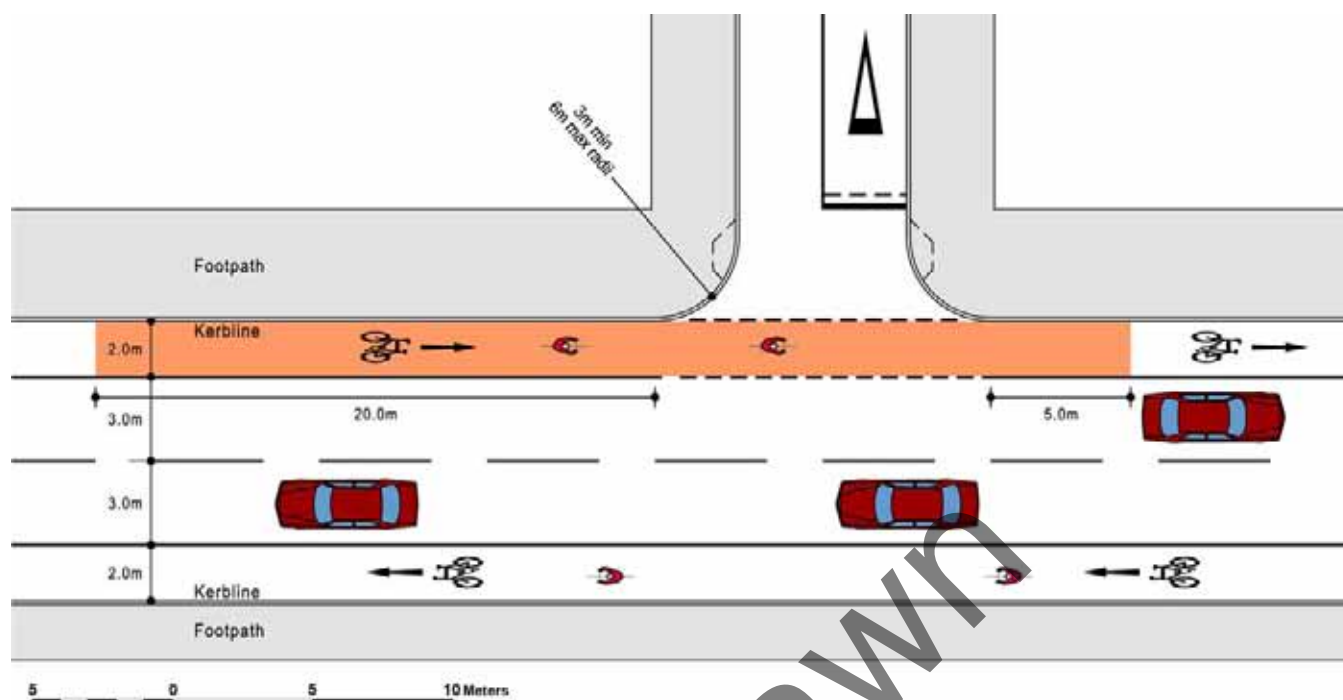
Side Road joining Mixed Street



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)



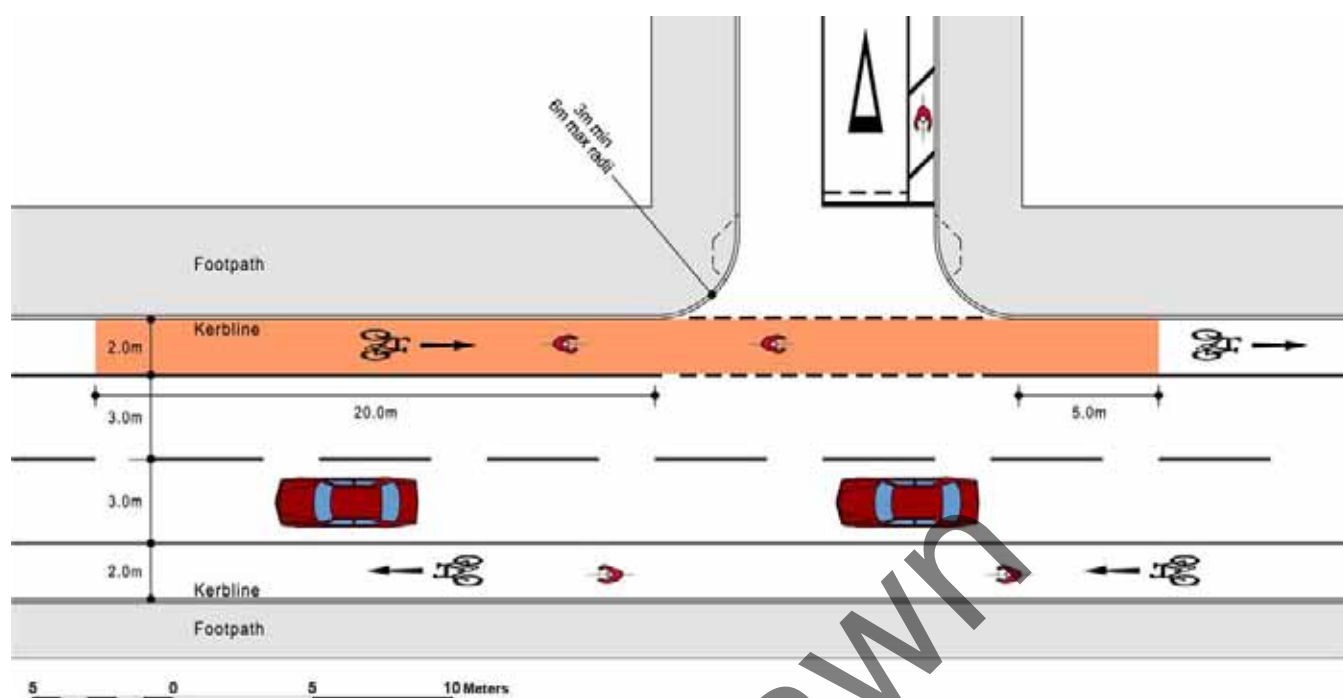
Side Road joining Street with Cycle Lane



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



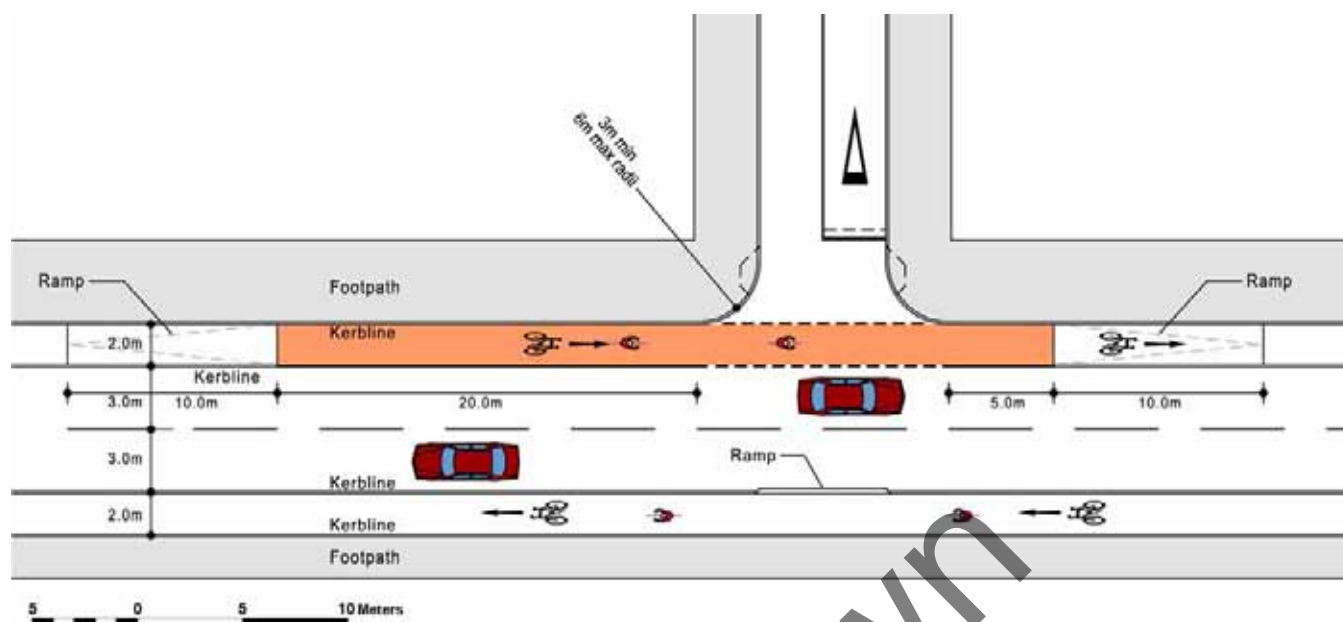
Side Road with Hatched Kerb Side



- Narrow side road in built up areas (6-7m, plus hatched kerb side)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



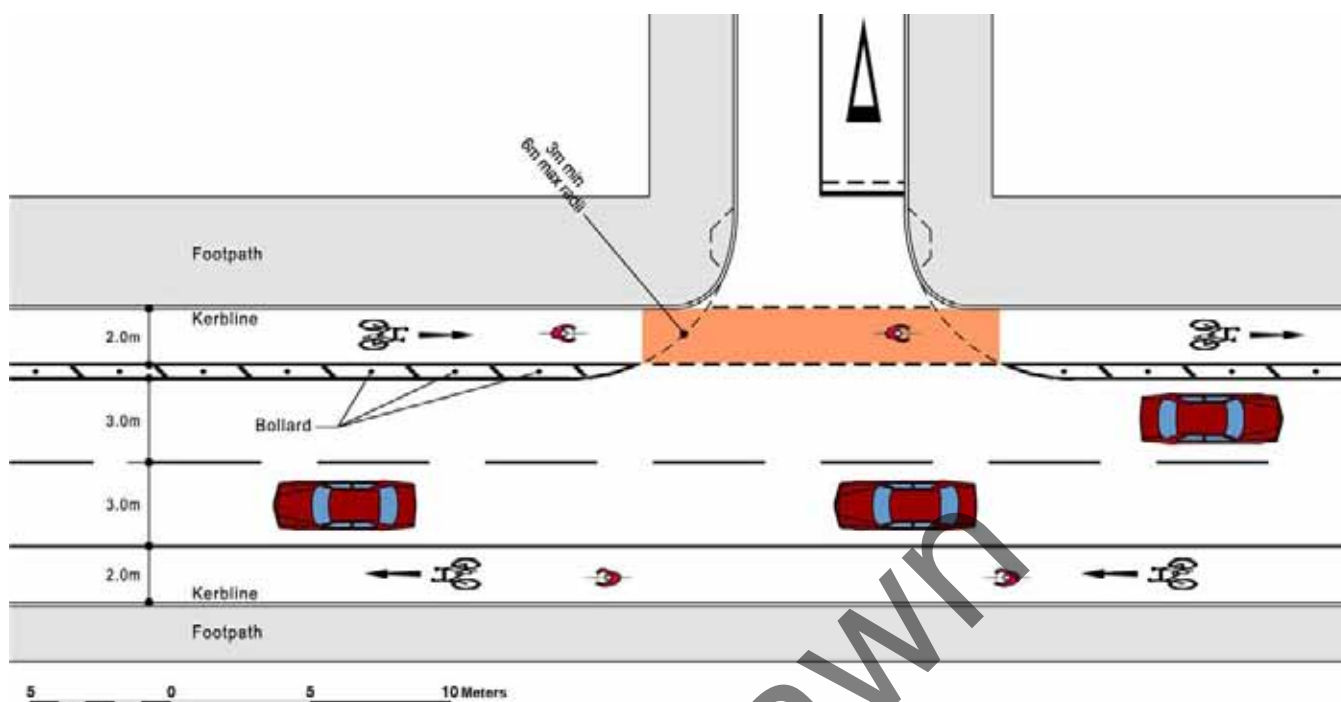
Side Road joining Street with Cycle Track



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Cycle track with transition to mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



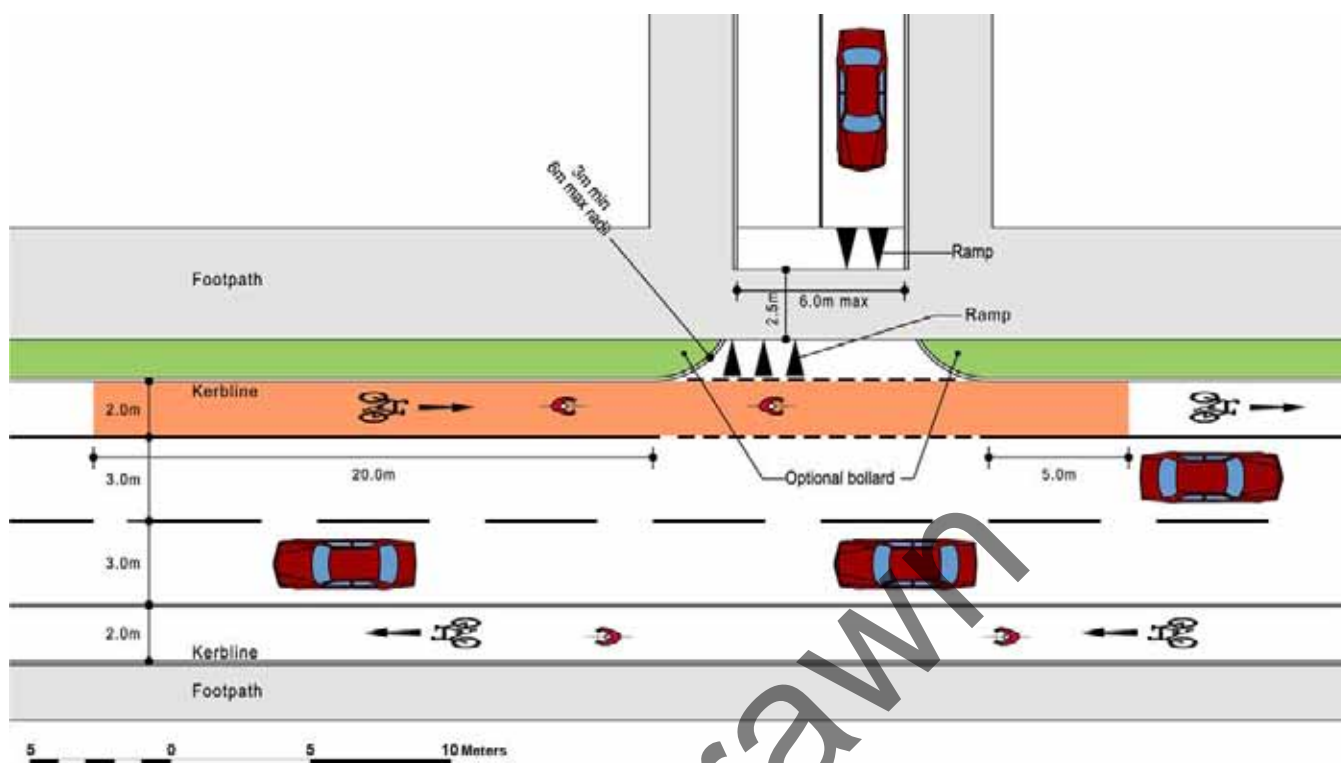
Side Road joining Street with Segregated Cycle Facility



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Segregated cycle lane approaching junction, to provide cycle space and preclude parking and ensure cyclist are not encroached by turning vehicles
- Cycle lane brought across mouth of junction in red colour
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



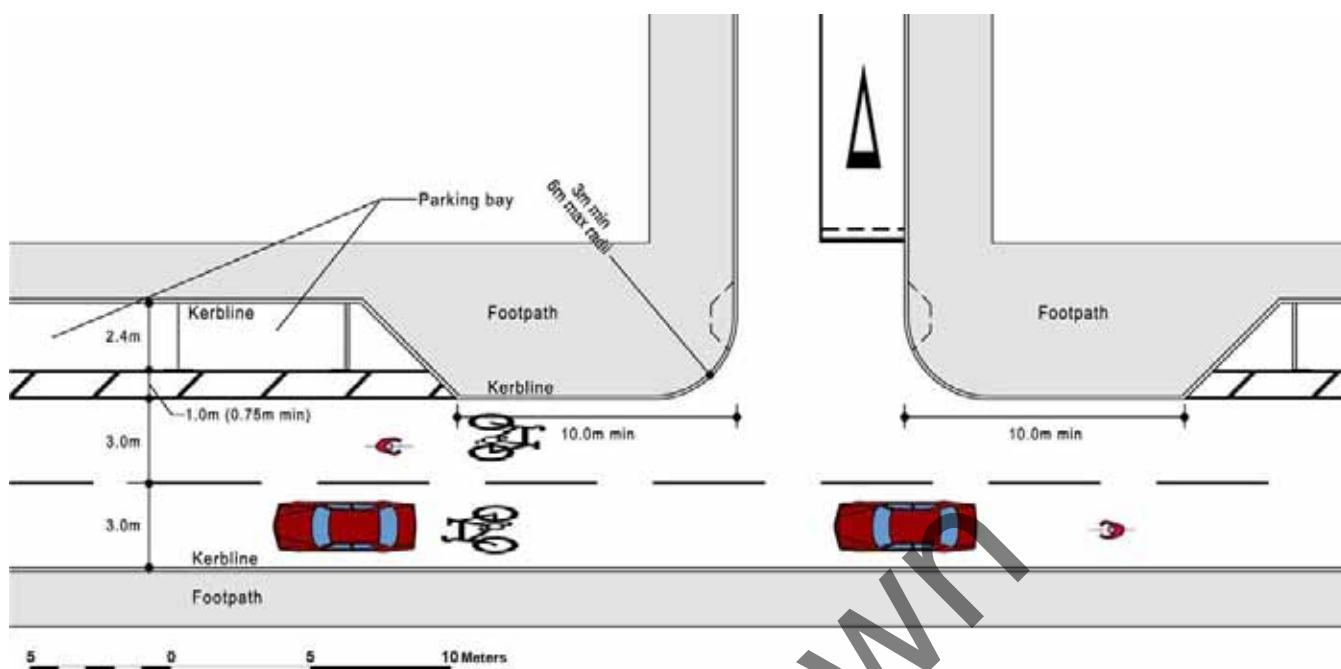
Minor Side Road with Pedestrian Priority



- Minor side roads and access streets in built up areas up to 6.0m wide
- Continuous footpath with vehicle cross over
- Vehicles on side road edge out slowly across the footpath and then into traffic
- Kerb radii tight (3-5m)
- Mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



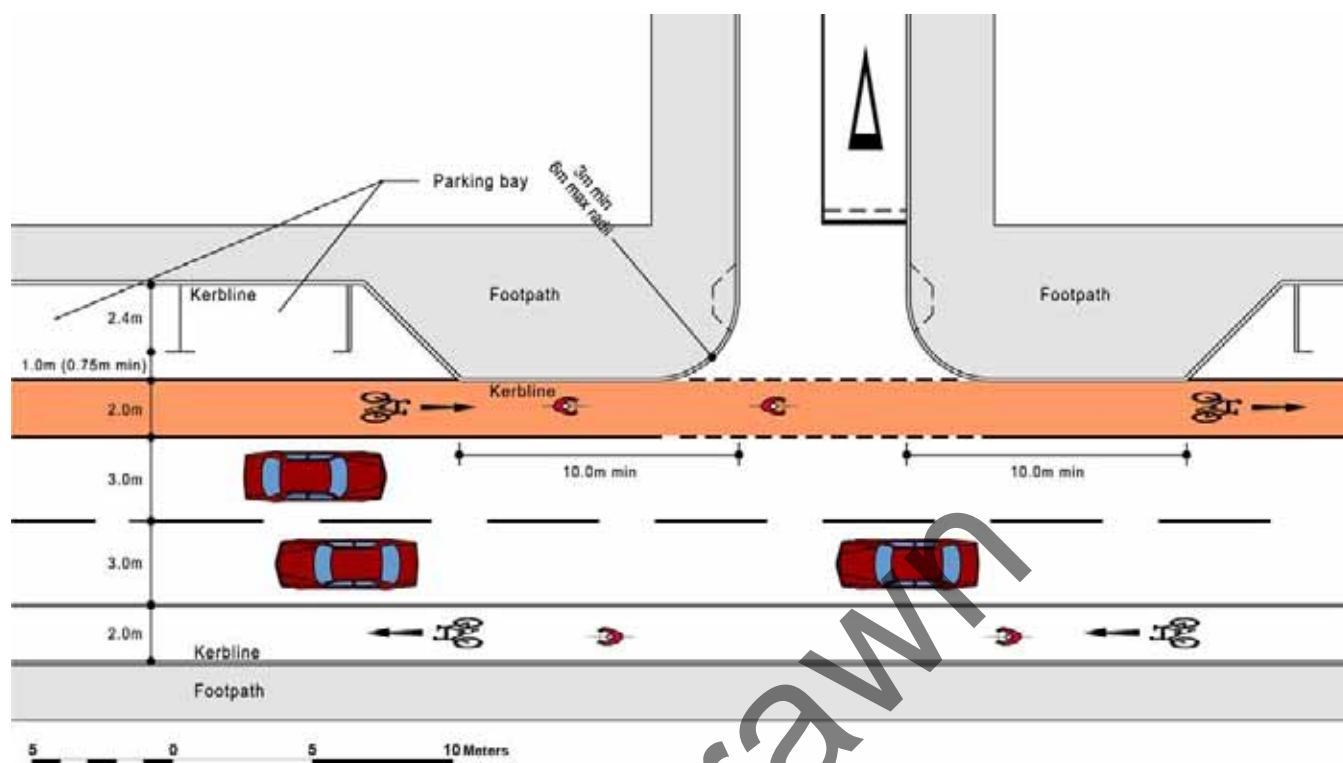
Side Road joining Mixed Street with Parking



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Built out footpath enhances visibility beyond parked cars for emerging motorists



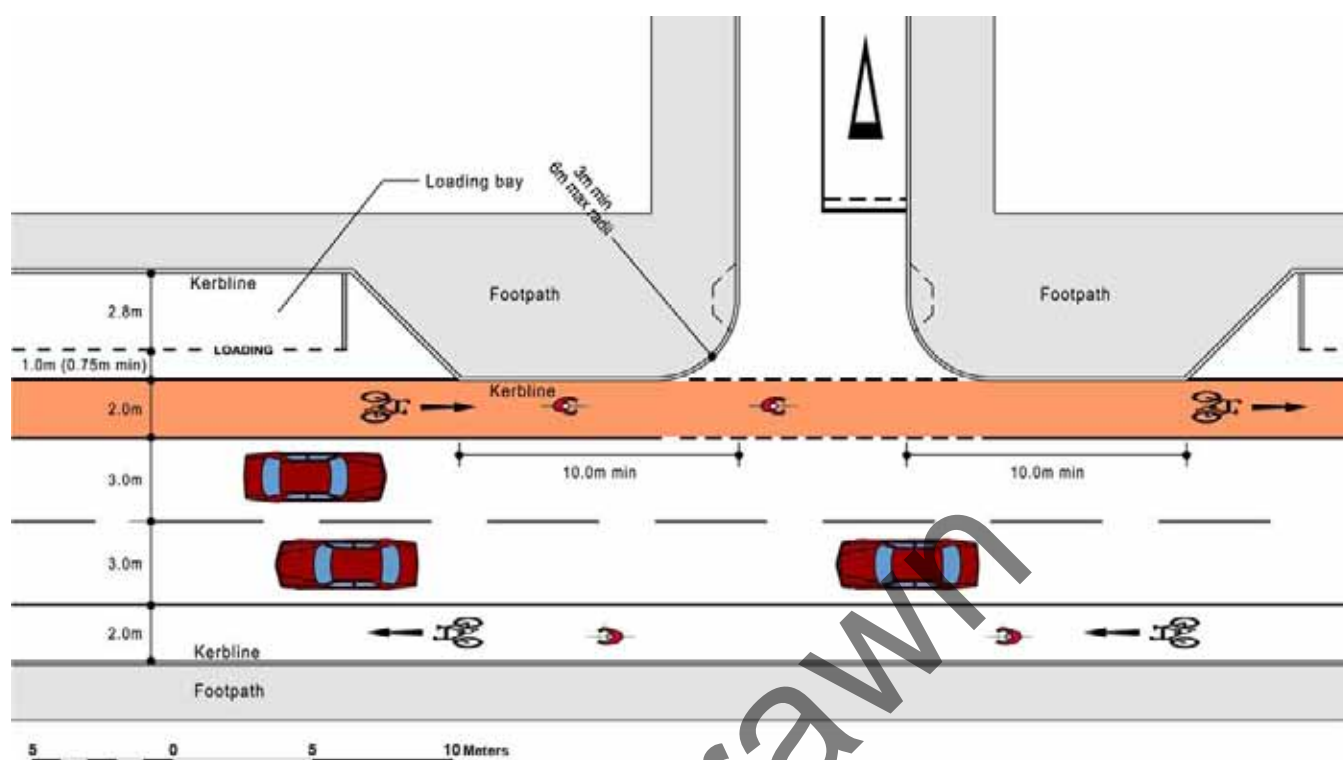
Side Road joining Street with Cycle Lane and Parking



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn
- Built out footpath enhances visibility beyond parked cars for emerging motorists



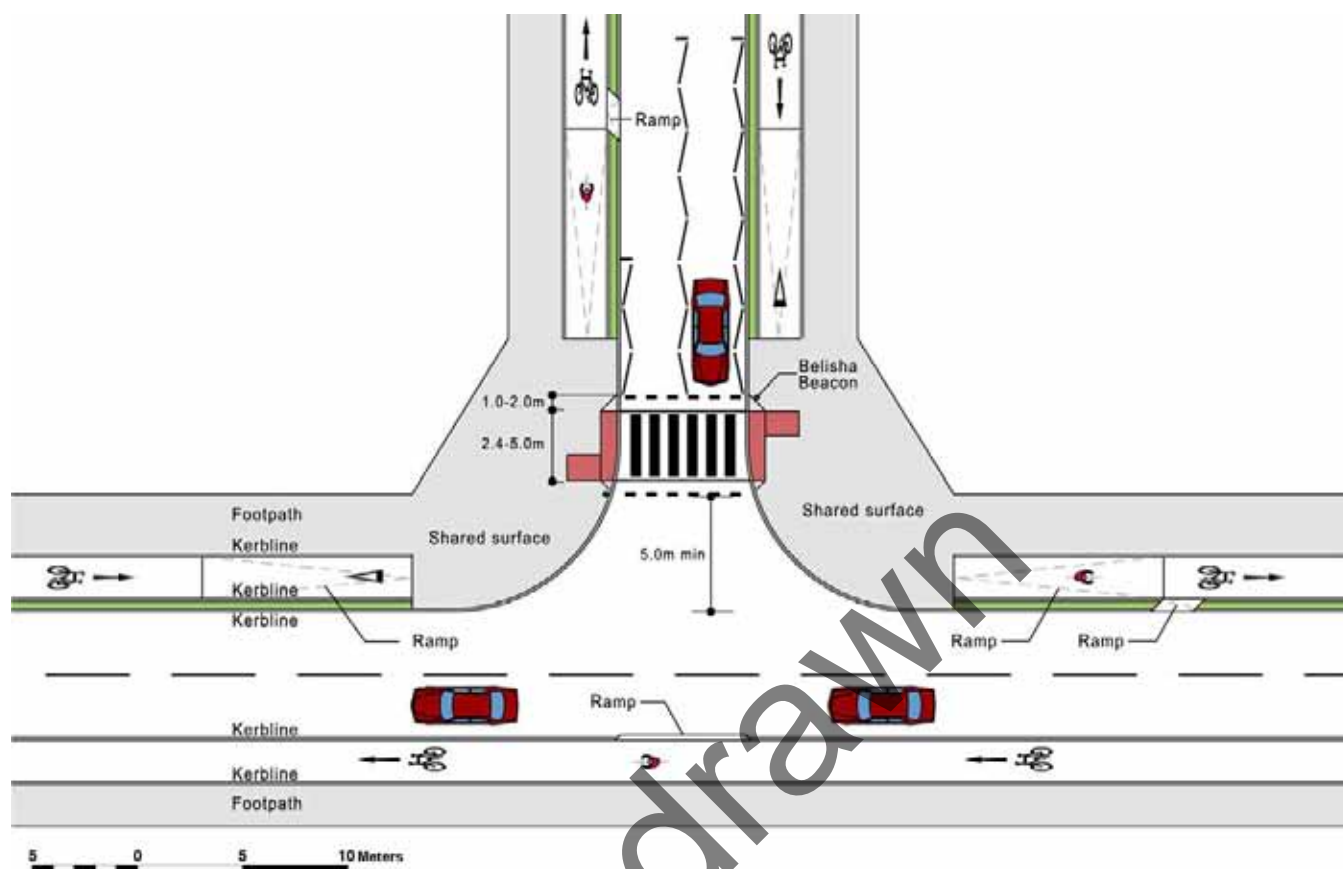
Side Road joining Street with Cycle Lane and Loading Bays



- Narrow side road in built up areas (6-7m, plus cycle lanes, if provided)
- For urban centres, stop or yield line at / behind rear of footpath
- Vehicle on side road makes two-stage progress, first across pedestrian crossing area, and then across cycle lane to enter traffic
- Pole (not shown) for stop / yield located at rear of footpath, away from desire line for pedestrians
- Kerb radii tight (3-5m)
- Mandatory cycle lane approaching junction, to provide cycle space and preclude parking
- Red coloured surface commencing 20.0m in advance of the side road to improve legibility
- Cycle lane brought across mouth of junction
- Cyclists opposite side road may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn
- Built out footpath enhances visibility beyond loading bay for emerging motorists



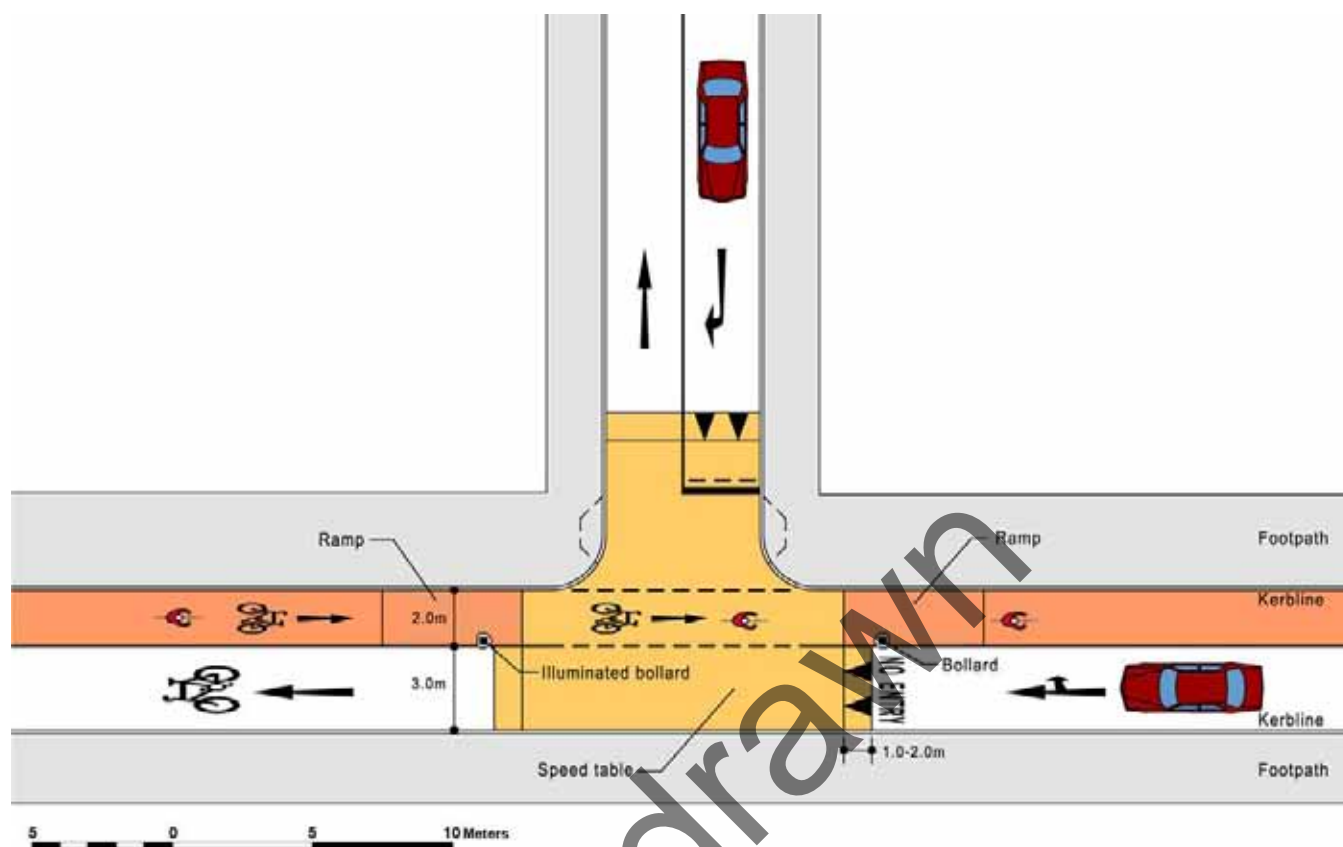
Side Road for HGVs



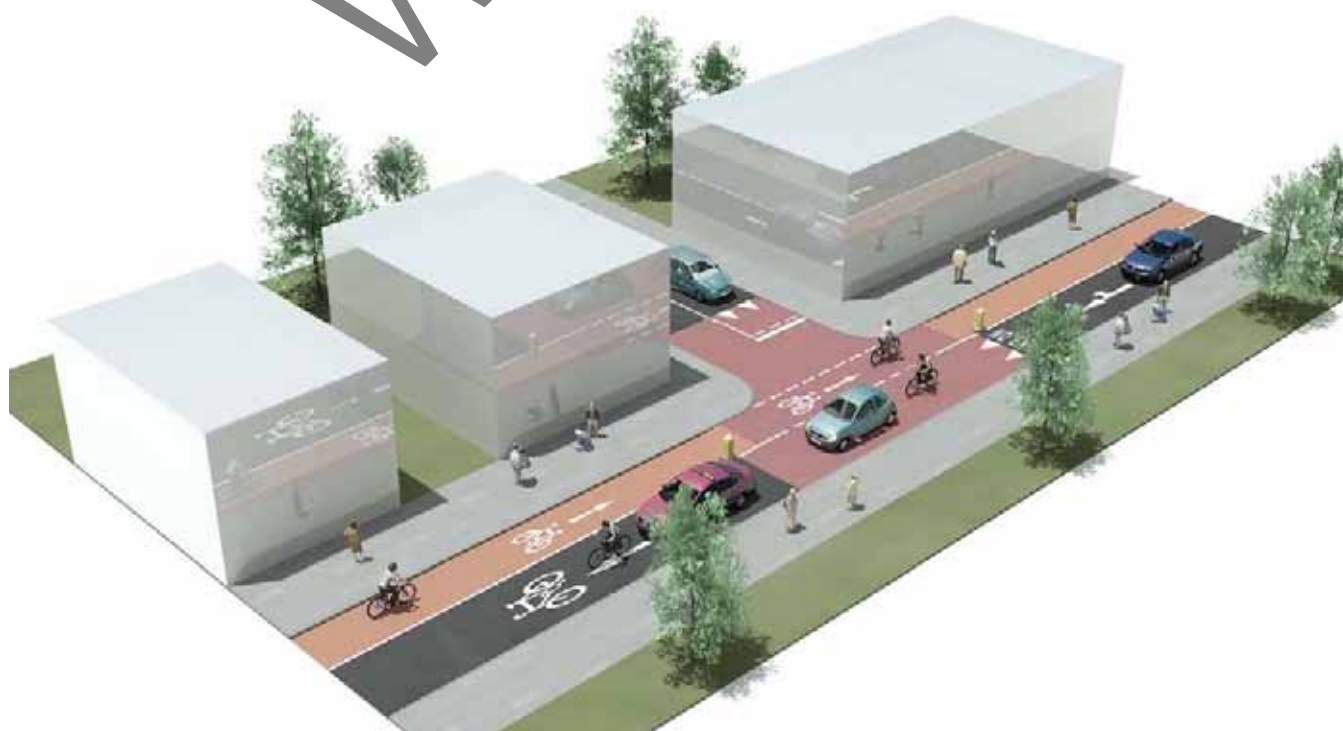
- HGV environment
- Larger kerb radii required
- Cyclists removed from the turning path of large trucks
- Main road cyclists lose priority and join shared pedestrian area at junction
- Use high kerbs to deter cyclists from joining the road



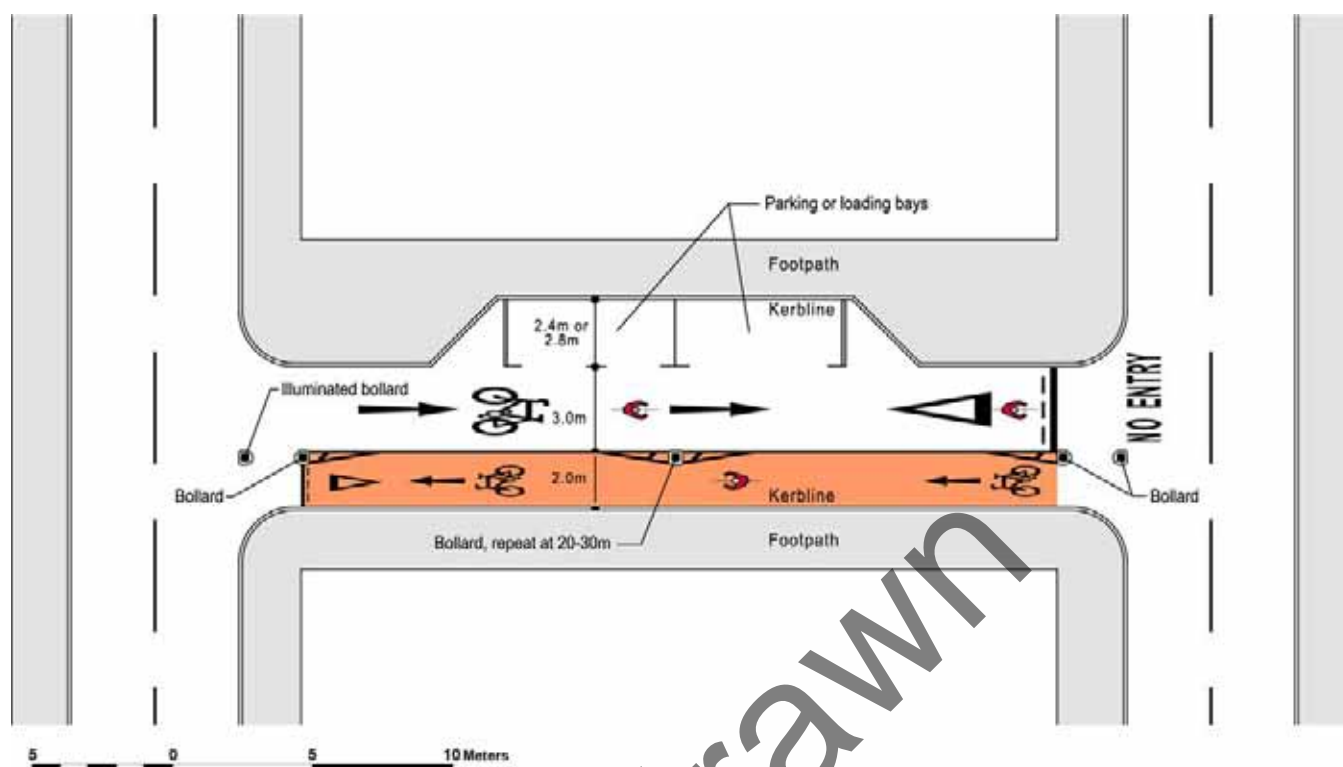
Side Road joining Contra Flow Street



- For quiet street environments
- Use junction table as shown
- Use lit bollards to emphasis edge of vehicular lane



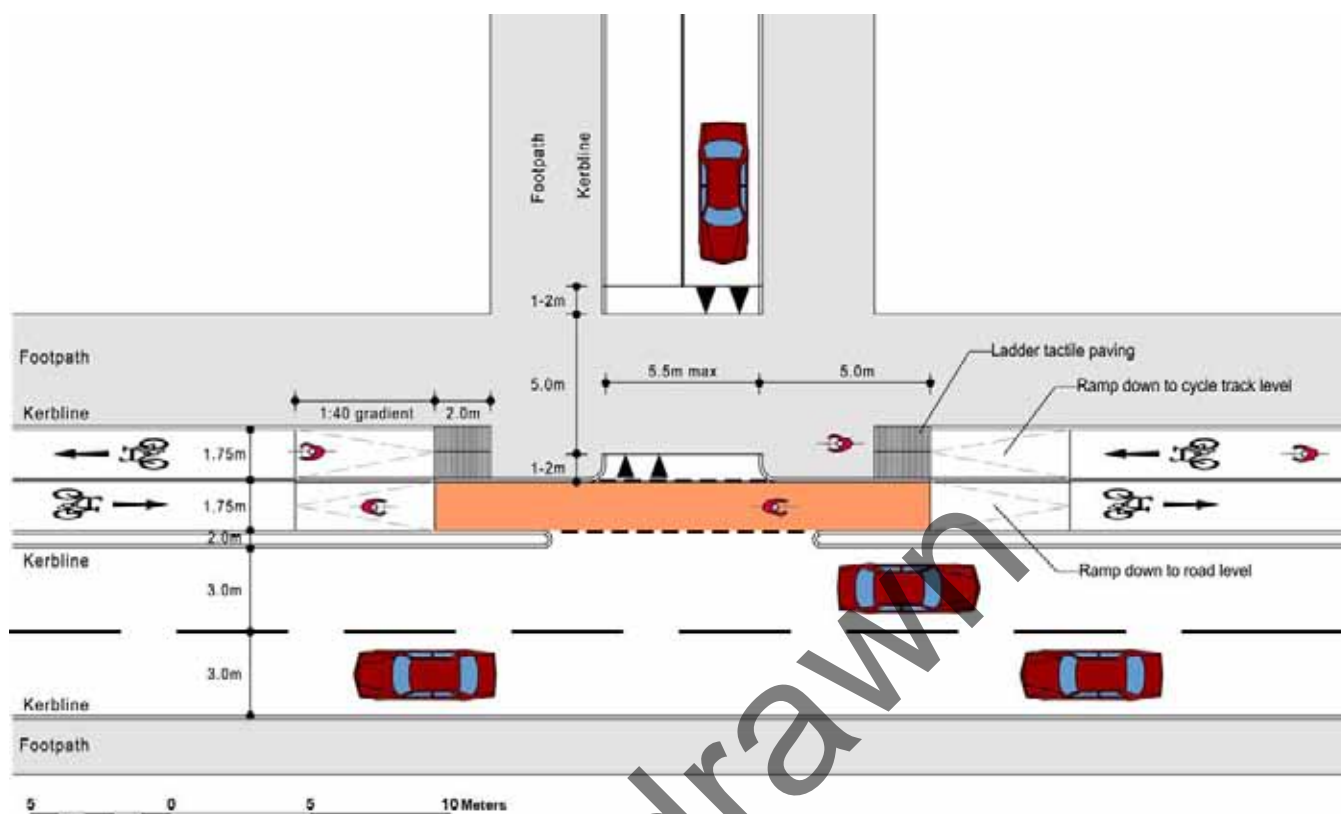
Contra Flow Side Road joining Main Street



- For quiet street environments
- Use lit bollards to emphasis edge of vehicular lane



Two-Way Cycle Track Crossing Side Road



Conventional Pedestrian Crossing

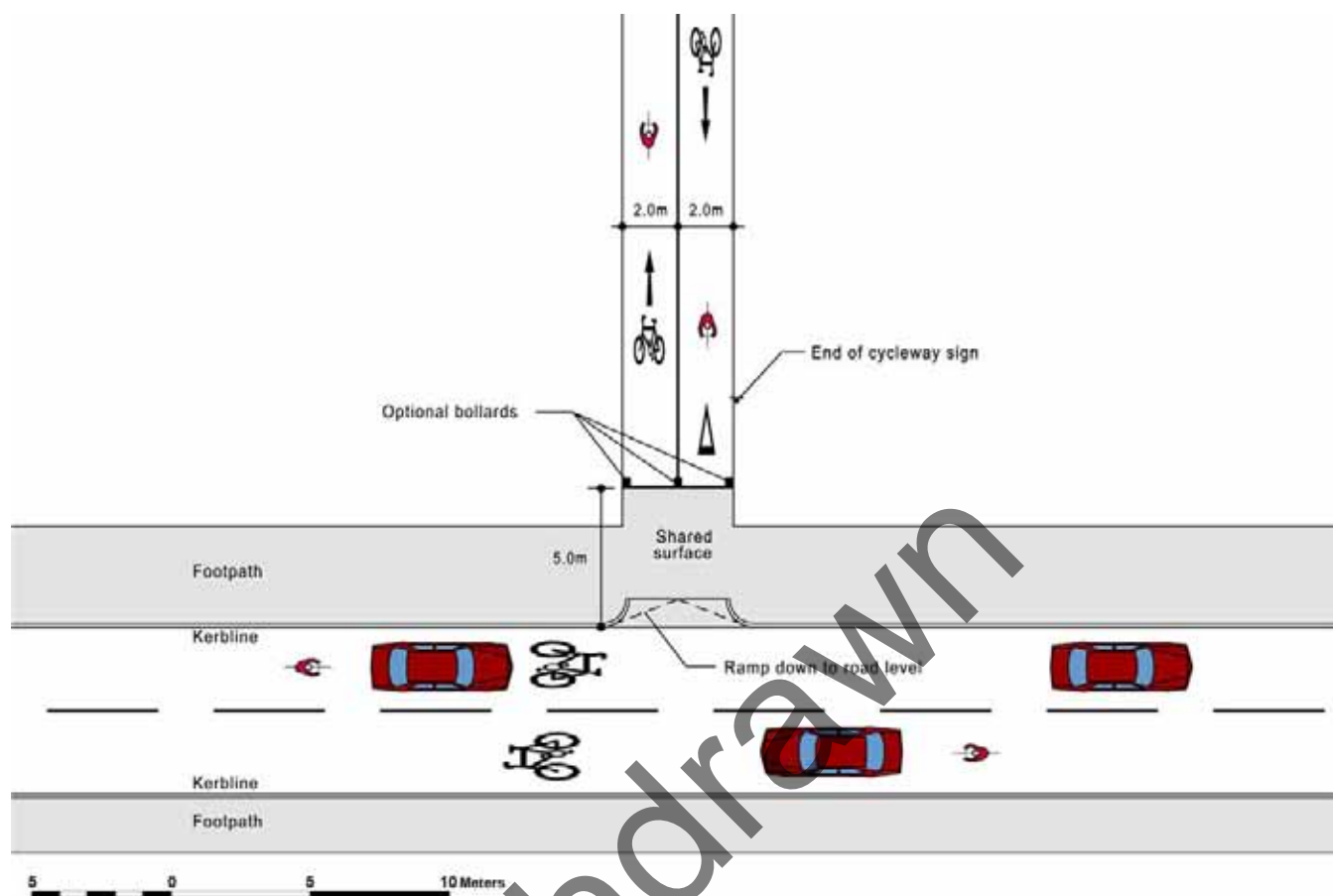
- Contra flow cycle track terminated at side road
- At conventional pedestrian crossing, contra flow cyclists must dismount and cross the side street as a pedestrian. At shared pedestrian crossings, contra flow cyclists must yield to pedestrians and join a shared pedestrian crossing of the side road
- Cyclists with main traffic flow maintain main road continuity across mouth of side road
- Kerb extends close to junction to segregate two way cycle track from main road traffic
- Cyclists opposite cycle way may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn

Shared Pedestrian Crossing

- Contra flow cycle track terminated at side road
- Contra flow cyclists must yield to pedestrians and join a shared pedestrian crossing of the side road
- Cyclists with main traffic flow maintain main road continuity across mouth of side road
- Kerb extends close to junction to segregate two way cycle track from main road traffic
- Cyclists opposite cycle way may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



Two-Way Cycle Track joining Main Street



- Termination of a cycle way at a street environment
- Continuous footpath with pedestrian priority shared space
- Bicycles edge out slowly across the footpath and then into traffic
- Cyclists opposite cycle way may stop / slow to make direct crossing, or take central position in traffic lane before making right hand turn



4.10 TRANSITIONS

Urban situations will invariably include different street widths, kerbside activities, segregation requirements and junction types. Cyclists will frequently be required to make a transition to the right or left, from on-road to off-road etc.

Transitions will generally be required in the vicinity of:

- bus stops
- left-hand filter lanes
- the start and end of off-road segregated facilities
- embayed parking and loading areas

Transitions should be designed and constructed to provide continuity, comfort and safety to cyclists.

4.10.1 Principles of Sustainable Safety

Legibility

The design should ensure that the bicycle does not “pop out of nowhere” into the middle of traffic, or a pedestrian environment. Rather, the change in direction of the bicycle through the transition must be designed so that it is anticipated and understood by the other road users, as well as the cyclist.

If the transition re-introduces cyclist into a traffic situation, there are two legibility-related requirements:

- physical protection for the cyclist – the cyclist must be physically protected until safely established on their new alignment
- zone of re-establishment between the cyclist and the adjacent traffic - this is a zone for both the cyclist and the traffic to settle into their relative positions after the transition, before any weaving or turning conflict presents itself. This zone should generally be 20m long

If the transition introduces cyclists into a pedestrian situation, it is important that the transition is well-signed (i.e. no surprises for either cyclist or pedestrian), and that it is clear that the pedestrian has priority within the shared environment.

Similarly, the cycle exit from the shared space should also be obvious, especially to the cyclist.

The transition should serve to ensure that the cycling arrangement (especially speed) is compatible with the receiving environment.



Bus passenger / cyclist conflict

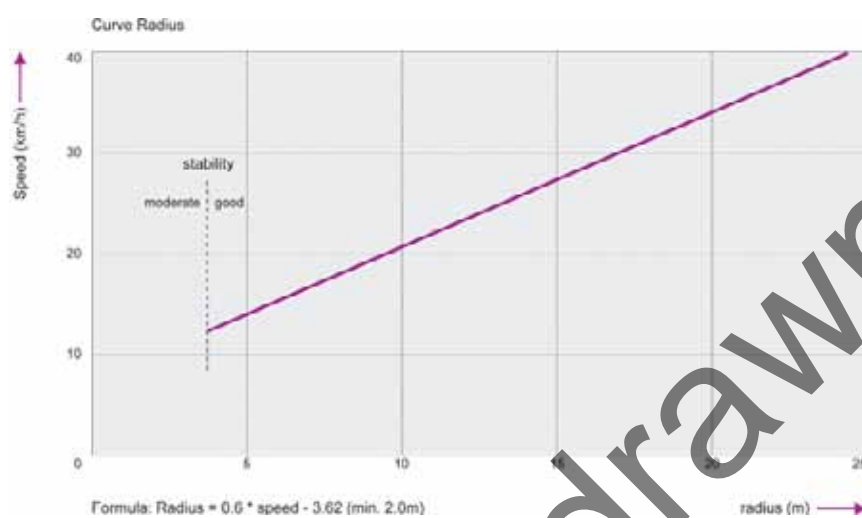


Complicated transition

Functionality

For cycle transitions to function properly, designers must consider their curve radius, surface quality and width.

The curve radius of a transition should permit cyclists to preserve momentum and maintain their balance. The radius increases with speed, and the graph below shows the relationship between cycle speed and the required curve radius. A curve radius of 16.0m along a cycle route is recommended to accommodate cyclists travelling at 30km/h. Tighter curves may be appropriate near junctions where cycling speeds are inevitably lower.



Construction joints should always be at right angles to the direction of travel of the bicycle. Cyclists traversing construction joints obliquely may become "rutted" in the joints and lose balance.

Additional width for the cycle facility will assist cyclists negotiating curves through a transition. A minimum width of 2.0m should be provided in any case.

4.10.2 Vertical Transitions

Vertical transitions involve shifting cyclists up and down from one level to another. Examples include transitions between road level and an adjoining raised track, or when bringing cyclists into or out of a shared pedestrian area.

4.10.3 Horizontal Transitions

Horizontal transitions are used to shift cyclists to the right or left. Examples include transitions in advance of a left-hand pocket, car parking and Island Type Bus Stops (See Section 5.1.5) etc.

4.10.4 Combination Transitions

There are situations where cyclists will need a combination of vertical and horizontal transition. A typical example would include moving from an off-road cycle track to a cycle lane in advance of a junction, and vice versa.

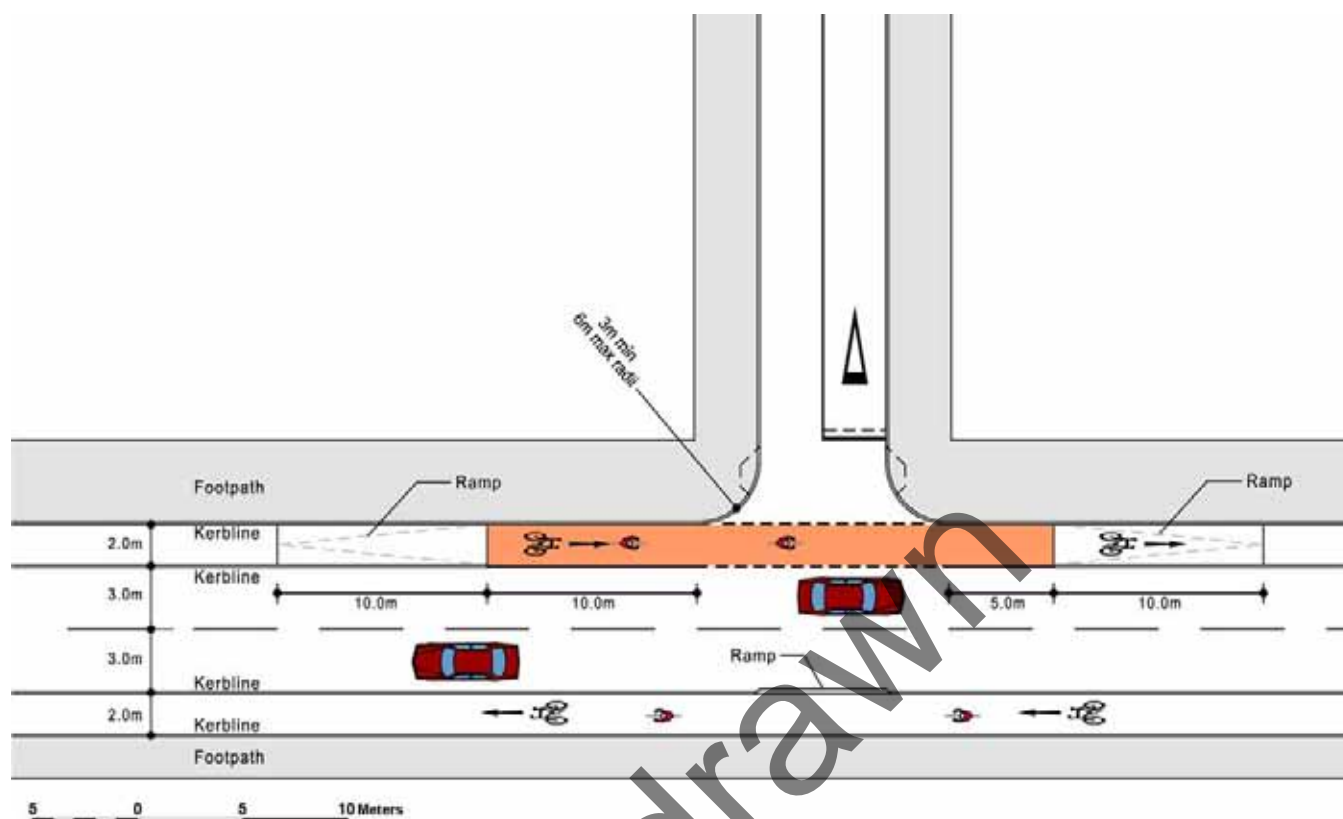
It has proved difficult for builders to construct combination transitions, and it has been equally difficult for cyclists to cycle on these.

This manual recommends that both movements are dealt with sequentially, but not at the same time.



Abrupt transition to carriageway

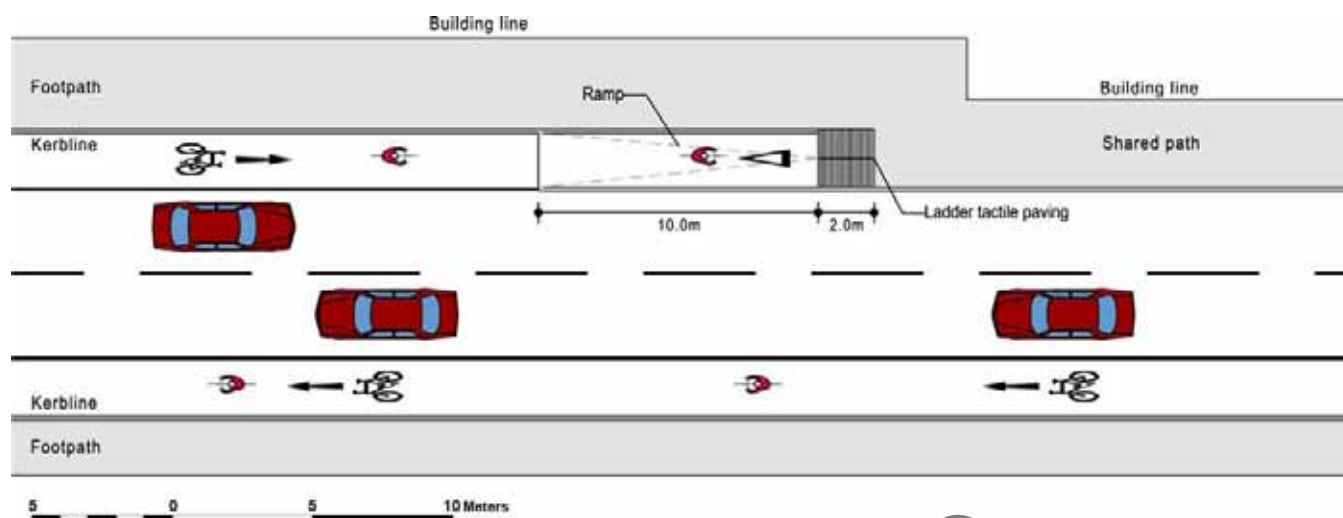
Vertical Transition - Cycle Track to Cycle Lane



- Ramp to have maximum slope of 5%
- Minimum longfall of 0.5% is required for drainage purposes
- Joints perpendicular to travel direction of bicycle, and completely smooth
- End of ramps to be rounded – no abrupt edges



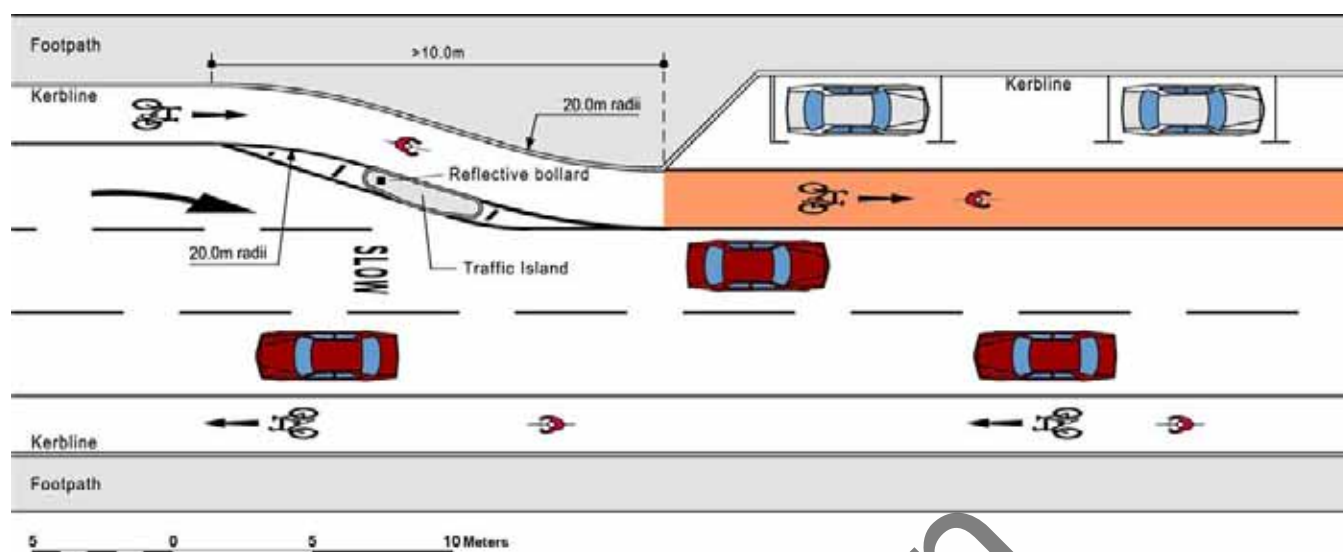
Vertical Transition - Cycle Lane to Shared Pedestrian Footpath



- Ramp to have maximum slope of 5%
- Minimum longfall of 0.5% is required for drainage purposes
- Joints perpendicular to travel direction of bicycle, and completely smooth
- End of ramps to be rounded – no abrupt edges
- 2m long ladder tactile paving at high level to denote that transition has been reached
- Give way marking on road to indicate cyclist must give way to pedestrians



Horizontal Transition - Shifting Cycle Lane to the Right



- Provide a physical barrier such as a traffic island to protect cyclists from traffic behind
- For legibility, the island should have a vertical element (signage, bollard, light, tree etc.) to make it obvious to approaching traffic
- Use reverse curves so that the cyclist is tangential / parallel to traffic flow before and after the transition

Curve Radius and Cycle Speed

- Minor cycle routes within a built-up area, $R \leq 10\text{m}$ will facilitate 20km/h
- Cycle routes within a built-up area, $R \leq 20\text{m}$ will facilitate 30km/h
- For higher cycle speeds (e.g. downhill sections), $R \leq 25\text{m}$ will facilitate 40km/h

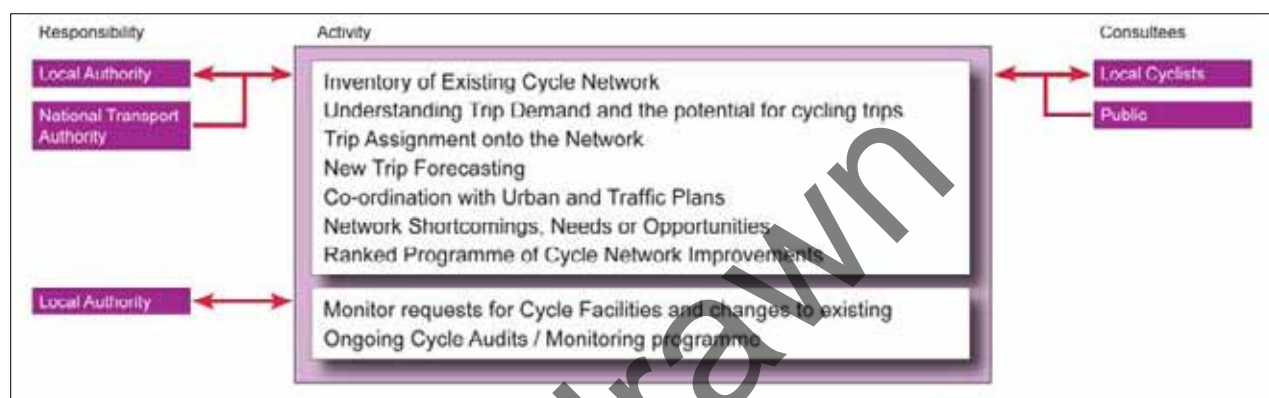


4.11 DESIGN AND CONSTRUCTION FLOWCHART

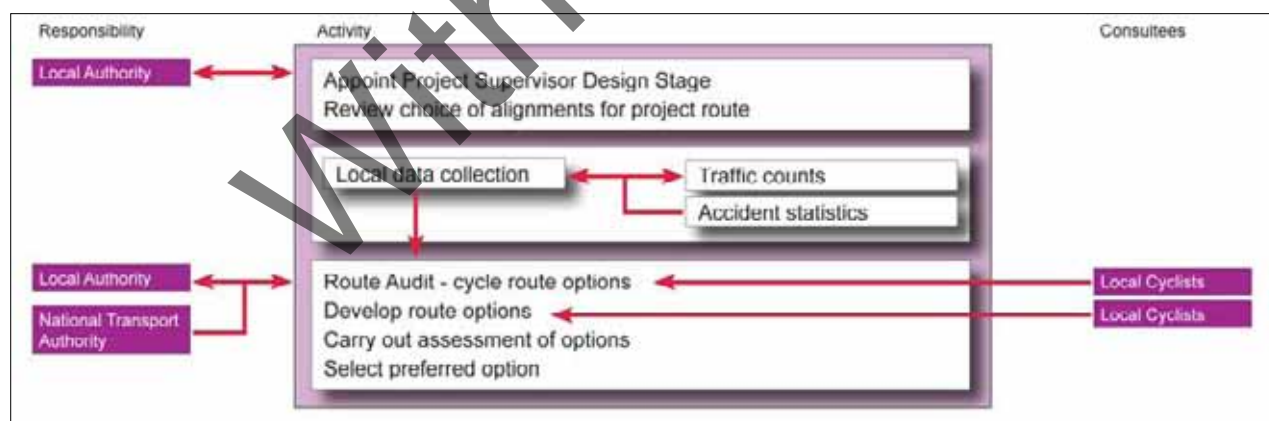
This section identifies the 9 Stages to designing and delivering a good cycle project. The purpose of this flowchart is that all designers understand the sequential process that is essential to designing for bicycles.

It is inadvisable to commence at any particular Stage without a clear output from all preceding steps. For example, it would be imprudent to embark on Stage 5: Detailed Design without a thorough understanding of the role of facility in the context of the overall network from Stage 1.

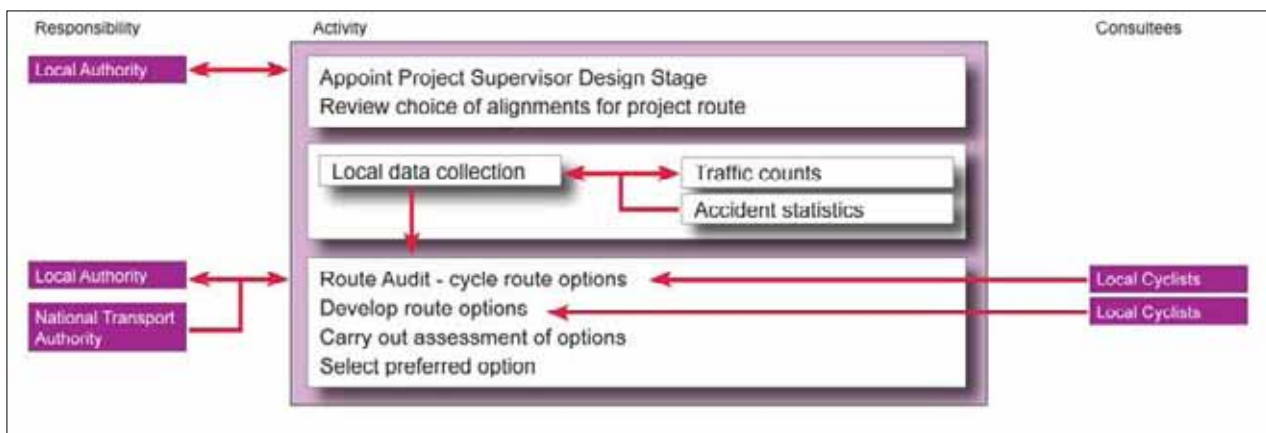
Stage 1 : Network Planning



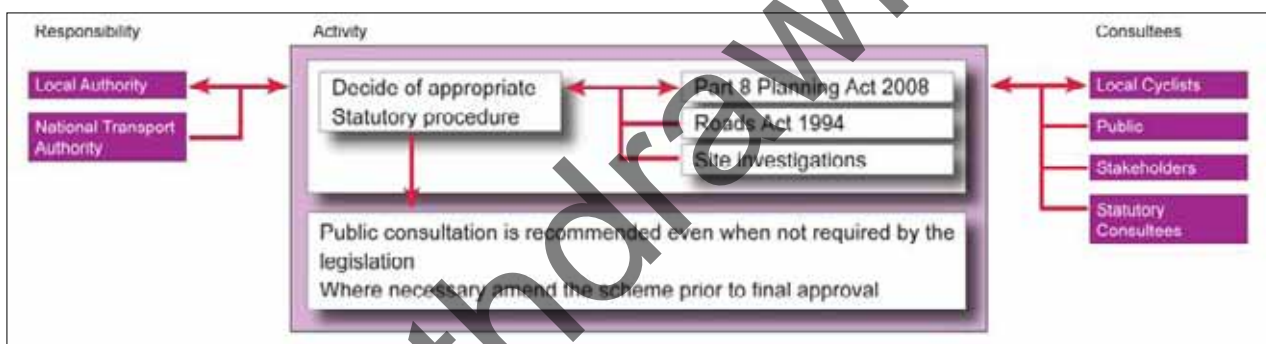
Stage 2 : Concept / Feasibility



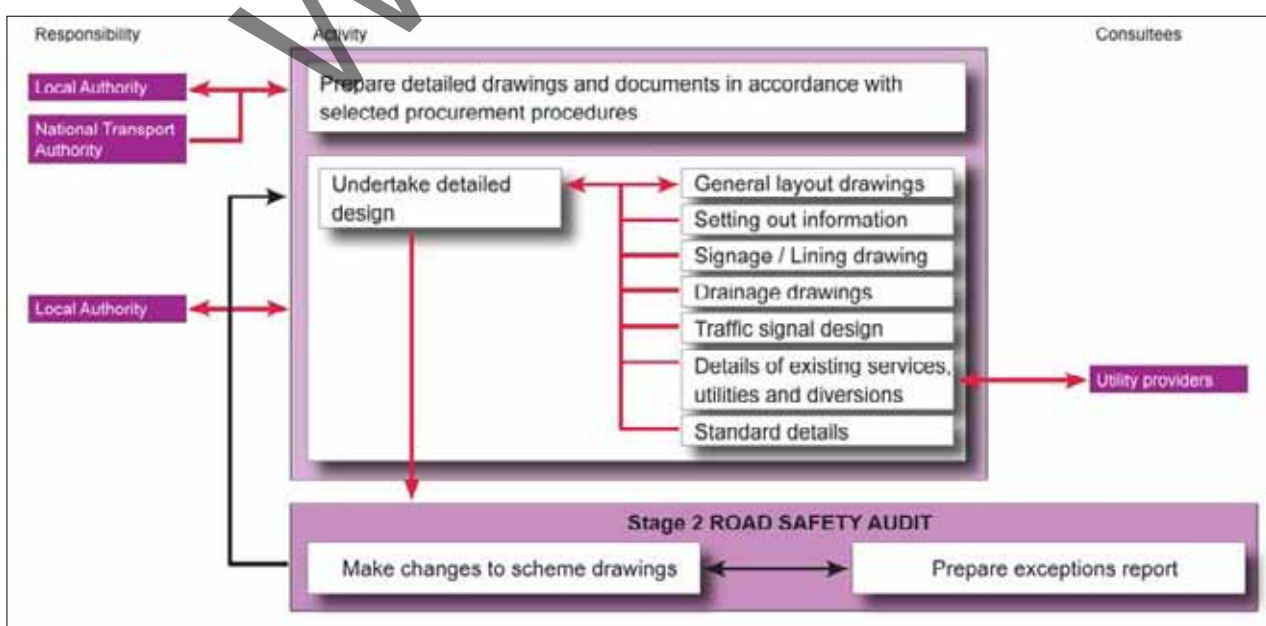
Stage 3 : Preliminary Design



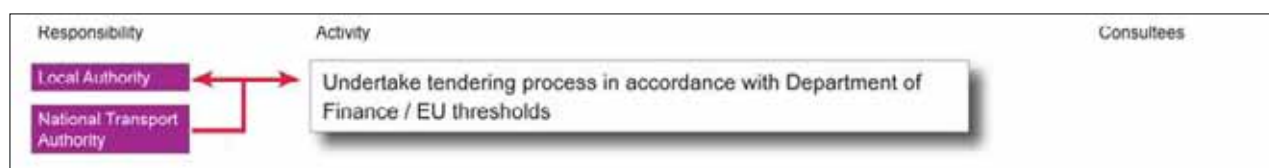
Stage 4 : Statutory & Legal



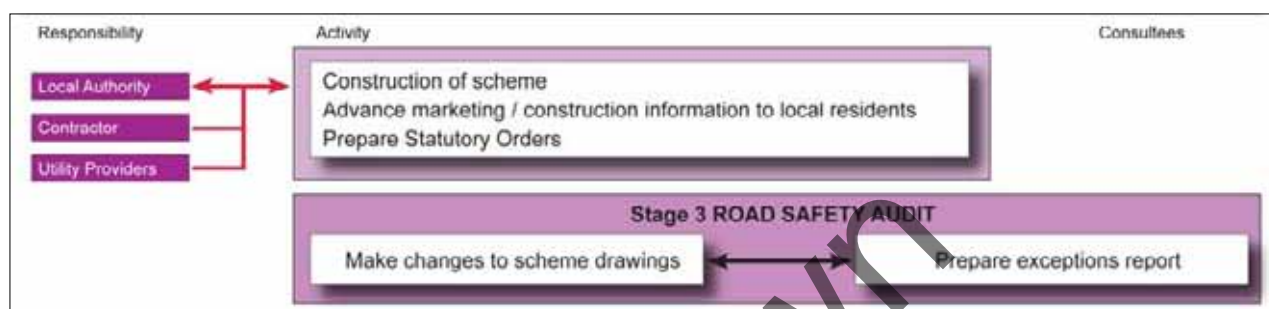
Stage 5 : Detailed Design



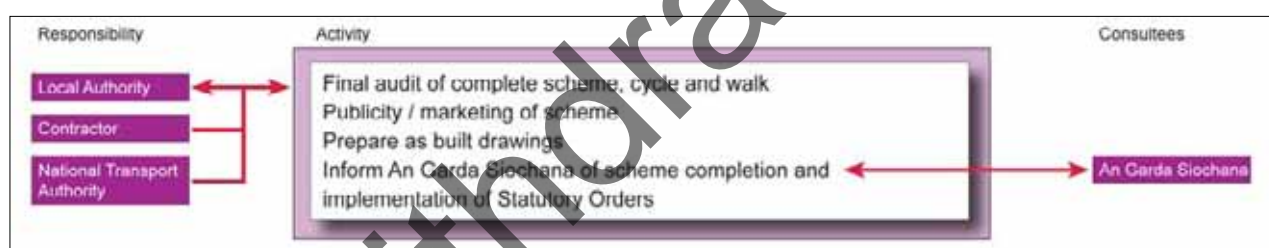
Stage 6 : Procurement



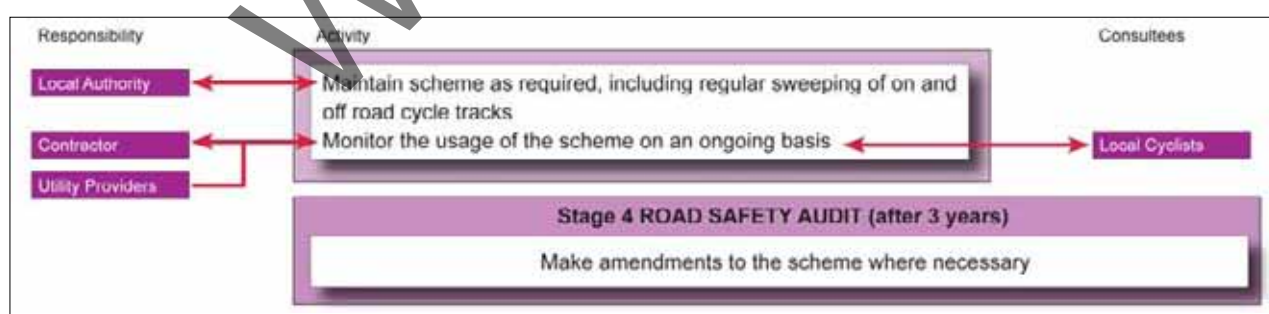
Stage 7 : Construction



Stage 8 : Commissioning & Opening



Stage 9 : Maintenance & Monitoring



Withdrawn

Getting the Details Right

Having established the network objectives, identified the correct link types and junction solutions, it is then essential to ensure that poor detailed design does not undermine the Quality of Service.

Good design will deliver for the bicycle in any weather condition, in daylight and at night, and regardless of the number of cyclists.

This section provides detailed advice on specific topics such as bus stops, drainage, construction details, lighting, crossing entrances etc.

Withdrawn

5.1 BUS STOPS

Design and Provision of Bus Stops

Existing guidance on the design and provision of bus stops, including their location, will be found in the Traffic Management Guidelines, and the Department of Transport Sectoral Plan prepared in response to the Disability Act, 2005.

5.1.1 Traffic Management Guidelines

As noted in the Traffic Management Guidelines (ref. Chapter 15: "Public Transport") buses must not only be able to move around the road network with minimum delay, but must also be able to pick up and set down passengers quickly and conveniently, if their full potential is to be achieved.

Section 15.5 of the Traffic Management Guidelines deals specifically with bus stop design, and sets out advice under a number of headings, including location, layout, passenger access arrangements, street furniture and adjacent parking.

5.1.2 Disability Act, 2005

Bus stations and bus stop design are included among the areas listed for action in the Sectoral Plan prepared by the Department of Transport as part of its response to the Disability Act, 2005. The plan requires that the needs of mobility-impaired persons must be taken into account when designing bus stops.

For the purposes of the plan, mobility-impaired persons include:

- Persons who are visually impaired, or blind
- Persons who are hard of hearing, or deaf
- Persons with children in buggies
- Wheelchair users and people with crutches

While it is recognised that it will not always be possible to provide conflict-free access for all users to and from buses and/or bus stops, there is an onus on the designer, nevertheless, to ensure in respect of mobility-impaired persons that access is facilitated, and that the highest degree of convenience is afforded them, insofar as is reasonably practicable.

5.1.3 Conflicts

As noted above, a certain level of conflict with other transport modes is generally unavoidable at bus stop locations. From the cyclist's perspective, possible sources of conflict might include:

- passengers waiting at the bus stop
- passengers alighting from or entering the bus
- buses pulling into or away from the bus stop
- interaction between waiting passengers and other pedestrians
- pedestrians on an adjacent crossing point, especially if these are obscured by other traffic, including a stationary bus
- general traffic movements in the adjacent carriageway

In this regard, bus stops are no different from other potential conflict locations such as junctions and pedestrian crossings. Like these, the conflicts can be addressed and managed by careful design consideration, and specifically by reference to the Principles of Managing Conflict.



Cyclists must yield

5.1.4 Design Checklist

Regardless of which design is chosen, the bus stop arrangement should at least meet the following requirements.

- The design should comply with the requirements of the Disability Act 2005
- Bus/cycle interchange facilities (including secure cycle parking bays) should be provided at bus stops where the demand exists, or where it is felt it can be developed
- Has the design addressed cyclists' conflicts with
- Pedestrian access to/from the bus stop?
- Passengers boarding/alighting from a bus?
- Passengers waiting for a bus?
- Buses pulling in and out from the kerb?
- Adjacent parking including passenger set-down/collection (kiss-and-ride)?



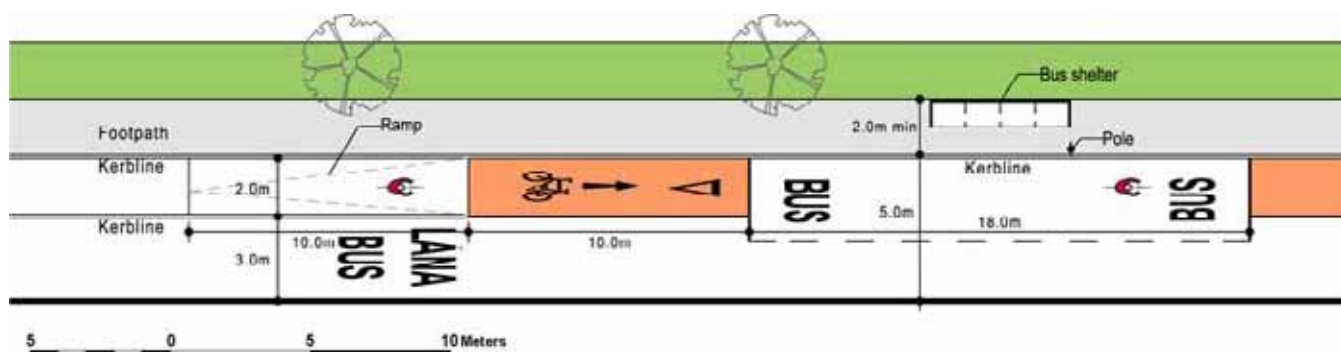
5.1.5 Design Options for Bus Stops

The choice of bus options and the design issues associated with each are included below. There are three basic design-types;

- In-Line Bus Stops
- Island Bus Stops
- Bus Stops using Kneeling Bus Facility



In-Line Bus Stop Option 1



Normal Use / Design Objectives

- Low to Medium Bus Flows (Headway 5 minutes or greater)
- Where it is necessary to provide conflict-free bus passenger movement

Space Efficiency

- 7m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- Bike yields priority when bus stops
- Bike may have to stop and wait if multiple buses arrive at the same time
- Bike may be able to overtake stopped bus

Main Conflicts

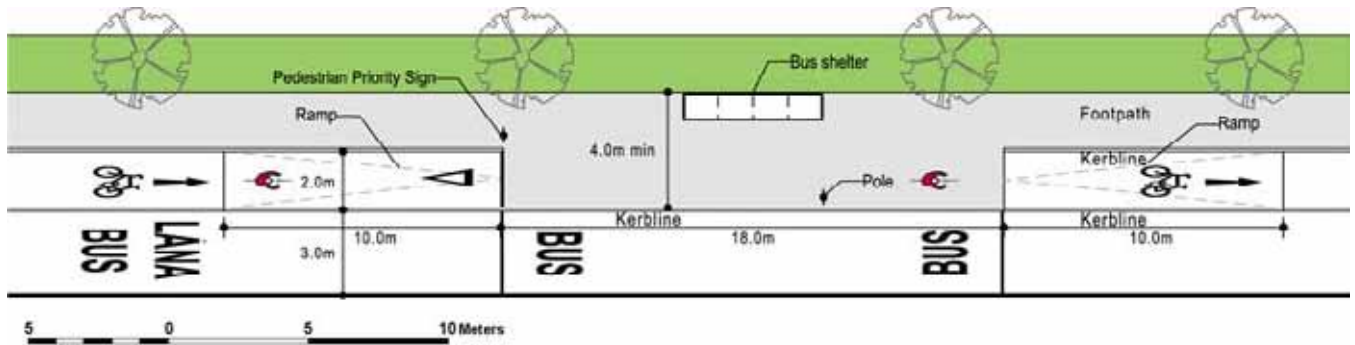
- Bus vs bike, as bus weaves left into bus stop
- Bike vs general traffic, as bike overtakes stopped bus
- Bus vs overtaking bike, as bus pulls out

Design Notes

- Clearly establish the bike in position 20m before conflict point with bus
- Ensure enough room exists for the bike to rejoin the lane / track in front of bus without sharp turns
- Bus stop surface prone to deterioration



In-Line Bus Stop Option 2



Normal Use / Design Objectives

- Low Bus Flows (Headway 10 minutes or greater)
- To preclude conflict between the bicycle and road traffic.
- Predominantly bus passenger drop-off location
- Where bicycles are intended to be separated from bus flows (e.g. BRT)

Space Efficiency

- 7 m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- Cyclists yield priority to pedestrians, waiting passengers and boarding / alighting passengers

Main Conflicts

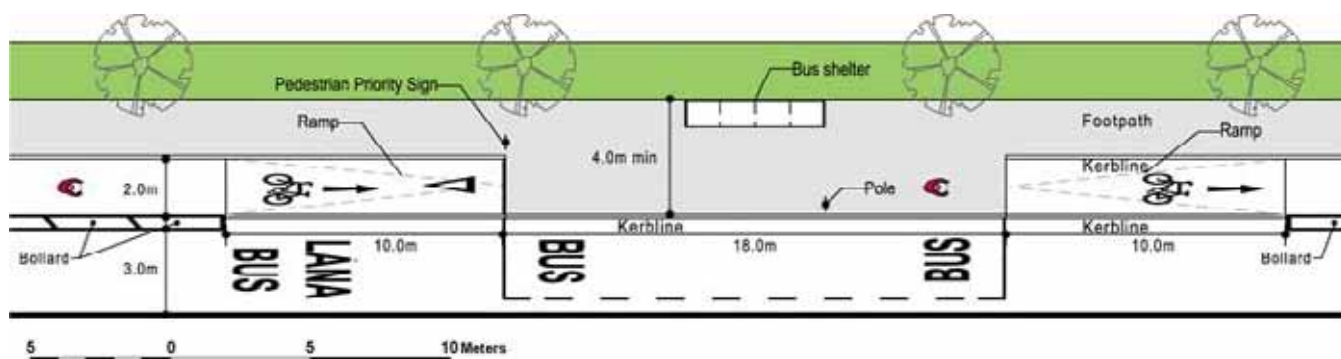
- Bike vs Pedestrian, Waiting Passenger and Boarding / alighting passenger in a shared space
- If a) cycle approach speeds are high, b) there are too many pedestrians, or c) there is simply insufficient shared space, the quality of provision for both cyclists and pedestrians / passengers will be affected

Design Notes

- Establish likely bus patronage profile at stop in advance of design choice
- Not suitable for dense pedestrian / passenger activity
- Clearly sign that cyclists yield to pedestrians
- Consider cycle calming if cycle approach speeds high
- Consider bus driver training on this route, to manage cyclist / alighting passenger conflict
- Consider relocating pole and / or bus information to back of footpath, if they constitute obstacles to cycling



In-Line Bus Stop Option 3



Normal Use / Design Objectives

- Low Bus Flows (Headway 10 minutes or greater)
- To preclude conflict between the bicycle and road traffic
- Predominantly bus passenger drop-off location
- Where bicycles are segregated from bus flows, but where bus speeds are low (30km/h)

Space Efficiency

- 7m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- Cyclists yield priority to pedestrians, waiting passengers and boarding / alighting passengers

Main Conflicts

- Bike vs. Pedestrian, Waiting Passenger and Boarding / alighting passenger in a shared space
- If cycle approach speeds are high, there are too many pedestrians, or there is simply insufficient shared space, the quality of provision for both cyclists and pedestrians / passengers will be affected

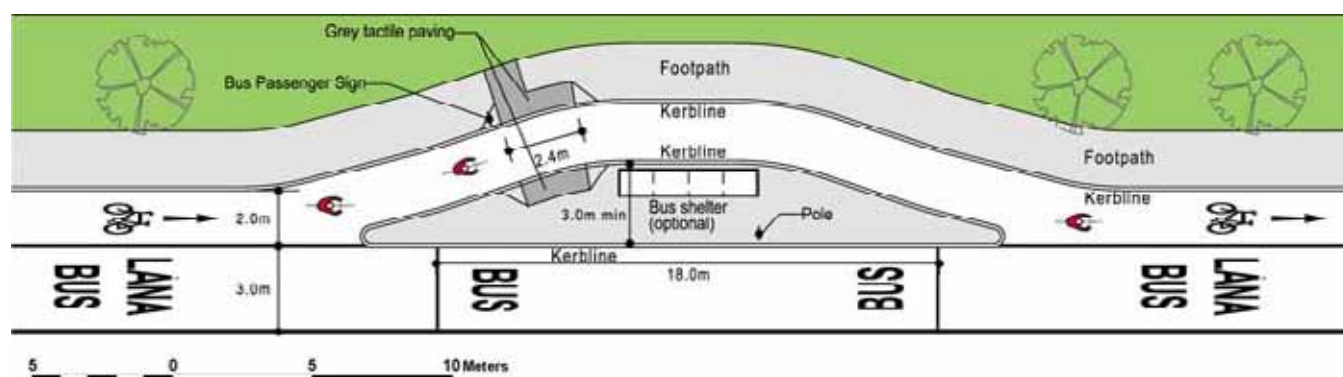
- Design of permeable segregation allows for confident cyclists to avoid the shared space by entering the bus lane before the stop and re-entering the cycle lane after the stop

Design Notes

- Establish likely bus patronage profile at stop in advance of design choice – not suitable for dense pedestrian / passenger activity
- Clearly sign that cyclists yield to pedestrians
- Consider cycle calming if cycle approach speeds high
- Consider bus driver training on this route, to manage cyclist / alighting passenger conflict
- Consider relocating pole and / or bus information to back of footpath, if they constitute obstacles to cycling



Island Bus Stop Option 1



Normal Use / Design Objectives

- High Bus Flows (Headway up to 2 minutes)
- Where bicycles are intended to be separated from bus flows (High frequency QBC) in vicinity of bus stop
- Where pedestrian access to the bus stop can include ramps, uncontrolled crossing
- To preclude conflict between the bicycle and road traffic.
- Where cycle priority is important

Space Efficiency

- 7m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- High cycle priority
- Pedestrians yield to cyclists crossing between bus stop island and footpath

Main Conflicts

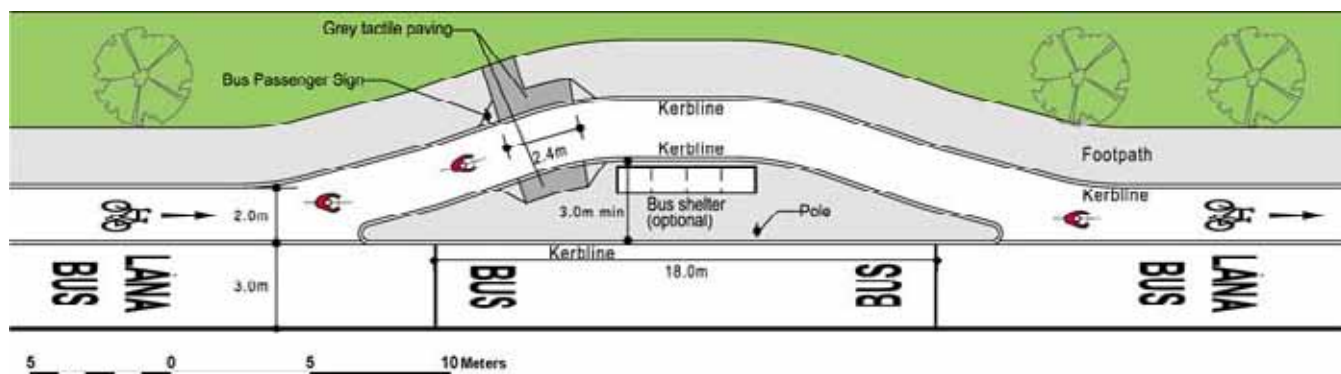
- Bike vs. Crossing Pedestrian
- The location of the shelter on the island requires more space
- Waiting passengers may spill over or stand on the crossing point with the cycle track – the shelter may block the cyclists view and conflicts with passengers may not be as legible

Design Notes

- Ensure sufficiently wide cycle lane on bend as cyclists reposition beside bus lane, to ensure cyclists do not encroach into bus lane
- Bus stop island width may need to increase depending on size of shelter, slope of ramps, presence of Kassell kerbs etc.



Island Bus Stop Option 2



Normal Use / Design Objectives

- High Bus Flows (Headway up to 2 minutes)
- Where bicycles are segregated entirely from bus flows (e.g. BRT, High frequency QBC) by cycle track
- Where pedestrian access to the bus stop can include ramps, uncontrolled crossing
- To preclude conflict between the bicycle and road traffic.
- Where cycle priority is important

Space Efficiency

- 7m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- High cycle priority
- Pedestrians yield to cyclists crossing between bus stop island and footpath

Main Conflicts

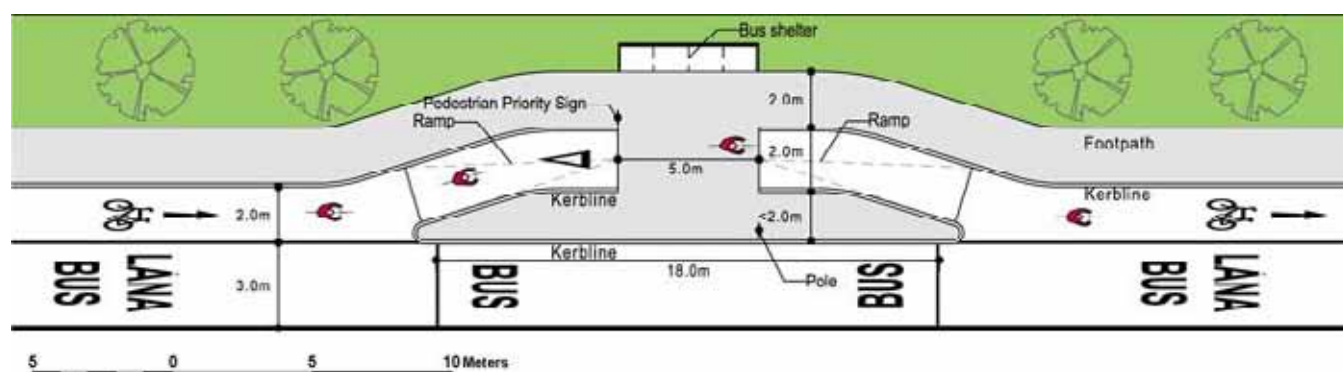
- Bike vs. Crossing Pedestrian
- The location of the shelter on the island requires more space
- Waiting passengers may spill over or stand on the crossing point with the cycle track
- The shelter may block the cyclists view and conflicts with passengers may not be as legible

Design Notes

- Ensure sufficiently wide cycle track on bend as cyclists re-emerge after bus shelter, to ensure cyclists do not fall into bus lane
- Bus stop island width may need to increase depending on size of shelter, slope of ramps, presence of Kassel kerbs etc.



Island Bus Stop Option 3



Normal Use / Design Objectives

- High Bus Flows (Headway up to 2 minutes)
- Where bicycles are intended to be separated from bus flows (e.g. BRT, High frequency QBC)
- To preclude conflict between the bicycle and road traffic

Space Efficiency

- 9m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- Cyclists yield priority to pedestrians crossing between bus stop island and bus shelter / footpath

Main Conflicts

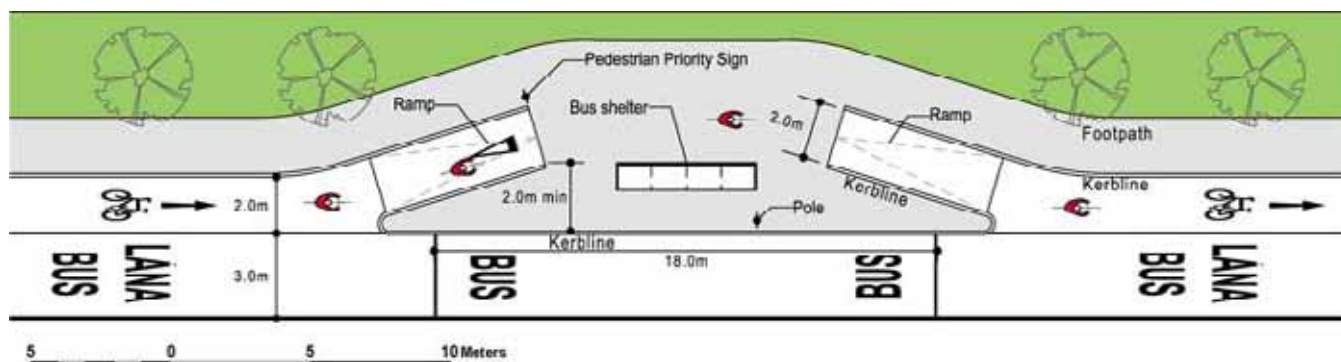
- Bike vs. Crossing Pedestrian
- By virtue of locating the shelter at the footpath, the conflict between cyclists and pedestrians may reduce (somewhat) to the times when the bus is actively at the bus stop

Design Notes

- Important that design and markings ensure that cyclists slow down and yield to crossing pedestrians on shared space
- Ensure sufficiently wide cycle lane on bend as cyclists reposition beside bus lane, to ensure cyclists do not encroach into bus lane



Island Bus Stop Option 4



Normal Use / Design Objectives

- High Bus Flows (Headway up to 2 minutes)
- Where bicycles are intended to be separated from bus flows (e.g. BRT, High frequency QBC)
- To preclude conflict between the bicycle and road traffic

Space Efficiency

- 9m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

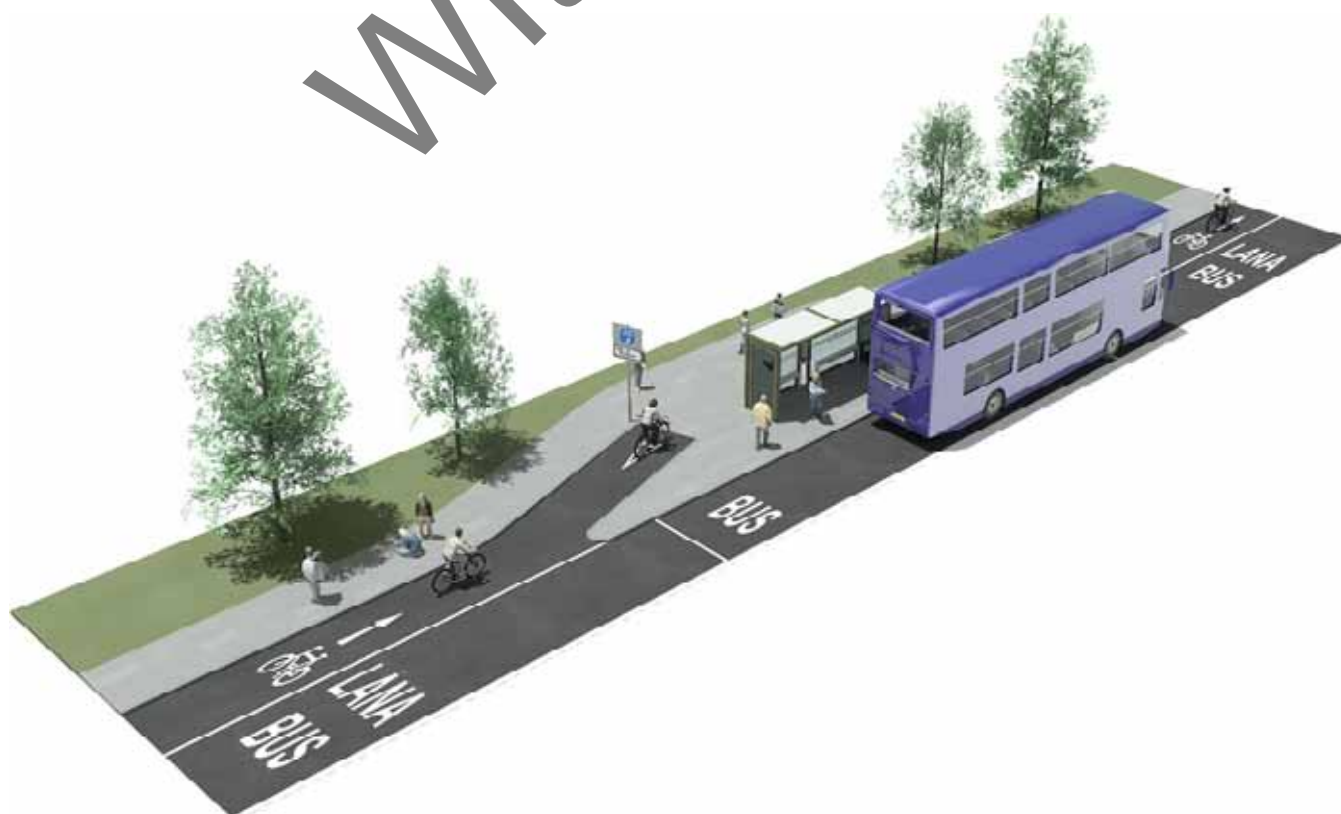
- Cyclists yield priority to pedestrians crossing between bus stop island and footpath

Main Conflicts

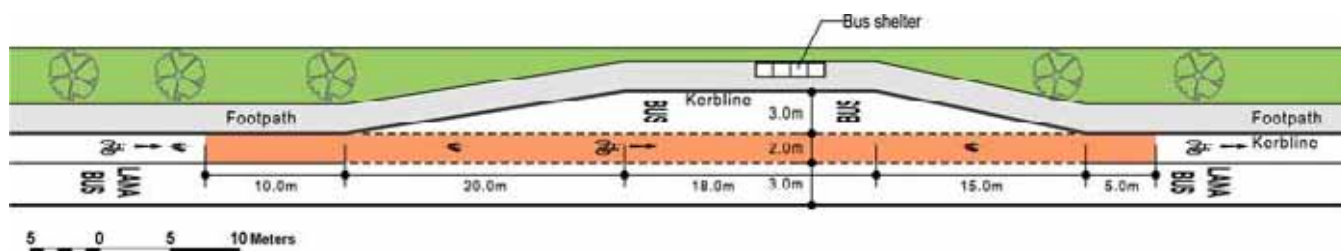
- Bike vs. Crossing Pedestrian
- The location of the shelter on the island requires more space
- Waiting passengers may spill over or stand on the crossing point with the cycle track
- The shelter may block the cyclists view and conflicts with passengers may not be as legible

Design Notes

- Important that design and markings ensure that cyclists slow down and yield to crossing pedestrians on shared space
- Ensure sufficiently wide cycle lane on bend as cyclists reposition beside bus lane, to ensure cyclists do not encroach into bus lane



Kneeling Bus Option 1



Normal Use / Design Objectives

- Low to Medium Bus Flows (Headway 5 minutes or greater)
- Where it is necessary to provide conflict-free bus passenger movement, but where Kassel kerbs are not necessary
- Where there are multiple bus services, and where a bus bay will allow other buses to pass by the stopped bus
- Where cycle priority is important

Space Efficiency

- 10m min to accommodate bus, bike, pedestrian

Cycle Priority Notes

- Bike may have to stop and wait if multiple buses arrive at same time and block the cycle lane
- Bike intended to overtake stopped bus

Main Conflicts

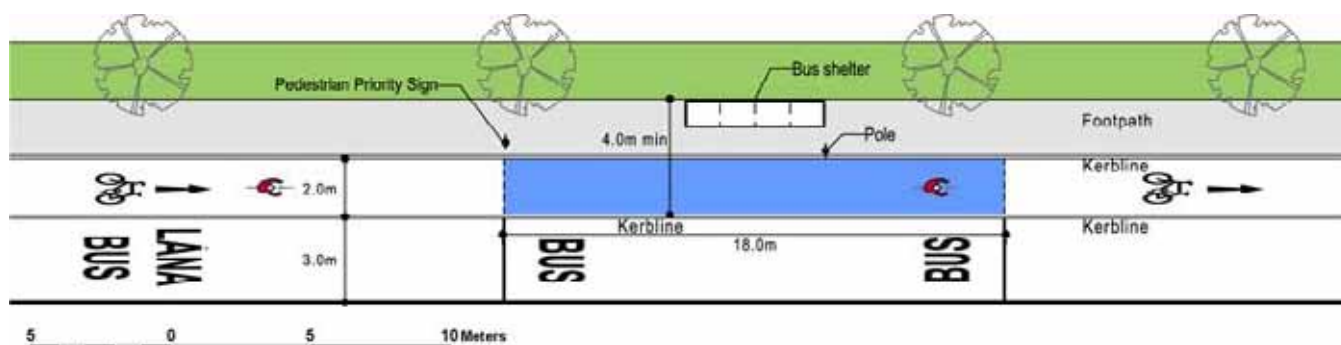
- Bus vs. Bike, as bus weaves across cycle lane into and out of bus bay

Design Notes

- Clearly establish bike 20m before conflict point with bus
- Ensure enough room for bike to rejoin lane / track in front of bus without sharp turns
- Bus stop surface prone to deterioration
- Drainage channel / construction joints between road and bus bay should be located entirely in bus bay, not at inner edge of cycle lane
- Bus bay design not suitable for articulated buses or Kassel kerbs
- Risk of footpath obstruction where bus shelter is located on narrow footpath



Kneeling Bus Option 2



Normal Use / Design Objectives

- Low to Medium Bus Flows (Headway 5 minutes or greater)
- Where bicycles are segregated entirely from bus flows (e.g. BRT, High frequency QBC) by cycle track
- Where Kassel kerbs are not necessary, and where a small step down from footpath onto cycle track is acceptable for access / egress to waiting bus
- To preclude conflict between the bicycle and road traffic.
- Where cycle priority is important

Space Efficiency

- 7m to accommodate bus, bike, pedestrian

Cycle Priority Notes

- High cycle priority
- Pedestrians yield to cyclists crossing between stopped bus and footpath

Main Conflicts

- Bike vs. Passenger, when bus is present or approaching

Design Notes

- The stepped arrangement requires that bus passengers board and alight from the cycle track, a small step down from the footpath
- The step between footpath and cycle track should be obvious
- A small bevel or dishing onto the cycle track may be possible
- Establish likely bus patronage profile at stop in advance of design choice
- Not suitable for dense pedestrian / passenger activity
- Clearly sign that cyclists yield (or stop) when bus is present
- Consider cycle calming if cycle approach speeds are high
- Consider bus driver training on this route, to manage cyclist / alighting passenger conflict



5.2 DRAINAGE

The appropriate detailed design of drainage can significantly impact on the quality and safety of cycling facilities.

Under the 1993 Roads Act (Section 13, Part 2), Local Authorities have an obligation to maintain public roads. The maintenance of cycle ways and cycle tracks falls within this remit.

5.2.1 Overview of Drainage for Cycling

The standard of drainage associated with cycle routes must be more effective than that for motorised vehicular routes. This is because:

- Bicycle braking systems and tyres are not as effective in the wet – it is harder to stop, and there is more risk of skidding in the rain
- Poor drainage increases the likelihood of standing water and spray, potentially drenching both cyclists and pedestrians
- Standing water can conceal serious surface defects, increasing the risk of accident for the cyclist or damage to the bicycle
- Excessive standing water or flooding on cycle lanes or tracks will result in cyclists cycling on parts of the road that are not designed for cycling

5.2.2 Design Objective

The drainage of a cycle route must aim to remove surface water quickly and efficiently, in a manner that is cycle-friendly, and consistent with sustainable drainage principles.

Continuous side entry drainage kerbs are generally preferred so that the entire road surface is available for cycling and not interrupted by gullies.



5.2.3 Key Issues to be Considered

This section provides advice in relation to the provision of effective drainage, and commentary on how certain detail design can either improve or hinder drainage and cycling.

5.2.3.1 Choice of Cycle Facility

On-road cycle lanes and mixed use streets are frequently the preferred retro-fit option given the limited changes to existing infrastructure, including drainage, that are required.

However, while the design of drainage is an important consideration, drainage convenience is never the primary or sole rationale for determining which facility should be chosen.

The various types of cycle facility and their appropriateness are dealt with in Link Types and Integration or Segregation.

5.2.3.2 Pavement and Surface Construction

The cycle route surface should be as smooth as possible to ensure efficient surface water run-off. A rough texture will provide for increased grip and reduced wheel spray compared to a smooth texture.

On cycle surfaces, there is no requirement for significant macro-texture. Therefore the wearing course should consist primarily of smaller aggregates, e.g. 10mm or less.

Surfacing material choice is significant when allowing for effective drainage solutions, and the materials commonly used on sealed or impermeable surfaces include:

- 45/6F or 45/10F hot rolled asphalt wearing course to EN13108: 4 (BS 594:1)
- 0/6 or 0/10 Dense bitumen macadam surface course to EN13108:1 (BS 4987:1)
- Close graded SMA (10mm or 6mm aggregate) to EN 13108-5

While high-friction (anti-skid) surfacing, in a range of colours, is often used to provide grip as well as delineation, the cost can be excessive, and its use should be limited to high-risk locations.



Poor detailing increases maintenance

5.2.3.3 Ironmongery

Drainage gullies, channels and manhole covers can present hazards to cyclists and should be located away from travelling surface used by cyclists. This is particularly important on bends and sharp curves as wet ironmongery is quite likely to cause cyclists to skid, slip or fall off. Gullies with slots running parallel to bicycle wheels are also a serious hazard to cyclists.

Cycle friendly design solutions include:

- Offline positioning for manholes etc
- Side-entry gullies
- Continuous kerb drainage

If ironmongery cannot be located offline, it must be finished flush (typically +/-5mm) and recessed manhole covers should be considered to avoid slippery metal surfaces.

If gullies cannot be located offline, their slots must be at right angles to the cycling direction.



5.2.3.4 Surface Geometry

Cross falls and long falls are be used to drain road and cycling surfaces. Adequate drainage will generally be provided within the following gradient ranges:

Cross Fall: 1.25% to 2.5% (1:80 to 1:40)

Long Fall: 0.5% to 5.0% (1:200 to 1:20)

Depending on the type of cycle link, the surface can either:

- Drain to both sides. This might be used on cycleways and on certain segregated cycle tracks
- Drain to one side only. This is applicable to on-road cycle facilities and certain cycle tracks

On bends, a cycle track should always drain towards the shorter radius. A right hand bend should drain to the right, and left hand bend should drain to the left. If a track were to drain the other way, there would be a negative camber, increasing the risk of skidding.



5.2.3.5 Road Markings and Coloured Surfacing

The extra thickness of road markings and coloured surfacing can block cross-flow and cause ponding. Detailed design should ensure that the finished levels of all surfaces are flush. This may require milling of existing surfaces to achieve a smooth joint of the new material with the adjoining surface.

Gaps may need to be provided in continuous line markings (mandatory cycle lanes and bus lanes) to ensure effective cross-flow.

5.2.3.6 Segregated Cycle Facilities and Independent Drainage

On adjacent cycle tracks, cross-fall away from the main carriageway is more comfortable for cyclists. However, this requires an independent gully or channel system. In such instances, ensure that the cycle track gully spacings match the main road gully locations to reduce pipework.

5.2.3.7 Impacts of Hard Surfaces on Drainage Infrastructure

The provision of footpaths and cycle facilities can generate as much run-off as a standard 7.3 metre wide carriageway. This must be taken into account in the design of the overall drainage network.

For new roads, this can be managed using sustainable drainage solutions such as permeable road surfaces.

Where new cycle facilities are retrofitted into verges or other permeable surfaces along existing roads, there is the potential for overloading the existing drainage system. Options for managing this include:

- Creating a permeable cycle route surface
- Maintaining a small verge with linear filter trench
- Upgrading the existing drainage network

5.2.3.8 Unbound Surfaces

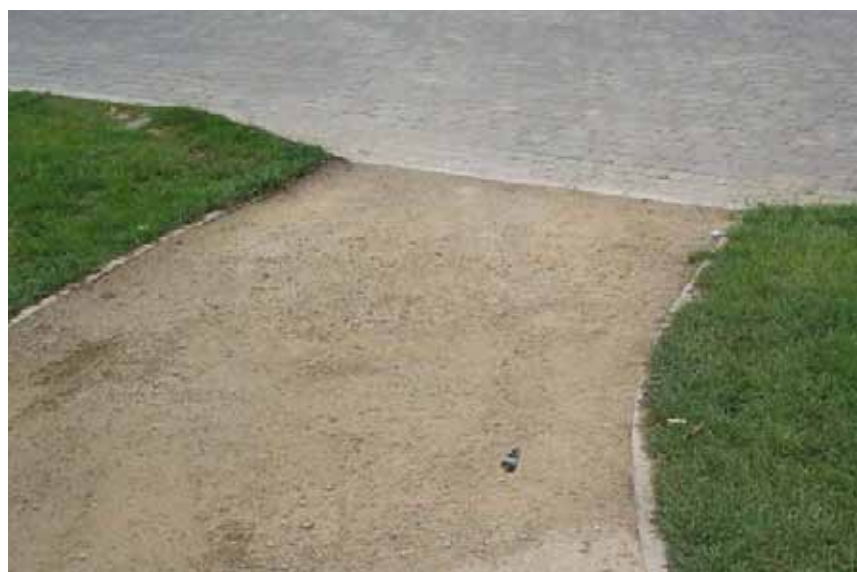
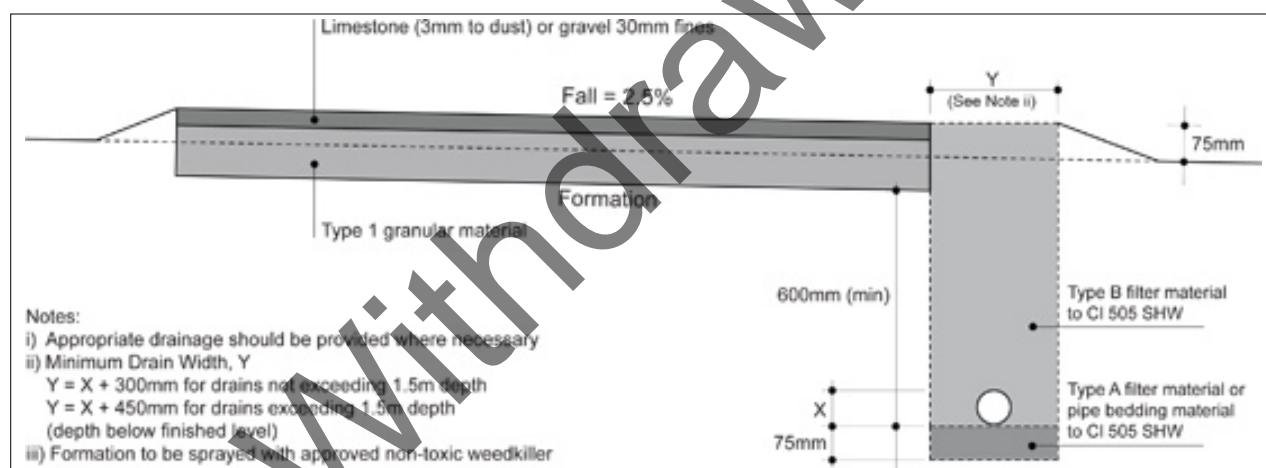
Unbound surfaces are appropriate for certain cycle routes such as cycleways and cycle trails.

Where an unbound surface is used, it is important that the cycle track is constructed so that surface water is shed to the sides, notwithstanding the fact that the surface is permeable. This is to prevent the sub-surface from becoming saturated.

Unbound surfaces are normally formed in a well-graded granular material such as CL 804 Sub Base material (sometimes referred to as dry bound macadam) or 20mm single sized stone pea gravel.

In locations with a high water table, a french drain should be considered in order to:

- Allow surface runoff from the track to be directed away quickly
- Reduce the effects of ground saturation locally by lowering the water table in the vicinity of the edge, and
- Limit erosion or rutting along the surface of the facility (exacerbated if the verge edge is higher than the track)



5.3 CYCLING AND PUBLIC LIGHTING

Public lighting improves the safety, comfort and security of all road users, including cyclists. It is an essential requirement for urban commuting during winter months.

Unlike motorised vehicles, bicycle headlamps will not illuminate the route. Their design purpose is primarily to alert other road users to the presence of the cyclist. Cyclists are dependent on ambient or public lighting to see where they are going.

Under the 1993 Roads Act (Section 13, Part 2), local authorities are statutorily required to maintain public roads, including cycle ways and cycle tracks. The provision and maintenance of public lighting facilities form part of this requirement.

Public lighting should always be considered as part of the Road Design and Road Safety Audit processes.

5.3.1 Design Objectives

Well-designed public lighting increases the attractiveness of the route and gives the cyclist a greater sense of security. It can also increase the accessibility and utility of the route.

Street lighting helps cyclists to see potential hazards such as street furniture, gullies, broken glass etc, but also to see other road users.

Street lighting should meet the following basic requirements:

- Illuminate the route ahead
- Illuminate the road surfaces
- Illuminate junctions, access points and conflict points etc.
- Illuminate obstacles and other users along the route

Street lighting needs to be maintained in order to ensure these objectives are met. Regular inspections during hours of darkness should be carried out to identify and replace faulty lanterns, and a fault reporting system should be available to the public.

5.3.2 Codes of Practice and Reference Guidelines

The design, installation and maintenance of public lighting measures should be carried out in accordance with the Codes of Practice and reference guidelines listed below. Any proposed derivations should be subject to consultation with, and agreement by, the relevant Local Authority Public Lighting Department.

BS 5489-1:2003 Code of practice for the design of road lighting

I.S. EN 13201-2:2003 Road Lighting

ILE TR 23 - Institute of Lighting Engineers, Technical Report 23



5.3.3 Key Issues to be Considered

This section provides detail design advice in relation to the appropriate selection of light fittings, lighting levels, the correct positioning of street lighting and ensuring the safety of users.

5.3.3.1 Road/Street Category

The height of lighting column to be provided will depend on the type of road, e.g. whether it is a Distributor, Local Collector or Access road.

Generally, bus routes and distributor or higher-order collector routes benefit from higher lighting columns, while residential areas benefit from lower lighting columns.

5.3.3.2 Design Speed of Cyclists

The design speed is directly proportional to the stopping sight distance.

Lighting in urban areas must allow a minimum cycling sight distance of between 20 metres to 40 metres, preferably towards the upper limit. This will cater for the majority of cyclists.

5.3.3.3 Locating Lighting Columns

Care should be taken to avoid creating an obstruction for cyclists or pedestrians when positioning lighting columns at the edge of the roadway. A minimum clearance of 0.5m between the lighting column and cycle lane or track is recommended.

If there is no verge outside the footpath to locate the lighting column, the column should be located to the back of the footpath, and adjusted if necessary to deliver the lighting levels attributed to the carriageway.

Public lighting columns should be relocated at an early stage in a retrofit project to allow for a smooth finish of pavements around the lighting column.

Vertical clearance to allow for maintenance and other access requirements should be a minimum of 4.0 metres.

In certain circumstances, e.g. for bridges and parapets, the use of deck, parapet or other non-column mounted lighting may be more appropriate.

Care should be taken not to locate lighting columns close to trees that may obstruct the light.



5.3.3.4 Strength and Uniformity of Lighting

Strength of Lighting

Street lighting should give enough light to enable all road users, including cyclists, to see each other, as well as objects on or next to the road, at a reasonable distance.

The strength of lighting required will differ depending on the road type and prevailing traffic regime. BS 5489 calls for an average luminance of 10 Lux and a minimum luminance of 5 Lux for Footpaths and Cycle Paths

The quality of light is improved by using brighter colours of road surface that reflect more light.

Street lighting in urban areas should be sufficient to allow motorists to use dipped headlights. This will reduce the risk of cyclists being dazzled by full beam headlights.

Uniformity of Lighting

On major roads the lowest light intensity on the road surface should be at least 30% of the highest light intensity. On lower-order roads, a corresponding low-high ratio of 15-20% may be adopted.

The adjustable parameters to achieve more uniform lighting are:

- distance between the street lamps
- height of the street lamps
- quality of the bulbs
- quality of the optical system used in the fittings

Further guidance is provided in the table below.

Recommended Ratio of Column Height to Spacing			
Lantern Type	Height of Column	Maximum Column Spacing	Comment
70w Son-t	6 to 8 metres	34 metres	Generally provided in residential areas
150w Son-t	6 to 8 metres	34 metres	Mixed use areas
250w Son-t	8 to 12 metres	40 metres	Traffic Route & City Centre Standard
400w Metal Halide	8 to 12 metres	One each side of crossing	Used at crossing points on roads

5.3.3.5 Dependence on Carriageway Lighting

In addition to normal street lighting, specific cycle track lighting may be required:

- where a cycle track is located more than 2.0m from the carriageway
- where there are sudden bends or corners on an unlit cycle track
- at the point where a cycle track diverges from the carriageway

Designers need also to be aware of possible light pollution in environmentally sensitive areas.

Crossings must be well-lit to highlight pedestrians and cyclists both approaching and using the crossing if the general carriageway lighting is insufficient. Additional lighting at both sides of the crossing may be required to achieve this.

5.3.3.6 Lighting and Safety at Isolated Locations

Outside of built-up areas, recreational routes will not normally require lighting unless there are specific road safety concerns, e.g. at junctions or crossings.

Underpasses require special attention to address a perceived sense of reduced personal safety for pedestrians and cyclists. Underpasses should be provided with a minimum level of 30 Lux unless a CCTV system requires a higher level.



5.4 ENTRANCES AND DRIVEWAYS

This section deals with the proper design of cycle facilities past entrances to private properties.

5.4.1 Design Principles

Legibility

The cyclist passing the gate, as with pedestrians, always has priority over access or egress traffic. Specifically, the designer should avoid the use of vehicular aprons.

Functionality

Entrances should be designed in such a way that vehicles can safely enter and exit the property, without comprising the cycling or pedestrian function. Specifically, the cycle and footpath facility should be continuous across the entrance and not 'dipped' at the crossover. This will reinforce the legibility above.

Homogeneity

Due to the inherent conflict in direction, it is essential that vehicular speeds are minimal when turning in or emerging from a driveway.

5.4.2 Main Design Elements

- Short ramps at kerbs to facilitate vehicular traffic – see Short Ramps below
- The footpath and cycle facility should be pulled right across the entrance(s) such that there is no change in vertical alignment of cycle facility
- Continuous surface materials reinforce the continuity of pedestrian and cyclist priority across the entrance
- At certain entrances with high volumes, such as petrol stations or retail parks, it may appropriate to construct a Vertical Transition to drop the cycle track to 50mm above road level. In such cases, the cycle facility must have a red surface to clearly identify the potential conflict. The 50mm level change will assist in reducing vehicular speeds



Uncomfortable and potentially dangerous surface due to driveway apron

5.4.3 Short Ramps

Where the cycle track or pedestrian footpath is immediately adjacent to the carriageway, the vehicular ramp is best provided by a bevelled kerb. Bevelled kerbs at entrances may need to be wider than the standard kerb width depending on the level change.



Where there is a verge between the cycle track and carriageway, the ramp is best placed within the verge width as this will not compromise the cycle track and will not require a bevelled kerb.



If a bevelled kerb cannot be provided in an existing or retro-fit situation, a short bituminous ramp extending slightly into the roadway may be considered. In this instance, care must be taken not to interfere with drainage channels.



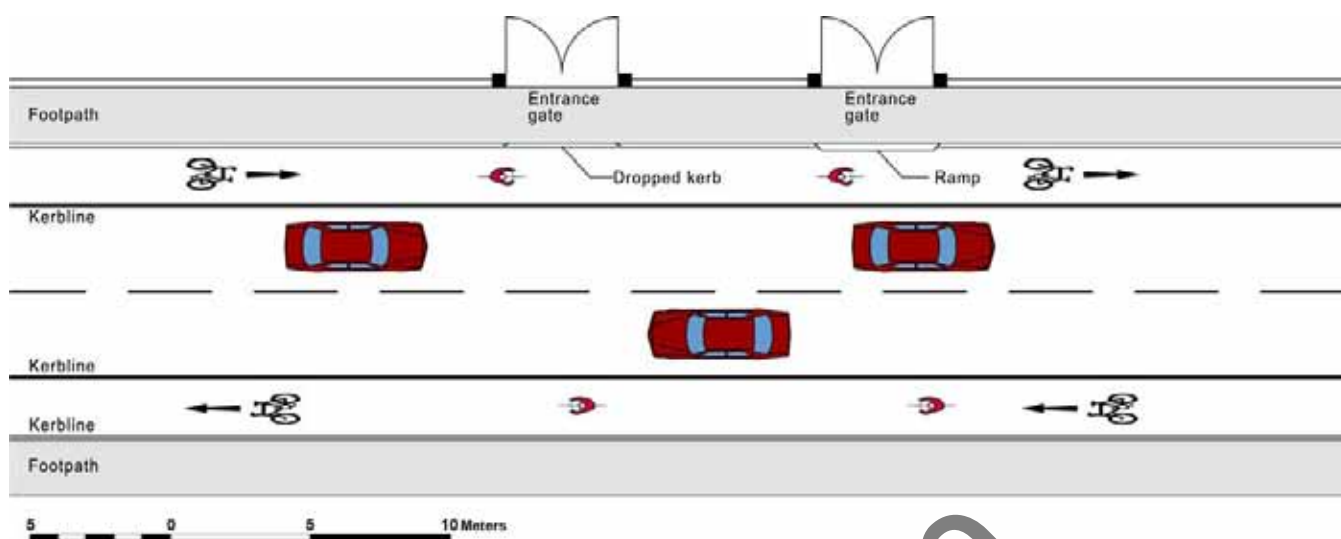
5.4.4 Frequent Entrances

Where there is a high frequency of driveways, consideration could be given to either a continuous raised cycle track or a segregated at-grade cycle lane. Alternatively, the route could be downgraded as an access route, with speed restrictions implemented and advisory cycle lanes provided.



Good detail for cyclists but should also be applied for pedestrians

Driveways along Standard Cycle Lanes

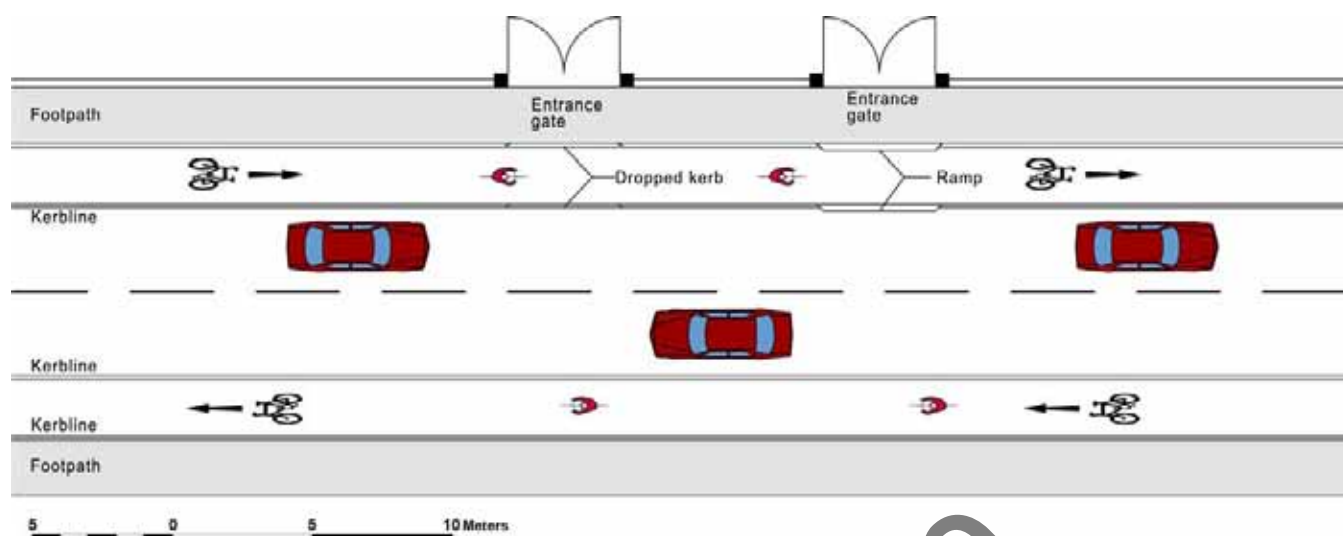


Design Issues

- Footpath and cycle lane continuous across all entrances
- Bevelled kerb ensures slow vehicular access and egress
- In existing situations, if a new kerb is not feasible, a bituminous ramp may need to take the place of the bevelled kerb



Driveways along Raised Cycle Tracks

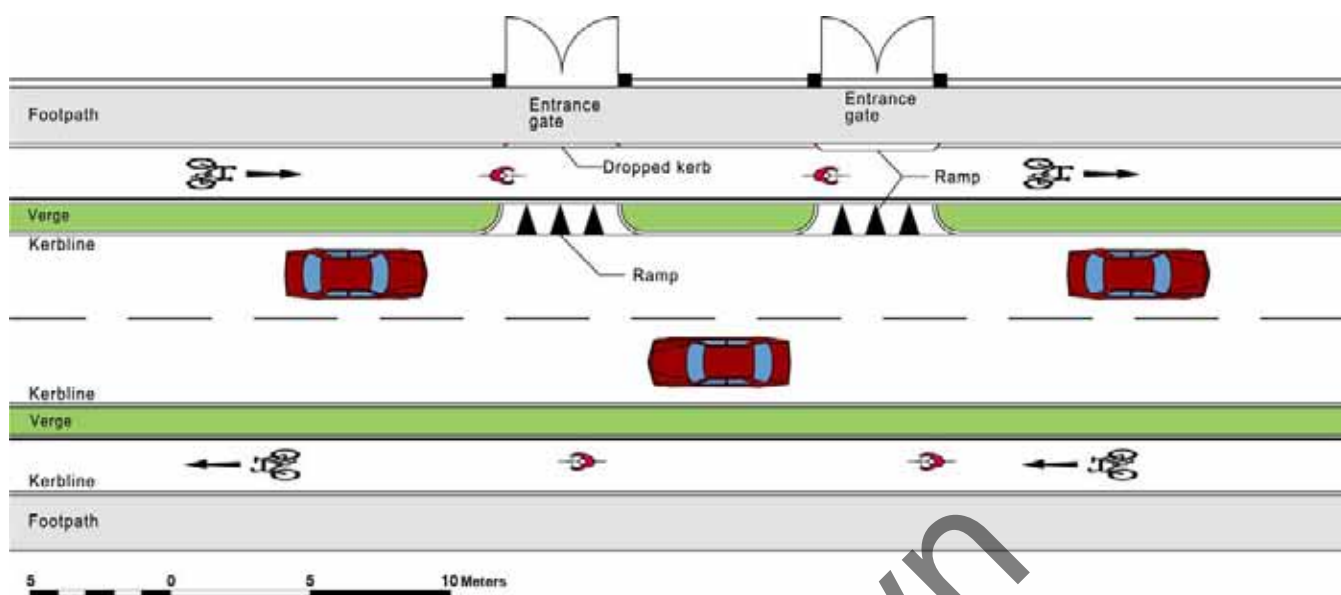


Design Issues

- Footpath and cycle lane continuous across all entrances
- Bevelled kerbs from carriageway to cycle track and from cycle track to footpath ensures slow vehicular access and egress
- In existing situations if new kerbs are not feasible, bituminous ramps may need to take the place of the bevelled kerbs



Driveways along Cycle Tracks with Verges

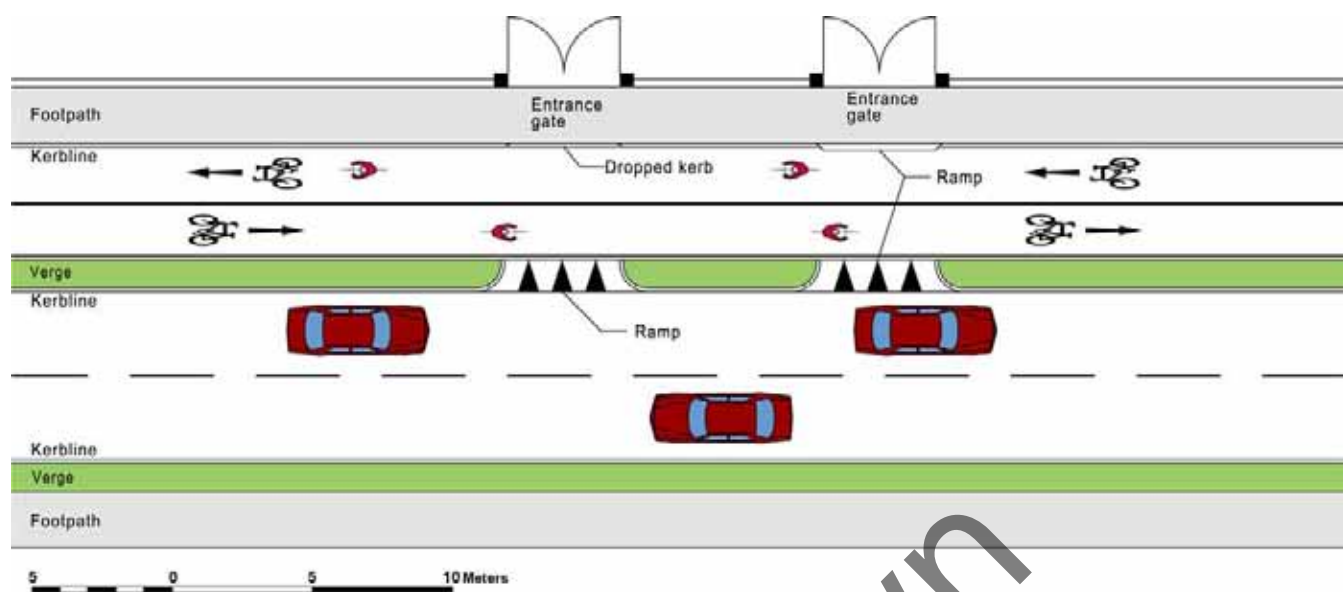


Design Issues

- Footpath and cycle lane continuous across all entrances
- Bituminous ramp from carriageway to cycle track
- Bevelled kerb from cycle track to footpath ensures slow vehicular access and egress



Driveways along Two-Way Cycle Tracks



Design Issues

- Footpath and cycle lane continuous across all entrances
- Bituminous ramp from carriageway to cycle track. If no verge present, use a bevelled kerb
- Bevelled kerb from cycle track to footpath ensures slow vehicular access and egress



5.5 BICYCLE PARKING

The availability of appropriate bicycle parking facilities at either end of a trip will heavily influence the decision to travel by bicycle in the first instance. The absence of such facilities, and the consequent risk of vandalism or theft, has been shown to undermine the investment in the overall network infrastructure.

Cycle parking is an integral part of any cycle network, but it can also precede any dedicated cycle infrastructure, in order to address the cycle parking needs at the outset.

5.5.1 Strategic Approach to Bicycle Parking

A strategic approach to the provision of bicycle parking facilities will contribute to:

- Promoting modal shift - locating cycle parking conveniently to destinations, building entrances etc., and reminding people of the bicycle
- Improving the quality of cycling facilities - where cyclists and their are fully considered
- Well-designed cycle parking in public spaces - well planned, considerate of the needs of pedestrians and other street users, visually attractive, and sufficient in terms of quantity and quality for the activities in the locality – resulting in less cycle parking against poles, railings etc.
- Security - where bicycle users are confident their bikes will not be stolen or vandalised
- Support for mobility management plans - where early provision of cycle parking indicates a level of real commitment towards the bicycle

5.5.2 The Need for Different Cycle Parking Solutions

There are many different types of bicycle and bicycle value, different cycle parking duration, and different locations. The Sheffield Stand is not the solution for all situations. Convenience is less important for bicycles that are only used occasionally.

Cyclists will consider the following:

Bicycle-related:

- How valuable is the bike?
- Has the bicycle particular features such as a trailer, or is it a tricycle?
- Does the bicycle have a luggage facility, requiring additional security?

Location related:

- How close is the parking to the destination?
- How likely is there to be available parking slots?
- What is the area like, from a personal security point of view?
- How much public activity is there, a deterrent to vandalism?
- How visible is the cycle parking?
- Is the parking covered or exposed to the elements?

Duration related:

- How long and how often will the bike be left there?
- Will the bike be left overnight?
- Is it possible to get into the parking area, if the access is locked?



5.5.3 Balancing Convenience, Cost and Quality

In providing sufficient appropriate cycle parking, the designer will need to consider the relative merits of convenience, cost and quality.

Convenience

- Ease of parking and retrieval of bicycles at dwellings compared to the ease of access to the car
- Short term, high turnover public parking facilities are required near actual destinations
- Longer term secure parking facilities are suitable up to 250m from public transport facilities

Cost

- Are the facilities free to use, or is there a charge?
- Do higher quality and more secure bicycle parks, perhaps with on site bicycle repair facilities, warrant a higher charge?

Quality

- Outdoor bicycle racks outside versus indoor bicycle parking?
- Covered versus non-covered parking facilities?
- Guarded versus non-guarded facilities?
- Parking as a stand-alone facility versus parking with additional services (e.g. bicycle-repair and rental)?

5.5.4 Location Specific Characteristics

The following gives an overview of the varying characteristics of parking at different locations that should be considered in determining the most appropriate parking facility.

Residential

- Convenience is essential for frequently used bicycles, and preferably not via living areas
- Private parking should accommodate residents and visitors
- Shared parking facilities can be suitable for multiple dwellings (e.g. apartment complex)

On-Street

- Proximity to origin or destination, up to 50m.
- Is the bicycle rack covered or exposed?
- Is the facility close enough to nearby pedestrian areas, bus stops, taxi ranks to provide sufficient passive surveillance?

Stored

- Internal or constructed parking for neighbourhoods or employees
- Located at up to 250m from origin or destination
- Accessible by key, pass or chip-system
- Supervision by camera
- Limited amount of bicycles (up to 50-60 bicycles)
- Well laid out internally for convenience



Commercial

- Internal or constructed city centre parking, guarded by personnel, locked
- Possibly combined with other public services such as bike rental & repair outlets, shopping centres, etc.
- Larger bicycle parking capacity than other stored units, often greater than 100
- Located up to 500m from origin or destination
- May require support service infrastructure

5.5.5 Developing and Implementing a Local Bicycle Parking Plan

The process involves six steps as follows:

Step 1: Data Collection

For new development proposals, cycle access and appropriate parking provision should be considered as a matter of course.

For existing locations, the authority should conduct regular (at least annual) counts and surveys at the following locations:

- origins, especially high-density residential developments, including residential estates and apartment blocks
- destinations, e.g. in vicinity of employers, educational establishments and retail centres
- key municipal locations, e.g. public transport stops and interchanges, council and public offices, public parks and playgrounds
- city or town centre on-street locations

The data collected should include:

- the level of uncontrolled cycle parking such as cycles locked to traffic poles, railings etc. This will give an indicator of the extent of unmet demand, and the appropriateness of existing facilities
- the nature and extent of current cycle parking provision, including number of spaces and racks, and the turnover and usage at different times of day and week
- additional location-specific information that can be provided by user-groups and individual cyclists
- suitability of current cycle parking facilities, through observation and inspection:
 - how easy are they for cyclists to use?
 - are the spaces between bikes too close (less than 750mm) or too far apart (greater than 1.0m)?
- Impact of current cycle parking arrangements on cyclists:
 - are spaces available when cyclists stopping to park?
 - are the cycle racks too close to moving traffic?
- Impact of current cycle parking on other road users:
 - are other users (especially pedestrians) affected when cyclists are parking their bicycles?



Counts should be conducted during May to September when cycling is in peak demand. It is useful to seek the views of cyclists, as their experiences as users of cycle parking will give additional insights:

- Is there a preference for certain types of facility?
- Where are the current shortfalls? Where should new facilities be located?
- Whether bicycle parking should be subject to tariffs (paid parking)?
- How much would you be prepared to pay (is there an acceptable threshold)?

Step 2: Spatial Analysis

By mapping existing provision and usage, it is easier to identify additional locations where cycle parking should be provided, such as:

- centres of employment
- centres of education
- district, town and city centre
- public transport interchanges, train stations, tram stations, busy bus stops
- arenas, sports grounds, leisure complexes
- locations of public events and recreation
- tourism and heritage destinations, including trails and walks

Not all of these are in public ownership, and it may require co-ordination through mobility management initiatives to identify and support appropriate new provision.

Step 3: Drafting the Implementation Plan

The next step involves balancing distance, cost and quality at each location, and then considering the most appropriate cycle parking infrastructure

Within the plan, it should then be feasible to define priorities for short term and long-term implementation, and draw up a suitable implementation plan.

Step 4: Public Participation

- Local Authorities should clearly set out their policies and targets in relation to bicycle parking and communicate them to all the stakeholders at the outset. A system should be put in place to facilitate ongoing feedback from relevant target groups. This will assist in establishing consensus on priority areas and in identifying possibilities and opportunities for future action

Step 5: Implementation Stage

A Bicycle Parking Plan can be determined once priorities have been established, preferably by consensus with the stakeholders, and the necessary funding has been secured. Advertising revenue from bicycle parking structures may be a part of the funding.

The Local Authority can then implement the Bicycle Parking Plan on a phased basis, subject to agreed arrangements for project management and control.



Step 6: Monitoring and Evaluation

Following implementation, the operation and utilisation of the bicycle parking facilities should be regularly monitored and reviewed. It is recommended that any monitoring programme should include, inter alia, the following items:

- Occupancy
- Turnover per bicycle place per day
- Unmet demand (e.g. by counting bicycles parked at poles, railings etc.)
- Vandalism
- Number of bicycles reported stolen

In addition to the authority's own inspections, stakeholders and end-users should be encouraged to monitor and provide feedback on the effectiveness or otherwise of the measures provided.



Lack of parking facility results in obstruction for pedestrians

5.5.6 On-street Parking as a Central Element in a Cycle Parking Plan

On-street parking should be the central “public” element in any bicycle parking strategy. On-street bicycle parking is highly visible and:

- promotes a strong pro-cycling message
- provides cyclists with kerb-free access to cycle parking
- does not compromise or affect pedestrians if properly installed
- needs no land/property acquisition
- can be installed easily, and at low cost, as drainage and alignment issues will have been catered for in designing the adjacent carriageway
- has minimal add-on costs other than perhaps some protection from adjacent vehicular movements (e.g. bollards)
- can be provided without difficulty at the end of parallel vehicular parking bays, to define and maximise effective use of kerbside space

There is a strong case to be made for re-assigning a certain percentage of on-street car-parking space to cycle parking as a way towards achieving sustainable transport/ modal shift objectives.

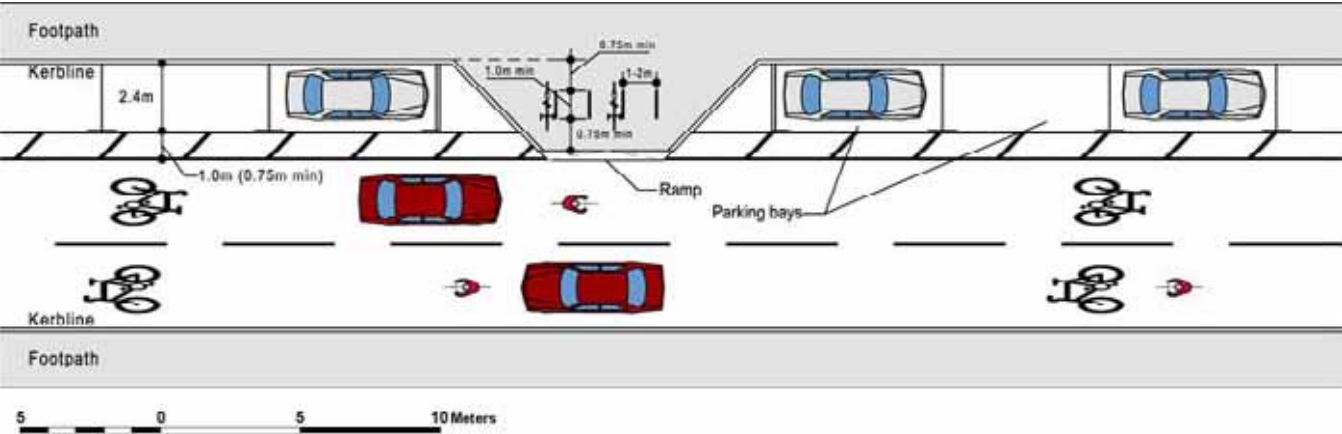
Locations proximate to public transport and taxi ranks will provide a degree of informal supervision that discourages vandalism.

Beyond a certain volume, however, or for particular destinations, on-street parking will not be enough, and the local authority will have to consider additional storage facilities.

Dedicated commercial storage for bicycles will become more viable as the cycle market increases. An element of bicycle parking should be included as part of all multi-storey/commercial (paid) car parks.



Cycling Parking in Lieu of Car Parking



5.5.7 How much parking – Cycle Parking Guidance

Planning Authorities should include a requirement for bicycle parking in conditioning new development permissions. The following table gives guidance on the minimum number of spaces which should be provided initially at new private and public facilities in urban areas. However, more generous provision should be considered in district, town and city centres, around public transport hubs, and on campuses.

Location	Guideline minimum number of bicycle parking spaces
Housing developments	1 private secure bicycle space per bed space (note - design should not require bicycle access via living area), minimum 2 spaces 1 visitor bicycle space per two housing units
Offices	10% of employee numbers, (subject to minimum of 10 bicycle places or one bike space for every car space, whichever is the greater)
Schools	10% of pupil registration numbers, minimum 10 places Consider separate teacher / employee parking
Other developments	1 bike space per car space, or 10% of employee numbers in general
Shops	1 stand per till / check-out
Public Transport pick-up points (Rail, tram, taxi Ranks & QBCs)	2.5% of number of daily boarders at that point / station, subject to minimum of 10 bicycle places
Off-street car-parks (incl. Multi-storey)	10% of total car-spaces, subject to a minimum provision of 50 spaces
Park and Ride locations	Consider sheltered parking at P+R
On-street (public)	Minimum of 5-10 spaces, depending on expected level of usage
Events	5% of forecast attendees
NOTE: The above guidance does not preclude the need for compliance with the requirements of the Planning and Development Acts and associated Regulations. The designer should consult with the local Planning Authority for clarification and/or further information in this regard.	

Consideration should be given to requiring the provision of direction-signs, in particular for Storage and Commercial parking facilities. Bike lockers, showers & changing rooms should be available at Final Destination Storage facilities (private).

5.5.8 Basic Requirements of Bicycle Parking Facilities

All bicycle parking facilities should be capable of performing the basic functions of

- supporting the bicycle from falling over
- protecting it against theft
- allowing the cyclist room to position/ lock / unlock the bike

Consideration should also be given to

- lighting
- protection against the weather
- ease of access
- requirements at public transport



Bicycle Stands

All racks, bicycle stands and clamps should provide enough support to prevent any type of bicycle from falling over. This usually requires support for the frame and/or forks. The Sheffield Stand (U-bar) will achieve this, but there are many other architectural products on the market also.

Units that are designed to grab the front wheel only are not generally recommended for public cycle parking. While they are often space efficient, they are ineffective for many tyre widths -see *Section 5.5.9 Choosing an Appropriate Design of Rack or Stand* for further detail.

Protecting the bicycle from theft

A key concern for many cyclists is having their bicycle stolen while it is parked. Different parking arrangements provide different levels of security.

Bicycle parking facilities can protect a bicycle against theft in two ways, either by enabling cyclists to lock their bicycle to the rack, or by providing a built storage facility that can be locked or guarded by personnel and/or cameras.

On-Street Racks

It must be easy for cyclists to lock the bicycle frame to the rack or stand. For additional peace of mind, many cyclists will seek to secure individual parts of the bike, such as the frame, wheels, trailer etc. This is done using a long bicycle lock that is woven through the various components and around the rack itself.

Locked Storage Facilities

These offer greater protection against theft or vandalism. They are particularly suited to schools or places of employment where full-time supervision cannot be provided but where security may be an issue. Access arrangements can include keys or gate codes being issued to individual cyclists, or can be controlled from a central location or by a caretaker.

The bicycle parking cellar is an indoor variation of the locked storage facility for use in residential units, especially apartment blocks.

Bike Lockers

Individual bicycle lockers are another way to provide safe parking. This solution is particularly appropriate for commuters completing the main part of their journey by public transport, and can be used at bus stops, tram, light rail, or railway stations. Lockers can be hired out to cyclists on a day-to-day basis, or longer-term if required, with keys issued from a central location. The disadvantage, compared to other locked storage units, is that they occupy more space per bicycle, and are more costly to build and maintain.



Guarded Bicycle Facilities

Guarded bicycle parking facilities may offer the best way to protect bicycles from being stolen in busy areas such as shopping districts, bus depots, central railway stations, and city-centre locations. Full-time supervision is required, and cyclists will generally have to pay to park their bicycle. Facilities of this type are often associated with bike rental, repair and/or retail operations.

Allowing the cyclist room to position/ lock / unlock the bike

There must be enough space around individual bicycle parking places to allow cyclists to put a bag or pannier on the ground, and to stoop to access locks, pumps, lights, wheels etc.

If bicycle lifts are provided to increase parking space, these are generally used only after the ground level parking is full, since there is an additional degree of physical effort and delay involved in accessing the bicycle on the upper tier.



Lighting

Lighting is important for cycle parking – it is necessary to have a cycle parking location well lit to allow for bicycle locking, for checking the bicycle equipment etc. It is also very important from the point of view of both personal security and bicycle security.

Off-street parking, and its access, should be well lit. On street parking should be located where the street is well lit.

Protecting the bicycle against inclement weather:

Exposure to rain can damage bicycles and result in increased maintenance costs. This is particularly important for longer term parking at homes, schools, work places and at public transport stations.

On-street racks and stands may be covered, if this can be incorporated into the streetscape appropriately. Covered bicycle parking facilities such as indoor storage units, bicycle sheds or lockers will help to keep the bicycle dry and in prime condition.

Lockable bicycle sheds that provide added security, also serve a double purpose of providing weather protection.

Ease of Access to Cycle Parking

The location of cycle parking should be such that the time spent walking to / from the cycle parking is not a disincentive to using the bicycle, compared with other modes.

It should also be possible to cycle directly to the cycle parking location, without prior dismounting. For offices, this means providing bicycle-friendly ramps, gates, barriers, ideally not mixed with car or pedestrian traffic.

Requirements at Public Transport

Commuters will often cycle to bus or rail stations if secure parking is available. Given the long parking duration, security is a particular concern.

On high frequency routes, a degree of security is provided through passenger-activity around the station. In such circumstances, daily bicycle commuters may be happy with on-street cycle parking that is highly visible.

For less frequent public transport services, and quiet locations, consideration should be given to locked options (e.g. bike-size lockers).

Park & Ride sites will be mainly long-stay (all-day) parking. Reasonable security is required and can be provided achieved using bicycle locker or lockable shed, although this may not be required if there is full-time supervision on site. Such facilities can be paid or free of charge.

5.5.9 Choosing an Appropriate Design of Rack or Stand

There are many different clamps, racks and stands for public bicycle parking available from a wide range of manufacturers and suppliers. They can be categorised into two basic types:

Front-Fork holding

Front fork-holding clamps and racks are space efficient. They are suitable where convenience of parking and removal is important, but only where bike security is not an overriding issue. The relatively tight spacing can make it difficult to stoop down between adjacent bicycles to apply locks.

Fork-holding clamps are better than wheel-holding stands as they will accommodate any tyre width and will not give rise to wheel buckling if the bicycle gets pushed aside.

Frame-Supporting Stands

Frame-supporting bicycle stands are the simplest type of bicycle parking facility. They are often little more than a support rail, to which the bicycle frame can be locked without difficulty. Frame-supporting stands have the great advantage of being suitable for all types of bicycles and every tyre width.

The Sheffield Stand is probably the best known example of this type of facility. The stands can be used on both sides, and should be set between 1.20m and 1.50m apart to allow the cyclist enough room to place and access the bicycle.

Specialist / Domestic / Residential Units

There are a wide variety of products available catering to a variety of particular needs and situations. These include:

- bicycle lockers (which can accommodate a bike and luggage)
- wall, roof and other domestic cycle holding equipment (for garages etc.)
- sheds, pre-fabricated bike huts etc. (for various applications)

5.5.10 Cycle Parking Area

Cycle parking areas with a large number of parking places need careful design, and the parking area layout needs to be borne in mind when selecting the type of rack or stand to be used.

In general, frame-supporting stands are more appropriate for small parking clusters of up to up to 10 or 15 stands.

The final aspect of the parking layout to be considered is the space to be provided between parking rows. The length of a standard bicycle is approximately 2.0m. A well-designed parking facility should provide 2.5m between the rows to allow cyclists room to manoeuvre when parking and collecting their bicycles.



5.5.11 More Information

The NTA manual identifies key principles and approaches. However, cycle parking knowledge and design is comprehensive and well developed in Europe, and provide solutions that have been developed in cities and countries with far greater experience of cycle parking issues.

Please consult the following for more information around these:

Danish Bicycle Parking Manual:

http://www.celis.dk/Bicycle_Parking_Manual_Screenversion.pdf

European Presto Fact Sheets on Cycle Parking at Interchanges

<http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20cycling%20facilities%20at%20interchanges.pdf>

European Presto Fact Sheets on Cycle Parking in Residential Areas

<http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20bicycle%20parking%20in%20residential%20areas.pdf>

European Presto Fact Sheets on Cycle Parking in City Centre

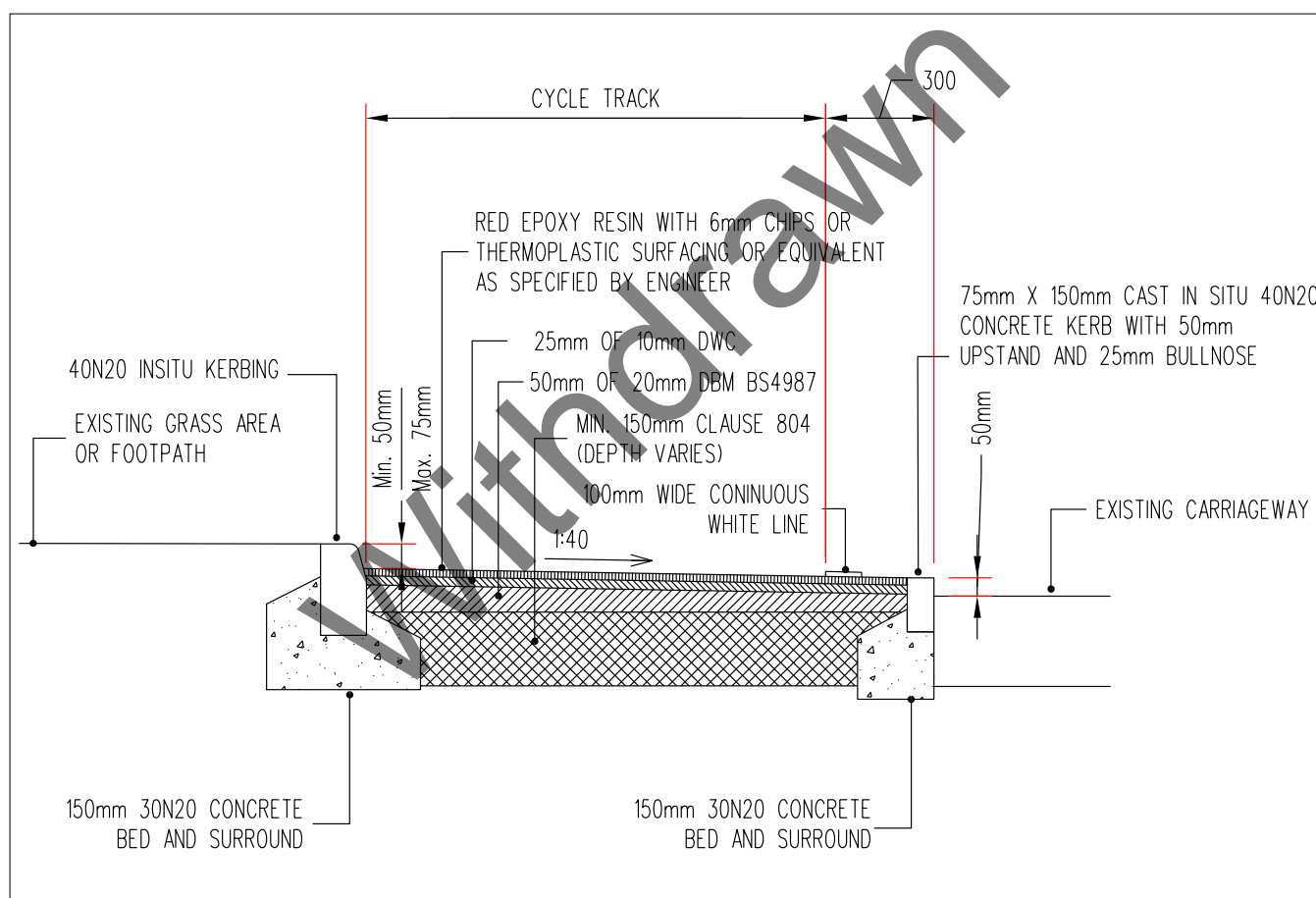
<http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20bicycle%20parking%20in%20the%20city%20centre.pdf>



5.6 SURFACE CONSTRUCTION DETAILS

The following details are as supplied by the Quality Bus Network Project Office (now, the National Transport Authority Design Section). For further details contact cyclemanual@nationaltransport.ie.

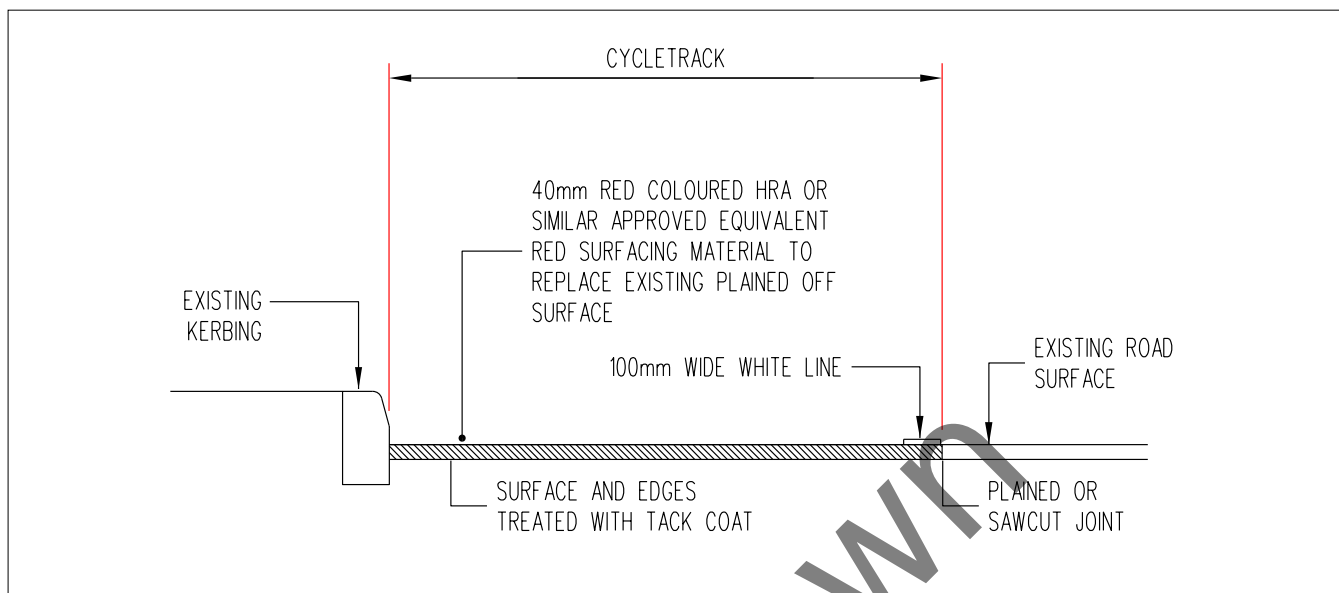
Cycle Lane Construction



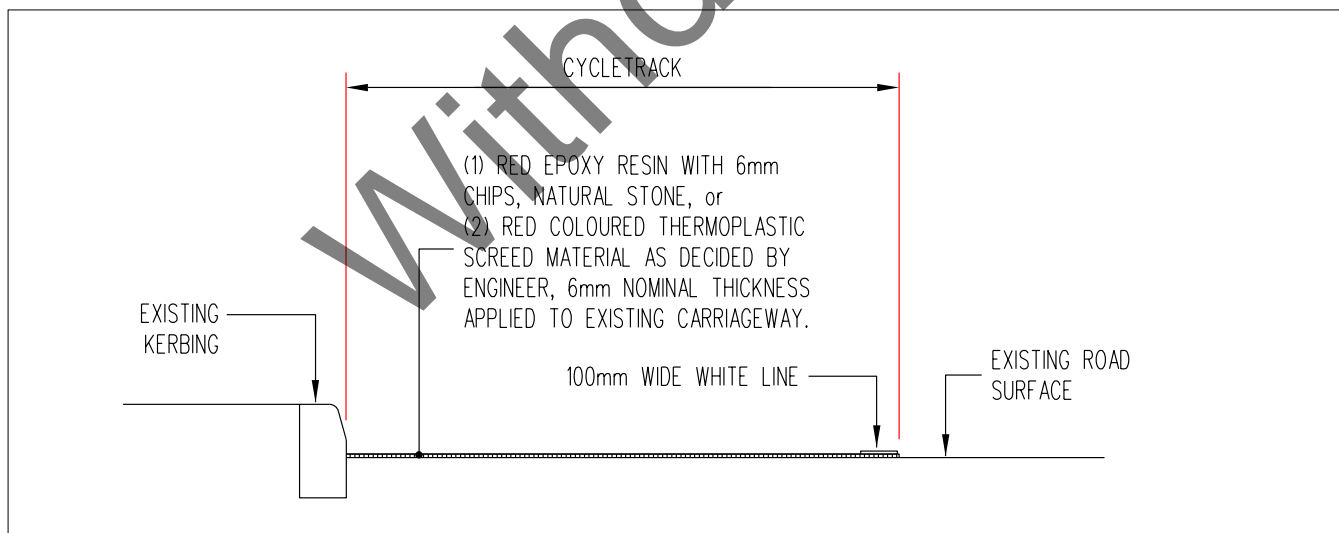
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SHOWN OTHERWISE.
2. IN PLACE OF THE SURFACE LAYER SHOWN, THE 25mm LAYER OF 10mm DWC MAY BE COLOURED RED, AND THE WHOLE SECTION BROUGHT UP TO LEVEL ACCORDINGLY.
3. ALL CLAUSE REFERENCES RELATE TO VOLUME 1, SPECIFICATION FOR ROAD WORKS (NRA).

(A) Typical Cycle Track using HRA Surfacing



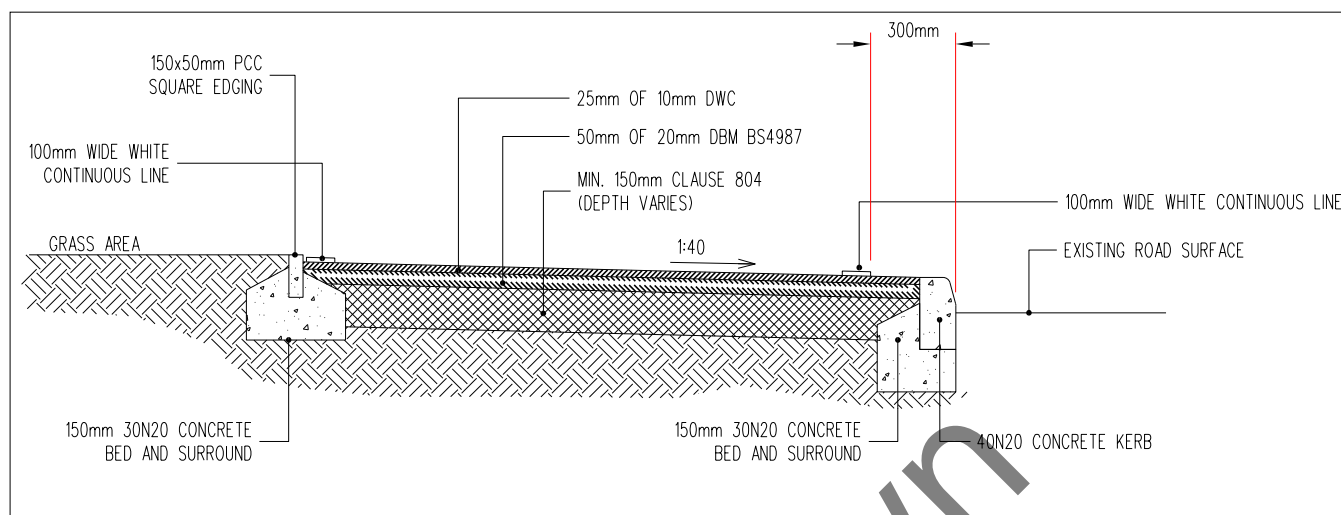
(B) Typical Road Cycle Track using Red Epoxy Resin or Thermoplastic Surfacing material



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SHOWN OTHERWISE.
2. HRA - HOT ROLLED ASPHALT.
3. MATERIAL TYPE TO BE USED IN MATERIAL (B) TO BE SPECIFIED BY ENGINEER.
4. WHEN THERMOPLASTIC SCREED IS TO BE USED IN OPTION (B), IT SHOULD BE SUPPLIED FULL WIDTH IN ONE GO.
5. CYCLE TRACK WHITE LINE TO BE
 - (a) CONTINUOUS - MANDATORY CT
 - (b) DASHED - ADVISORY CT
 - (c) DASHED - JUNCTIONS

Typical Cycle Track



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SHOWN OTHERWISE.
2. SUBBASE MATERIAL SHALL COMPLY WITH CLAUSE 803 OR 804. MATERIAL TO CLAUSE 804 SHALL COMPLY WITH MINIMUM CBR REQUIREMENTS AS PER NRA SPECIFICATIONS.
3. KERBS SHALL BE LAID IN ACCORDANCE WITH CLAUSE 101. FOR ACTUAL KERB TYPES SEE LAYOUT DRAWINGS.
4. JOINTS SHALL COMPRISE OF A 10mm THICK PRE-FORMED FILLER TO CLAUSE 1015 RAKED OUT TO 10mm DEPTH AFTER CASTING AND SEALED WITH A GREY POLYSULPHIDE SEALANT TO CLAUSE 1017.
5. JOINTS SHALL ALSO BE PROVIDED AROUND MANHOLE AND OTHER COVERS WITHIN AREA.
6. ALL CLAUSE REFERENCES RELATE TO VOLUME 1 SPECIFICATION FOR ROAD WORKS (NRA)

Withdrawn

Maintenance

The proper maintenance of cycle facilities should ensure that they will actually be used and fulfil the purpose for which they have been provided.

A poor quality cycle route will generally have a much greater impact on cyclists than a poor road will have on motorists. Due to the position of cyclists on roads, the edge of the road requires more attention and possible maintenance than the central part of the carriageway.

The target Quality of Service will only be met with continued and effective inspection and maintenance.

Under the 1993 Roads Act (Section 13, Part 2), local authorities have an obligation to maintain public roads. The maintenance of cycle ways and cycle tracks falls within this remit.

Withdrawn

6.1 PRINCIPLES

The following principles should always be considered at the outset of the design process and when preparing a maintenance strategy. This will ensure the functionality and safety of cycling facilities and will also minimise the potential for ongoing maintenance costs.

6.1.1 Principle of Sustainable Safety: Functionality

Proper maintenance is essential to the safe use of cycle facilities. Poor maintenance regimes that do not address defective surfaces, debris and unevenness etc will undermine the functionality and even the legibility of cycling facilities. This will reduce the actual and perceived safety levels.

6.1.2 Meeting Cyclist's Needs

The role of maintenance is especially relevant in meeting the cyclist's requirements for Road Safety, Attractiveness and Comfort.

Road Safety: Any reduction in safety, whether actual or perceived, will deter cyclists from using the facility.

Attractiveness: A well maintained cycle facility will be attractive to all users, including beginners and casual recreational cyclist.

Comfort: Poor quality cycling surfaces and the presence of cracks or unevenness will result in a reduced level of comfort and impact on the ability of cyclists to maintain momentum.

6.1.3 Maintenance Orientated Design – Designing out the Problem

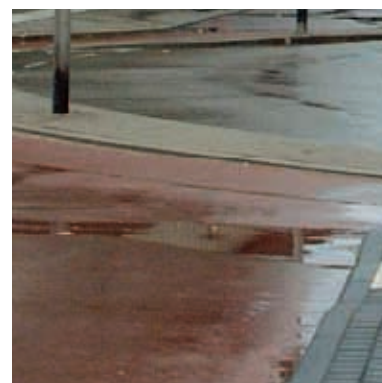
The need for maintenance and the ease of maintenance can be minimised at the design stage by careful attention to the following in particular:

- Selection of materials, including sub surface materials
- Drainage, including ponding
- Type of cycle facility
- Proximity to street furniture
- Proximity to vegetation
- Maintenance vehicles – adequate width and access points

6.1.4 Common Design Problems

Commonly encountered problems that can be avoided at the design and specification stage include wrongly orientated gully gratings, badly fitting manhole covers, ineffective drainage systems, incorrect or missing road markings, surface unevenness and surface failure.

For further detailed discussion on appropriate detailed design, see *Section 5 Getting the Details Right*.



Poor drainage detailing

6.2 PREVENTATIVE MAINTENANCE

An effective maintenance programme will identify faults in advance of their becoming a safety hazard and more costly to repair.

A preventative maintenance programme will include a definitive inspection schedule. Serious consideration should be given to having maintenance inspections carried out by bicycle as this will more accurately report the maintenance need from a cycling perspective.

6.2.1 Basic Maintenance Programme

A standard basic maintenance programme will include the following:

- Mechanical sweeping every 2 months
- Cutting back overgrowth twice a year (outside bird nesting period)
- Clearing gullies twice a year

To achieve this, all cycle routes should be examined on a priority basis between late August and mid-October for evidence of ponding, blockages, debris build up, or structural deterioration. Greater attention is required for off-road cycle tracks as they do not benefit from the passive cleaning associated with general carriageways.

Reporting Facility

Often, faults and defects can be detected by road users, especially cyclists and bus drivers, in advance of a scheduled inspection. A reporting mechanism is required so that such faults and defects can be reported as soon as they arise. This may take the form of a website, specific telephone or email address etc.

Fault Logging

The results of all examinations and reports should be logged and prioritised as appropriate.

6.2.2 Preventative Programmes

Preventative programmes have three components:

- Inspection
- Logging
- Risk Management and Resource Allocation



Substandard reconstruction



6.2.2.1 Inspection

Scheduled inspections should record the following:

- Design flaws – lips, poor transitions and poor quality reinstatements
- Surface defects – longitudinal and transverse cracks, holes or general surface break-up
- Debris – grit, glass and leaves
- Height restrictions – where trees or signage reduce the clear height below 2.5m.
- Width reductions – encroaching vegetation, poorly placed signage and road works
- Signs and Lines – signs are damaged or removed, or line markings have deteriorated and become less visible
- Ironmongery – gullies are sunken or proud, or lids have become loose
- Drainage – evidence of ponding on the cycle facility or blocked drains causing flooding and splashing on the carriageway

Joint Inspection with Cyclists

Local Authorities should consider joint inspections with cyclists who are familiar with the routes and who can point out flaws that may not be immediately obvious, relevant or urgent to the inspector.



Damaged facilities must be identified

6.2.2.2 Logging

All defects should be logged centrally. Ideally logging systems should be geo-referenced (map based) so as to facilitate the location of the defect, when it was reported, when it should be fixed and when it has been fixed.

6.2.2.3 Risk Management and Resource Allocation

Defects such as potholes, uneven surfaces and defects pose a much greater risk to cyclists than they do to other road users. The same is true of broken glass, debris, wet leaves, standing water or ponding. These should be urgently attended to within the maintenance programme.

The nature and potential hazard of the reported defects from inspections and users should be prioritised on the basis of risk and the potential cost of non-feasance.

Normal maintenance works arising from inspection is generally funded from current expenditure. Maintenance coupled with Quality of Service improvements may in some cases be appropriately classified as capital expenditure.

Resources should not be wasted maintaining areas that are due to be dug up under other capital or maintenance works such as surface restoration, utilities installations etc.



General road maintenance should not obstruct cycle facilities

6.3 COMMON MAINTENANCE ISSUES AFFECTING CYCLISTS

The following is a list of issues that frequently impact on the safety of cyclists, and that may not currently be addressed in maintenance activities. It is important that inspectors and maintenance personnel understand how these issues impact on cyclists, the urgency of carrying out remedial works, and the detail of how they are best remedied.

6.3.1 Autumn Leaves

These are extremely dangerous to cycle on when wet. If cyclists have to stop, turn or veer on surfaces with wet leaves, they are likely to lose control and fall over. Leaves are a major cause for blocked drains, ponding etc.

Design Options

- set back trees more than 5m from cyclists
- choose evergreen trees / bushes
- locate trees away from critical points on cycle routes (bends, turns, bus stops) where wet leaves could result in accidents and injury

Maintenance Action

- Regular mechanical sweeping during the Autumn and early Winter
- Inspections to assess effectiveness of sweeping
- Particular attention to bends, turns, transitions, bus stops
- Unblock gullies regularly during the Autumn / early Winter



Wet leaves are slippery

6.3.2 Broken Glass

This is the main cause of punctures, and a deterrent to continued cycling. The principal sources are (i) broken panels at bus stops (ii) broken bottles or jars, including around litter bins (iii) where parked cars have been interfered with.

Design options

- Locate bus shelter a distance from the cyclist (see Bus Stop design choices)
- Locate litter bins at the inside of the footpath, not at the kerbside (but pay attention to the needs of blind pedestrians)
- Ensure buffer space between parked cars and passing cyclists

Maintenance Action

- Reporting facility clearly marked at bus stops, so that passengers or cyclists can report broken panels
- Provide sweeping arrangements in response to verified calls



Broken glass causes punctures

6.3.3 Debris (e.g. grit)

Winter gritting and road works / reinstatements tend to deposit grit and small stones at the edge of the road where cyclists ride. If cyclists pass across grit or larger loose material, (especially with narrow "racing" wheels), this can result in loss of balance and result in accidents.

Design options

- Ensure that sweeping and debris removal are part of contractual arrangements for roadworks licence
- Specify reinstatement standards using non-granular material where possible (e.g. foam concrete)

Maintenance Action

- Regular mechanical sweeping during roadworks, or after road gritting sessions
- Inspections to assess effectiveness of sweeping
- Particular sweeping attention to bends, turns, transitions, bus stops



Built-up grit is hazardous

6.3.4 Rutting and Joint Maintenance (in Bus Lanes and elsewhere)

While surface failure can occur anywhere, there tends to be more wear and tear on bus routes. Buses tend to be the slowest moving and heaviest vehicle in urban roads and streets. They are a major cause of surface deterioration, especially regarding rutting (around bus stops and slow sections of route) and joint failure (where there are construction or reinstatement joints near the kerb or the bus wheel running track).

For cyclists in shared bike /bus lanes, or on cycle lanes beside bus lanes, it is important that the surface is of good quality, so that the cyclist spends as much time as possible looking ahead and around (at traffic movements) instead of looking down (to avoid failed surfaces).

Design options

- Separate cyclists from the area of bus travel, especially around bus stops (see *Section 5.1 Bus Stops*)
- Ensure bus stop area (where the bus slows and stops) are joint-free i.e. plan the wearing course construction joints away from the bus stop vicinity
- Pay special attention to road building design and construction quality around bus stops, to prevent future road failure
- Request full-lane reinstatements for roadworks within bus lanes
- Avoid location of ironmongery in vicinity of bus stops, as these may sink / stand proud of the rest of the bus stop surface over time
- If drainage is necessary at the bus stop, install side-draining gullies. Replace conventional gullies with side draining gullies if differential settlement is occurring

Maintenance Actions

- Joint inspection, filling and sealing on bus lanes annually
- Reporting arrangement with bus drivers / cyclists, where surface deterioration can be reported



Incomplete reinstatement

6.3.5 Defective or Uneven Surfaces

The principal surface defects are potholes, break up of coloured surface, poor reinstatement of previous roadworks, joint movement etc. Depending on the degree of deterioration, these can affect cycling safety.

Design options

- Proper specification of materials
- Proper detailing of construction joint locations (always at right angles to bicycle wheel)
- On site supervision of new surface laying and joint sealing (avoiding cold weather)
- Sufficient drainage

Maintenance Actions

- Reporting facility for cyclists
- On site inspection of reinstatements prior to re-taking in charge from the contractor
- Visual inspection of joints as part of sweeping regime



Uneven surface

6.3.6 Ironmongery

The principal problems for cyclists associated with ironmongery are as follows:

- Poorly located gullies, lids
- Gully slots running parallel to cycle wheels
- Differential settlement – ironmongery either sunk or proud compared with the surrounding surface
- Slippery flat steel surfaces
- Temporary steel-plate roadworks
- Broken or loose lids
- These basic and reasonably obvious problems continue to be a hazard to cyclists, and should be eliminated from the street and road network

Design options

- Locate ironmongery away from cycle routes, particularly from bends
- Specify recessed manhole lids, finished in surface layer material (paving, wearing course, specialist surface, etc.)
- Choose side draining gullies / kerb arrangements in preference to channel-located gullies. Choose flat grill gullies in preference to slotted gullies
- Ensure solid construction under ironmongery (e.g. chamber walls)
- Ensure that ironmongery is raised as part of any road or street overlay – failure to do so may result in excessive edge-of-road camber, and / or sunken lids and covers, neither of which are conducive to cycling
- Restrict use of steel plates; insist on gripped surfaces; insist on smooth transition from existing road through the steel plate back to the original road surface again
- On-site supervision of all ironmongery during installation, to preclude poor choice or alignment of gullies

Maintenance Actions

- Reporting arrangement for cyclists / bus drivers to report problem ironmongery
- Inspection of ironmongery as part of route inspections
- Re-setting of broken, loose or poorly aligned gullies or manhole covers or lids under small works contract



Poorly located ironmongery

6.3.7 Ponding

Ponding affects cyclists directly: the standing water can render routes impassable, by slowing bicycles down to a stop; the ponding can hide hazards (debris, holes etc.) making the route dangerous; it can also make the route slippery, and difficult to use brakes on.

Ponding and poor drainage can also indirectly affect cyclists; spray from the road can make it difficult for drivers to see cyclists; passing vehicles can spray pedestrians and cyclists by driving through kerbside water.

Finally, ponding water (especially coupled with freezing temperatures) can have a significant impact on the integrity of the road surface, with risk of potholing.

Design Options

- Proper attention to provision of sufficient crossfall, longfall and amount of surface water sewerage
- Additional drainage capacity for any retrofitted hard standing
- Use of spray reducing surfaces (e.g. porous asphalt) where possible on roads

Maintenance Actions

- Regular channel sweeping
- Regular emptying / cleaning of gullies
- Route Inspections during periods of rainfall
- Reporting mechanism for cyclists and other road users (including photo uploads)



Poor drainage maintenance

6.3.8 Roots and Weeds

Roots and weeds tend to be a problem that is associated with cycle tracks. As cycle tracks have significantly less construction depth, it is easier for roots to undermine the cycle track, and “pop” the surface.

Again, systematic spraying of weeds tends to deal with road and streetside weeds, but on cycle tracks, weeding tends to affect longitudinal joints at the edges of tracks, as well as undermining the surface.

Design options

- Set back trees more than 5m from cyclists
- Choose shorter evergreen trees / bushes with compact root system
- Careful attention to sealing joints

Maintenance Action

- Regular mechanical sweeping during the Autumn and early Winter
- Inclusion of cycle tracks in weed spraying programme



Overgrown vegetation needs to be cut back

6.3.9 Wear and Tear of Markings and Linings

Road line visibility is an important contributor to the Legibility of a design. Worn markings will be less visible in the dark and wet, and make result in the driver (or cyclist) misreading the road layout. Visible road markings are a requirement for successful penalising of drivers who disregard such markings.

Locally worn road markings may be an indication of significant vehicular traffic crossing or driving along the road line – this may not be as the design was intended.

Design options

- Before relining, rethink - ensure that the road layout is optimal for its purpose before remarking the road with its original lining. Worn lining represents an opportunity to consider the potential inclusion of specific lanes (bus, bicycle), the reassessment of certain functions (e.g. parking, loading) and the type of bicycle facility that should be included (mixed, lane, track)
- Specify high quality thermoplastic line paint (e.g. 4mm thick etc.)
- Ensure road lining done in appropriate weather conditions

Maintenance Action

- Prioritise QBC, cycle routes and junctions within road line renewal programme

6.3.10 Lighting

Most local authorities have a well-developed urban lighting maintenance programme, operated in conjunction with the Electricity Supply Board (ESB). As bulbs wear out, or light poles are damaged, the local authority lighting inspectors systematically notify the ESB for attention.

The cycle-specific maintenance issues are principally related to the quality of the light to illuminate the edge of the road; the obstruction of light through tree coverage; night time shadows disguising the presence of cyclists (to motorists);

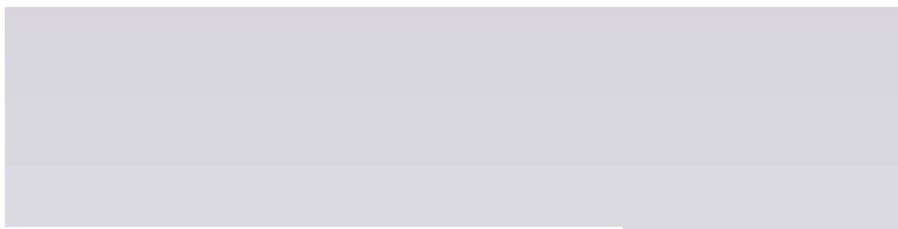
Design options

- Ensure the lighting is of sufficient quality and intensity to illuminate where cyclists will be
- Consider additional lighting fixtures where there is changes in direction, especially on cycle tracks
- Set back trees from the line of street lights
- Choose shorter evergreen trees / bushes with compact root system

Maintenance Action

- Include cycle routes as priority routes for lighting inspection
- Prioritise lighting inspections on collector routes, where there are higher traffic speeds and volumes
- Yearly cutting back of encroaching trees at known points from inspection above
- Reporting facility from cycle users for poor or defective street lighting





Withdrawn



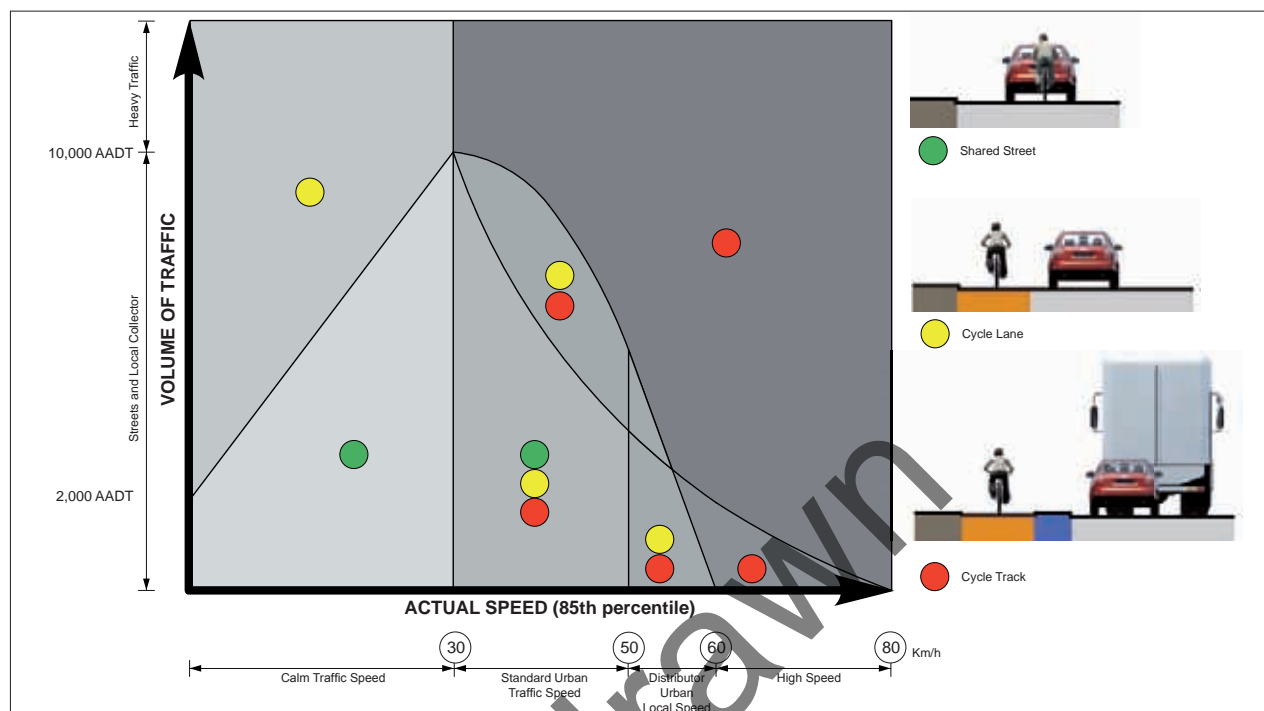
Tools and Checklists

For your convenience, this section contains frequently used Tools and Checklists in summary form. More detailed versions of these are contained elsewhere in the manual.

Depending on the results of web analysis, the contents of this section will be updated periodically to contain the most common or frequently used tools or pieces of text.

Withdrawn

7.1 MIXED OR SEPARATED



NOTES ON USING THE GUIDANCE GRAPH

Note 1 – There are two ways to use this graph

A. Choose your preferred cycle environment

Choose the type of facility you would like to have (e.g. mixed streets), and then reduce the speeds and volumes of traffic to an appropriate level. This approach is appropriate when the designer's intention is to emphasise an informal, calmed, relaxed town or village centre, or perhaps where the road is so narrow that there is no possibility of dedicating space to cycling.

B. Plan your traffic speeds and volumes

Determine the design speeds and volumes of traffic according to the regional and/or local sustainable traffic plan, and provide the appropriate cycling facility for that regime.

Note 2 – Threshold Values

The guiding thresholds in this graphic represent the most widely internationally-accepted values of traffic speed and volume for various cycle provision options. They are approximate values in their scope, to give designers a sense of the appropriateness of their design solutions.

It beholds the designer to ensure that the Principles of Sustainable Safety, especially, Functionality, Homogeneity and Legibility, are applied to each design, regardless of the solution(s) offered in this graphic.

Note 3 – Traffic Volumes - some rules of thumb

The graph's Y-axis is the total two-way vehicular flow per day based on AADT. Some useful rules of thumb:

- 1 Peak hour traffic volumes = approximately 10% of 24-hour AADT.
- 2 Peak hour traffic splits 66% inbound 33% outbound.
- 3 A bus or HGV is equivalent to 3 PCUs (passenger car units). A busy bus lane (e.g. a bus every minute, and regular taxis) could have as high a traffic flow (in PCUs) as the next traffic lane.
- 4 A busy inbound urban traffic lane within a signalised system carries between 650 – 850 PCUs per hour.

Note 4 – Actual speeds of motorised traffic

In cycle design, it is not the theoretical speed of traffic, or the posted traffic speed limit – it is the actual 85%ile traffic speed that counts

The actual speed of traffic can be quite different to the signed speed limit for the road, especially off-peak. In some cases, the roadscape may need to be re-configured to ensure that speeds of traffic are no higher than the designer intends within the design.

Traffic lane widths are an important consideration. With the exception of primary distributor roads, traffic lane widths should not exceed 3m in general. (see *Traffic Management Guidelines*, Table 9.2: "Typical Lane Widths".).

Further guidance on Speed and Traffic Calming can be found in the *Traffic Management Guidelines*, Chapter 6, Table 6.1(b) "Traffic Calming on Existing Roads".

Note 5 – Relative speed of traffic

Average urban commuter cycling speeds are up to 20km/h. Where weaving occurs, the Dutch advice (CROW) is to limit the speed differential between bicycle and traffic to 10km/h, in order that bicycles can weave in front of vehicles with relative comfort and safety etc.

For this reason, the 30km/h speed limit (ensuring it is observed) becomes central to the concept of mixed traffic.

Beyond 50km/h actual speed, the relative speed of vehicles to cyclist is getting high (30km/h or higher). In relative terms, cyclists travelling at 20km/h in a 50km/h zone are equivalent to pedestrians walking along the road with their backs to traffic, within a 30km/h zone.

For this reason segregation is generally appropriate for urban roads where:

- actual motorised speeds are above 50km/h or
- on such roads where the speed limit is set at 60km/h or higher

Note 6 – Critical Thresholds – 10,000 AADT and 5,500 AADT

In reviewing the graph, the threshold of 10,000 AADT is important. At 30km/h actual traffic speed, this represents the maximum level of traffic flow at which mixed cycling is likely to be the most appropriate choice. 10,000 AADT is roughly equivalent to 1000 PCUs in the peak hour, or 666 PCUs inbound in the morning peak hour.

At 50km/h actual speed (the standard urban speed limit) the maximum traffic flow is 5,500 AADT if mixed cycling is preferred. This is equivalent to 360 PCUs inbound in the peak hour – a relatively low volume of traffic.

Note 7 – Multi-Lane Roads

In general, and under the Principle of Legibility, this manual does not recommend designs that intend cyclists to slew across multiple lanes of traffic for right turns.

While some experienced cyclists may negotiate such manoeuvres, where possible, the designer should provide an appropriate crossing arrangement in accordance with the Principles of sustainable safety.

If the street or road in question has more than one general lane per direction (between junctions), the designer should re-assess the layout:

- 1 If the road is genuinely and necessarily a higher order collector / distributor road with a strong vehicular traffic function, cycle lanes or tracks are likely to be required.
- 2 If the road has low amounts of through traffic, the roadspace should be re-configured in favour of the bike.

Note 8 – Limiting Right Hand Turn Pockets

In many situations, right hand turn pockets are introduced simply because the space exists. Right hand turn pockets should only be included on roads where traffic delay is a real concern (i.e. on higher order collector, or distributor roads).

Careful attention is required to the provision for cycling in the vicinity of right hand pockets, where there may be local traffic weaving and turbulence.

Note 9 – Feasibility of widescale segregation

It may not be feasible to re-engineer much of the existing urban space to provide for segregated facilities.

Integrated cycling solutions, based on the hierarchy of provision, are likely to be more effective in terms of cost and delivery. However, integrated facilities are likely to require significant changes to the traffic regime.

The transport implications of significant reductions in speed and volume of traffic on key arteries to and through cities and towns needs to be fully understood and planned for, within the sustainable urban traffic plan, before embarking on such changes.

7.2 WIDTH CALCULATOR

There are three basic elements that determine the width of a cycle lane or track, A, B, and C below.

- The space to the left of the cyclist
- The space required to support the cycling regime (two-abreast, single file, overtaking etc.)
- The space to the right of the cyclist

In addition, there may be additional width required depending on:

- Topography, traffic, locality etc.

The table below provides a simplified means of determining the actual width required for cycle lanes and tracks. Standard wobble is already built into the values in the table.

A B C

A Inside Edge	B Cycling Regime	C Outside Edge	D Additional Features
Kerb 0.25m	Single File 0.75m	30kph, 3.0m wide lane 0.50m	Uphill 0.25m Sharp bends 0.25m
Channel Gully 0.25m	Single File + Overtaking, Partially using next lane 1.25m	50kph, 3.0m wide lane 0.75m	Cyclist stacking, Stopping and starting 0.50m
Wall, Fence or Crash Barrier 0.65m	Basic Two-Way 1.75m	Raised kerb, dropped Kerb or physical barrier 0.50m	Around primary schools, Interchanges, or for larger tourist bikes 0.25m
Poles or Bollards 0.50m	Single File + Overtaking, Partially using next lane 2.00m	Kerb to vegetation etc. (ie. cycleway) 0.25m	Taxi ranks, loading, line of parked cars 1.00m (min 0.8m)
	2 Abreast + overtaking (tracks and cycleways) 2.50m		Turning pocket cyclists 0.50m

Example:
To determine required cycle width, select the appropriate Inside Edge, Cycling Regime, Outside Edge and any Additional Features

Channel Gully 0.25m	Single File + Overtaking, Partially using next lane 1.25m	50kph, 3.0m wide lane 0.75m	Around primary schools, Interchanges, or for larger tourist bikes 0.25m
----------------------------	--	------------------------------------	--

0.25m
+ 1.25m
+ 0.75m
+ 0.25m

Required width = 2.50m Note: This is the maximum width for an on road cycle lane. Cycle tracks can be wider.

7.3 QUALITY OF SERVICE EVALUATION

Quality of Service is measured by considering five criteria:

- Pavement Condition Index (PCI) is a measure of the physical integrity of the cycling surface. It is determined by comprehensive visual inspection as set down by the Department of Transport. In the absence of a formal PCI score, use a locally derived marking system out of 100
- Number of adjacent cyclists describes the capacity for cycling two abreast and/or overtaking. "2+1" accommodates two abreast plus one overtaking
- Number of conflicts is a measure of the potential interruptions to a cyclist per 100m and may include bus stops, side-roads, driveways, entrances, junctions, pedestrian crossings, parking and loading etc.
- Junction time delay is a measure of the actual time delay at junctions as a percentage of the overall journey time, assuming an average journey speed of 15km/h
- HGV influence is a measure of the number of HGVs and buses adjacent to cyclist as a percentage of the total traffic during peak hours

Quality of Service	Pavement condition (PCI range)	Number of adjacent cyclists	Number of conflicts per 100m of route	Journey time delay (% of total travel time)	HGV influence (% of total traffic volume)
Level A+	86 – 100	2 + 1	0 – 1	0 – 5%	0-1%
Level A	66 – 85	1 + 1	0 – 1	6 – 10%	0-1%
Level B	51 – 65	1 + 1	1 – 3	11 – 25%	2 – 5%
Level C	41 – 50	1 + 0	4 – 10	26 – 50%	6 – 10%
Level D	20 – 40	1 + 0	>10	>50%	>10%

Quality of Service (QOS) is ranked from Level A+ (highest) to Level D (lowest). To achieve any particular QOS, at least 4 of the 5 criteria must be achieved. The fifth may be no more than one level lower, e.g., a route meeting four criteria at Level B and one at Level C has an overall QOS Level B.

7.4 CHECKLIST: FUNCTION / FORM / USAGE

Movement Related Functions (inter alia)

- Pedestrians – walking, crossing
- Cycling
- Vehicular traffic (all modes)
- see *Road Classification Section 1.6, Traffic Management Guidelines*
http://www.dto.ie/traffic_manual.pdf
- Drop-offs and pick-ups
- Access to property
- Turning
- Abnormal vehicle manoeuvres
- Parking of vehicles and bicycles
- Bus stops – waiting and crossing to and from the bus
- Loading and delivery
- Refuse collection

Place Related Functions (inter-alia)

- Housing and access
- Parks and open space
- Communication and information points
- ATMs and postal services
- Meeting and gathering
- Play and recreation
- Shops including window display
- Social and community services
- Shelter and public convenience
- Heritage and architectural value
- Services (gas, water, sewerage etc.)

7.5 SIX WAY CHECK

When designing a junction, apply the following Six Way check to each of the junction approaches.

When traffic is moving

- How does the cyclist go straight ahead?
- How does the cyclist turn right?
- How does the cyclist turn left?

When traffic is stopped

- What is the cyclist's approach, waiting position and delay for going straight ahead?
- What is the cyclist's approach, waiting position and delay for turning right?
- What is the cyclist's approach, waiting position and delay for turning left?

7.6 NO ROOM FOR THE BICYCLE

The route is as good as its weakest link.

If a solution for a particular bottleneck, accident location or poor QOS link cannot be found after considering the advice below, it is strongly recommended that no further cycling investment or cycling dependence is generated through that link or area. See *Section 3.4 Seven Steps to Planning a Network*.

At a link level

Consider the Hierarchy of Solutions;

In particular,

- Identify all accidents, especially vulnerable road user accidents
- Identify functions for which roadspace has been provided, between building lines. Consider which functions are truly necessary or desirable, and which ones could be removed (e.g. loading, parking,) and when (peak, all day, during school hours etc.)
- Consider lane widths – 3m is sufficient for general traffic lanes (see *Traffic Management Guidelines, Table 9.2*). Perhaps any surplus space could be assigned to cycling
- Consider whether turning lanes, hatching etc. can be removed
- Consider other traffic problems in the area (e.g. turbulence, lane switching, pedestrian crossing difficulties, etc.) so that cycling solutions can be developed in tandem with other traffic problems
- Consider the Place functions that may need to be included more prominently in the overall layout

At a route level

Consider the Hierarchy of Solutions in conjunction with the *Strategic Traffic Management Plan*, and consider the 7 steps in *Section 3.4 Seven Steps to Planning a Network*.

In particular,

- Identify the key origin and destination zones served by the route
- Consider the impact of do-nothing on the overall cycling QOS
- Consider signalised route management that is bicycle friendly e.g. keeping saturation levels below 80%, using short signal cycle times etc.
- (Re) consider design solutions for public transport priority, to see if cycling can be improved without significant loss to public transport Quality of Service
- Consider alternative alignments for other modes or traffic functions
- Consider alternative alignments for cycling, the impact of any deviation, and perhaps the redundancy of cycle route provision that may arise

At a Strategic Level

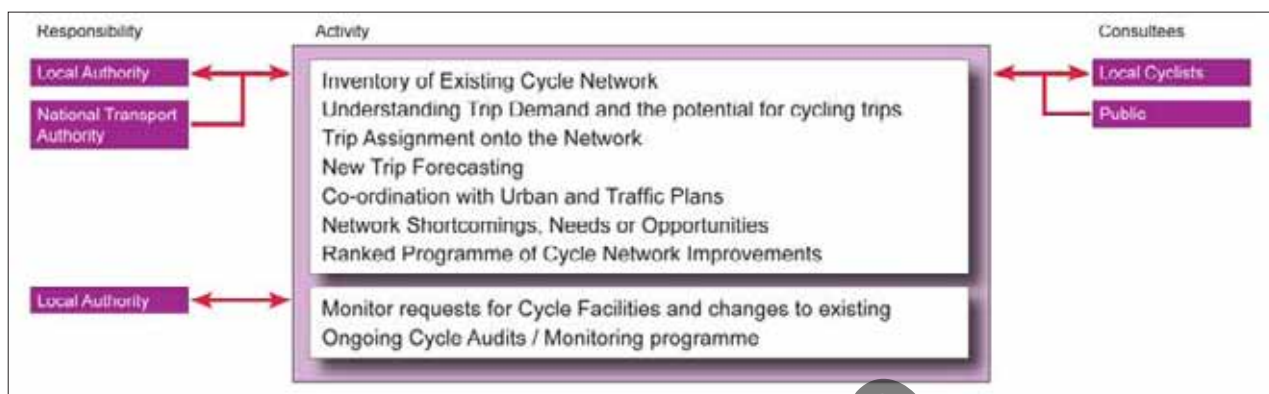
Consider broad solutions to overcome bottleneck issues.

In particular,

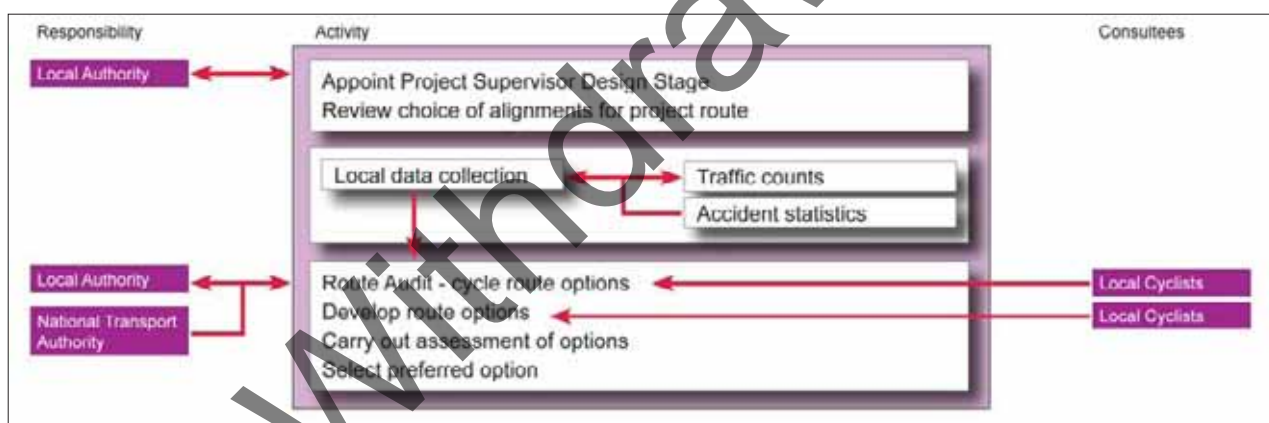
- Consider overall traffic capacity reduction for the area, with accessibility provided by other means or modes
- Consider re-routing of other modes in order to provide for the bicycle
- Consider land acquisition to provide additional space
- Consider new alignments – roads, cycle-only routes, bridges
- Consider demand management measures targeted at particular urban sectors fed by the route

7.7 DESIGN AND CONSTRUCTION FLOWCHART

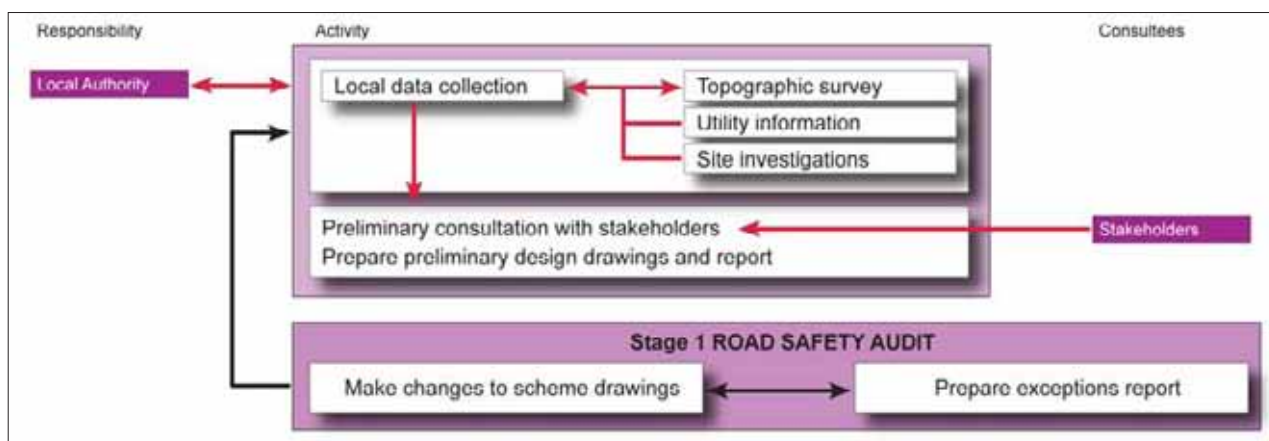
Stage 1 : Network Planning



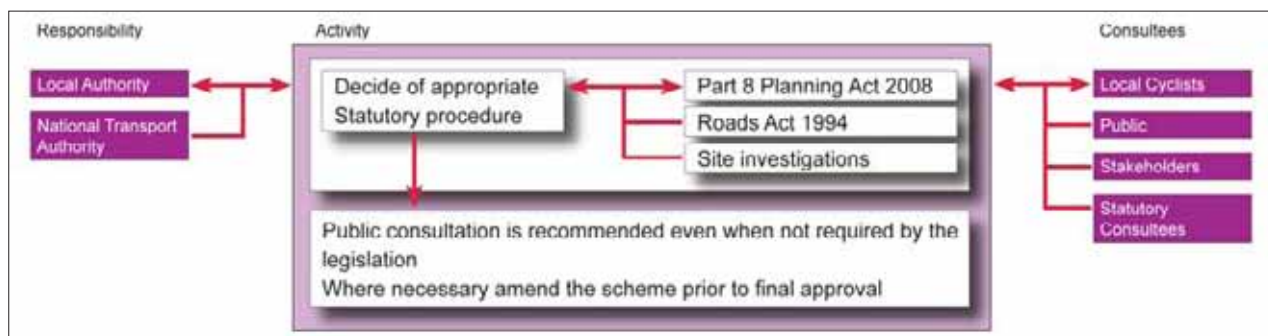
Stage 2 : Concept / Feasibility



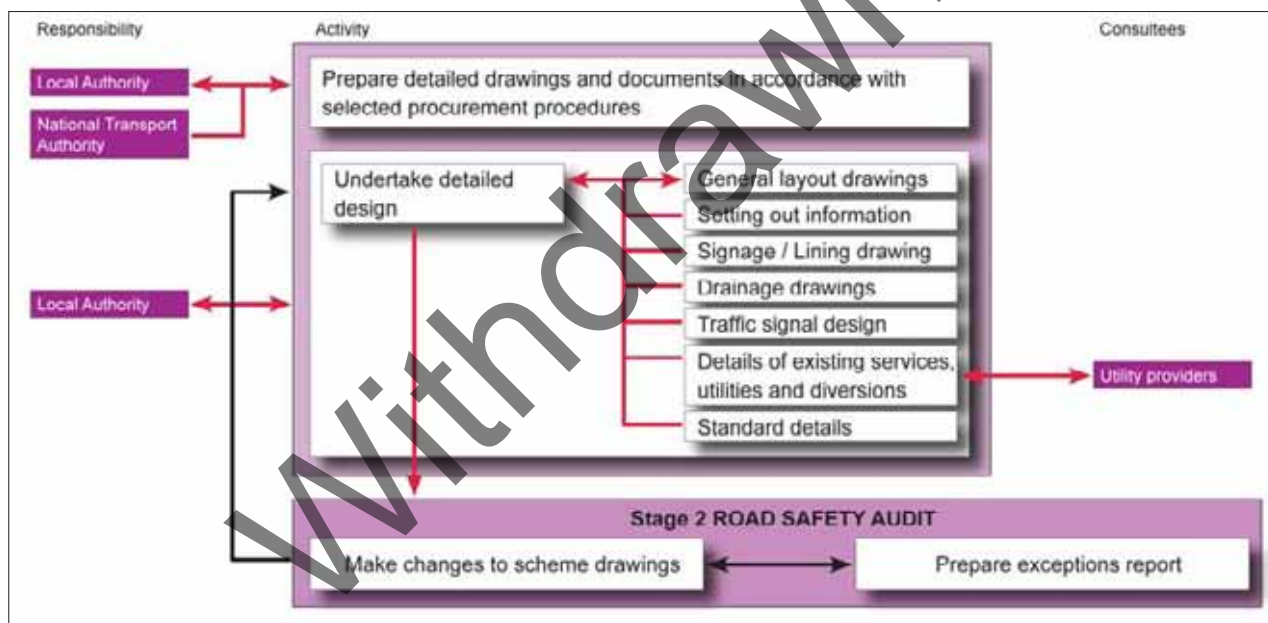
Stage 3 : Preliminary Design



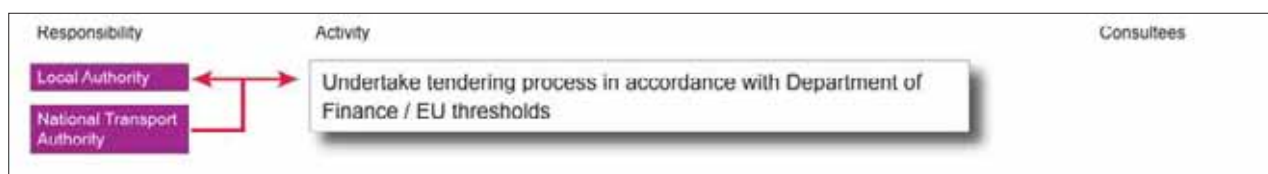
Stage 4 : Statutory & Legal



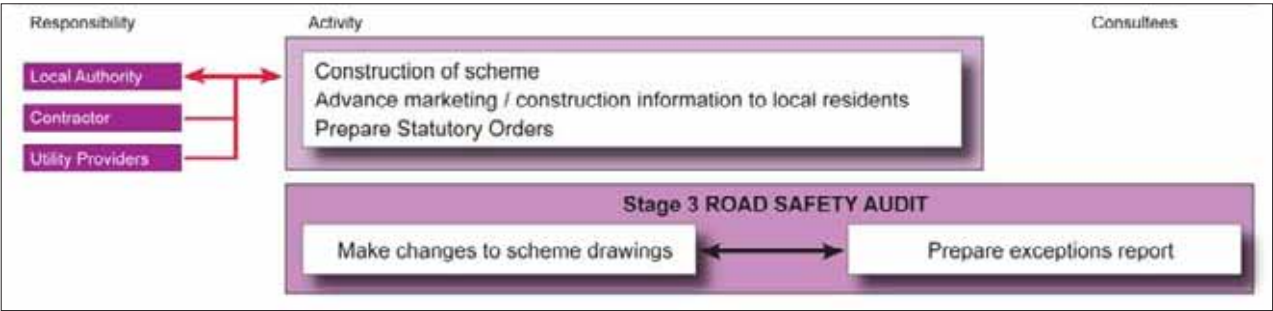
Stage 5 : Detailed Design



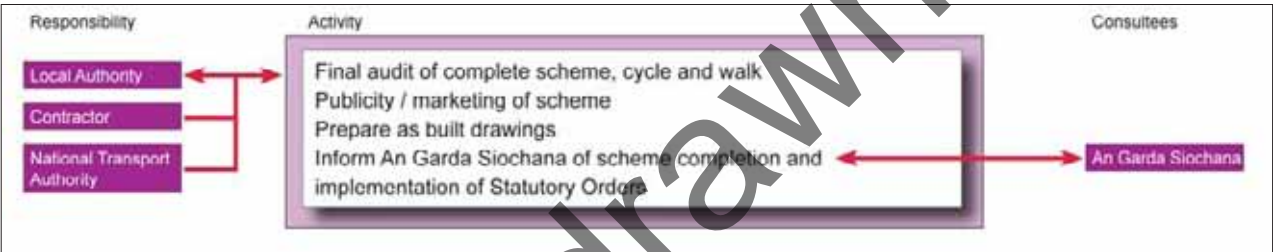
Stage 6 : Procurement



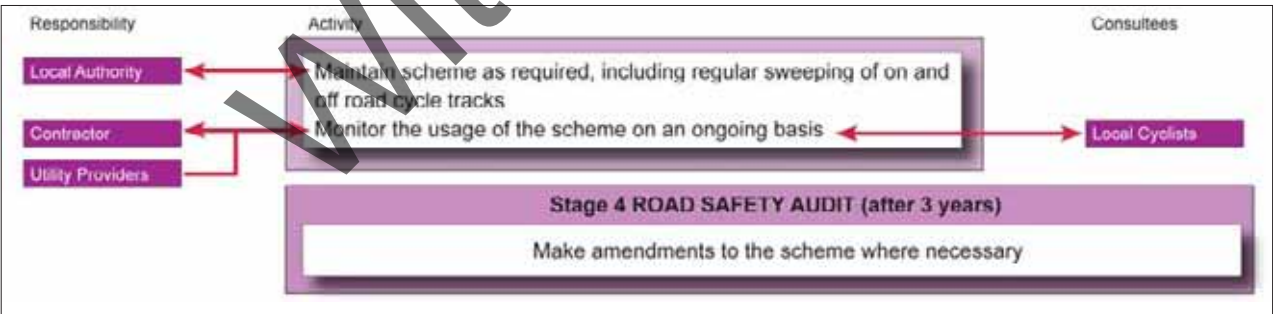
Stage 7 : Construction



Stage 8 : Commissioning & Opening



Stage 9 : Maintenance & Monitoring



7.8 JUNCTION KEY DESIGN ISSUES AND CHECKLIST

Junction Layout

The location of the junction should be obvious to everyone approaching the junction. In addition, all users should understand the shape of any junction (e.g. T-junction, crossroad, roundabout etc), the movements permitted at it, and the junction control system (priority, signalised, lollipop etc.).

Junction Approaches

All road users should be guided to their appropriate position in advance of the junction. Good signage and clear lane markings will greatly assist, particularly in poor weather conditions, at night-time, or in unforeseen circumstances (traffic signal failure etc.).

Right of Way

It should be clear to all users as to who is expected to yield priority at any junction. See also *Section 1.8 Right of Way*.

Checklist

The checklist below provides a simple guide to design better and safer junctions.

- Minimise the number of approaches, and preclude right hand vehicle turns to and from minor roads and properties within 50m of a junction
- Simplify junction layouts by removing slip lanes and avoiding turning pockets where possible
- Ensure junction entrance and exit lanes are aligned (i.e. no merging or lateral shifts within a junction or the approaches to the junction)
- Minimise exposure of Vulnerable Road Users (VRUs) to significant conflict within junctions (e.g. tighten lane widths to reduce crossing distance, programme staging of main VRU movements immediately after the longest stage etc.)
- Reduce vehicle approach speed (e.g. tighten lane widths, programme non-peak off-sets between signals to dampen traffic speeds to be speed limit compliant)
- Ensure the design provides for all typical movements, or precludes certain movements if necessary (provide clear advice in the case of the latter as to alternative routes)
- Apply the 6-way check
- Reconfigure oblique junctions to maximise the opportunity for cyclists to make eye contact



Withdrawn

GLOSSARY

Advance Stacking Locations; ASL	ASLs are red coloured areas at signalised junctions ahead of stopped vehicular traffic. They permit higher volumes of cyclists to stop and wait in a forward position. They facilitate cyclists moving off before other traffic.
All Pedestrian Stage	At signalised junctions, the All Pedestrian Stage is when all vehicular traffic is stopped and a green man is displayed simultaneously on all arms of a junction.
Attractiveness	One of the Five Needs of Cyclists, and a measure of the degree of shelter, comfort, lighting, maintenance and visual interest along a route. It is particularly important for beginners, tourists and recreational routes.
Balance	Balance is essential to cycling and is maintained by a combination of adequate forward momentum and handlebar adjustment.
Bevelled Kerb	A bevelled kerb facilitates vehicular movement from the carriageway to an entrance or driveways. They avoid the need for driveway aprons that render cycle tracks and footpaths uneven and bumpy.
Box Turn	Box turns, often referred to as "Left To Go right", are used to facilitate cyclists turning right from multi-lane carriageways. Cyclists join the stopped traffic to their left and wait for the green signal to proceed – avoiding the need to weave across multiple lanes of traffic. In central urban areas, pedestrians will be slightly displaced from their desire line at the junction to accommodate box turns.
Bus Lane	
Combined Cycle and Bus Lane	A narrow 3.0m wide lane shared by both cyclists and buses and taxis. Speed limit of 50km/h and cycle logo required.
Cycle Lane beside a Bus Lane	A separate cycle lane, minimum 1.5m wide, running alongside a 3.0m wide bus lane. Bus lane speed limit of 60km/h applies.
Retro-Fitting Cycling into Bus Lane	Similar to a Combined Cycle and Bus Lane where existing space available for a bus lane is greater than 3.0m but not wide enough to provide a separate cycle lane as well. The excess road surface over 3.0m should be hatched off, or given back to the footpath/verge.
Bus Stops	
In-Line	Cycle facility is In-Line with the Bus Stop. This design is the most space efficient.
Island	Cycle facility is brought behind the bus stop.
Kneeling	In this design, Kassel kerbs are not possible and buses are required to kneel in order to provide level access for passengers.
Coloured Surface	Coloured bitmac or specialist bitumen based material, usually red, to clearly identify points of conflict. Blue colour is also be used for more significant potential conflict points at junctions.
Comfort	One of the Five Needs of Cyclists, requiring consideration of width, gradients, stopping, delay, surface quality and shelter etc.
Conferring advantage on the Bicycle	Designing in such a way that cyclists have priority or advantage over other modes, e.g. in terms of more direct routes, reduced delay, lanes approaching signals, more convenient parking etc.

Conflict	The potential for collision. In other words, where two or more modes cross or approach each other.
Consistency	Ensuring that cyclists are afforded a consistent Quality of Service along a route.
Continuity	Ensuring that a cycle facility is continuous along a route, e.g. not disappearing intermittently or for short distances.
Contra-Flow	Cycle facilities designed to run contrary to the main traffic direction.
Cross Fall	The side slope of a pavement to facilitate good drainage. Cyclists are more comfortable when the direction of fall is away from the main traffic and not towards it.
Crossing	
Toucan	Signalised crossing that facilitates pedestrians and mounted cyclists to cross at the same time, but pedestrians retain priority. Not suitable for wide roads.
Pelican	Signalised crossing which permits stopped traffic to move off on a flashing amber if the pedestrian crossing is clear. Not suitable for wide roads.
Zebra	Non-signalised crossing where vehicular traffic must yield to pedestrians or cyclists intending to cross the road. For low speed environments.
Two-Stage Crossing	Crossings where each traffic direction of the carriageway is negotiated sequentially, with an intervening island.
Curve Radii	A measure of the geometry of a kerb at a turn. A small or 'tight' radius will reduce the speed of turning traffic and oblige the vehicle to "turn" at a tight angle rather than "veer" or "sweep" into the side road.
Cycle Lane	
General	A cycle facility that is marked on the main carriageway. Minimum width is 1.5m. Generally should not exceed 2.5m in width, to avoid confusion with a traffic lane.
Advisory	A cycle lane identified by a broken white line where vehicular traffic can enter or cross the space. (The Dutch refer to these lanes as "suggestion lanes" as they merely suggest that motorists should avoid driving in them). Normally used where a Mandatory Lane would leave insufficient space for traffic or at junction approaches at locations where vehicles need to cross the cycle facility. Parking and loading is allowed unless specifically restricted.
Contra Flow	A cycle lane is provided on a one way street running against the main traffic flow where the traffic speed is no more than 30km/h. Parking and loading are not permitted.
Mandatory	A cycle lane identified by a solid white line prohibiting vehicular traffic except for access and where parking and loading is not permitted. Usually 24 hour unless time plated.
Raised	Similar to Mandatory Lanes but raised 25 to 50mm above the main carriageway surface. These are always 24 hour and parking is never permitted.
Cycle Links	The cycle facility between junctions.
Cycle Network	A system of connected cycle routes, serving all local zones in the urban area.
Cycle Routes	A set of connected links and junctions that follow logical corridors between zones or urban centres.

Cycle Track

General	Cycle facility that is physically segregated from vehicular traffic by a level change or other physical means such as bollards.
At Grade	Cycle facility at carriageway level but is segregated by a continuous kerb or line of bollards.
Behind Verge	A verge separates the cycle facility from traffic. The verge can be grass or paved.
Contra Flow	Segregated cycle facility provided on a one way street running against the main traffic flow where the main traffic speed is greater than 30km/h.
Raised	Cycle facility is alongside the carriageway but raised above to kerb level. Suitable for main carriageway speeds up to 80km/h. Also called "raised adjacent".
Two-Way	Facility designed to accommodate contra-flow cyclists as well as with-flow cyclists. On two-way cycle facilities, contra-flow cyclists lose all expectation of priority at junctions. Typically used where multi-lane district distributor and collector roads have infrequent crossing points or where there is only development on one side of the road, or where the time penalty for crossing the road to travel with-flow is too great.
Cycle Trail	Cycle facility in a non-vehicular environment, typically serving green routes, parks, waterways, shores etc. Pedestrians take priority in all cases of potential conflict.
Cycle Way	Roads for cyclists exclusively, often provided through parks or as off-road short cuts.
Cycling Regime	Describes the existing or intended usage of a cycle facility in terms of single file, two-abreast, overtaking etc.
Dedicated Left-Turning	A dedicated left turning facility > 30.0m in length, typically used with higher levels of left turning vehicles. Will generally require a signalised cycle track.
Dedicated Left Turning Pocket	A short lane additional left turning traffic but which permits designers to consider streaming for cyclists.
Dedicated Right Turn Cycle Facility	A dedicated facility with an ASL that allows cyclists to weave across a single traffic before traffic starts to split into separate traffic streams.
Delay	From a cyclist perspective, anything that causes unnecessary stopping or deviation and gives rise to extended journey times.
Delineation	Using a painted line to mark off space intended as a cycle or traffic lane. Delineation is no segregation: it does not ensure separation. Delineation should not be used to separate cyclists from pedestrians – consider segregation or shared space instead.
Directness	One of the Five Needs of Cyclists, requiring cycle routes to be as direct as possible (compared with "as the crow flies") avoiding detours and deviation.
Drainage	Removal of surface water on cycle surfaces and avoidance of ponding.
Entrances	Refers to the access and egress to properties from carriageways.
Eye Contact	Essential between cyclists and motorists particularly at junctions or other potential points of conflict.
Feeder Lane	A lane that is provided to bring cyclists past stationary traffic to a junction or an ASL. Should be mandatory generally.
Flares	Local widening of carriageway at a junction to facilitate traffic doubling up approaching a junction – not recommended.

Forgivingness	A Principle of Sustainable Safety, and is a measure of the degree to which an environment will contribute to a benign outcome in the event of an accident. In other words, minor errors by vulnerable road users do not result in serious injury or loss of life.
Functionality	A Principle of Sustainable Safety, that the design is fit for purpose – both functional and place related.
Green Routes	Routes that are free of vehicles and cater for pedestrians and cyclists as well as recreational uses.
Hierarchy of Provision	A proposed approach in the National Cycle Policy Framework to considering traffic regime changes in advance of infrastructural provision.
Homogeneity	A Principle of Sustainable Safety, that reducing the relative speed, mass and direction of different modes increases safety.
Inside Edge	Refers to the physical nature of the (usually) left hand side of a cycle facility, and could be a wall, grass, a kerb etc.
Integration	Cycling with the general traffic, with or without marked cycle lanes.
Journey Time	The time taken to get from origin to destination.
Jug Turn	A form of right turn used to facilitate high volumes of cyclists turning right, such as at a school entrance.
Kerb-side Hatching	Hatching to keep traffic away from the kerb and allow cyclists to approach a junction past stationary traffic. Used in low volume and low speed environments where there is insufficient space to accommodate a proper cycle lane.
Late Release Left Hand Turn	Subject to Departmental approval, permits left turning traffic to proceed on a flashing amber filter, yielding to any pedestrians crossing.
Left Hand Pocket	A dedicated left turning facility shorter than 30.0m. Not generally recommended, but where provided, can be with or without a dedicated left turn cycle lane.
Left Hand Slip Lane	A priority facility for traffic to proceed on a yield arrangement, in an otherwise signalised junction. Not recommended.
Left-To-Go-Right	Left-To-Go-Right, often referred to as “Box Turns”, is used to facilitate cyclists turning right from multi-lane carriageways. Cyclists join the stopped traffic to their left and wait for the green signal to proceed – avoiding the need to weave across multiple lanes of traffic.
Legibility	A Principle of Sustainable Safety, that a road environment that can read and understood by all road users is safer.
Local Streets	Low traffic environments where cyclists and pedestrians take precedence over vehicular traffic, and where cyclists “take the lane” in line with vehicles.
Long Fall	Refers to the longitudinal fall or gradient along a cycle facility.
Merging	Where two or more streams of road users are brought together into a single stream or lane.
Mixed Street	Where cyclists share the same space with traffic.
Outside Edge	Refers to the physical nature of the (usually) right hand side of a cycle facility, and could be a painted line or a kerb etc.

Overrun Area	A slightly raised paved area at a turn that will facilitate a large vehicle tracking around an otherwise tight junction.
Pavement Condition Index; PCI	A measure of the physical integrity of the cycling surface – measured out of 100 points.
Pedestrian Priority Area	A area where pedestrians have priority over all other road users.
Principles of Sustainable Safety	Developed in 1992 and subsequently in the Netherlands, they underpin all road design. Adherence to them has contributed to the Netherlands leading record in road safety.
Quality of Service	Essentially a measure of the transport offer to cyclists. A measure of the degree to which the attributes and needs of the cyclist are met.
Re-Establishing	Bringing cycle tracks and off-road cycle facilities to an on-road position in advance of a junction – typically for significant left turns.
Relative Speed	Speed differential between two road users.
Right of Way	In Ireland, all road users have equal right of way. However, all road users, including emergency vehicles and cyclists alike, are expected to proceed with due care and consideration for other road users in all cases.
Roundabout	Essentially a necklace of T junctions where the traffic joins by turning left onto and off the roundabout. They are priority junctions that can facilitate relatively high volumes of turning traffic. Cycle and pedestrian friendly roundabouts are included in this manual. There are all single lane entry and single traffic lane circulating designs.
Segregation	Cycling on dedicated cycle tracks or cycle ways that are separated from the general traffic by a physical barrier.
Self-Awareness	A Principle of Sustainable Safety, that when road users are aware of their own abilities and limitations to negotiate a road environment, the environment is safer.
Set Back Stop and Yield Line	At side roads in central urban areas, where emerging traffic stops and yields in advance of the crossing pedestrian desire line – usually the building or boundary line.
Set Back Stop Line (signals)	Used at tight junctions to facilitate larger vehicles that may need to track well into the junction to complete their turn.
Shared Pedestrian Footpath	Not generally recommended as they offer reduced or poor Quality of Service and safety to pedestrians and cyclists. Pedestrians should always have priority, clearly reinforced by signage.
Shared Street	A street design where pedestrians can expect priority in the vehicular part of the street. Generally kerb free.
Shifting the Cyclist Right	Bringing cyclists out from the kerb to their correct alignment in advance of kerb side parking, loading bays, a left hand pocket or certain bus stops.
Side Entry Gully	Drainage gully that receives run off through the 'face' of the kerb, thereby maximising the unobstructed available road surface for cycle facilities.
Side Road	A smaller road joining a larger road. Will present as a T-junction if approached from the side road, or as a left or right turn from the main road depending of the direction of travel.
Side Swipe	An oblique collision along the side of a vehicle. The risk of side-swipe increases where vehicles are merging or weaving. Side-swipe is a serious hazard for cyclists and should be addressed.

Skill Level	Refers to cycling competency.
Stability	A pre-requisite of cycling, and hampered by poor surface conditions, obstructions and steep gradients.
Streaming	Cycling between two adjacent lanes of traffic.
Taking the Lane	Cycling in the middle of the lane rather than close to the kerb so as to be in-line with vehicular traffic.
T-Junction	A minor road joins a larger road at (nominally) right angles.
Transition	Transforming from one cycle facility to another by means of a vertical or horizontal change, or a combination of both.
Trip Demand	A measure of the usage requirements of all modes determined by census data, surveys and transport models.
Trip Forecast	A measure of future usage requirements of all modes informed by development plan projections, target modal shifts, future trends and expected policy outcomes.
Two-Way Cycle Facilities	Facilities designed to accommodate contra-flow cyclists as well as with-flow cyclists. On two-way cycle facilities, contra-flow cyclists lose all expectation of priority at junctions.
Vulnerable Road User; VRU	Road users who are most at risk – pedestrians and cyclists, specifically children, the elderly and people with mobility impairments.
Weaving	Cyclists wishing to turn right will move across traffic so as to get into the correct road position or lane. Designs should not require cyclist to weave across multiple traffic lanes.
Width	Refers to the effective width of a cycle facility.
Wobble Room	The additional space needed to maintain balance at slow speeds, or starting up.

ACKNOWLEDGEMENTS

The National Transport Authority wishes to acknowledge the assistance and contributions of the following persons to the National Cycle Manual:

DTO Technical Working Group (for Draft Manual):

Chair: Muiris O'Keeffe

Dublin Transportation Office:

Michael Aherne
Robert Parkinson
Mick MacAree
Julie Galbraith
David Clements
Colin Clarke

Department of Transport:

John McCarthy
Ann Cody
Dominic Mullaney

Dublin City Council:

Niall Gormley
Ciarán Fallon
Eoghan Madden
Tim O'Sullivan

South Dublin County Council:

Denis Ryan
Helena Fallon

Kildare County Council:

Dónal Hodgins

Laois County Council:

Michael O'Hora

Limerick City Council:

Vincent Murray

Quality Bus Network Project Office:

Anne McElligott
Eoghan Forristal
Sorcha Sheehy

National Roads Authority:

Helen Hughes

An Garda Síochána:

John T Murphy

Consultants:

Sean Doherty, Mott McDonald
Joe Seymour, DBFL
Seamus MacGearailt, Roughan & O'Donovan

Expert Review Group:

International experts:

Alex Sully (England)
André Pettinga (Netherlands)
Erl Wilkie (Scotland)
Niels Jensen (City of Copenhagen)
Robert Kelly (Ireland)

Consultants for Editing and Production:

Brady Shipman Martin (John Kelly, Partner, and Rafal Nieznalski)
Bnew Designs (Anew McKnight - hard copy design)
Fusio (website development)

Photographs:

Michael Aherne, Robert Parkinson, Jeroen Buis
John Kelly
Dublin Bus (supply of open-top bus)
Selected photos from Sustrans

Preliminary Research:

Interface for Cycling expertise

Jeroen Buis
Roelof Wittink

Consultation:

The National Transport Authority also wishes to acknowledge the comments and contributions of the many persons and organisations who reviewed the draft Cycle Manual.

The National Cycle Manual recognises the role that cycling can play in creating more sustainable and efficient urban and suburban environments. It seeks to promote a modal shift from private vehicular transport to cycling, walking and public transport.

The Manual presents the current best practice and advice in providing proper cycling facilities in contemporary urban and suburban environments. This document is a printed representation of the content of www.cyclemanual.ie as of June 2011. Please consult the website for the most up to date advise.

Withdrawn

Contact Us

Feedback on the National Cycle Manual should be sent to:
cyclemanual@nationaltransport.ie

National Transport Authority

Dún Scéine
Harcourt Lane
Dublin 2
Ireland.

+353 1 879 8300

www.cyclemanual.ie
www.nationaltransport.ie