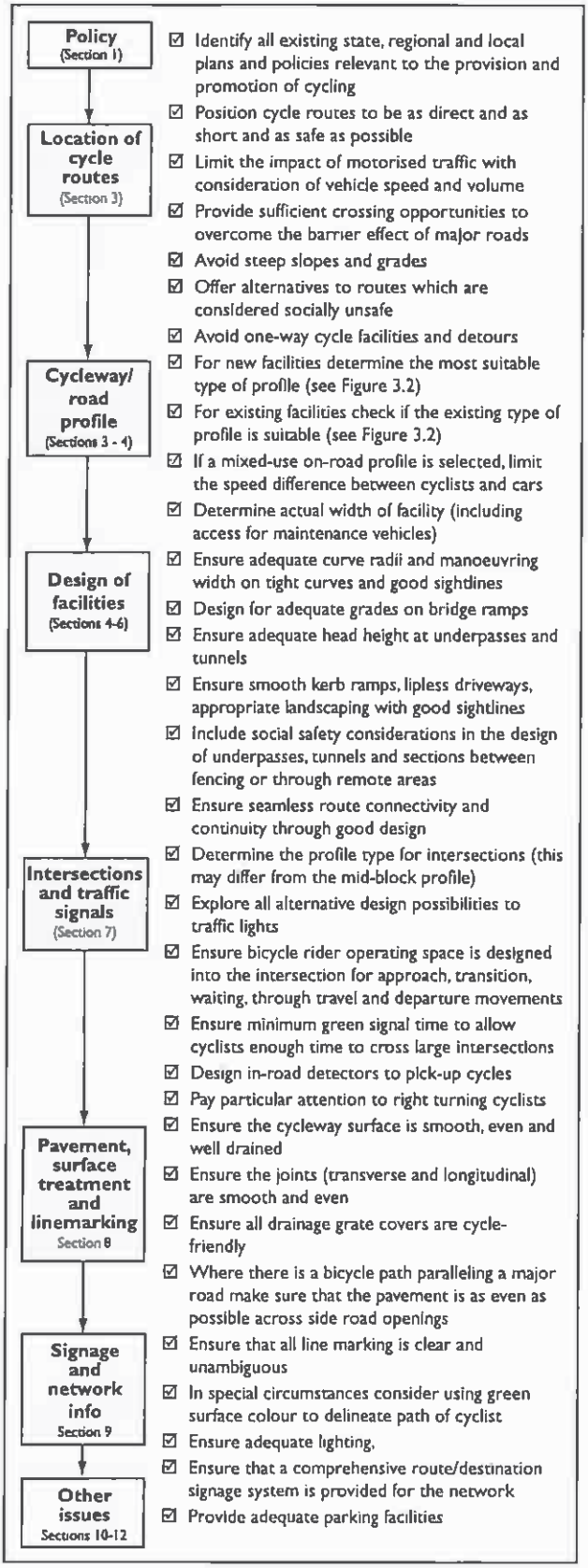
3. Planning and engineering concepts

Figure 3.1: Bicycle facility design checklist.



This section explains the design principles and the philosophy which underpin this manual. Figure 3.1 provides a simple checklist which can be used to follow the decision process through the various sections of this document.

3.1 Principles of bicycle network provision

The needs of bicycle users and their requirements for an efficient and useable bicycle network can be best summed up in five key principles listed below. Table 3.1 provides criteria and design considerations for implementing these principles.

Coherence: Bicycle network infrastructure should form a coherent unit by linking popular destinations with local residential streets via regional routes and local routes. The network should be continuous and it should be very clear to the user where the facility leads. Intersections should seek to provide a clear path for bicycle riders as well as for other modes. The quality of network facilities should also be consistent throughout the length of the route regardless of whether the facility uses a separated or shared road profile. Routes should be easy to find from local streets and the network should be of such a density that there is always a choice of nearby routes available to the user.

Directness: Network infrastructure should be as direct as safely practicable. Long detours should be avoided as human energy is required to propel the vehicle. This should always be balanced against the problems of topography – a slightly longer route may work better because it contours around a hill rather than tackling it at its steepest climb. Regional route design should take into account both the slowness in operating speed of bicycles up-hill and the relatively high speeds when descending. Delays due to prolonged crossing times of major barriers should be avoided and the aim of the designer should be to ensure that riders are able to maintain a safe, comfortable and consistent operating speed throughout the length of the route.

Safety: Well designed bicycle network infrastructure improves and enhances the road safety of riders, pedestrians and motorists. Intersections should be designed to explicitly include bicycles as well as other categories of road users. Special intersection designs that include a path for cyclists are an important element of integrated network design. Mid-block treatments need to provide safe and easy major roadway crossings for riders. The design of bicycle routes past bus stops should be designed for safe accommodation of riders, bus passengers, other pedestrians and vehicles.

Attractiveness: Community support exists for cycling provided it is an enjoyable activity. Enjoyable cycling requires attractively designed and located facilities. Bicycle network infrastructure, such as regional and local routes, should be fitted into the surrounding environment so that the enjoyment of the experience is enhanced. Clear well-placed signposting should indicate major destinations, while centrelines and edgelines should indicate the serious

Table 3.1: Key design principles of the bicycle transport system.

Principle	Criteria	Design considerations		
		Regional routes	Local routes	Mixed traffic streets
Coherence	Continuity of routes	No breaks in route	Connect to regional route	Easy access to local routes
	Consistent quality of routes and facilities	Minimal quality changes	Minimal quality changes	N/A
	Easy to follow	Regional route signage	Local route signage	All street signs visible
	Freedom of choice of routes	Choice of at least two	Choice of at least two	Less than 250m to a route
Directness	Efficient operating speed	50 km/h design speed	30 km/h design speed	Consistent with street design
	Delay time	15 sec/km	20 sec/km	20 sec/km
	Detour factor * Detour factor is the relationship between the most direct distance between origin and destination and the distance taken by the actual route taken. A detour factor of 20% means that the route will be 20% longer than the distance as the crow flies.	20%*	30%*	40%*
Safety	Minimum risk of accident on routes Minimum risk of conflict with car traffic Minimum risk of unsafe infrastructure	Monitor use of facility and investigate any links between accidents and design.	Monitor use of facility and investigate any links between accidents and design.	Monitor use of facility and investigate any links between accidents and design.
Attractiveness	Support for the system	Public support and ownership	Public support and ownership	N/A
	Attractiveness of environment	Well lit and open appearance	Well lit and open appearance	N/A
	Perception of social safety	Minimum reports of vandalism & harassment	Minimum reports of vandalism &harassment	N/A
	System attractiveness	Coordination of all supporting system elements (maps, fittings, signage etc)	Coordination of all supporting system elements (maps, fittings, signage etc)	N/A
Comfort	Smoothness of ride *(Refer to Austroads - Part 14 Section 8.5)*	Smooth riding surface	Smooth riding surface	Smooth riding surface
	Comfortable gradient	Steep climbs minimised	Steep climbs minimised	N/A
	Minimum obstruction from vehicles	Minimise illegal parking	Minimise illegal parking	N/A
	Reduced need to stop - number of stops (average per km)	0.5	1.0	1.5
	Protection from adverse climate	Shade trees and wind	Shade trees and wind	N/A

transport intent of the off-road sections of routes. New housing developments should provide easy to use and attractive bicycle transport facilities. Bicycle routes should also feel safe and offer good personal security. The community prefers well-lit pathways and open-to-view routes rather than dark and dingy alleyways.

Comfort: The bicycle network has to be easy to use for all types of riders. A smooth well maintained riding surface is essential both for comfort and operating safety. Depending on the speed and volume of other traffic (motor vehicles or pedestrians), some level of separation is often needed. Clearly marked bicycle facilities that allocate operating space to bicycle users are the most appropriate types of facilities on all but low traffic volume and low speed roads. Effective intersection treatment is a critical factor in joining streets to a coherent route or network, as well as providing safe and comfortable crossings of major arterial roads.

3.2 Locating bicycle route facilities

A network approach is recommended in order to create an efficient system of facilities to best serve the bicycle riding public. The following parts of this section outline the fundamental principles and issues relating to bicycle network provision. All new facilities should be considered in relation to their function and importance to the network as a whole. The relationship with the existing road network will also need to be carefully considered.

The major aims of the cycling network facilities designer are to:

Reduce encounters between cyclists and high-volumes of fast-moving traffic. The best-practice method of achieving this is by separation. This can be by marked lanes or by bicycle paths. Figure 3.2 shows the relationship between the degree of separation provided and the prevailing traffic speed and volume.

Treat every crossing by a bicycle facility of a street or road as an intersection. Crossings should be designed following normal intersection traffic management principles:

- There should be an explicit assignment of priority to specific legs of the intersection. This should be indicated by regulatory signage (STOP or GIVE WAY) or traffic signals. The priority should be allocated in accordance with normal traffic management methods.
- Intersection layouts should be simplified and marked on approaches to show each road user where they are to position themselves in order to safely negotiate the intersection.

Treat all bicycle facilities as serious transport facilities. An off-road cycleway is a transport facility and should be built and managed similar to streets and roads ie: centrelines to separate and regulate bi-directional flows; proper side and head clearances; adequate warning of potential hazards.

Design for efficiency and comfort as well as safety to suit a wide range of user types. In past years a high emphasis was placed on designing facilities to suit either the very experienced or the very inexperienced rider. World best practice designs bicycle facilities for a broad range of riders in the community by providing efficient, well-connected facilities that offer consistent quality throughout. This approach focuses on the comfort of the rider and aims to create a riding environment which allows the maximum possible mobility with the minimum stress and risk.

3.3 Function, priority and speed

Three important overriding issues in the bicycle network design process which need to be considered are: road/cycleway function; the priority assigned to both the cycleway and any adjacent roadway; and, the prevailing speed environment. These factors are seldom in balance and can be influenced by good engineering design as well as by management measures such as additional regulation and enforcement programs.

Road and cycleway function

One of the first considerations in the design of any bicycle facility, is the relationship between the bicycle network hierarchy and the prevailing road hierarchy. Where bicycle routes parallel or cross the road network, the design of route and intersection facilities should reflect the network functions for both the road and the cycleway.

If the function of the bicycle facility is for regional through route access, then the cycleway should be designed to provide the highest level of continuity, consistency, and connectivity with other major intersecting routes. Where major State or regional roads are crossed, the network function of the roadway should be maintained. For example, in a situation where a regional bicycle route crosses a state road or highway, a grade separated crossing may provide the best solution in order to preserve the network function of both facilities.

Priority

A primary aim of the bicycle transport network designer is to reduce travelling times by minimising delays. This can often be achieved by the assignment of priority to the bicycle route. Sound traffic management practice aims to assign explicit priority to various elements of the road network in order to maintain a safe and efficient operating environment. Traffic signals and stop and give-way signs are the most commonly used devices to assign priority and these and other measures are also available to the bicycle facilities designer.

In instances where the bicycle and main road networks intersect, priority will usually be allocated according to the status of the road and the bicycle facility within each hierarchy. For instance in the case of a local bicycle route crossing an arterial road the latter would obviously have priority and give-way signage or traffic signals would be fitted to the cycleway approaches.

Speed difference between riders and other modes

Good bicycle network facilities, like roadways should be designed to reduce the seriousness of accidents and conflicts and cater for all members of the community. In places where separation is impossible or undesirable the most effective means of crash prevention is to reduce the speed difference between bicycle riders and cars. This can also apply to paths shared with pedestrians.

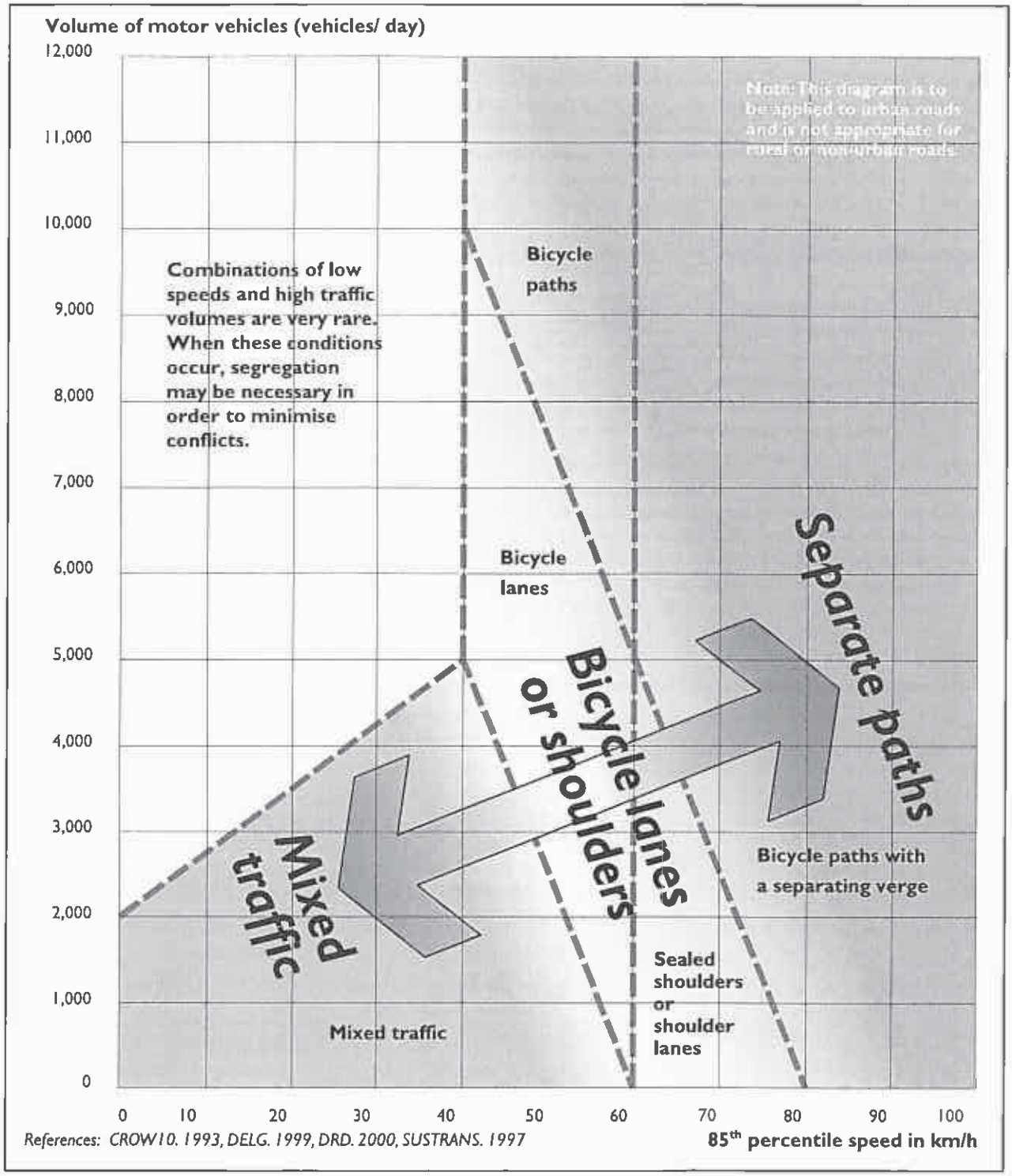
3.4 Separation or mixed traffic

The issue of physical separation is one of the most important considerations in designing bicycle facilities and may result in high levels of acceptance and possibly a reduction in accident rates. The application of on-road bicycle lanes and road shoulders is a recognised part of the NSW road environment. A network approach requires that

Table 3.2: Bicycle network functions and details.

	Network function	Planning/development	Funding
Regional bicycle routes	High-quality, high-priority routes to permit quick unhindered travel between the major regions of cities, towns or urban areas	RTA Regional Bicycle Network *(Action for Bikes - Bikeplan 2010)*	RTA and other partnership agencies
Local bicycle routes	High quality routes with seamless connections to regional routes. These routes connect the local street system to the major regional routes	Council bike plans in consultation with the RTA. (RTA's *How to Prepare a Bike Plan* publication)	RTA, Councils and partnership agencies
Mixed traffic streets (door to door access to all destinations)	The residential street system, though not a marked part of the network, is very important as it provides local access to residential destinations in a 'low stress' environment	Councils own and control this resource which provides local access and mobility.	Councils

Figure 3.2: Separation of bicycles and motor vehicles according to traffic speed and volume.



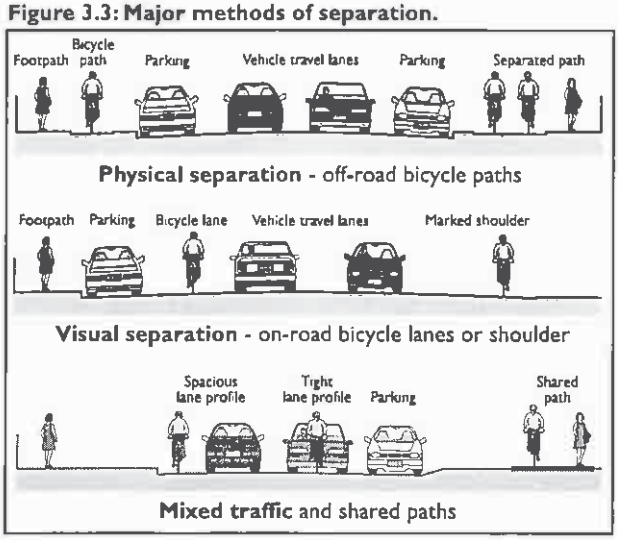
bicycle operating space also be included and designed into intersections in order for the network to function safely and efficiently as a coherent whole. Intersection treatments are covered in detail in Section 7.

Figure 3.2 provides guidance on the selection of separated or mixed facilities. The relationship between the prevailing traffic speed and volume is an important factor in the decision to provide physically separated facilities, mixed profile, or something in between.

Operating space in the form of lanes and marked crossing points should be designed to provide a clear indication to the bicycle rider as to where the road builders and managers would like them to safely and comfortably travel along any road. It is always important to consider the degree of separation, either visual (lanes or shoulders), or physical (bikepaths), to be provided.

In deciding on the need for separation for bicycles, it should be recognised that there are equally great benefits to motorists when this is done. Bicyclists normally travel much slower than motorised traffic and when they are required

Figure 3.3: Major methods of separation.



to share normal road lanes they often find themselves in a very stressful and unpopular position. This can also create disruption to the motor-vehicle flows and increase the risk to the rider. By allocating road space to bicycles, road designers/builders can improve safety for all users and increase the efficiency of the roadway.

At low traffic speeds and volumes it is possible, however, to plan and construct a successful shared road environment provided that the transitions from separated space to shared space are safely handled.

There are three main methods of separation:

Physical separation

Riders cycle on bicycle paths or shared paths off-road. The widest section of the community prefers to cycle in environments without traffic.

Visual separation

Bicycle riders ride on the road but are separated from motor vehicles by either specially allocated space (bicycle lanes) or marked shoulders. This type of facility is suitable for use on regional bicycle routes for short distances (depending on the nature of the road) and for general use on local bicycle routes. Cycling on freeway or motorway shoulders and other high speed roads is only appropriate for experienced riders and such facilities cannot form part of the general bicycle network.

Mixed traffic

Bicycle riders share lane space on the road with motor vehicles and off-road with pedestrians. In road environments there can be a further sub-categorisation of shared space into tight and spacious profiles. A spacious profile road is where there is a consistently wide kerb lane to allow riders and drivers to comfortably share space according to the prevailing road speed. In very low speed environments such as residential areas and on very narrow inner-city streets, where the aim is to keep all vehicle speeds low, it is preferable to restrict the lane width so that all vehicles must follow each other in turn. This type of treatment can be used for bicycle network routes in low-speed, low volume environments where high visibility and a high level of network connectivity is necessary.

Figure 3.4: Legend of symbols used in diagrams throughout this manual.

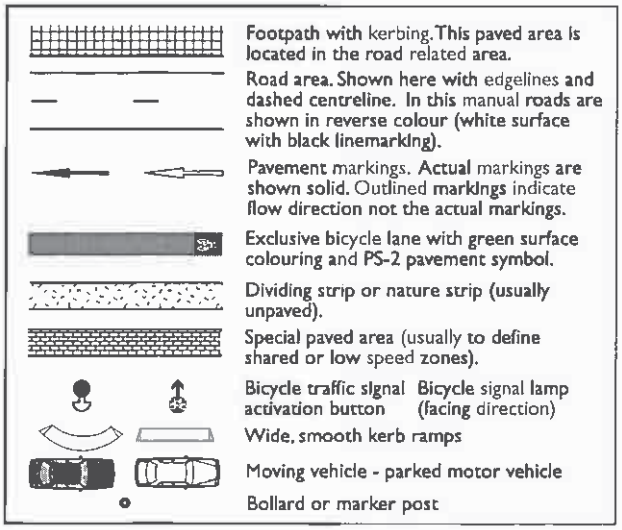


Figure 3.5: Signs, linemarking and pavement symbols most commonly used in this manual. For full details of all signs, linemarking and symbols for bicycle facilities see Sections 8 and 9.