ROAD DESIGN

1. INTRODUCTION

This chapter deals with the requirements for the design of roads, vehicle access, paths and associated structures and embellishments. Details are not necessarily comprehensive. The designer should refer to, and be competent with, the standards nominated as references. Generally, the parent documents for road design are the Austroad guidelines and Roads & Maritime Services (RMS) supplements.

Engineering designs should include geometric details of, road and drainage layouts, their gradients, cross sections, and kerb returns. (See appendix for full details). All existing infrastructure, surface features and underground services must be shown on the plans.

All design proposals must be carried out by experienced and competent practitioners.

2. GEOMETRIC DESIGN

2.1. ROAD HIERARCHY AND SPECIFICATIONS

Roadway infrastructure shall be determined and designed in accordance with, "Development Consent" issued by the consent authority, and the requirements of this Manual.

Widths of roads for residential subdivision are defined by their status within Council's road hierarchy, which adopts maximum lot catchments for various road types. The following table "ROAD TYPES AND DIMENSIONS" provides details of minimum road parameters according to lot catchment and lot-size; further divided into sub-categories for purposes relating to design traffic specifications. The table relates primarily to "greenfield" sites, generally applicable to large-subdivision release areas.

2.1.1. Road Width for Lot Catchment

For purposes of determining the appropriate road-width for a local lot catchment area, the assessment should be based on an assumed and reasonable traffic distribution analysis of the ultimate development and the contributing lots, along desire-lines to points of destination such as for recreation, schools, shops, workplace, etc.

This approach may vary, resulting in higher hierarchy levels where:

- staged development may significantly increase traffic flow in an intervening period, affecting safety and amenity of the area,
- a new public roadway serves a function greater than the immediate local residential area serviced by the road. This may occur where the specific land-use development consent is over part only of a broader integrated area, with roads connecting other centres of population, a Public Transport route or roads servicing commercial or school precincts, recreation facilities, or other major traffic generating destinations.
- there is potential to utilise a road as a "by-pass" of some traffic related constraint on another road, such as traffic congestion, traffic signals etc. [In this case careful planning should be practiced in order to avoid such circumstances.]

2.1.2. Consistent Road Width

Where lot catchment numbers trigger more than one road type within a defined length of road/street, unless justified, the higher road type shall be adopted. Opportunities where road width may be varied may be at intersections, traffic management device, curving horizontal alignment, or similar.

2.1.3. Impacts on Existing Roads

Where a new subdivision impacts on the existing local road network and road-works such as pavement widening or rehabilitation are required, the road alignment and pavement needs shall be determined by Council independently of the following Road Type table taking into account traffic volume and type, the needs and amenity of the existing road network, and an appropriate service to the community. Road widths greater than those shown in the 'table', may be required.

Where works are required as part of the development to augment an arterial or classified road, Council shall determine independently of this Manual the needs for that road.

[Refer also to Local Area Precinct plans for possible specific parameters for road needs.]

2.1.4. Part-width Roads

Nominal "part-width construction" of roads may be considered for subdivision servicing up to 10 lots (unless justified otherwise for a greater number, with adequate traffic safety and convenience measures), to facilitate shared construction costs across property boundaries, or which share a common road reserve, the subject in each case of separate development consents. Such roads are considered an interim treatment to facilitate subdivision.

Part-width roads may be permitted along a property boundary, and generally parallel to that boundary, and adjoining undeveloped land not part of the subdivision which also has subdivision potential under a planning scheme.

Part-width roads may also be permitted where the proposed road utilises an existing adjoining public road reserve (whether that road is unformed, or formed in-part only) and where undeveloped land not part of the subdivision also adjoins the opposite side of that road, and which has subdivision potential under a planning scheme.

The proposed part-width road must provide adequate safety for two-way traffic movement [one-way traffic movement may also be considered as an interim treatment].

The width of such road pavements may extend beyond the road centreline, and should be a minimum of 5.5m wide for two-way traffic. The overall construction width may be greater than the pavement width, subject to assessment of constraints such as kerb type (rolled type preferred), common boundary fencing type, pavement restraint or shoulder support, subsoil drainage, surface drainage, etc.

Where part-width construction is permitted within an existing road reserve (for roads with a catchment greater than 10 lots) a minimum of 9m is required which includes a bitumen sealed shoulder 0.5m wide.

In all cases of part-width construction, "No Stopping" zones are necessary considerations.

ROAD TYPES AND DIMENSIONS

ROAD TYPE	MAX NO. LOTS	RESERVE WIDTH (m) [a]	CARRIAGEWAY / KERB–KERB (m) [b]	ON-ROAD BICYCLE FACILITY	FOOTWAY VERGE (m) [c]	KERB [d]	FOOTPATH (1.5m WIDE) [e]	DESIGN ESA [f]
Local – Place [l]	10	17	8	Mixed	4.5	Rolled	As Required	1×10^5
Local – Access [l]	20	17	8	Mixed	4.5	Rolled	One side	1×10^5
Local – Secondary [l]	50	17	8	Mixed	4.5	Rolled	One side	2×10^5
Local - Primary [l]	100	17	8	Mixed	4.5	Rolled	One side	5×10^5
Collector - Secondary [l]	200	17	8	Mixed (Parking)	4.5	Upright	One side	1×10^6
Collector - Primary [lv]	300	20	11	Mixed (Parking) [p]	4.5	Upright	One side	1.5×10^6
Distributor –Secondary [v]	400	23	14	Mixed (Parking)[p]	4.5	Upright	Both sides	2×10^6
Distributor - Primary [m v]	500	24	15 [q]	1.5m Lane	4.5	Upright	Both sides	5×10^6
Sub-Arterial [n]	3500	24.4	15.4 [r]	1.7m Lane [s]	4.5	Upright	Both sides	1×10^7 min
Industrial - Secondary	10 [g]	22	13	Mixed	4.5	Upright	As Required	5×10^6
Industrial - Primary	> 10	22	13	Mixed	4.5	Upright	As Required	1×10^7
School Bus/Public Route [o]			9min / 12min					$2/5 \times 10^6$ min
Business / School Precinct			15.4	1.7m Lane	5.5 min [h]	Upright		1×10^7 min

LARGE-LOT SUBDIVISION

LAND USE TYPE	MIN. LOT AREA	RESERVE WIDTH (m)	CARRIAGEWAY / KERB–KERB (m) [i]	ON-ROAD BICYCLE FACILITY [t]	FOOTWAY VERGE (m) [c]	KERB [d]	FOOTPATH (1.5m WIDE) [e]	DESIGN ESA [e]
Residential (R5-V)	2000	18	7.5 (k)	Mixed	5.25	Rolled	One Side	per 'lots' above
Residential (R5-X)	5000	18	6.5 (k)	Mixed	5.75	Rolled	One Side	per 'lots' above
Residential (R5-Y)	10000	20	7.5 (f) j	Mixed	6.25 k	Not Mandatory	Nil	per 'lots' above
Residential (R5-Z)	20000	20	7.5 (f)	Mixed	6.25 k	Nil	Nil	per 'lots' above
Rural [u]	40Ha	20 min	7	Mixed	Nil	Nil	Nil	1×10^5 min

See *Notes* next page.

Notes:

a) Reserve width shall be increased where footway verges are greater than 4.5m

b) Additional width in accordance with Austroads or RMS standards may be necessary where on-road cycle lanes are required.
For a rolled kerb profile the nominal face of kerb shall be 150mm from the back of kerb.

c) May be reduced to 2.0m for roads up to and including Collector status where there is an adjacent public reserve.
Increased width to 5.5m where shared paths are required. Regardless of road hierarchy, a 5.5m wide footway shall be provided wherever a shared path is required.
Widths may be increased where necessary to accommodate public utility services.

d) Edge restraints are required for AC wearing surfaces. Concrete edge beams may be permitted.

e) Where a shared path is required along a street footway, a 1.5m path may be deleted.
Short cul-de-sac may be exempt from footpath paving subject to any connections to the path network.

f) Minimum Equivalent Standard Axles up to nominated maximum number of lots. Parameters do not include bus access to Local Streets.

g) Includes corner lots

h) A shared path 2.5m wide, or where pedestrian traffic is concentrated full verge concrete paving, shall be provided

i) Formation width includes the whole road pavement as a full-width bitumen seal

j) Rolled K & G with a 6.5m carriageway width may be provided in lieu of table drains (swales). One-way crossfall and a high-side concrete edge constraint is optional

k) Provide a 2.0m width of grassed footpath profile within footway verge

l) Normally classified as "50km/hr roads" servicing the local subdivision only; not through-roads connecting remote areas.

m) Roads which are within large residential areas only, sometimes referred to by other authorities/documents as 'Collector' roads

n) Sub-Arterial - Road connecting Arterial Roads to urban districts, and carrying traffic directly from one district or precinct to another. See Austroads Pt 2
Arterial Roads are defined separately to this Manual where location and design parameters are determined by Council. 'Classified' Highways, Regional and State Roads are typically Arterial Roads.

o) Bus routes for pick-up and set-down of school students in residential areas should be confined to 11m or greater width roads. An absolute minimum of 9m may be considered for special circumstances. For the public bus network and destinations such as business areas, schools and terminals, greater widths will be required.

p) Line-marking may be required to delineate pavement areas for vehicle travel separation.

q) Based on a 3.5m travel lane to operate as a bus route. Where it can be shown that the road will not be utilised by busses, the width may be reduced to 3m.
Where the route is planned to carry large numbers of trucks, the travel lane shall be widened to 3.5m. See Austroads Pt 3 section 4.2.5

r) Based on a 3.5m travel lane

s) Council may require a dedicated bicycle path fully separated from the road pavement.

t) To a maximum of 300 lots, otherwise bicycle lanes or paths must be considered

u) Not through-roads connecting areas remote from the subdivision

v) For roads greater than 300 lots consideration should be given to safe street crossing points (pedestrian refuges etc)

2.1.5. Crown Roads

Where Crown Roads are intended to be developed as part of a subdivision, such roads shall be constructed in accordance with this Manual and subsequently dedicated to Council (subject to relevant legislation and/or the Minister's concurrence) as public road on the Subdivision Certificate.

2.2. PAVEMENT TREATMENTS

Council will consider the construction of alternative pavement types, colours, textures and widths on their individual merits, but their consideration will be restricted to areas of low lot catchment, and where, for example, residential lots are on one side of the street, or opposite to and adjoining a Public Reserve or "Open Space". Such pavements shall only be provided at the terminal end of residential streets, and shall cater for a maximum number of five properties, including the corner allotment. In addition, such pavements, if being considered as a connection between two streets, must not create an alternative route for "through traffic".

2.3. HORIZONTAL CURVES

The horizontal alignment should be carefully chosen to balance the topography, with the desired speed control and adequate safety, for all road users.

- In urban areas, a changing alignment is encouraged in order to maintain low traffic speeds. Curve radii are generally established by the approved subdivision plan.
- Long straights connected with short (isolated) radii curves are undesirable.
- The maximum deflection for which a curve is not necessary is 1.5 degrees.
- Horizontal curves on urban arterial, sub-arterial and distributor roads shall comply with Austroads standards. The desirable minimum curve length should be 70m and the minimum desirable radius, 400m (due principally to adverse crossfall). [Ref: Urban Road Design, A Guide to the Geometric Design of Major Urban Roads (AP-G69/02)]
- Horizontal curves on rural roads shall comply with Austroads & RMS standards for rural roads
- "Broken-back" curves (created by a short length of intervening straight between two uni-directional curves) should be avoided in an urban street environment regardless of road hierarchy due to an unsafe changing alignment. Such curves are not permitted on roads of Collector status or greater, or within Large-Lot subdivisions. Exceptions may be granted by Council where travel speed necessarily varies appreciably (as may occur at sharp curves/bends approaching 900 or approach to a traffic control facility, interrupting traffic flow) and, where the connecting straight is greater than 150m between tangent points. Regardless, good design practice should prevail with improvement by the substitution of a single curve or a compound curve.
- Compound (uni-directional) curves with common tangent points should provide comparable radii ratios, generally not less than 0.75 (smaller divided by larger), although a lesser value may be considered in constrained urban situations.
- Reverse curves without tangent point separation, are not desirable and should be avoided.
- Where vertical curves are combined with horizontal curves, the combined respective sight distance requirements should ensure compliance with relevant standards.

- All curves must be assessed to accommodate large-vehicle access to urban areas taking into account the road hierarchy and the potential for passing of moving vehicles, and of parked vehicles.
- Travel lane widening for vehicle-tracking must be considered on major roads (roads with a carriageway width greater than an 11m) in relation to line marking and parking requirements. Generally, a 3.3m wide travel lane will accommodate large vehicles. [Ref Guide to Road Design – Part 3: Geometric Design 4.2.4 & 5]

2.4. LONGITUDINAL GRADES

For urban areas centreline longitudinal grade limits are as follows:

LONGITUDINAL GRADES

	FLEXIBLE PAVEMENT	RIGID PAVEMENT
Minimum	0.5%	0.5%
Maximum	16%	25%
Bus route maximum	12%	12%

Grading for an intersecting side-street shall attempt (where applicable) in the first instance to achieve a sag point in advance of the intersection. Where this occurs in deep cuttings, the deletion of the sag in favour of a dished concrete (being flat and wide – 40mm deep x 1.5m wide) may be utilised, subject to acceptable drainage considerations.

2.5. VERTICAL CURVES

Crest vertical curves shall be designed as a minimum for Stopping Sight Distance (SSD) for the nominated design speed. Sag vertical curves shall be designed for riding comfort. Where minor changes in grade (less than 1%) occur, vertical curve lengths shall satisfy appearance criteria.

Reaction times shall be 1.5 seconds for urban and 2.5 seconds for rural areas.

In order to improve gutter flows and pit inlet capacity where grades are less than 1%, sag vertical curves in kerb and gutter design should be eliminated. An increase in the road crossfall in the vicinity of the sag pit to achieve this requirement will ensue.

2.6. CROSSFALL AND SUPERELEVATION

Generally, roads should be crowned in the centre with 3% crossfall. Offset crowns are acceptable where warranted, to achieve satisfactory cross section profiles for adequate gutter/road capacity for stormwater runoff.

One-way crossfall may be applied in special circumstances subject to Council's concurrence (such as in difficult cross-sloping topography) with special attention given to control of the catchment contributing stormwater runoff to the gutter, (such as providing IAD pipelines) that does not exceed gutter capacity.

Superelevation should not be applied, but may be permitted on major urban and rural roads with design speeds of 80 km/h or greater, unless otherwise advised by Council.

2.7. FOOTWAYS, FOOTPATHS, STEPS

Footpath and footway parameters shall be designed in accordance with standard drawings SD001, SD002, SD007, & SD012, section 2.1 and the following:

- Footway minimum widths - 4.5m & 5.5m (subject to footpath width)
- Footway crossfall - 4%.
- Footpath width - 1.5m & 2.5m
- Footpath crossfall - ≤2.5%
- Longitudinal grades of footpaths shall match adjacent roadway/kerb grades.
- Where footpath grades exceed 12% special consideration shall be given to pedestrians.
- Steps are an undesirable element in public space design and should be replaced with ramps wherever possible. Where approved, they shall conform to the Building Code of Australia and handrails shall be provided.

Variation to these parameters will only be considered under exceptional justifiable circumstances.

A concrete footpath within the footway shall be provided, in principle, for lot catchments of generally greater than 10 lots. Footpath warrants, particularly in the vicinity of, or within the desire-line of, commercial and school precincts must be determined in conjunction with such surrounding development (present and planned), and with direction/desire-line destinations. Footpaths in industrial (IN1) and rural (RU1, RU2 & R5) zoned areas are not generally required unless specifically required by a planning instrument.

2.8. BATTERS

Batters of cut and fill should generally comply with the following requirements unless otherwise advised by the geotechnical engineer. This is to ensure that property access, pedestrian safety, and maintenance issues are satisfactorily achieved. Refer to Council's standard drawing SD002.

BATTER SLOPES

	MAXIMUM SLOPE (HOR : VERT)
Road Reserves	4 : 1[(1)]
Lots	4 : 1[(2)]
Public Open Space	5 : 1[(3)]

Notes:

(1) This slope is nominated primarily for purposes of maintenance rather than batter stability.

(2) Steeper slopes, up to 3:1 are permitted but should be avoided. Lots with steep batters shall be assessed for acceptable garage locations and driveway grades that conform to Council Standard Drawings SD008.

(3) Where regular maintenance is expected, 6:1 should be provided. Where maintenance is not required such as for natural bush, 3:1 may be permitted.

- Confirmation by a geotechnical engineer of suitable batter slopes for particular soil types may be necessary.
- Cuttings in rock may be near vertical, as recommended by an engineer.
- Batters for lotfill shall be contained within the lot.
- Road batters which extend into lots, should intersect with the natural surface level within the building line setback as adopted by Council.
- Variations outside of these parameters will only be approved where justified.

2.9. CULS-DE-SAC AND KERB RETURNS

A *circular* turning head within a cul-de-sac is the preferred treatment. Other treatments will be considered only where site constraints exist, with a turning head layout that caters for manoeuvres of a single unit Heavy Rigid Vehicle (HRV), typically a garbage truck. See Council's standard drawing SD027.

The minimum pavement crossfall in turning heads shall be 2%. In turning heads where the depth of excavation is significant, in order to reduce the effect of the cutting and batter, the crossfall from the circle centre may be adverse (positive).

NOMINAL KERB FACE RADIUS (MINIMUM METRES)

	RESIDENTIAL	INDUSTRIAL
Cul-De-Sac	10	16
Transition	30	50
Kerb Return (at intersections)	8	12
Kerb Return (at sharp mid-block bends)	15	See note

Note: Sharp mid-block bends are not appropriate in industrial areas. If unavoidable, B-Double turning paths must be satisfied.

3. INTERSECTION DESIGN

Intersections for the control of converging, merging and diverging traffic streams may employ various design elements which are generally referred to as "traffic control facilities", being, Major Facilities such as, Traffic Signals, Channelized (with auxiliary lanes), Roundabouts in urban and rural environments, and Minor Facilities, such as Local Urban and Rural Intersections, as defined below.

Intersection requirements shall be implemented in accordance with Austroads guidelines and as supplemented by RMS standards, and in accordance with development consent. As generally encompassed by Austroads standards, warrants for typical intersection requirements shall be determined based on design objectives parameters such as: safety, traffic capacity and flow, sight distances, crash history, lighting, consistency, driver expectation, and including: speed, travel time, interruptions, queuing, freedom to manoeuvre, driving comfort and convenience, and operating costs; factors embodied in the Level of Service (LoS) of an intersection.

"General objectives for intersection design are to:

- design the intersection to be as safe as possible
- cater appropriately for the movements of road users
- provide adequate facilities for all road users (including pedestrians, those with a physical impairment and cyclists)
- maximise driver comfort
- minimise costs
- minimise adverse environmental effects.

One option to improve capacity (and safety) is through channelisation and auxiliary lanes, to separate movements on an approach and provide storage space or remove conflicting flows, and to raise capacity by eliminating constraints on the priority flow" (Austroads Pt 6), and to achieve an outcome "to maintain capacity of the through road…to operate with very minor interference to the through movement" (RMS).

Intersections shall be designed to accommodate the legal speed limit of the road existing at the time of construction approval.

Application of an Extended Design Domain (EDD) approach will not be considered unless adequately justified, whereby removal of constraints to achieve Normal Domain Design (NDD) is unreasonable or prohibitive.

For traffic-control design features, Council and RMS Traffic and Development Committee requirements may be inherent within the consent, or otherwise approved through or associated with, the Construction Certificate process for traffic device features such as signposting and linemarking. (See section 4.5.2)

3.1. TRAFFIC SIGNALS

All traffic signal facilities (including those for pedestrians) shall be approved in design and construction by the RMS through appropriate agreements with the RMS (eg. Works Authorisation Deed).

3.2. CHANNELISED INTERSECTIONS

Channelised intersections (CH), together with auxiliary (AU) lanes to provide safety in diverging, storage and continuous flow of vehicles and cyclists, shall be provided in accordance with Austroads guidelines and as supplemented by RMS standards.

Intersections shall incorporate the following (but not limited to):-

- Adequate capacity for the projected design life
- Adequate Stopping Sight Distance (SSD) where applicable, Approach Sight Distance (ASD), Safe Intersection Sight Distance (SISD) and, Minimum Gap Sight Distance (MGSD) where practically possible, as the circumstances require.

  [Where an intersection is required in the vicinity of a crest vertical curve, it should be placed at the crest rather than immediately beyond the crest, where sight distance may be compromised.]
- Compliance with "turn treatments"
- Provision of auxiliary lanes
- Provision of islands medians and kerbs where required
- Provision for utility services, cyclists, pedestrians, disabled access, and lighting where required.
- Provision for 19m (and "B-Double" where on an approved route) articulated vehicle turning paths.
- Provision of signposting, pavement markings and furnishings, including raised pavement markers in accordance with RMS standards.
- Intersection angles should be perpendicular wherever possible, otherwise within the limits according to road design standards.

3.3. ROUNDABOUTS

Roundabouts shall be designed in accordance with Austroads and RMS Guidelines.

General geometric layout principles should be confirmed with Council prior to preparation of a detailed design. Particular attention will be given by Council to future traffic needs as they relate to the number and configuration of approach and circulating lanes. Wherever possible and appropriate, two approach lanes should be adopted. Pavement markings shall be utilised for dedicated traffic-lane movements. Two lane circulating roundabouts must employ two travel lanes at departures.

The following principles should also be addressed:-

- Circulating vehicle paths catering for a 19m Articulated Vehicle (AV)
- All roundabout road pavements should be constructed in fibre reinforced concrete. (see chapter 5)
- Adequate design capacity and strength, with a 40-year (min) design life.
- Appropriate sight distance and provision for future services, pedestrians, cyclists, drainage, lighting, signposting and line marking.
- A maximum through-movement deflection radius of 100m.

- An absolute maximum adverse radial crossfall of 4%
- Splitter islands, where pedestrian movement is expected, should be of sufficient width to accommodate "refuge" design parameters
- Suitable landscaping in the central island (where approved) providing sight lines at the adopted design eye-height.
- Subsoil drainage for any landscaped (unsealed) areas.
- Subsoil drainage at the perimeter (upright) kerb returns.
- On-road cycleways are to be provided for arterial and sub-arterial roads and in accordance with the Bike plan.

3.4. MINOR INTERSECTIONS

3.4.1. Urban

In urban environments intersections configured within the standards of kerb radii and road-width within this chapter shall generally be adequate for traffic access needs in local streets. Roads with higher levels of traffic usage such as Collectors or greater, should be assessed regarding traffic volumes and safe traffic usage in accordance with Austroads standards, addressing auxiliary lane potential for left and right turn manoeuvres. Use of regulatory signposting and linemarking in accordance with SD030 can usually accommodate most movements. Entry and exit movements for heavy vehicles that cross the road centreline within high volume roads are not permitted. (See "Kerb Returns" below)

Staggering of intersections, to achieve a desirable minimum separation distance of 40m between opposing road centrelines, is desirable. Four-way intersections should be considered where the separation is below the above standard, employing adequate traffic control measures.

3.4.2. Rural

In rural, or transitional urban/rural environments (being generally where the legal speed limit is greater than 60kms/h), and where single-lane two-way roads are impacted by a new road junction, intersections shall be assessed regarding traffic volumes and safe traffic usage in accordance with Austroads and RMS standards, addressing potential for auxiliary lanes for left and right turn manoeuvres, and flag lighting.

3.5. KERB RETURNS

Kerb returns shall be provided at all road or street intersections. Any variations to this requirement are subject to Council's determination, such as within RU zoned areas where returns may, if justified, be deleted.

An adequate kerb radius/road-width relationship shall be adopted for the maximum sized expected design vehicle (usually a 19m Articulated Vehicle - AV) to provide acceptable access to a subdivision and for manoeuvrability within intersections. In urban environments the usual minimum standard kerb radius is 8m, although, depending on the type or the Level of Service (LoS) of the intersection, Council shall determine an acceptable sweep path (and hence kerb radii) that may or may not employ cross-lane vehicle manoeuvres.

To cater for single-lane approach and departure for AV requirements at square intersections, the nominal minimum radius is 15m.

4. PUBLIC TRANSPORT (BUS)

A public transport route within this Manual refers to an approved route traversed by a bus. A "bus route" (not being a school bus route) is determined by:

- Transport NSW, together with the Lower Hunter Councils Transport Group or
- A planning instrument or
- Development Consent

School bus route needs shall be assessed by developers in conjunction with the local bus companies and Council, with the aim to provide for locations for buses to stops at intervals along a nominated road that will service the major part of a population walking distance of approximately 400m.

Bus routes should be confined to roads providing a carriageway width of 11m or greater (in R1 & B zoned areas) when determining either the route along an existing road, or determining the alignment of a new/proposed road.

Bus facilities such as bus stop and parking areas, signposting, set-down paving and shelters shall be provided where required by Council, and designed in accordance with Council's requirements and Austroad Standards for individual items, as follows:

- Bus set-down verge paving and shelters where required shall conform to Council's standard
- Bus shelters, unless otherwise approved by Council, shall be the adopted style current at the time of installation.
- Road pavement for bus lay-by parking areas at major destinations such as business and school terminals, shall be provided in concrete

Typically, shelters may be required as part of major release areas and may be located along a route within the release area or on a route nearby or adjoining the area.

For new subdivision release areas the applicant for the development or the designer shall submit to Council verification of arrangements made (or otherwise) with Transport NSW and local bus companies of public transport routes (existing and planned) and of any specific requirements for those routes, such as bus stop/set-down locations, for consideration by Council for implementation within the road design.

5. STRUCTURES

Designs related to concrete, masonry, steel and timber elements, such as for bridges, large culverts, retaining walls, headwalls, subdivision entry features, etc, shall be carried out in accordance with relevant Australian Standards and RMS Design Standards, and shall be certified by a practicing structural/civil engineer.

All precast and pre-assembled structures shall be similarly certified for structural adequacy. Where design elements are ancillary to a Construction Certificate for *Roads & Drainage*, documentation shall be submitted to Council for each component.

5.1. RETAINING WALLS

Retaining walls in this Manual relate to their location, design and construction as part of a major subdivision, and as part of a development (Chapter 8 - Developments) whereby they are an integral part of a development approved with consent under the EP&A Act. These guidelines may be applicable for other scenarios beyond the intent of this Manual.

5.1.1. Location

The location of retaining walls shall be determined by Council and the design engineer and should adopt the following guidelines:

- At public/road reserve boundaries – within the adjoining lots.
- At adjoining lots (common boundaries) – within the uphill lot with the face of the wall on the boundary. An easement 900mm wide within the downhill lot, to prevent excavation and for access for maintenance, shall be created.
- At stormwater overland flow paths – within the dedicated flow path or easement, being of concrete or masonry construction suitable for a flow path.
- Obstructions, such as walls or any other above-surface structures are not permitted within easements that act as overland flow paths. These easements are usually 3m wide, or greater.

Retaining walls within stormwater drainage easements (Inter-allotment Drainage) are not desirable due to the potential interference with the stormwater pipe and difficulty for access to the pipe for maintenance purposes.

- If a retaining wall is permitted/required, then the following guidelines/actions should be considered:
  - Avoidance of adverse impacts on the pipe from any structural elements of the wall
  - Footings shall be finished below the zone of influence * of the drainage line and no loading shall be directly applied to the pipe without a detailed design demonstrating mitigation of the load.

    * The zone of influence is defined as a line drawn at 1:1 slope from the invert of the pipe.
  - Maintenance of a reasonable means for physical access for personnel and light machinery to "lay, place and maintain a line of pipes" (Conveyancing Act).
  - Adequate measures to eliminate any potential loading on a pipe that passes through a wall or its footing.
- If a retaining wall is permitted/required and an adjustment to the pipeline is also required, a review of the hydraulic design of the pipeline, such as Hydraulic Grade Line, surcharge, pipe capacity, etc, must be made to ensure that there is no compromise to stormwater flows, that may create an adverse affectation on properties that either benefit, or surround the proposed adjustments.

5.1.2. Design

Retaining wall design shall be in accordance with AS 4678 Earth Retaining Structures, and be certified by a qualified engineer, taking into account loads from existing or future anticipated dwellings, pools, vehicles, etc.

Excessive cut and fill and subsequent retaining structures are not desirable. In this regard Council's policy of a maximum height of 1.5m between lots should be maintained. Retaining wall heights beyond 1.5m for other than "lot benching" (such as for road embankments) shall be subject to Council's approval through development consent.

Where approved by Council, retaining walls shall:

- Be designed in accordance with the Australian Standards
- Be of the materials in the specified locations, as nominated in the section of the Manual
- Where supporting a public/road reserves, be constructed in masonry or reinforced concrete.
- Where supporting lots adjacent to public/road reserves may be other than concrete/masonry, being installed in accordance with the manufacturer's recommendations.
- Where located within a public/road reserve, under justifiable circumstances, be constructed of reinforced concrete or an approved masonry specification.

Retaining walls of treated timber walling (sleepers) at common lot boundaries shall be incorporated into galvanised steel I-beam posts set in concrete in accordance with an engineer's design.

6. ANCILLARY DESIGN REQUIREMENTS

6.1. SAFETY AUDIT

A Road Safety assessment, where required by Council, shall be conducted in accordance with the RMS Road Safety Audit process.

6.2. TRAFFIC CONTROL DEVICES (TRAFFIC COMMITTEE)

Traffic control devices may include a sign, signal, marking, structure or other device to direct or warn traffic (incl. pedestrians and cyclists) on a road or road related area that is prescribed by the regulations. Traffic control devices may also be of a type to reduce travel speeds to match urban design requirements where road geometry cannot provide that control. Such devises may also be used in conjunction with street landscaping and furniture.

The devices, including associated signposting and linemarking, shall be designed where applicable, in accordance with RMS, Australian Standards or Austroads guidelines, and Council's requirements, and will be presented to Council's Local Traffic Committee upon receipt at Council of an acceptable engineering design.

Roads with an 11.0 metre (or greater) carriageway width, centreline and/or edgeline marking may be required. Raised pavement markers shall be provided where required by Council at intersections in accordance with RMS standards, in conjunction with line marking at locations that warrant particular traffic safety considerations.

The manoeuvrability of an articulated design vehicle shall be considered for traffic control devices.

6.3. STREET NAME SIGNS

Street signs shall be provided to Council's standard specifications and Standard Drawing SD029. An application for new street names shall be lodged with Council, and be supported by adequate justification for the proposed names. Names shall conform to the guidelines of the Geographical Names Board.

6.4. GUARDFENCE & GUIDEPOSTS

Guardfence refers to any approved type of safety barrier such as concrete barrier/kerb, steel W-Beam or wire rope. Where possible, effective road design should aim to negate the need for guardfence. Where there is a warrant, and where unavoidable, guardfence shall be provided in accordance with the current RMS Design standards or as directed by Council. Guardfence on the outer edge of a road carriageway shall be located within a constructed or extended road shoulder which shall be bitumen-sealed.

Guideposts shall be provided in accordance with Roads and Maritime Services Design Guide.

6.5. PAVEMENT EDGE RESTRAINTS

Concrete restraints such as kerbs, flush edge-beam restraints or kerb & gutter shall be provided on both sides of all roads on urban residential subdivisions as determined by Council.

6.6. TEMPORARY TURNING HEAD

Where a road is terminated for staged construction, a temporary turning head with a two coat bitumen seal (as a minimum treatment) shall be provided, with optional layouts complying with those shown in SD027. The facility may not be necessary where it is adjacent to an intersecting street, enabling a 3-point turn.

The road pavement may be constructed either as an extension of the adjoining section (catering for future extension), or a lesser pavement by special design.

A chevron sight board shall be placed at the termination of the temporary turning head on the prolongation of the centreline of the road.

6.7. VEHICLE TURNING PATHS

Vehicle manoeuvring templates, in accordance with Australian Standards or an approved computer application shall be employed for each appropriate vehicle type. Public roads shall cater for Articulated Vehicles (AV) turning paths. Where a "B-Double" route exists, the appropriate turning path shall be employed.

6.8. CYCLEWAYS & SHARED PATHS

Cycleways shall be provided on routes as defined by the Maitland City Council Bike Plan or in accordance with any Development Control Plan or condition of development consent.

Off road cycleways (ie, beyond the road pavement) are usually nominated "shared paths" being 2.5m wide for both cyclist and pedestrian usage, and shall be constructed in accordance with standard drawings SD012 & SD020. Such paths, usually located within footways that are 5.5m wide (See SD001) may also be located in open space corridors. Council may consider a shared path 2.0m wide where justified by special circumstances such as constraints of available corridor widths.

Shared path or cycleway connectivity between a road (ie. a road reserve either existing or proposed, with or without a path) and the main path shall be constructed as a shared path, 2.5m wide.

6.9. KERB RAMPS

Kerb ramps (pram ramps) shall be provided at locations to cater for road crossings but only when directing pedestrians to a continuing path, in accordance with Council's Standard Drawing SD019. The surface of the kerb ramps shall be coloured with a terracotta colour oxide, with a stretcher bond brick stencilled finish. Ramps and their texture shall be perpendicular to the road and aligned to be directly opposing, to assist directional orientation of sight impaired persons.

6.10. PATHWAYS

Public pathways within dedicated land shall link common destinations such as schools and commercial precincts and recreation areas. They may also act as stormwater overland flow paths (see chapter 6). Pathways shall be provided with concrete footpaths in accordance with development consent and Council's standard drawing SD012 & SD037. Typical pathway reserve widths between allotments shall be a minimum of 3.0m containing concrete path 1.5m wide, and 3.5m wide containing concrete paths 2.5m wide.

Street crossing points, for cyclists, shall be provided where appropriate and pedestrian refuges where traffic volumes are greater than 3000vpd.

6.11. ACCESS CORRIDORS FOR DRIVEWAYS

Unless approved otherwise under development consent, the following minimum dimension (subject to an acceptable cross section design incorporating pavement, underground drainage & services and good quality landscaping) shall apply to access corridor "handles" (see also chapter 8).

HANDLE WIDTH (M)

ZONING[1]	SINGLE HANDLE [2]	DUAL HANDLES[3]	PAVEMENT WIDTH[4]
Residential (R1)	3.5	3.0 [5,6]	2.7 [7]
Residential (R5-V & X)	3.5	3.0	2.7
Residential (R5-Y)	4.5	3.0	2.7
Residential (R5-Z)	6.0	3.0	2.7
Business (B) & Industrial (IN1)	6.0 [8]	4.0	3.3 min [9]
Rural (RU)	6.0	4.0	3.5

Notes:

(1) For zoning criteria see chapter 2.
(2) For a single allotment.
(3) Each handle width for two adjoining lot handles, with a single driveway covered by a full-width reciprocal ROC.
(4) For single lane.
(5) Three metres (x2) permits vehicle passing within o/a 6m width for each residential zone. It is assumed regular conflict is unlikely and "give-way" will apply in residential zones.
(6) Where lots are >600m^2 (excluding handle), having potential for further subdivision, adopt 3.5m.
(7) Where lots have potential for high density development with regular traffic movements, adopt 4.8m, preferably as two carriageways with a 400mm grassed separation.
(8) Increase to 8m where regular two-way conflict is likely.
(9) Generally for one-way or minor two-way movements with "give-way". For two-way movements with regular traffic conflict 6.0m min should be provided.

6.11.1. Dual Handles

Adoption of the dual handle widths considers potential for:

- Independent individual usage for each lot if necessary
- Good quality landscaping (excluding trees)
- Provision for vehicle passing bays, emergency access or breakdown clearance

6.11.2. Rights of Carriageway (No Handle)

Where site constraints dictate, particularly within the existing built environment, a right of carriageway in lieu of an access handle may be considered.

6.11.3. Underground Services

Services, including stormwater conduits, shall be provided within and along the full length of individual access handles.

6.11.4. Pavement

Driveway pavements shall be provided along the full length of the access corridor handle prior to issue of a Subdivision Certificate in accordance with standard drawing SD012, including splays at each end and may be shared between adjoining properties. Pavements within Rights of Carriageway for all zone areas shall be provided as heavy-duty "commercial/industrial standard" slab type reinforced concrete, or to a greater design as determined by expected usage.

In single-lot residential areas concrete drive wheel-strips within the handle length are encouraged in order to reduce impervious surfaces and hard surface expanse. Pavement widths are subject to an assessment for the potential for vehicle-passing and turning movements.

7. ROADS FOR LARGE-LOT RESIDENTIAL

For road dimensions refer to the table in section 2.1 of this chapter. Subject to Council approval the follow design elements should be applied/considered:

- Road pavements shall be provided with an asphaltic concrete wearing surface in accordance with the requirements of this Manual.
- The requirement for a table drain (swale) on the low side of the road is subject to specific design geometry such as downhill batter slope, road longitudinal grade and swale-drain relief. In situations where the batter slope is significant, the longitudinal grade is low and the catchment area is small the swale may be deleted.
- In lieu of a swale, one-way crossfall on the road pavement against the natural topography is optional.
- Swale (or table drains) that may be crossed for vehicle access should be designed wherever possible to provide vehicle clearances for a dished invert crossing in accordance with AS2890, to avoid the necessity for a pipe crossing. Acceptable grades can often be achieved with reshaping of the natural surface within the property.
- In cut situations where a dished crossing is not practical, a 5m long, 375mm (minimum diameter) Class 4 concrete or equivalent FRC pipe, with attached sloping headwalls, shall be provided for each new lot, preferably in the centre of the lot. The pipe size shall provide sufficient capacity for the 10-year ARI storm event for the contributing catchment area, ensuring that major overflows can be contained within the road reserve. Driveway details are shown on Council's standard drawing SD013.

8. RURAL ROADS

Rural roads in this Manual are assumed to be new roads within RU zones that either, service rural properties fronting the road, or roads (new or existing) that extend access to those roads from an existing public road. Such roads do not usually relate to existing rural roads under Council's control, such as a classified "main road", although Council may apply the design principles herein to those roads where works on those roads are necessarily the subject to development consent.

The parameters shown in the table under section 2.1 of this chapter are specific to subdivisions with a minor vehicle catchment, particularly as "no-through" roads; otherwise rural road & drainage design shall conform generally to the parameters required by Council based on Austroads and RMS design guidelines.

8.1. RURAL DESIGN ELEMENTS

Subject to Council approval the follow design elements should be applied/considered:

- Rural roads shall be provided with a two-coat bitumen flush seal wearing surface across the full formation width.
- Table drain (swales) shall be grassed with a stable medium such as a jute-mesh type product or similar means.
- Driveways for vehicle access shall be provided, including a recessed access where appropriate where a vehicle with trailer can park clear of the road pavement.
- Clear zones shall be provided in accordance with the Austroads & RMS Design standards.