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1.0 INTRODUCTION

The chapter outlines the general road design criteria and other specific requirements in relation to the provision of transport and traffic facilities in the City of Brisbane. Roads should be designed and constructed to adequately provide for:

- Safe and acceptable travel for pedestrians, cyclists and vehicles.
- Access to properties.
- Parking for vehicles.
- Stormwater drainage.
- Installation of other service mains.
- Accommodation of the largest service vehicle (such as refuse collection trucks or buses) likely to access the site.
- Aesthetics, improved livability and economic growth.
- Amelioration of noise and other pollution.
- A low maintenance asset for Council.

Paths for pedestrians and cyclists may be constructed within the verge in the road reserve or outside of the road reserve, generally in public open space areas. Where the development site is amenable to the incorporation of water sensitive urban design principles to the road network, this opportunity should be maximised. Refer *Water Sensitive Urban Design Engineering Guidelines* (Brisbane City Council, August 2005) for details.

2.0 GEOMETRIC DESIGN STANDARDS

In the City of Brisbane, the planning and design of transport and traffic facilities should be undertaken in accordance with the current edition of the following key reference documents, unless the specific requirements of this chapter or other Council references dictate otherwise.

1. *Guide to the Geometric Design of Major Urban Roads* (Austroads)
2. *Guide to the Geometric Design of Rural Roads* (Austroads)
3. *Guide to Traffic Engineering Practice* (Austroads). The series at the time of writing this document are listed below:
   Part 1 Traffic Flow
   Part 2 Roadway Capacity
   Part 3 Traffic Studies
   Part 4 Road Crashes
   Part 5 Intersections at Grade
   Part 6 Roundabouts
   Part 7 Traffic Signals
   Part 8 Traffic Control Devices
   Part 9 Arterial Road Traffic Management
   Part 10 Local Area Traffic Management
   Part 11 Parking
   Part 12 Roadway Lighting
   Part 13 Pedestrians
   Part 14 Bicycles
4. Road Planning and Design Manual (Queensland Department of Main Roads)
5. *Queensland Streets - Design Guidelines for Subdivisional Streetworks* (Institute of Municipal Engineering Australia Queensland Division). Note that IMEAQ is now the Institute of Public Works Engineering Australia Queensland Division.

3.0 ROAD HIERARCHY

3.1 GENERAL

The road hierarchy is shown in the City Plan's Planning Scheme Map 1. It enables the development of a safe and efficient road system catering for the movement of people and goods, while maintaining the amenity of urban areas. The road hierarchy structure, as depicted in Figure B1.1, is divided into two broad categories.

- Major roads, which encompass arterial route, suburban route, and district access, provide the major movement function for peoples and goods.
- Minor roads, which encompass local access, neighbourhood access, and industrial access, provide for local movement and individual property access. They comprise the larger proportion of the road system.

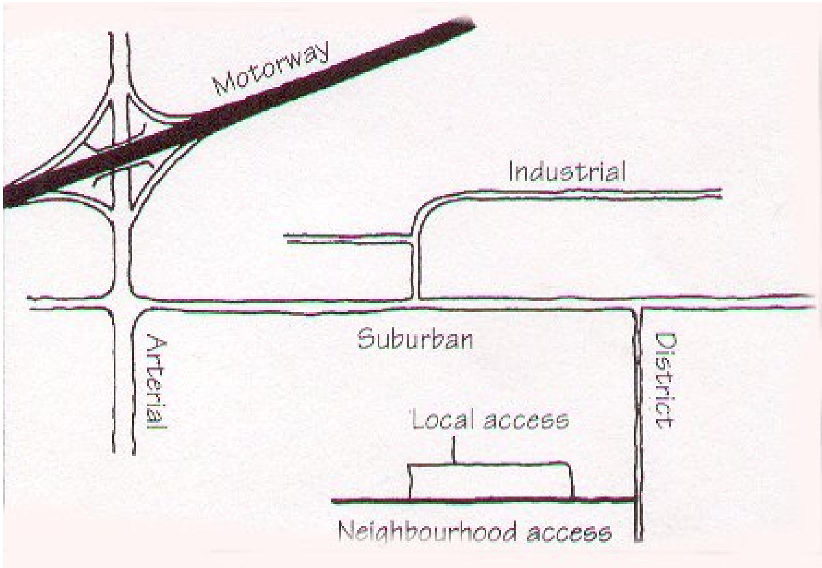

FIGURE B1.1
ROAD HEIRARCHY CONCEPT PLAN

The intent of each of the components of the road hierarchy is described in Section 3.2 to Section 3.8 below.

3.2 MOTORWAYS

Motorways provide for inter and intra-regional connections, and direct longer distance traffic around heavily developed areas. It is intended that motorways will:

- Be constructed to limited access arterial standard.
- Be designed for efficient and safe movement of high volumes of people and goods.
- Be designed to help present attractive landscaped entrances and routes through Brisbane.
- Incorporate design measures to minimise environmental impacts on surrounding land uses.
- Provide for bikeways separate from vehicle carriageways.
- Typically have four or more lanes when fully developed.
- Not provide property access.
- Usually Main Roads controlled.

3.3 ARTERIAL ROUTES

Arterial routes (road types F & G) provide intra-regional connections between major activity centres and residential areas of the City. It is intended that arterial routes will:

- Be designed for efficient and safe movement of high volumes of people and goods.
- Be designed to help present attractive landscaped entrances and routes through Brisbane.
- Incorporate design measures to minimise environmental impacts on surrounding land uses.
- Serve as bus routes.
- Provide for bicycle lanes on the carriageway of the road and pedestrian paths on the verges.
- Typically have four or six lanes when fully developed.
- Ideally have no direct property access.
- Be designed for the estimated traffic loads derived from approved traffic studies with minimum traffic loading of 3.7×10^6 equivalent standard axles for road type F and 1.0×10^7 equivalent standard axles for road type G.

3.4 SUBURBAN ROUTES

Suburban routes (road type D) connect arterial routes through and around suburbs. It is intended that suburban routes will:

- Be designed for efficient and safe movement of moderate to high volumes of people and goods.
- Be designed to help present attractive landscaped routes.
- Incorporate design measures to minimise environmental impacts on surrounding land uses.
- Serve as bus routes.
- Provide for bicycle lanes on the carriageway of the road and pedestrian paths on the verges.
- Typically have two to four lanes when fully developed.
- Ideally have no direct property access.
- Be designed for the estimated traffic loads derived from approved traffic studies with minimum traffic loading of 7.5×10^5 equivalent standard axles.

3.5 DISTRICT ACCESS ROUTES

District access routes (road type D) carry primarily district based traffic. It is intended that district accesses will:

- Be designed to carry freight associated with the local or suburban area.
- Minimise environmental impacts on surrounding activities.
- Provide walkways, bikeways and bus routes. Bicycle lanes should be provided on the carriageway of the road.
- Typically have two lanes.
- Ideally have no direct property access.
- Be designed for the estimated traffic loads derived from approved traffic studies with minimum traffic loading of 7.5×10^5 equivalent standard axles.

3.6 NEIGHBOURHOOD ACCESS

Neighbourhood accesses (road type C) collect low volumes of local traffic. It is intended that neighbourhood accesses will:

- Provide direct property access and on-carriageway parking.
- Minimise environmental impacts on surrounding activities.
- Be designed to provide safe use by pedestrians and cyclists.
- Be designed for traffic loading of 1.5×10^5 equivalent standard axles.

3.7 LOCAL ACCESS

Local accesses (road types A & B) provide for individual property access. It is intended that local accesses will:

- Provide direct property access and on-carriageway parking.
- Minimise environmental impacts on surrounding activities.
- Provide a pedestrian and cyclist preferred environment.
- Be designed to provide safe use by pedestrians and cyclists.
- Be designed for traffic loading of 1.5×10^4 equivalent standard axles for cul-de-sac or 3.7×10^4 equivalent standard axles for local access.

3.8 INDUSTRIAL ACCESS

Industrial accesses (road type E) provide for individual property access. It is intended that industrial accesses will:

- Provide for truck access.
- Be designed to provide safe use by pedestrians and cyclists.
- Serve industrial areas and link directly to district access routes (preferably).
- Be designed for the estimated traffic loads derived from approved traffic studies with minimum traffic loading of 1.5×10^6 equivalent standard axles.

4.0 MAJOR ROAD DESIGN

4.1 INTRODUCTION

Existing and proposed major roads, whose function is primarily the movement of people and goods, are shown on the Road Hierarchy Planning Scheme Map. Direct vehicular access to individual fronting properties is usually not appropriate to these roads, which currently carry, or in the future will be carrying in excess of 3000 vehicles per day, at speeds generally in excess of 60 kph. Major roads are used as public transport routes and commuter cycling routes.

4.2 DESIGN VEHICLE

The normal design vehicle for major roads is the 19m long articulated vehicle. Roads that are identified in the Freight Hierarchy Plan (Queensland Transport) should be designed for larger design vehicles such as B-doubles. Standard cross sections and road geometry standards generally accommodate these design vehicles, but special attention is required in the provision for appropriate turning paths at intersections.

4.3 DESIGN ELEMENTS

Table B1.1 lists a summary of the design elements that are applicable to major roads. It should be noted that some parts of the existing road network might not comply with all the current specified design parameters.

TABLE B1.1 MAJOR ROAD DESIGN ELEMENTS

Design criteria	**District access (road type D)**	**Suburban route (road type D)**	**Arterial route (road types F&G)**
GENERAL REQUIREMENTS			
Individual lot access	No	No	No
Reserve width (minimum) (1)	19.5-24.0 m	33.0-38.0 m	40.0-45.0 m
Verge width (minimum) (2)	4.25 m (3)	4.25 m (3)	4.25 m (3)
Traffic volume (vpd)	3000-15000	15000-35000	>35000
Design speed	60 kph min	80 kph min	80 kph min
Road carriageway (1) - Total width (m) - Median width (m) - No. of moving lanes - No. of parking lanes	 11 N/A 2 None	 2/7.3-2/11.75 6 4 (4) None	 2/11.1-2/15.25 6 6 (5) None
Pedestrian facilities - concrete footpath	Both sides	Both sides	Both sides
Cyclist facilities (1)	On carriageway	On carriageway	On carriageway
GEOMETRIC REQUIREMENTS			
Longitudinal grade - Maximum - Minimum	 6.0% 1.0%	 6.0% 1.0%	 5.0% 1.0%
Length between tangent points (minimum)	50 m	50 m	80 m
Vertical curve length for grade change >1% - Minimum	60 m	60 m	90 m
Horizontal curve radius - Minimum	130 m	300 m	300 m
CROSS SECTIONS			
Crossfall on straights - Road carriageway - Verge	 2.5% 2.0%	 2.5% 2.0%	 2.5% 2.0%
Superelevation	Full	Full	Full

NOTES:

(1) Refer Standard Drawings UMS 141and UMS 142. Although the cross sections show bicycle paths on the verges, they are infrequently used in practice, because of commuter preference for on-carriageway facilities and other design factors.

(2) Verge width for roads providing frontage to open space may be relaxed by 1.5 m subject to service corridor considerations.

(3) Where a bikeway is proposed on the verge, the verge width is increased to 6.5 m.

(4) In some instances a suburban route may have 2 traffic lanes, depending on expected traffic volume.

(5) In some instances an arterial route may have 4 traffic lanes, depending on expected traffic volume.

4.3.1 Cross Section

Typically, arterial routes would have six running lanes, suburban four lanes, and district access two. However, in practice overlaps occur. In unavoidably constrained situations, relaxation to dimensions of the cross section elements may be accepted. Typical cross sections incorporating kerbed carriageway edges are shown on Standard Drawing UMS 142. Alternative water sensitive urban design sections that incorporate swales are shown on Standard Drawing UMS 151.

The basic standard through lane width is 3.5 m. An additional 0.3 m should be provided adjacent to kerb. The standard crossfall on carriageway straights is 2.5% and on verges 2.0%. This verge profile should be maintained across the full width.

4.3.2 Bicycle Provision

Marked on-road bicycle lanes are preferred for commuter cycling on major roads, so that bicycles are not disadvantaged in terms of priority relative to other vehicles. The standard widths of 1.5, 2.0, and 2.5 m correspond to the 60, 80, and 100 km/h speed zones respectively. Bicycle lanes should be constructed with full depth pavement and a smooth surface flush with the vehicular lanes.

In more constrained locations, wide kerb lanes of 4.5 m may be used. Wide kerb lanes are usually appropriate where off peak kerbside parking is permitted, or as part of a permanent parking lane.

On-verge bikeways of 3 m width in addition to the on-road facilities, are typically provided in the vicinity of schools for use by children, where it is preferred that they not ride on the carriageway.

4.3.3 Verges

Major roads provide the most important pedestrian corridors, because they link people generating activities on the most direct and best-graded alignments. They also are the principal bus routes, so pedestrian access to bus stops must be provided.

A 4.25 m wide verge should accommodate a concrete footpath continuously on both sides of all major roads (refer Section 10.2.2 for appropriate paved widths which vary with location). This verge width also provides for the planting of trees, which are important from the pedestrian shading and visual amenity viewpoints. Verge width should be maintained where indented bus bays are located. The absolute minimum width, which can be used at pinchpoints and not over any extended distance, is 2.5 m. Where a bikeway is proposed on the verge, the verge width should be increased to 6.5 m. Refer Section 9.0 for further details.

4.3.4 Bus Provision

Bus routes normally run on the major road network with stops located in indented bays. Where a higher standard of service is provided, bus or HOV lanes are used, but these are usually no wider than standard lanes. Priority facilities, such as queue jump lanes would typically be located at intersections. Bus stops should be located in the vicinity of intersections (preferably on the depart side) to enable pedestrians to cross roads at signals.

4.3.5 Medians

The standard 6.0 m median facilitates quality landscaping and allows gap-accepting vehicles to shelter safely without intruding into through lanes. Apart from the safety aspects of separating opposing vehicle streams, raised medians are the only effective means of restricting access to properties to left in/left out. Direct vehicular access to abutting properties is normally not appropriate on major roads, except for some uses, such as service stations, which most effectively service motorists from this type of road. Medians, even of minimal width, are very important for the staging of pedestrian movements across busy roads. Refer Section 14.0 for further details.

4.3.6 Turning/Passing Lanes

On two lane roads, typically district access routes, turn lanes or passing lanes are required at all but minor intersections/driveways. A typical passing lane treatment at an intersection with a neighbourhood access is shown in Standard Drawing UMS 814. This requirement also applies in situations where access is being obtained from an existing two lane road, which will be widened to a multi lane cross section in future.

4.3.7 Parking Lanes

With control of access there should be no requirement for the provision of parking on major roads. In already developed areas, on-road parking may need to be retained. Indented parking lanes with provision for bicycles with an overall lane width of 4.5 m should then be used. Where space constraints prevent the adoption of indented parking lanes, parking can be accepted outside of clearway restriction times in a 4.5 m wide kerbside lane. Reversing movements and conflicts with cyclists make angle parking inappropriate on major roads.

4.3.8 Clearances

Adequate clearances from running lanes are required to any roadside fixed objects or appurtenances. The distance should be a minimum of 0.3 m to kerbs and a minimum of 0.6 m to higher fixed objects, including median barriers. A clearance of greater than 0.6 m is required near bus stops.

Larger clearances, which are provided as offsets, are required on approaches to traffic islands or the introduction of other fixed objects. Clearances increase with design speed. If adequate offsets cannot be achieved at exposed rigid barrier ends, devices such as crash cushions should be installed.

Within the road reserve, including medians, special attention needs to be paid to fencing used to restrict pedestrian movement to/from certain areas. Horizontal tube rails should not be used, as they can be a spearing hazard to errant vehicles.

4.3.9 Services

In general, utility services should be located in the standard allocations in accordance with Section 9.4. Access to services should be designed so that maintenance can be undertaken with minimum interruption to normal traffic flow.

4.3.10 Kerb and Channel

Kerb and channel (refer Standard Drawing UMS 211) is the normal edge treatment in built up urban areas. The vertical profile (Standard Type E) dissuades inappropriate driver behaviour (eg footpath mounting) and should be used on major roads where there are kerbside activities such as parking lanes and pedestrian facilities. The mountable type kerb should be used in medians and traffic islands. Refer Section 13.0 for further details.

4.3.11 Pavement Taper

Pavement widening is generally required on the road frontage of the development site that is not fully constructed. A minimum 1 in 10 taper is required to transition between new and existing pavements of differing widths. The taper shall commence at the beginning of the lot boundary and extend away from the lot. The tapering of pavement is not permitted in tight curves.

4.3.12 Staging

When only part of the ultimate design is constructed (such as one carriageway of a future dual carriageway, or an upgrading of a section of existing road), the interim cross section should allow for all road users.Bicycle, pedestrian and public transport facilities should be incorporated into the partial design.

4.4 ALIGNMENT

4.4.1 General

Alignment standards are typically stated as minima, but it should be remembered that thehighest standard, which can be reasonably achieved in any particular situation, should always be adopted. In many instances, the higher standard can be provided without any cost penalty. Not only is road user safety and comfort maximised but more aesthetically pleasing solutions usually result. Arterial and suburban routes should be designed to an 80 km/h minimum standard and district accesses to 60 km/h. Stopping sight distance should be met in both the horizontal and vertical planes, as per the Austroads standards.

4.4.2 Horizontal Alignment

The minimum curve radii of 300 m and 130 m correspond to the 80 km/h and 60 km/h speeds respectively. Superelevation is an important factor in the determination of the speed value of a curve. In urban areas, constraints may dictate the adoption of adverse crossfall, which would require larger radii to compensate. At intersections, through lane alignments should preferably be straight. If a curve is unavoidable, it should not commence within the intersection.

The speed value of a curve as suggested by its geometry may not be able to be achieved because of stopping sight lines being restricted by lateral obstructions. Where the angle of deflection is small, significantly larger radii should be used to achieve an adequate curve length and avoid the unaesthetic appearance of kinks. It is the radii achieved for the through lanes, not for the design centreline, which is important.

In a reverse curve situation, a length of tangent should be used between the curves to improve driveability and aesthetics and the curves should be of a similar radius. Broken back or compound curves, where the radius of the second curve is less than that of the first, should not be used. These, or higher, standards should be applied to deviations of through lanes which result from the introduction of turn lanes.

Where there is reduction in the number of lanes is proposed, tapers that are appropriate for the design speed are to be provided for the terminating lane. They should also be located so as to provide merging vehicles with good visibility of the traffic stream that is being entered to facilitate safe and effective merging. The preferred location for terminating the lane is on a straight, but the inside of a curve may be acceptable. The lane should not be terminated on the outside of a curve. In a multi lane situation, the dropping of the right hand lane is not appropriate, since that lane should have priority over others and because visibility is far more restricted than for the normal merge.

4.4.3 Vertical Alignment

Grades should not exceed 6%. For an 80 km/h speed, the minimum crest vertical curve radius is 2900 m (driver eye height to object height) and for 60 km/h speed, 1250 m. Sag vertical curves can have smaller radii, based on comfort and aesthetic criteria, as sight distances are usually not restricted. It is desirable, if possible, to coordinate vertical curves with horizontal. This can fit the terrain better and is aesthetically pleasing.

Intersection location is often dictated by vertical sightline considerations. The consideration of intersection-specific sight distance requirements can influence the vertical alignment adopted for the major road carriageway.

4.5 INTERSECTIONS

4.5.1 General

In a road network, intersections are typically the locations of capacity constraint and concentrations of crashes. To match mid-block capacity, intersection flaring, by the addition of left and right turn lanes and in some cases, through lanes, is employed on major roads. Where possible, right turn lanes should be off-set from through lanes. On the major road network, all turning movements in general should be available, so as to minimise rat running on lower order roads.

4.5.2 Types

Intersections can be categorised as priority controlled, signalised or grade separated.

Priority Controlled

These rely on minor movements accepting suitably sized gaps in the major traffic stream and would in general not be applicable to intersections between major roads. They are, however, the normal forms of treatment in major road/minor road situations, in which impacts of minor road traffic on the operation and capacity of the major road are minimised.

T-intersections should be used in preference to cross or multi-leg treatments, as they are simpler, safer and reduce the possibility of rat running movements. Restriction of movements to “left in/left out” through the use of continuous medians on the major road further improves major road operations and safety.However, this constraint may increase U-turn demands at other median openings.

Roundabouts also fit into this category, because entering flows have to accept gaps in the circulating flow, however priority is equalised for all approaches. Consequently, this form of intersection should only be used with roads which are no more than one level apart in the road hierarchy and have reasonably balanced traffic flows to ensure that traffic on major road approaches is not unreasonably impeded by the minor approach traffic. On major roads, roundabouts should only be used at the lowest end of the traffic volume range, where single lane operation can suffice. This could be as a staged treatment with single lane approaches before widening to multi lane standard is required, at which time traffic signals may be installed.

In general, multi lane roundabouts (ie two or more circulating lanes) are not a desirable treatment because of the difficulties they present to pedestrians and cyclists, who can negotiate an intersection more safely under traffic signal control. Multi lane roundabouts also inherently have lower capacity than the signalised counterparts and cannot be integrated into a linked signals system.

Signalised

Traffic signals separate vehicular and pedestrian movements in time. Signalised intersections, when appropriately spaced, can be linked to provide two way progression. They can also be controlled to give special priority for certain movements or vehicles, such as buses and emergency vehicles.

It is always desirable to provide separate lanes for turning movements and, in most cases, left turn slip lanes. Where there is high pedestrian generators (eg shopping centre) in the vicinity of slip lanes, consideration should be given to a signalised pedestrian crossing. Single stage pedestrian crosswalks should desirably be provided across all legs.These crossings should be minimised in length to avoid the “walk” phase controlling “green” times where possible.

Particular attention needs to be given to the provision for cyclists, usually in the form of cycle lanes on both the through and turning lane approaches to signalised intersections.

Detailed design requirements for signals are provided in the UMS 600 Series Standard Drawings.

Grade Separated

The separation of traffic movements by means of overpasses or underpasses results in the safest and highest capacity intersection treatment, but generally is the most expensive and is normally applied to fully access controlled, motorway type roads with entry and exit ramps. The ‘freeway to freeway’ interchange between two such roads is the highest order facility, but the most common interchange is one where ramps connect to major surface roads, usually by means of signalised intersections. In the access controlled environment, ramps are designed for merging, diverging and weaving manoeuvres, where appropriate lengths of facility required to accommodate these are defined.

4.5.3 Location

Intersections on curves should be avoided. This is particularly relevant to signalised intersections, because major stream vehicles can inadvertently deviate from their paths, especially when taking off from a stopped condition on a multi lane carriageway in poor light/weather conditions. Ceramic studs are often used on the pavement to provide guidance where a curved path cannot be avoided, but they are a maintenance problem. If a T-intersection has to be located on a curve, the outside of curve situation is preferred because of better sight lines.

To ensure adequate visibility, intersections should be located on a constant grade or in a sag vertical curve. Locations near crests should be avoided, although sometimes it may be acceptable to position an intersection right on the very crest. In some situations it may be appropriate to adopt a tighter crest vertical curve to improve the sight distance to a nearby intersection. Where it is not possible to achieve adequate sight distance, flashing warning lights should be installed. These warning lights should be linked to the yellow phase on critical approaches. These types of intersections are often associated with poor crash histories and they should be avoided if at all possible.

Major road intersections should not be located where longitudinal grades exceed approximately 3%, to avoid high turning vehicles from tipping over on adverse crossfall. Braking on steep grades is also affected.

4.5.4 Spacing

Spacings of intersections on major roads should provide for signal coordination between intersections that are planned for signalisation (400-500 m), as well as a reasonable time interval between driver decisions for other intersections with lesser roads (150 m).

4.5.5 Stagger

It is preferable to stagger T-intersections right-left, so that any turning movements between the side legs are made as left turns from the major road. Right turn lanes would normally not be required in the major road between the intersections in this situation. It is possible to use a smaller spacing than between left-right intersections.

4.5.6 Traffic Islands

On major roads, traffic islands are a general feature of intersections. The function of these islands is to effectively restrict vehicles to certain paths, providing safe refuges for pedestrians and locations for the erection of traffic control devices. They should be raised and constructed with semi mountable kerb. Pedestrian paths through islands should be flush with the road surface.

Raised island kerbs should be set back from traffic lanes and have larger offsets on approaches. Tthe islands should be fully outlined by solid painted lines. Appurtenances and any landscaping on islands have to have adequate clearances to moving traffic and not obstruct visibility. Planting is normally restricted to clean trunk trees and low ground covers.

5.0 MINOR ROAD DESIGN

5.1 INTRODUCTION

While drivers have the expectation of high speed/ high traffic volume conditions on major roads, they should expect that speed and volumes are constrained in residential and industrial areas. New subdivisions should be designed according to the principles described in the following sections. Existing streets may require the introduction of Local Area Traffic Management (LATM) measures to manage traffic generated through development.

5.2 LAYOUT DESIGN PRINCIPLES

The layout of minor roads should incorporate the following principles.

- Cul-de-sac and loop layouts should ensure strict geometric control of traffic speeds and volumes in residential areas.
- Cul-de-sacs and loop layouts in industrial areas should ensure that the design vehicle can be accommodated around bends and cul-de-sac turning areas.
- Circulation between near neighbourhoods should promote travel via roads used for local access rather than major roads.
- Good pedestrian/cyclist connectivity internally and to the road network should be provided. External connections to the surrounding public transport, pedestrian and cycle network should be incorporated into the design.
- No more than three minor roads should be traversed from the most remote lot to the nearest accessible district access road.
- Travel time for a vehicle in a low speed residential environment should be no greater than 90 seconds.
- For network legibility, consistent forms of speed control treatment should be used along neighbourhood access roads.
- A pavement surface treatment should be provided on the 50km/h minor road at the 60km/h major road interface. No other minor road intersections should be provided with pavement surface treatments. This will also assist network legibility.
- Pavement surface treatments are not required in industrial estates.
- To minimise maintenance commitments and improve visual amenity, signs would not normally be used except at:
  - Roundabouts.
  - Entrances to low speed residential areas, where ‘Local Traffic Area 40 km/h’ signs are used.

  - Locations where isolated devices might be installedrequiring signage to comply with the *Manual of Uniform Traffic Control Devices (MUTCD)*.

- Night time conspicuity of speed control devices should be enhanced by appropriate means including street lighting, raised retro-reflective pavement markers, white reflective road markings including white painted kerb faces.
- The design vehicle for residential minor roads, including cul-de-sacs, is the Council standard design Split Refuse Truck. Refer to Standard Drawing UMS 816.
- The temporary storage and collection of refuse and recyclables from each lot should be considered when planning the layout of the development and subdivision. Refer to Chapter 2 of Part A of these guidelines for further details.
- Corner truncations, comprising minimum 6 m long by 3 equal chord truncations, are required.
- A kerb return radius of 6 m at street intersections is generally appropriate.

5.3 TRAFFIC VOLUME CONTROL

Traffic volume on the individual minor road should be determined based on the following generation rates:

- In low density residential areas intended to accommodate single detached housing, assume 10 vehicles per day (vpd) from each dwelling unit.
- For multi-unit dwellings, assume 6 vpd from each dwelling unit.
- For other developments, use design data from approved traffic studies/guidelines.

Potential rat running should be prevented through appropriate layout design, ie ensure that a local residential neighbourhood is not permeable to vehicular through traffic, while maintaining access to pedestrians and cyclists.

The maximum acceptable volumes are:

- 3000 vpd on minor roads with 7.5 m pavement (neighbourhood access)
- 750 vpd on minor roads with 5.5 m pavement (local access).

Individual lot access is only permitted on minor roads that will ultimately carry less than 3000 vpd.

Where an estate is accessed by only one road and that road is likely to carry more than 1000 vpd, alternative emergency access should be provided.

5.4 DESIGN ELEMENTS

Table B1.2 lists a summary of the design elements that are applicable to minor roads. It should be noted that some parts of the existing road network might not comply with all the specified design parameters. It should also be noted that Council will not accept road reserves less than 14 m wide and pavements less than 5.5 m wide.

TABLE B1.2 MINOR ROAD DESIGN ELEMENTS

Design criteria	**Industrial access (road type E)**	**Local access (road types A&B)**	**Neighbourhood access (road type C)**	
			Non bus route	**Bus route**
GENERAL REQUIREMENTS				
Individual lot access	Yes	Yes	Yes	Yes
Reserve width (minimum) (1)	22.5 m	14 m	16 m (2)	19.5 m (2)
Verge width (min) (3)	4.25 m	4.25 m (4)	4.25 m	4.25 m
Traffic catchment (max)		100 lots	300 lots	300 lots
Traffic volume	3000 vpd max	0-750 vpd	750-3000 vpd	3000 vpd max
Design speed	60 kph max	40 kph max	40 kph max	40 kph max
Road carriageway (1) - Total width - No. of moving lanes - No. of parking lanes	 14 m 2 2	 5.5 m 1 1	 7.5 m 1 or 2 2 or 1	 11 m 2 2
Pedestrian facilities - concrete footpath	Both sides	Not required	One side	Both sides
Cyclist facilities	On carriageway	On carriageway	On carriageway	On carriageway
GEOMETRIC REQUIREMENTS				
Longitudinal grade - Maximum - Minimum	 5.0% 1.0%	 16.7% 1.0%	 16.7% 1.0%	 10.0% 1.0%
Length between tangent points (min)	30 m	15 m (5) cul-de-sac 20 m (5)	30 m	30 m
Vertical curve length for grade change >1% - Minimum	35 m	20 m (5) cul-de-sac 30 m (5)	35 m	35 m
Horizontal curve radius - Minimum centreline (6)	40 m	12.75 m	13.75 m	13.75 m
CROSS SECTIONS				
Crossfall on straights - Road carriageway - Verge	 2.5% 2.0%	 2.5-3.0% 2.0%	 2.5-3.0% 2.0%	 2.5% 2.0%
Superelevation	Full	Normal	Normal	Normal

NOTES:

(1) Refer Standard Drawing UMS 141.
(2) Relaxable subject to verge width.
(3) Verge width for roads providing frontage to open space relaxable to 1.5 m subject to service corridor considerations.
(4) Verge widths for local access servicing less than 30 lots relaxable to 3 m where justified by additional streetscaping and landscaping provision. Total minimum reserve width of 14 m.
(5) Where the geometry would allow a higher speed, a higher standard is required.
(6) Tight curves are a preferred speed control feature.

5.4.1 Cross Section

Typical cross sections incorporating kerbed carriageway edges are shown on Standard Drawing UMS 141. Alternative water sensitive urban design sections that incorporate swales are shown on Standard Drawing UMS 151. Unkerbed edges, which can be preferred in non-urban environments, usually require table drains and wider verges than in kerbed/underground drainage situations.

The cross section of the local access road is based on a single moving lane concept in which the 5.5 m pavement width provides for one two-way moving lane and one parking lane. Special passing provision is usually not required in residential minor roads.

The 7.5 m pavement width in a non-bus route neighbourhood access road also provides for a single moving lane, but with two parking lanes. The 11.0 m pavement width in a bus route neighbourhood access road provides two moving lanes and two indented parking lanes.

The 14.0 m pavement on an industrial accessroad is designed for two moving lanes and two parking lanes.

The standard crossfall on carriageway straights is 2.5% and on verges 2.0%. This verge profile should be maintained across the full width.

5.4.2 Verges

Verges are generally 4.25 m wide. For residential streets (except bus routes), the verge width may be reduced to 3 m at localised points of constriction (such as at speed control devices or at cul-de-sac heads) or where the proposed road will meander within the road reserve, provided pedestrians and service utilities can be accommodated. In rural residential areas an absolute minimum width of 2.5 m may be accepted.

A 4.25 m wide verge can accommodate a concrete path, but these are typically provided only on the more highly trafficked minor roads because it is accepted that pedestrians can share the carriageway with very low volume, low speed traffic (refer Section 10.2 for footpath requirements which vary with location). Verge design should avoid the clearing or disturbance of significant vegetation identified by the Natural Assets Local Law where roads front existing or proposed Council managed natural areas and parkland. In these situations, walkways, bikeways and drainage features should be aligned to protect significant vegetation.

This verge width also provides for the planting of trees, which are important from the pedestrian shading and visual amenity viewpoints. Verge width should be maintained where indented bus bays are located.

Refer to Section 9.0 for additional requirements for verges.

5.4.3 Services

In general, utility services should be located in the standard allocations in accordance with Section 9.4. Access to services should be designed so that maintenance can be undertaken with minimum interruption to normal traffic flow.

5.4.4 Kerb and Channel

Kerb and channel is the normal edge treatment in built up urban areas. The vertical profile (Standard Type E, refer to Standard Drawing UMS 211) should generally be used on industrial access and neighbourhood access (bus route) roads to dissuade inappropriate driver behaviour such as footpath mounting. 200 Type E kerbs should be used along the frontage of parks, usually in conjunction with the log barrier fence, to deter vehicles from entering the park.

The layback profile kerb (Type D) should be used on local access and neighbourhood access (non bus route) roads. It should also be used on median and splitter islands.Refer Section 13.0 for further details.

5.4.5 Local Access Roads

The maximum length of a cul-de-sac in residential areas should not exceed 150 m. The leg length between speed control devices or sharp curves is usually between 60 m and 80 m. Local access turning heads may be conventional bulb or T or Y shaped and the design based on turning requirements for a split refuse truck or single pass refuse and recycling unit (refer Standard Drawings UMS 811 and UMS 812).

5.4.6 Industrial Access Roads

Accesses to industrial sites require wide carriageways (minimum 14 m) and large turnaround areas to accommodate 19 m long articulated vehicles. B-doubles are permit controlled vehicles and turnaround areas for them should be provided on private property. However, industrial access roads are required to accommodate B-double truck movements. The radius of the outside kerb alignment of the cul-de-sac should not be less than 20 m (refer Standard Drawing UMS 813). The treatment for the centre islands can be either low maintenance landscaping with a 1 m wide concrete backing strip behind the median kerb, or a combination of landscaping and car parking bays as shown in *Queensland Streets*.

5.5 SPEED CONTROL

5.5.1 Geometric Design

Wherever possible, control of vehicle speed in residential streets should be achieved through tight horizontal alignments by providing curved alignment and limiting the ‘road leg length’.

A tight bend has an inside kerb radius of 10 m. The most effective control is the right angle bend, 12.75 m radius and 13.75 m radius for 5.5 m and 7.5 m carriageways, respectively. The 90° horizontal curves should be used in conjunction with the correct placement of traffic splitter islands to prevent drivers from cutting across corners to achieve a faster driving line. On low speed minor roads, traffic splitter islands can be located to incorporate significant vegetation as identified by the Natural Assets Local Law.

For a 40 km/h speed environment, the leg length between 90° horizontal curves should not exceed 80 m. Similarly, this distance should not exceed 120 m for a 50 km/h speed environment. If straights exceed the leg lengths for appropriate speeds, traffic control devices need to be used to restrict speeds.

5.5.2 LATM Schemes

Local Area Traffic Management (LATM) involves planning the use of road space within a local residential area to improve residential amenity and reduce vehicle speed. A primary LATM objective is to create a street layout arrangement which is self regulating in terms of traffic behaviour. LATM schemes have a major impact on residents and public involvement in their preparation is essential. In all new residential developments, speed can be managed using geometric design and speed control devices should be avoidable.

Where LATM involving speed control devices on existing roads is proposed, it should be in accordance with a scheme approved by Council. The Developer is to undertake consultation, with guidance from Transport and Traffic Branch of City Policy & Strategy Division, with the Ward Councillor, residents, property and business owners and community groups as outlined in City Plan's Consultation Planning Scheme Policy prior to submitting the functional layout for approval.

5.5.3 LATM Devices

General

While speed control is commonly achieved by the use of speed control devices, it is not the preferred approach. However, in areas where the road network is fixed, alternatives are usually not possible. Recurrent maintenance costs, driveway access and parking demand should be considered in the design and location of speed control devices.

The horizontal radius should be limited to 20 m at restricted car paths (2 m wide between lines of kerb). Horizontal deflection devices are preferred to the vertical deflection type. If vertical deflection devices are used, the following criteria should also be satisfied.

- The proportion of vertical deflection devices to horizontal deflection devices should not exceed a ratio of one in two.
- No two vertical deflection devices should be installed consecutively unless approved otherwise by Council.

The most effective speed control devices are depicted on the Council's UMS 900 Series Standard Drawings. Any deviation from the geometry of these speed control devices should be authorised by Council. The overall length of speed control treatments and islands within treatments should be minimised to reduce impact on access to abutting allotments and to on-street parking.

The limitation which devices may impose on access to allotments should be considered, the proposed location of driveways should be shown on the submitted engineering drawings with the words 'to be constructed by others'. For vehicular property access requirements refer to Chapter 6 of Part B of these guidelines. The number of driveways servicing any single allotment should generally be limited to one.

Drainage

Carriageway drainage may require special attention at speed control devices, in particular, on very flat or steep grades. When designing the 50 year ARI overland flow drainage within the road reserve, attention needs to be given to the impact of speed control devices and landscaping. The 50 year ARI flows through speed control devices should remain within the road reserve. The designer will need to check that the speed control device does not redirect flows into either another catchment or downhill properties. Also refer to Chapter 2 of Part B of these guidelines.

Landscaping and surface treatments

Substantial landscaping and surface treatment can enhance the effective operation of speed control devices by increasing the 'visual barrier' and lateral enclosure, to control pedestrian movement, to improve the appearance of the speed control device and total streetscape. Also refer to Chapter 4 of Part B of these guidelines, for a list of suitable plant species and particulars of landscaping.

Staged construction

Delay to the construction of devices until dwellings are built or until the subsequent development stages are completed to avoid damage is not permitted.

5.6 ON-STREET PARKING

5.6.1 General Requirements

The availability of on-street parking relates to the width of road pavement, the width of the frontage of the allotments and the size of the traffic catchment to the street. The standard carriageway cross section is usually adequate in the provision of parallel parking for visitors. It is expected that property owners will provide adequate off-street parking for their individual needs. Typically additional parking bays could be required in the vicinity of cul-de-sac heads where sufficient kerb space is not available.

The provision of on-street parking for allotments intended for single detached dwellings should be assessed in accordance with the following criteria.

- Provide parking at a rate of 0.5 car space per lot. A minimum 5 m length parking bay should be assumed for each car in the assessment.
- Each lot should have a car parking space within 25 m, measured between the nearest points of the lot boundary and the parking space.

All development requires off-street parking to be provided in accordance with the *Transport, Access, Parking and Servicing Planning Scheme Policy and the Residential Design Codes of Brisbane City Plan*.

5.6.2 Cul-de-sac Turning Areas

Driveway locations combined with inappropriate car parking within the cul-de-sac head (such as conventional bulb or T or Y shaped) may impair the vehicle manoeuvring capabilities of these turning facilities. Therefore the limited frontage within the cul-de-sac head, measured from the first approach tangent point, should be excluded when assessing on-street parking requirements. Instead special parking provisions, such as indented bays or central island parking, should be incorporated.

5.7 INTERSECTIONS

5.7.1 Spacing

Intersections within the minor road network should be located sufficiently far apart to separate the traffic movements at each intersection, and to provide a reasonable time interval between driver decisions. The desirable minimum intersection spacings (centreline to centreline distance) are:

Local Access Roads:

- 60 m if intersections are located on same side of through street
- 40 m if intersections are located on opposite sides of through street

Neighbourhood Access Roads:

- 100 m if intersections are located on same side of through street
- 60 m if intersections are located on opposite sides of through street
- Roundabouts: 70 m

5.7.2 T-intersection

A T-intersection is the simplest intersection treatment. Normally priority is assigned to the through road while traffic on the terminating road should give way. Types of treatments for T-intersections are shown on Standard Drawings 931 and 932.

5.7.3 Roundabout

Roundabouts in local and neighbourhood access roads should be designed with a minimum radius of 8 m with a 1.5 m wide concrete backing strip. Council's design guideline for a typical roundabout treatment is shown in Standard Drawings 911 and 912. Council should approve any deviations from this guideline.

6.0 SIGHT DISTANCE

A principal aim in road design is to ensure that the driver is able to perceive any potential road hazards in sufficient time to take action and avoid mishap. Sight distance is defined as the distance over which visibility occurs between a driver and an object, or between two drivers, at specific height above the ground.

The Austroads “Stopping Sight Distance”, “Approach Sight Distance” and “Safe Intersection Sight Distance” requirements always should be met in both the horizontal and vertical planes. The “Entering Sight Distance” would normally not have an application in Brisbane. Roundabouts have additional sight triangle requirements.

7.0 PAVEMENT DESIGN

7.1 DESIGN OBJECTIVES AND PRINCIPLES

The underlying principle of pavement design is to achieve a pavement that is functional, structurally sound, has good ride quality, and requires minimal maintenance over its design life. The design criteria specified in this section have been taken and modified from the following publications:

- *Pavement Design. A Guide to the Structural Design of Road Pavements* (Austroads, 2004).
- *A Guide to the Design of New Pavements for Light Traffic* (APRG Report No. 21, Austroads, 1998).
- *Reference Specifications for Civil Engineering Work* (Brisbane City Council).
- *Pavement Rehabilitation Manual* (Brisbane City Council).
- *Pavement Design Manual (*Queensland Department of Main Roads, Amendment 2005).
- *Guide to Stabilisation in Roadworks* (Austroads, 1998).

There is a distinction between the design principles that are applied to roads subject to for light traffic and heavy traffic.

Roads subject to light traffic loadings (types A, B, C)

An empirical approach is adopted. This is based on a statistical analysis of the performance of actual roads, and takes into account both traffic loads and environmental effects. Designs must be based on Figure 13.8.2 (A) in *A Guide to the Design of New Pavements for Light Traffic* (APRG Report No. 21, Austroads), that is adopting the 95% confidence level.

Roads subject to heavy traffic loadings (types D, E, F, G)

A mechanistic approach is adopted. This based on a mathematical model of the response of the pavement to traffic loads. The model is based on linear elastic theory and on the cumulative damage hypothesis. This is described in detail in the *Pavement Design Guide* (Austroads 2004). The salient features are:

1. Damage functions are of the form:

$$N = \left[\frac{b}{\mu\varepsilon} \right]^m$$

where *N* = traffic load repetitions
$\mu\varepsilon$ = microstrains ie 10^{-6}m
b, m = empirically derived constants for each response type

2. AC performance for straight grade binders is based on the Shell fatigue strain relationship.
3. Multigrade AC performance is based on the BCC Multigrade fatigue strain relationship where *b* = 17800 and *m* = 3.52. The modulus for Multigrade (MG) AC is 3468 MPa.
4. The *Pavement Design Guide* introduces the concept of Project Reliability and provides Reliability Factors (RF) to be applied to cemented material fatigue (Table 6.7) and asphalt fatigue (Table 6.13). At this time, the required Project Reliability is set at 95% and the RF is therefore 1.00.
5. Sub-layering of granular materials and select subgrade must be in accordance with Table 8.1(d) of the *Pavement Design Guide.*
6. Maximum moduli of granular base material shall be in accordance with Table 6.4(a) and Table 6.4(b) of the *Pavement Design Guide.*
7. The subgrade performance is based on the Austroads rutting strain relationship where *b* = 9300 and *m* = 7.
8. Wheel loadings are to be full standard axle with tyre pressures set at 750 kPa.

Designs must be carried out using the CIRCLY5 or subsequent versions of this program.

7.2 DESIGN PROCEDURE

7.2.1 Design Life

The design life for flexible pavements is 20 years. This value could be increased in certain circumstances for the higher order roads. The design life for rigid pavements is 40 years.

7.2.2 Traffic Loading

Pavement thickness is a function of the nature and level of traffic encountered over its design life. The method for determining traffic loadings is described in Section 7 of the *Pavement Design Guide (Austroads, 2004).* The significant changes introduced are the concepts of Heavy Vehicle Axle Groups (HVAG) and Standard Axle Repetitions (SAR). Designers are referred to the *Pavement Design Guide (Austroads, 2004)* for detailed explanations. The difficulties with this approach, however, are its complexity and the lack of available data on the actual traffic spectra. Presumptive values may be used to simplify the design process, and SAR can be converted back to ESA.

1. For urban areas the presumptive value of HVAG per Heavy Vehicle is 2.5 HVAG/HV.

2. The damage caused by traffic is based on SAR where:

$$SAR_k = \left[\frac{Actual\ Load\ on\ axle\ group}{Std\ Load\ on\ axle\ group} \right]^m$$

where k = damage type and m= exponent specific to that damage type

3. SAR are converted to ESA using presumptive Traffic Load Distributions (TLD) given in the *Pavement Design Guide (Austroads, 2004)*. The following parameters may be used.

Damage type	k	m	Damage index	Presumptive urban TLD
Granular (with thin bituminous surface)	e	4	ESA/HVAG	0.7
			ESA/	1.8
Asphalt	a	5*	SAR_a/ESA	1.1
Subgrade	s	7	SAR_s/ESA	1.6
Concrete	c	12	SAR_c/ESA	12

* Does not apply to Multigrade asphalt.

The nominal/minimum traffic loadings for the various road classifications are given in Table B1.3. The ESA values for local access and neighbourhood access can be adopted for design purposes for:

- All new roads.
- Widenings on existing type A, B, and C roads.

Where deemed appropriate by Council, higher ESA values (based on predicted traffic, types and percentage of heavy vehicles) will apply to type D, E, F and G roads. For road widening on these types of roads, the design ESA values shall be based on actual traffic counts.

TABLE B1.3 DESIGN TRAFFIC BY ROAD TYPE FOR FLEXIBLE PAVEMENTS

Road classification	Nominal design traffic ESA (20 years design life)
Type A: Local access (cul-de-sac)	1.5×10^4
Type B: Local access	3.7×10^4
Type C: Neighbourhood access	1.5×10^5
Type D: District access (1)	Minimum 7.5×10^5 (3)
Type D: Suburban route (1)	Minimum 7.5×10^5 (3)
Type E: Industrial access (1)(2)	Minimum 1.5×10^6 (3)
Type F: Arterial route - minor (1)	Minimum 3.7×10^6 (3)
Type G: Arterial route - major (1)	Minimum 1.0×10^7 (3)

NOTES:
(1) Refer to Council for design parameters, in particular on higher order roads.
(2) Pavement design to incorporate traffic generated by potential industries in the estate, and where applicable, the projected loading from external catchments.
(3) Do not use these traffic loadings for road widening. Pavement design should be based on the actual traffic counts. If the traffic counts result in lesser traffic loadings, the minimum design traffic loadings apply.

7.2.3 Subgrade Strength

General

The design parameter for the subgrade is the California Bearing Ratio (CBR). The pavement design should be based on the CBR tests being representative of the subgrade over the various lengths of road at the box depth.

A design CBR should be determined for each identifiable unit defined on the basis of topographic, geological and drainage conditions at the site. In determining the design CBR, account should also be taken of the variation of the subgrade strength with depth below subgrade level. The critical layer of material should be established to ensure each layer has adequate cover.

Sampling frequency

Subgrade should be evaluated at the following frequencies.

- Road length ≤ 120m: 1 test for every 60m or part thereof, but not less than 2 tests for each project.
- Road length > 120m: 1 test for every 60m-120m, but not less than 3 tests for each project.

Notwithstanding the above frequencies, at least one sample should be evaluated for each soil type. Spacing of test sites should be selected to suit subgrade, topographic and drainage characteristics.

Laboratory determination of design CBR

The design CBR should be based on the soaked condition in the subgrade at a compaction of 100% standard ie the design CBR is the 4-day soaked CBR as determined by testing in accordance with AS 1289.6.1.1 (single point test).

When the subgrade CBR is particularly sensitive to changes in moisture content, adequate testing of the CBR over a range of moisture contents and densities should be provided and CBR interpolated at the design moisture content and density conditions ie 4-point test using QDMR Main Roads test Q113A.

Soft subgrades

If the CBR determined for the subgrade is less than the minimum CBR nominated in Table B1.4 and Table B1.5; then one of the following subgrade treatment options is required.

- Remove unsuitable subgrade material and replace with Class 3 gravel or select material that meets the requirements for select fill as specified in *Reference Specification S140 Earthworks*. The depth of subgrade replacement must be determined for each specific site.
- Carry out lime stabilisation treatment in accordance with methodologies set out in Section 7.3.4.
- Utilise other techniques such as rock spalls on geotextile, geogrids together with correctly sized gravel blanket course, etc. These proposals need to be submitted to Council for approval.

After subgrade improvement, the pavement design should be based on subgrade CBR 3 for granular pavement and CBR 5 for concrete pavement. Also refer to publication *A Guide to the Design of New Pavements for Light Traffic - Section 13 Subgrade Evaluation* (APRG Report Number 21, Austroads).

7.3 PAVEMENT TYPES

7.3.1 Granular Pavement

The granular pavement comprises the majority of Council road network. Council prefers this pavement type as it provides the lowest whole of life costs, enables ready access for installing and maintaining utilities, the best opportunities for rehabilitation in urban situations and acceptable ride quality. This pavement is also the most cost-effective pavement to construct. The design of the granular pavement can be taken from Table B1.4.

All granular pavements must be sealed with a prime coat or a primer seal prior to surfacing with asphalt.

TABLE B1.4
GRANULAR PAVEMENT DESIGN

ROAD CLASSIFICATION	TYPE A: LOCAL ACCESS (CUL-DE-SAC)	TYPE B: LOCAL ACCESS	TYPE C: NEIGHBOURHOOD ACCESS	TYPE D: DISTRICT ACCESS (5)	TYPE D: SUBURBAN ROUTE (5)	TYPE E: INDUSTRIAL ACCESS (5)	TYPE F: ARTERIAL ROUTE (MINOR) (5)	TYPE G: ARTERIAL ROUTE (MAJOR) (5)
DESIGN TRAFFIC (ESA)	$1.5x10^{4}$	$3.7x10^{4}$	$1.5x10^{5}$	Min $7.5x10^{5}$	Min $7.5x10^{5}$	Min $1.5x10^{6}$	Min $3.7x10^{6}$	Min $1.0x10^{7}$
SUBGRADE CBR (4-day soaked)	MINIMUM TOTAL THICKNESS (1)(2) INCLUDING ASPHALT WEARING COURSE (mm)							
1	Subgrade replacement or treatment, then treat as CBR 3						Pavement thickness can vary	
2								
3	410	440	490	500	500	540		
4	340	370	410	440	440	470		
5	290	310	350	410	410	440		
6	260	290	320	380	380	420		
7	240	260	290	360	360	400		
8	230	240	270	340	340	390		
9	210	220	240	330	330	380		
10 (3)	200	210	240	320	320	360		
COMPOSITION	MINIMUM COURSE THICKNESS (mm)							
Asphalt	25	25	25	50	50	50	100	100
Prime coat/seal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Base Class 1 (4)	100	100	100	125	125	125	150	>180
Sub base Class 2 (4)	100	100	100	100	100	100	100	100
Sub base Class 3 (4)	As required to obtain minimum design thickness							

(1) Source reference for local access, neighbourhood access, district access, suburban route: *A Guide to the Design of New Pavements for Light Traffic* (APRG Report No. 21, Austroads). Source reference for industrial access, arterial routes: *Pavement Design. A Guide to the Structural Design of Road Pavements* (Austroads).

(2) For total pavement thickness ≥250 mm, extend pavement edge 75 mm past the back of the concrete kerb and channel to ensure stability of the pavement edge. For total pavement thickness <250 mm (shaded areas), provide a minimum 75 mm crushed rock bedding under the concrete kerb and channel. Continue pavement at least 75 mm past the extremities of the CKC to ensure stability of the pavement edge.

(3) Adopt a maximum CBR of 10.0 for design purposes. Granular subgrade with CBR values greater than 10 and which have a known insitu service life may be accepted if accompanied by a satisfactory geotechnical report.

(4) Refer *Reference Specification S300 Quarry Products* for material properties.

(5) Pavement thickness for district access, suburban route, industrial access and arterial routes to be approved by Council.

7.3.2 Concrete Pavement

Full depth concrete roads are generally used only in heavily trafficked situations. These roads (types D, E, F, G) must be designed in accordance with the *Pavement Design Guide* (Austroads, 2004) and submitted to Council for approval.

A full depth concrete road can be designed for local streets (refer Table B1.5), subject to the following requirements.

- The pavement must have a minimum 100 mm thick unbound granular sub-base consisting of Class 1 granular material.
- The flexural strength of the concrete must be a minimum 4.0 MPa.
- The Load Safety Factor (LSF) must be 1.3.
- Integral or structural concrete shoulders are not required.
- Special attention should be paid to the jointing details in regard to ride quality and the provision of additional conduits for future services. The design, detailing and construction of concrete pavements for residential streets should be in accordance with the publication *Guide to Residential Streets and Paths* (Cement & Concrete Association of Australia, C&CAA T51, February 2004).

TABLE B1.5 PAVEMENT DESIGN AND CONSTRUCTION, MINIMUM CONCRETE THICKNESS

ROAD CLASS	TYPE A: LOCAL ACCESS (CUL-DE-SAC)	TYPE B: LOCAL ACCESS	TYPE C: NEIGHBOURHOOD ACCESS
SUBGRADE CBR (4)	MINIMUM CONCRETE THICKNESS (1)(2)(3) (mm)		
1	Subgrade replacement or treatment where required Then treat as CBR 5		
2			
3			
4			
5	170	180	190
10	170	170	180

NOTES:

(1) Source reference for local and neighbourhood access roads: *A Guide to the Design of New Pavements for Light Traffic* (APRG Report No. 21, Austroads).
(2) Based on 28 day design characteristic flexural strength of 4.0 MPa, concrete grade N40.
(3) Provide a minimum 75 mm crushed rock bedding under the concrete kerb and channel. Extend pavement edge 75 mm past the back of the CKC to ensure stability of the pavement edge.
(4) Based on the 4-day soaked values.

7.3.3 Full Depth Asphalt

General

This pavement is not generally used for local streets. However, it is used in areas where the speed of construction is critical, such as on major roads or narrow pavement widening.

Where full depth AC widenings are to be constructed alongside existing granular pavements, the design must consider the possible effect on subsoil drainage of the pavement, and the need for additional subsoil drainage to prevent ‘tanking’.

Working platform

Full depth asphalt should be underlain by a minimum of 125 mm thick granular working platform. However, the actual thickness required is a function of the subgrade strength.

Working platform over 300 mm thick may be required for low strength subgrade. The granular working platform should comprise the following sub base courses in accordance with *Reference Specification S300 Quarry Products*.

- Minimum 100 mm thick top layer of Class 2 material (or alternatively Class 1 material).
- Subsequent sub base courses of Class 3 material (or alternatively Class 2 material) as required to obtain design pavement thickness.

<u>Asphalt properties</u>

Asphalt modulus[1] is a function of temperature, speed, binder type, and mix design. Refer to Figures 6.6, 6.7, and 6.8 in the *Pavement Design Guide* (Austroads 2004). As a guide, the following typical design values are applicable for the Brisbane region.

- Asphalt modulus 1000-1500 MPa for Class 170 bitumen binder.
- Asphalt modulus 1900-2200 MPa for Class 320 bitumen binder.
- Asphalt modulus 3468 MPa for multigrade (Class 1000/320) bitumen binder.

Full depth asphalt pavement designs must be submitted to Council for approval. These designs should detail the material parameters and assumptions used in the model, and should be accompanied by CIRCLY5 outputs.

7.3.4 Treated Pavements

<u>General</u>

Treated pavements that may be acceptable to Council include:

- In-situ cement stabilisation of base material in existing roads.
- Cement treatment of imported base course material for new roads.
- Foam Bitumen stabilisation of imported base course material for new roads.
- Lime stabilisation of subgrades.

Full details of the proposal should be submitted to Council for approval. A NATA registered laboratory should undertake all the required testing.

Council will not approve the construction of ‘upside down’ pavements ie pavements which have a stabilised granular sub-base course under an unstabilised upper granular base course. Stabilised granular sub-base courses must extend to the underside of the asphalt layer.

<u>Cement treated materials</u>

The properties of a cement treated layer are influenced by:

- The nature of the material to be stabilised;
- The percentage and type of additive; and
- The efficiency of the mixing process.

Council will permit cement stabilisation on lightly trafficked roads, but not on heavily trafficked roads where the traffic loading is above 1.5×10^6 ESA. Cemented materials will inevitably crack due to thermal and shrinkage stresses. This will result in reflective cracking of the asphalt surface. While this may be tolerable on lightly trafficked roads, this is less so on heavily trafficked roads. *Pavement Design Guide* (Austroads 2004) indicates that 175 mm of asphalt is required to inhibit this reflective cracking. This

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1 Modulus is also a function of the way it is measured ie the specific laboratory procedure used to measure the stiffness of a sample of material. Hence, caution should be used when quoting a modulus value from a reference source. A detailed discussion is outside the scope of this guideline.

renders such pavements uneconomic. However, cracking due to thermal and shrinkage stresses can be limited by good design and construction methods[2].

The design can be undertaken in accordance with the *Pavement Design Guide* (Austroads, 2004). The proposed design together with the results of tests undertaken to determine the design and prove the adequacy of the material to satisfy design requirements, should be submitted to Council at least two weeks prior to commencement of the work. Alternatively, designs based on Council research as set out in Table B1.6, can be adopted.

TABLE B1.6 CEMENT TREATED BASE COURSE THICKNESS

ROAD CLASS	A & B: LOCAL ACCESS	C: NEIGHBOURHOOD ACCESS	D: DISTRICT ACCESS/ SUBURBAN ROUTE	E: INDUSTRIAL ACCESS	F&G: ARTERIAL ROUTES
DESIGN TRAFFIC (ESA)	3.7×10^4	1.5×10^5	Max 7.5×10^5 (1)	Max 1.5×10^6 (1)	Max 3.7×10^6 (1)
SUBGRADE CBR					
<3	200	N/S	N/S	N/S	N/S
3	150	200	220	230	N/S
5	150	195	215	225	N/S
8	150	190	210	220	N/S

Notes:

1. The pavement depths are appropriate for traffic loadings up to the "minimum" loadings for these road types. Where the estimated traffic loading exceeds these values, the design is to be undertaken in accordance with *Pavement Design Guide (Austroads 2004)*.
2. The cement additive must be Type GB 70/30 Fly Ash Blend to AS 3972.
3. The material to be stabilised must have a PI <20%. It will not be acceptable to improve higher plasticity materials with lime.
4. The material grading must fall within the preferred grading envelope as given in Figure B1.3.
5. The additive application rate must be 4.5% by weight of the design target depth.
6. The target depth must be the lower bound, ninety percentile characteristic depth d_{90}. (Note: $d_{90} = d_{50} - 1.28s$).

2 Although not mandatory, the maximum cement content should be limited to 4.5% by weight to limit reflective cracking of shrinkage cracks in the treated layer and asphalt surfacing.

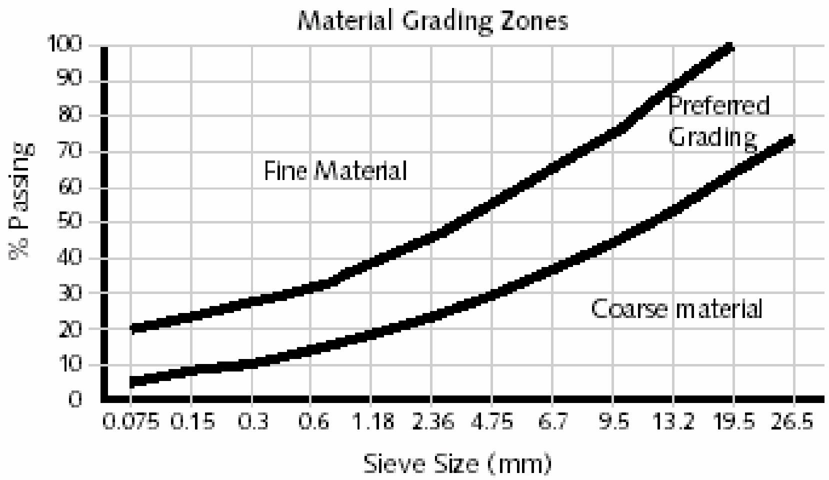

FIGURE B1.2
GRADING ENVELOPE OF MATERIAL TO BE STABILISED
Source reference: *Guide to Best Practice for the Construction of Insitu Stabilised Pavements AP-G75/03* (Austroads)

After construction, the cement treated pavement must be immediately sealed with a primer seal for a minimum 4 week curing period prior to surfacing with asphalt. The pavement must be tested using a Falling Weight Deflectometer after the minimum curing period and prior to placing of the asphalt, and test results must be submitted to Council for approval.

Foamed bitumen stabilisation

The use of foamed bitumen is a relatively new technique and requires the design to be carried out by experienced personnel. Any proposal for bitumen stabilisation will require the design to be prepared by Queensland Department of Main Roads for submission to Council for approval.

Lime stabilisation

Lime stabilisation of the base or sub base is generally not acceptable as a pavement treatment. Lime stabilisation of the subgrade may be acceptable.

Testing will need to be carried out in accordance with the AustStab Guidelines. Specifically, lime demand tests and UCS testing of prepared samples must be carried out to determine the amount of lime required and the strength gains achieved. Refer to *AustStab Technical Note 1C: Lime Stabilisation Practice* (April 2005).

7.4 SUBSOIL DRAINAGE

Refer to Standard Drawing UMS 261 for details. Sub-surface drains should be used to protect the road structure from moisture ingress. Typical cross section pavement details should show side drains. Unless approved otherwise by Council, side drains should be provided at the following locations:

- Both sides of all streets and roads under the kerb and channel, except where Council determines that such drains are unnecessary or disadvantageous.
- Under the kerb around all landscaping areas, depending on location. Landscaping in footpaths should not be placed immediately behind the kerb. Landscaping adjacent to pavements must not have irrigation systems.
- Across the end of the road at the stage boundary. This must be removed when the next stage is built.
- Along the line of fill when subsoil water is affected by the compaction of the fill.

- Where springs are located.
- Where moisture can ingress.
- Under the invert of flat grassed overland flow paths in areas that are usually subject to pedestrian or vehicle traffic.
- At the toe of cuttings greater than 2m high.
- Blanket courses. Blanket courses should be limited to areas with grades <5% and should not be used where they may affect the structural integrity of the pavement.

8.0 ROAD SURFACING

8.1 ASPHALT

Asphalt is the preferred surfacing material for all roads within the road hierarchy. For coloured treatments on asphalt surfaces, refer to Section 9.4 for specific requirements. The following asphalt types may be used in Brisbane.

- Dense-graded Asphalt (DG).
- Stone Mastic Asphalt (SMA) may be used subject to Council approval.
- Open Graded Asphalt (OGA) will generally not be approved for use.
- Polymer-modified asphalts will generally not be approved for use.
- Proprietary products such as Emoleum microsurfacing, SAMI Fricseal etc need to be submitted for approval.

8.2 CONCRETE

A wide variety of surface finishes are available for concrete pavements. There is no restriction on the use of tyned or broomed surface finish. For coloured treatments on concrete surfaces, refer to Section 8.4 for specific requirements.

Exposed aggregate surface is permitted in local traffic area threshold treatments provided that the crushed aggregate finish:

- Achieves a minimum Polished Aggregate Friction Value (PAFV) value of 45.
- Complies with the skid resistance requirements of *Reference Specification S150 Roadworks*.

Stamped concrete is not permitted as the surface texture can cause a potential hazard for cyclists.

8.3 SEGMENTAL PAVERS

8.3.1 General

Segmental pavers may be used, although future maintenance considerations should be taken into account when approval is sought for their use on roads and footpaths. Pavers laid to the herringbone or stretcher bond pattern are only permitted on residential streets (local access roads) and should not be used as the surface treatments on major roads. Slip and skid resistance values and permitted colours should comply with *Reference Specification S150 Roadworks*.

8.3.2 Limitation of Use

Pavers should be restricted for use in local traffic area threshold treatments, landscaping features in speed control devices, traffic medians, traffic islands and on footpaths in both the central city and suburban centres. As a guide, paved areas should not make up more than 10% of the total road pavement area. Types of paver, colour, manufacturer, product number, etc should be shown on the engineering plans. Slip and skid resistance values and permitted colours should comply with *Reference Specification S150 Roadworks.*

8.3.3 Treatment Around Obstructions

The preferred method for treatment of pavers around gullies, manholes, service pits and like obstacles is to use specifically manufactured pavers, designed to be placed around these obstructions. Pavers adjacent to these obstructions or the lip of the kerb and channel should have the arris reduced to a 5 mm radius to narrow the gap between the pavers and the adjacent structures.

8.3.4 Pavement Design

The pavers should not be considered as contributing to the structural strength of the pavement. The detail of the pavement design should be shown on the engineering drawings. A typical entrance threshold treatment is shown on Standard Drawing UMS 262. The acceptable standard of pavement composition for residential streets should comprise a minimum 60 mm thick pavers laid on 25 mm thick cement mortar bed, and founded on a reinforced concrete base not less than 170mm thick.

8.3.5 Drainage

Outlets for roof water drains on the high side of one-way crossfall paved streets are not permitted in the kerb. Roof water reticulation is required in this situation with the outlet into the main underground drainage stormwater system.

Particular attention needs to be paid to the design and construction of road drainage for paved roads, in particular sub-surface drainage. Refer to Standard Drawing UMS 261. No-fines concrete blocks or PVC tubes placed over side drains to drain the pavement are not an acceptable design. Full details of the sub-surface drainage should be shown on the engineering drawings.

8.3.6 Edge Treatment

Edge restraints should be provided along the perimeter of all paved areas. They should be able to support traffic loads and to prevent the escape of the bedding sand from beneath the paved surface. An edge restraint may be in the form of a kerb, combined kerb and channel, established structure or rigid flush abutment. The minimum standard for edge restraint is 230 mm x 230 mm with a Y12 reinforcing bar (refer Standard Drawing UMS 211). An isolation joint is required at the junction of the channel. A header course (full size pavers laid side by side) should be used along the edge of the road pavement abutting a kerb or channel or any footpaths or medians edge or edge restraint. This is also the preferred treatment for footpaths and medians.

8.3.7 Transverse Restraints

Use of cross beams and/or restraints are required for inclined areas and roadways, and also for surfaces where heavy vehicular braking may cause shoving of pavers. Details should be included in the engineering drawings.

8.4 COLOURED SURFACE TREATMENTS

Coloured surface treatment must serve a traffic management function such as thresholds at local traffic areas and to visually enhance school zones. The use of coloured surface treatment as an aesthetic enhancement to the streetscape is not permitted. For further details, refer to *Guidelines for the Use of Coloured Pavement Treatments in Brisbane City Council* (April 2006). For particular requirements on coloured treatments, texturing, decorative, and high friction coatings on asphalt and concrete surfaces, refer to *Reference Specification S150 Roadworks*.

9.0 VERGES

9.1 GENERAL

Verge is defined as that part of the road reserve between the carriageway and the boundary of adjacent lots. Verge widths are measured from property boundaries to invert of the kerb and channel. Verge widths in older established areas may vary from those specified in Section 4.3.3 and Section 5.4.2 in order to fit in with the existing situation.

9.2 CROSSFALL

The crossfall of the verge is 1V in 50H (2%) across the full width from the top of the kerb to the property boundary. The exception is where swales are proposed to improve the quality of stormwater runoff (refer Standard Drawing UMS 151). Where the slope of the allotment batter is steeper than 1V in 6H, the toe of fill batter or the top of cut batter abutting existing or future public space (eg road reserves, parks etc) should be provided with a minimum setback distance of 0.3 m from the property boundary.

If practical constraints limit the formation of the verge to the correct profile across the full width, a section of verge with a minimum width of 2.5 m at the ultimate level with maximum 1V:40H crossfall may be approved. Each case will be assessed on merits.

Approval may be given to vary the crossfall of the verge where significant trees will be retained. Full details and cross sections should be provided on engineering drawings and approval obtained from Council.

Steps are not acceptable within the verge. All cut and fill batters should be located outside the road reserve or access restriction strip, unless specifically approved by Council.

9.3 LONGITUDINAL GRADE

The maximum longitudinal grade on any verge is 1V in 6H, which corresponds to the maximum grade of the road. The preferred option however, is to accommodate people using mobile devices such as wheelchairs and prams. Refer to *AS 1428 - Design for Access and Mobility*.

9.4 SERVICES

9.4.1 Alignments

Standard alignments of underground reticulated services are given in Standard Drawings UMS 121, UMS 122, UMS 123, UMS 124 and UMS 151. Evidence of approval of the relevant service authorities should be provided to Council where non-standard alignments are proposed, particularly on variable verge widths in road reserves, cul-de-sac heads and adjacent to speed control devices, etc. Where required by service authorities, additional road reserve should be provided beyond the standard verge width for the location of specialised equipment such as transformer equipment, electronic switching equipment, etc.

Council may approve the location of multiple services in a single trench if written approval of a proposal is submitted from the service authorities involved. However, relaxation of verge widths will not be permitted as a result. Costs associated with the relocation of any services as a result of the development should be borne by the Developer.

9.4.2 Service Pits and Manholes

Service pits and manholes within the roadway or verge should be installed accurately, blending smoothly with the longitudinal and transverse grades of the verge. Furthermore, they should comply with the requirements of the relevant service authorities. Service pits should not be placed in areas that would compromise the construction of kerb ramps to the relevant standards.

9.4.3 Service Conduits

Service conduits required by the relevant service authorities should be installed prior to final surfacing of the roadway or verge to the requirements of the service authorities. Service conduits should not conflict with the general requirements for cover, as given in Standard Drawings UMS 122 and UMS 124.

Kerb markers (brass indicator discs) should be placed in the kerb and channel at service conduit crossings. In the case of interlocking paver or mass concrete roads, developers should make provision for incorporating spare conduits (with markers) at the time of construction to alleviate the need for unsightly repair work in the future.

9.5 PERMITS

When it is proposed to undertake work within the road reserve, a Council permit is required.

10.0 PEDESTRIAN FACILITIES

10.1 GENERAL

Pedestrian facilities are generally provided on footpaths within road reserves, although walkways through developments, residential subdivisions and open space areas, particularly as linkages to public transport routes and activity nodes, are also required. For specific shared path requirements, refer to Sections 11.1 and 11.2.

10.2 FOOTPATH

10.2.1 Definition

Footpath is defined as a pavement intended for pedestrians (including wheelchair users) separate from the road or street carriageway, and either within or outside a road reserve.

10.2.2 General Requirements

Footpaths are generally required at the following locations.

- On both sides of major , industrial access and neighbourhood access (bus route) roads.
- On one side of neighbourhood access (non bus route) roads.
- In areas where high pedestrian volumes are likely. For example at frontage of schools, other educational facilities, railway stations, high density housing, shopping centres, major sporting facilities, hospitals and parks.

Exceptions apply in instances where the roads front Council managed natural areas and parkland where the construction of the footpath will result in the clearing of significant vegetation as identified by the Natural Asset Local Law. In these situations, the construction of footpaths should be avoided unless specifically recommended by a Local Plan.

Table B1.7 sets out the varying width requirements for footpaths appropriate to its location, depending on land use and road hierarchy. Where the development (material change of use) contains a mix of land uses, the more stringent criteria will apply. Footpath construction should extend along the entire street frontage(s) of the development.

TABLE B1.7 FOOTPATH WIDTHS

Land use	**Footpath width**
Sports & leisure facilities	1.8 m/full width(8) on suburban route and arterial route 1.5 m on district access 1.2 m on other roads
Parks & gardens	1.5 m on suburban route and arterial route 1.2 m on other roads
Multi-unit dwellings	1.8 m/full width(8) on suburban route and arterial route 1.5 m on district access 1.2 m on other roads
Industrial activities	1.8 m/full width(8) on arterial route 1.5 m on district access and suburban route 1.2 m on other roads
City centre(1)(7)	Full width on all roads
Major centre(2)(7)	1.8 m/full width(8) on all roads
Suburban centre(3)(7)	1.8 m/full width(8) on all roads
Convenience centre(4)(7)	1.8 m/full width(8) on all roads
Special purpose centres(5)(7)	Full width on all roads
Community use area(6)	1.5 m on local access 1.8 m/full width(8) on other roads

NOTES:

(1) City centre is the political, administrative, economic and social heart of Brisbane.

(2) Major centres are the major concentrations of centre activities outside the city centre. Major centres are located at Fortitude Valley, Toowong, Indooroopilly, Upper Mt Gravatt, Carindale, Toombul-Nundah, Chermside and Brookside-Mitchelton.

(3) Suburban centres provide a variety of services. They may be characterised by small tenancies within a limited area, or lower density larger tenancies over a broader area. They generally contain more than 6000 m^2 of gross floor area.

(4) Convenience centres are smaller centres providing local services within walking distance of residents, generally containing less than 6000 m^2 of gross floor area.

(5) Special purpose centres provide for particular major activities including major hospital and medical facility, major sporting stadium, major residential institution, etc.

(6) Community uses include school, health care service, childcare facilities, community facilities, emergency services, railway activities, utility installations, etc.

(7) Refer *Centres Detail Design Manual* (Brisbane City Council, 2000) for details on paving material, patterns and colours, and other streetscape works.

(8) Provide full width footpath with associated with landscaping works if the development is subject to one or more of the following conditions:
   - The grassed verge would pose potential maintenance problems eg difficult to mow or lack of established grass cover in a shady area.
   - There is significant demand for on-street parking.
   - The building entrance abuts the verge eg covered awning in front of a row of shops as typically encountered in the older suburbs.

The standard 1.2 m wide concrete footpaths should be constructed in accordance with Standard Drawing UMS 231, with 1.42 m setback from the property boundary. These footpaths should be located clear of water mains.

Full width concrete footpaths or pavers (refer to Standard Drawing UMS 232) should generally be provided to frontages of commercial and shopping centre developments, and in areas where the verges are narrow (less than 2 m wide). However Council may approve exemptions for isolated businesses in residential areas. There should be provision for street trees and landscaping in full width paved footpath.

10.2.3 Surface Treatment

The use of non-standard footpath surfacing such as pavers or exposed aggregate concrete is not permitted in residential streets unless approved otherwise by Council. Any disturbed areas within the verge should be re-established, trimmed, shaped and re-grassed as soon as possible.

Specialised verge surface treatments in both the central city and multi-purpose centres should be provided in accordance with the *Centres Detail Design Manual* to complement the streetscape. Standard concrete strip footpaths are to be provided elsewhere. In general, existing asphalt footpaths should be removed and replaced with at least 1.2 m wide concrete footpaths with turf adjacent or as specified in Table B1.7.

All improvement works on public footpaths require Council approval. All applications for construction of paved footpaths or other specialised surface treatments of footpath fronting developments should be made in writing to Council. The application should be accompanied by working drawings at appropriate scales to indicate clearly the layout of proposed footpath and details in plan and cross section showing:

- The extent of proposed footpath works.
- Proposed paving material, patterns and colours.
- Proposed position and number of street furniture and pedestrian lights.
- All finished surface levels.
- All proposed and existing services in footpath.
- Proposed artwork, balustrades, planter boxes and any other structures.
- A full specification and details of the proposed treatment.
- Where required, a full specification of the footpath construction.

10.3 PATHWAY

Pathway is defined as a strip of land, sole or mainly for the purpose of accommodating a footpath, bike path or dual-use path. Pedestrian pathways through developments and residential estates should not be less than 5 m wide. Concrete footpaths within pedestrian links should be at least 1.8 m wide and increased to 2.5 m when required to provide a shared facility with bicycles. The concrete footpath in the pathway should be extended to the kerb and channel with a kerb ramp, or to the existing concrete footpath in the street, as depicted on Figure B1.3.

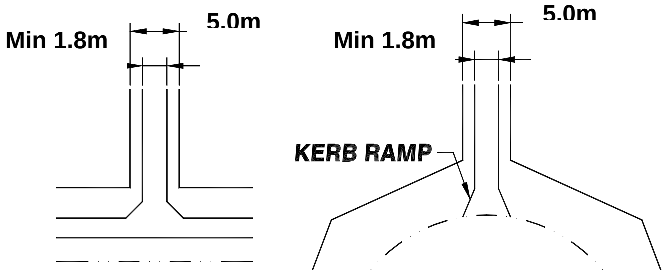

FIGURE B1.3
FOOTPATH/PATHWAY DETAIL

Pedestrian pathways should be as wide and short as is feasible to make them as obvious, convenient and secure as possible. The ideal walkway between a residential cul-de-sac and a major road has the full width residential street right of way contiguous with that of the major road, so that a concrete strip of the order of 5 m length would form the link.

10.4 KERB RAMPS

Kerb ramps are required where a concrete footpath:

- Leads to a street intersection.
- At a pedestrian crossing.
- At median islands.

Where practical ramps should be avoided at median islands if the island can be modified to ensure that pedestrians and cyclists can pass through at road pavement level.

Kerb ramps should be clear of obstacles such as stormwater gullies, street signs, posts and trees. The ramps should be constructed in accordance with Standard Drawing UMS 213.

11.0 CYCLIST FACILITIES

11.1 GENERAL

Bikeway is defined as a route suitable for cyclists, combining linked sections of local streets, bicycle lanes, bicycle paths, shared footpaths or separated footpaths.

Commuter cyclist facilities are generally to be provided for on the carriageway on all of the major road system (design speeds of 60 km/h or above) by means of marked bicycle lanes or wide kerbside lanes. Refer Standard Drawings UMS 861 to UMS 877 for further details.

Recreational bikeways on verges or through open space areas are not attractive to commuter cyclists and are mostly provided in the vicinity of schools for school children and for recreational cycling.

On the minor road system (design speeds of less than 60 km/h), cyclists share the carriageway with other road users. In some locations, particularly those with high pedestrian and cyclist volumes, shared pathways are not appropriate and segregated facilities are required. Standard Drawing UMS 258 shows the standard pavement markings required for off-road shared path and typical connections between the high and low use network.

Research shows that walk and cycle trips are more enjoyable when mid-trip facilities are available. Action 6.5 of the *Brisbane Active Transport Strategy: Walking and Cycling Plan 2005-2010* requires the provision of quality travel along the priority arterial routes (Greenway corridors for investigation) identified on Map 1, by incorporating amenities such as shade trees, rest areas, water fountains, wide paths and interpretative signage.

11.2 PLANNING

Bikeway planning is an integral part of transportation planning, and the provision of appropriate facilities for cyclists needs to be coordinated as an integrated part of the land development process. Bikeways therefore need to be addressed at the initial planning stage of any development/subdivision in conjunction with the street and allotment layout, surrounding area, existing bikeway network, and future (strategic) planned links in the network.

The *Bicycle Brisbane Plan* provides a strategic cycle network throughout the City; the hierarchy of bikeways and identifies the major links forming the greater bikeway network. By nature the majority of the strategic network will be commuter or recreational. The strategic network should guide the provision of bikeways in a similar manner to establishing a road network and hierarchy.

The *Walking and Cycling Plan 2005-2010* contains the *Bicycle Brisbane Plan* network maps that guide Council's investment in walking and cycling infrastructure. These maps are in an electronic format on Council's iBIMAP mapping so they can reflect changes on the built environment.

In order to promote the continuity of travel for cyclists and pedestrians throughout the subdivision, special attention should be paid at the layout stage in relation to access roads, mid-point loop roads, existing and future bikeways. The most appropriate location for pathways and bikeways is where access is improved with respect to schools, shops, parks, or transport nodes. Bikeways may not be permitted through areas deemed by Council, to be of high natural value and this will be determined on a site-by-site basis.

11.3 WIDTHS

Bike paths (off road path intended for the exclusive use of cyclists) should have a minimum width of 3.0 m. However subject to Council approval, this width may be reduced to 2.5 m for connector or link with low level of usage. The bikeway should be constructed in accordance with Standard Drawing UMS 252, with attention to ensure a smooth riding surface. If a concrete footpath is also located on the verge, a distance of 1.0 m should separate the footpath from the bike path, and the footpath should be located on the property side of the bike path. All new shared pathways along the strategic "Greenway" network should be a minimum of 3.0 m wide and accessible for people with a disability.

11.4 ENTRANCE

Where geometry permits, a 'reverse curve' bike path entrance as shown in Standard Drawing UMS 253 should be constructed. Where the geometry does not permit, an 'offset chicane' bike path entrance as per Standard Drawing UMS 255 can be provided. The standard entrance for low volume and high volume paths are shown on Standard

Drawings 251 and 257 respectively. The rest rail and sign post should be provided in accordance with Standard Drawing UMS 256.

11.5 SURFACE TREATMENT

Dedicated bikeways on verges or through open space areas should be constructed from concrete. However specialised verge surface treatments in both the central city and multi-purpose centres should be provided in accordance with the *Centres Detail Design Manual* to complement the streetscape.

11.6 PROVISION AT STRUCTURES

Stormwater drainage inlets and outlets should be located a minimum 1 m clear distance from bikeways and protected by delineator posts, refer to Standard Drawing UMS 131. In particular, gullies should not be placed in the kerb and channel where a bikeway meets a road. The gully should preferably be positioned on the uphill side of the crossing.

Where circumstances necessitate the use of an inlet directly adjacent to a bike path, this should be provided with a bike-safe grate, refer to Standard Drawing UMS 332. The grate should have bars in two directions (longitudinal and transverse) and not be on a curve. The minimum setback from the invert of the kerb and channel to edge of bike path is 1.0 m. However, the maximum practicable available setback distance is preferred.

11.7 LIGHTING

Night lighting is generally not required for pathways designated for recreational purposes, where night travel is not anticipated. However, where a pathway is potentially hazardous for night travel by reason of grade, geometry, etc, Council would require that illumination of the bike path be provided.

11.8 APPROVAL PROCESS

Where a bikeway is included in a development, the High Level conceptual cycle requirements layout should be included in the road plans and approved by Council. Operational Works submission should include detailed engineering drawings.

12.0 PUBLIC TRANSPORT

Public transport relies fundamentally on pedestrian access to railway stations, ferry terminals and bus stops for its success and viability. Provision for access to these services is often required through developments, subdivisions and open space areas. It is desirable to encourage highest people generating land uses to locate as close as possible to public transport and conversely, not give over valuable land in the vicinity to carparking or passive open space. At least 90% of the lots proposed in the subdivision should be within 400 m (straight line distance) from existing and future stops on a public transport route. Pedestrian links should be provided from adjacent minor roads and particularly from cul-de-sac heads to public transport routes.

The preference is for buses to be routed on roads carrying more than 3000 vpd. Indented bus bays and associated facilities should be provided where appropriate along major roads. Bus stops should be located on the departure side at signalised intersections to enable pedestrians to cross safely. Neighbourhood access roads that are to be used as bus routes require different geometrical design criteria than those not used as bus routes. Refer to Standard Drawings UMS 271 to UMS 276 for bus stop and bus shelter details.

In large developments, provision for rail and busway stations, ferry terminals or bus interchanges may be required.

13.0 KERB AND CHANNEL

Kerb and channel or edge restraint is the normal edge treatment in built up urban areas. In some cases, the existing and ultimate alignment of the kerb and channel may not be known until a road survey is undertaken as many of these roads commenced as bush tracks. The survey should extend a minimum of 50 m along the road beyond the frontage of the subdivision and a minimum of 5 m onto the adjacent land to determine the alignment for kerb and channel and the extent of cut and fill batters. The road pavements may not always need to be centrally located within the road reserve.

The grade of kerb and channel should not be less than 1V in 250H. To reduce the length of possible pondage in the channel, the vertical radii should be limited to a maximum of 3000 m for crest curves and 1250 m for sag curves.

14.0 TRAFFIC ISLANDS

Types of traffic islands can be broadly categorised as roundabouts, channelised intersection, speed control devices, divided road islands, splitter islands, or pedestrian refuge islands/safety zones.

When traffic islands are required in an existing dedicated road, the Developer is to consult, with guidance from Transport and Traffic Branch of City Policy & Strategy Division, with the Ward Councillor, residents, property and business owners and community groups as outlined in City Plan’s Community Consultation Planning Scheme Policy prior to submitting the functional layout for approval.

Solid infill of islands should be referred to Council for approval. In general, coloured surface, exposed aggregate, broomed concrete, or stencilled concrete treatments are preferred to paver bricks, due to maintenance considerations. See Council’s *Reference Specification S150 Roadworks* for approved surface colours. Turfed and landscaped medians should have side drains installed under the median kerb (ie on both sides of the median). An outlet should be provided for these side drains to an existing manhole, gully or other functional side drain.

The standard mountable kerbs (finished height of 150 mm above the adjoining road surface) are generally used in conjunction with speed control devices on minor roads. If no rigid surfacing is proposed for the medians in vulnerable locations, eg industrial subdivisions or major roads subject to heavy vehicles, island noses or roundabouts, the mountable kerb with backing strip should be used. Where traffic is intended to regularly mount islands (eg apron of speed control devices), the standard mountable kerb should be lowered such that the finished height is 75 mm above the adjoining road surface. The vertical face kerbs (standard type E) are generally used around medians on major roads. Refer Standard Drawing UMS 211 for kerb profiles.

15.0 PAVEMENT MARKING

Pavement marking designs should be prepared in accordance with the *Manual of Uniform Traffic Control Devices* (MUTCD, Queensland Department of Main Roads) and the specific requirements of *Reference Specification S150 Roadworks*. Brisbane City Council’s specific requirements are detailed on Standard Drawings UMS 841 to UMS 852.

16.0 ROAD FURNITURE

16.1 TRAFFIC SIGNS

Traffic signs should be provided in accordance with the *Manual of Uniform Traffic Control Devices* (MUTCD, Queensland Department of Main Roads) and the specific requirements of *Reference Specification S150 Roadworks*. All traffic and street name signs should be installed before a subdivision is accepted 'On Maintenance'. Brisbane City Council's specific requirements are detailed on Standard Drawings UMS 821 to UMS 836.

16.2 GUIDE POSTS

Guide posts should be installed in accordance with Standard Drawing UMS 131.

16.3 FLEXIBLE GUARDRAIL

Flexible guardrails are not generally suited to urban situations. However, flexible guardrails (refer Standard Drawings UMS 132, UMS 133, UMS 134) should be provided at locations where the consequences of a vehicle leaving the road pavement would be worse than the vehicle hitting the guardrail. These locations would generally include:

- At steep road embankments.
- At roadside obstacles.
- At structures, ie bridges and culverts.
- At sudden narrowing of road pavement in addition to the use of hazard markers.
- Where pedestrians are vulnerable.
- Median barriers.
- Adjacent to water features.

16.4 ACOUSTIC BARRIERS

Landscaped acoustic fences are generally required along all suburban and arterial roads. The proposed noise attenuation measures should comply with the *Noise Impact Assessment Planning Scheme Policy*.

17.0 TRANSPORT IMPACT STUDIES

Assessments of the impacts of trip generation of developments in the context of land use and transport planning should be conducted by a suitably qualified Registered Professional Engineer of Queensland (RPEQ) when required by the *Transport, Access, Parking and Servicing Code of Brisbane City Plan*. These should include proposals for amelioration of the impacts on road, public transport, cyclist and pedestrian facilities. Some of the references on the preparation of transport impact studies are:

- *Transport, Access, Parking and Servicing Planning Scheme Policy* (Brisbane City Council).
- *Guide to Traffic Generating Developments* (Road Traffic Authority, New South Wales).
- *Guidelines for Assessment of Road Impacts of Development Proposals* (Queensland Department of Main Roads).

18.0 STATE GOVERNMENT AGENCY REFERRALS

Developments proposed on or near roads controlled by the Queensland Department of Main Roads (QDMR) should be referred to that Department as required by the provisions of the *Intergrated Planning Act*. Council requires a certificate stating that the Queensland Main Roads Department is satisfied with a development or submission that is located on or near roads controlled by that Department. The certificate should list any additional requirements and conditions imposed by that Department.

Similarly, developments located in the vicinity of public transport routes should be referred to the Queensland Transport (QT). Input should also be sought from Queensland Rail (QR) for developments proposed in the vicinity of railway infrastructure.

19.0 TRANSPORT RELATED CONDITIONS OF DEVELOPMENT

The following may typically be required through conditions of development:

1. Road dedication.
2. Pavement widening.
3. Kerb and channel along full site frontage.
4. Concrete footpath along full site frontage.
5. Pedestrian linkages.
6. On-road/off-road bikeways along full site frontage.
7. Bus stops/indented bus bays including bus shelters.
8. Median installation.
9. Parking provision.
10. Driveway access restrictions.
11. Street lighting.
12. Signage and pavement markings.
13. Acoustic fences/barriers.
14. Easements.
15. Infrastructure charges.