ROAD DESIGN & CONSTRUCTION GUIDELINES

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1. SCOPE

This standard provides guidelines to consulting engineers, planners, and developers of roads to be designed and constructed for the City of Karratha and is applicable to all roads, including driveways located within the Karratha region (where approvals are required by the local authority), including arterials, collector streets and local residential access & light industrial road infrastructure.

Contractors to liaise with Main Roads Western Australia and conduct works in accordance with Main Roads Western Australia standards and specifications for all major roads or roads owned and managed by the state government.

This specification details the design and functional requirements of road geometry, pavement design, traffic control features, drainage features and utility location.

Standards and specifications for roads, pavement and concrete structures are to be read in conjunction with the City's *CKS-900 Subdivision Guidelines.*

Contractors involved in the construction of roads shall develop construction methods for the City.

1.1 Responsibilities

The City is responsible for the operations and maintenance of the road infrastructure. The City shall engage developers, road engineers, and designers to complete designs of road infrastructure.

Road pavement designs must be completed by qualified, competent engineers experienced in applying Austroads guidelines and Main Roads standards and specifications.

All designs submitted to the City will be checked against these standards, specifications, and guidelines. The City reserves the right to request revisions or further details to determine whether a design is acceptable.

Any new development projects require a transport/traffic impact assessment to determine the impact of any proposed roads on the existing road network.

1.2 Applicable Standards

The installation, materials and workmanship shall comply with all relevant current Australian Standards, Codes and Regulations and all reference codes and Standards listed in the prefaces to those standards and codes.

Where Australian Standards and Codes do not exist the appropriate International Standard or Codes shall apply. Request an instruction from the City for amendments to Standards, Codes or Regulations that come into effect during the works and affect the works of the contract.

Document	Title

2011-021-01	City of Karratha Kerb Profile Drawing
AGPT	Austroads - Guide to Pavement Technology
AGRD	Austroads - Guide to Road Design
AP-R578-18	Austroads - Harmonisation of Pavement Markings and National Pavement Marking Specification
AS 1289 Suite	Methods of testing soil for engineering purposes
AS 1160	Bituminous Emulsions for the Construction & Maintenance of Pavements
AS 1742 Suite	Manual of uniform traffic control devices
AS 1743	Road signs – Specifications
AS 1906	Retroreflective materials and devices for road traffic control purposes
AS 2008	Bitumen for pavements
AS 2150	Asphalt – A guide to good practice
AS 2157	Cutback Bitumen
AS 2876	Concrete kerbs and channels (gutters) – Manually or machine placed
AS 3727.1	Pavements
IPWEA LGGSD 2017	Institute of Public Works Western Australia – Local Government Guidelines for Subdivisional Development
MRWA ERN 9	Main Roads Western Australia - Engineering Road Note 9 – Procedure for the Design of Road Pavements – Western Australian Supplement to Pavement Technology Part 2: Pavement Structural Design
MRWA Specification 501	Main Roads Western Australia – Specification 501 - Pavements
WAPC LN 2015	Western Australian Planning Commission – Liveable Neighbourhoods
WAPC Guidelines DC 2.6 1998	Western Australian Planning Commission – The Design & Geometric Layout of Residential Roads

1.3 Definitions

Term	Description
Asphalt	A mixture of aggregate and bitumen typically used as a surface course material
Bitumen	A viscous material used as a binder in asphalt
Basecourse	A layer of material placed on top of the subbase, below the surface course. Typically, crushed rock or gravel
Cutback bitumen	A product made from residual bitumen complying with AS 2008 by the addition of cutter oil complying with AS 3568 for the temporary reduction of viscosity
Equivalent	Dual Wheeled Single Axle applying a load of 80kN

Standard Axle	
Flexible Pavement	A road pavement designed to bend and deform under the weight of vehicles. Flexible pavements are common Australian roads typically composed of road base and asphalt
Roadbase	A material typically used as the basecourse in road paving, usually consisting of fine crushed rock
Reflective cracking	A common type of pavement distress that occurs when cracks in an underlying layer of pavement propagate through (or reflect) into upper layers
Road pavement	The hard surface layer of a road providing a durable and stable surface for vehicles to travel on. The pavement is prepared and compacted on top of the subgrade
Road reserve	The area of land the road is built on, and additional land on either side of the road, including for sidewalks, drainage, utility lines, and land for future road expansion
Subbase	A layer of pavement placed directly on the subgrade, located below the basecourse
Subdivision	The process of dividing a large piece of land for development, including the creation of new streets, and other infrastructure
Subgrade	The natural surface upon which a road pavement is built
Swale	A vegetated drainage ditch used to infiltrate stormwater into the ground

1.4 Acronyms

Acronym	Full Form
AC	Asphaltic Concrete. AC10 refers to Asphalt with an aggregate size of 10mm.
CBR	California Bearing Ratio
ESA	Equivalent Standard Axle
IFD	Intensity Frequency Duration (used to characterise stormwater)
MMDD	Maximum Modified Dry Density
MRWA	Main Roads Western Australia

2. DESIGN

2.1 Site Investigations

2.1.1 Land Survey

A feature, topographical and utility survey must be undertaken to enable a detailed and comprehensive road design and drawings. A feature/topographical survey is to be completed in accordance with City of Karratha's Specification *CKS-910 Survey & Construction Design Guidelines* and the MRWA's *Digital Ground Survey 67-08-43.* The underground utility survey is to be conducted in accordance with *CKS-910 Survey & Construction Design Guidelines* and the MRWA's *Underground Utilities Survey Standard 67-08-121 (Class B).*

All survey works are to include but not limited to the following:

- Identification of all above ground features including, but not limited to pit lids, kerbs, signs, poles, all services, ground levels, swale drain channels, crossovers, existing building levels, existing structures and topography.
- Identification of the locations of all underground services/structures including but not limited to water mains, electrical conduits, communication conduits/pit/pipe, gas reticulation mains, low voltage and high voltage mains and pits, hydrant locations, stormwater drains, subsoil drainage, sewer mains, inverts of chambers and all other relevant underground services/structures.
- Documentation of key information for all services located including type, depth, diameter, and material.
- Service location marking and maps.
- Cadastral boundary.
- Survey plans to include georeferenced aerial image underlay.

2.1.2 Geotechnical Investigation

A geotechnical site investigation must be completed prior to commencing any road designs. A geotechnical investigation is required to identify existing ground conditions at the site including insitu material properties. The investigation shall include test pitting, logging, sampling and testing of insitu materials to enable pavement design. As a minimum, a geotechnical testing shall include but not limited to California Bearing Ratio (CBR), Particle Size Distribution (PSD), Linear Shrinkage and Maximum Dry Compressive Strength. All testing procedures and methodologies must follow AS 1289 and undertaken at a NATA accredited laboratory.

The geotechnical data and report must detail site classification in accordance with AS 2870 and measures that could be adopted to improve this classification (if required) and recommendations in terms of site preparation, including the possible re-use of existing soils as controlled fill, specification for any imported fill and the removal/treatment of any unsuitable materials encountered.

The geotechnical investigation shall include but not limited to the following:

- Complete all works in accordance with the Main Roads WA Guidelines for Geotechnical Investigations of Road Works – Materials Engineering Report No. 2011-01M.
- Identify areas of uncontrolled fill, compressible layers, potential for liquefaction or any other problematic ground conditions. If encountered, provide recommendations to address any identified risks.
- Compaction densities, requirements, and specification.
- Presence of groundwater.
- Complete a Geotechnical Report outlining findings on site, recommendations for fill material, type/specifications, pavement structures' material types/specifications, pavement design, photos, site logs, all tests and certificates and any other relevant data or information to enable a detailed design of the road.

2.2 Design Criteria

Road design for Local Governments in Western Australia is guided by the *Institute of Public Works Engineering Australasia - Local Government Guidelines for Subdivisional Development (IPWEA LGGSD, 2017)*. These guidelines are considered the minimum standard for road design for Local Government and shall be read in conjunction with this document and other policies and legislations relevant to Agencies associated with subdivisional approvals.

2.3 Design Life

The design life of road pavements shall be in accordance with *IPWEA LGGSD 2017 Clause 3.3.8* for rural situations:

- 40-year design life for the pavement (subgrade, subbase, basecourse)
- 20 – 40-year design life for the wearing course depending on the seal design.

2.4 Existing Drainage

New road design shall consider the City's existing drainage specification in accordance with *CKS-500 Stormwater Design Guidelines*, which involves:

- Design of the road network with high kerbs to convey stormwater to topographic low points
- Conveyance of stormwater into existing swales that allow infiltration into the ground
- Discharge of excess stormwater to the ocean
- Designing in accordance with the most recent stormwater flood study and local water management framework. Refer to the Appendix (Figure 14) for the existing drainage design.

2.5 Drawing Requirements

The following drawings are required as deliverables:

- General Arrangement showing a plan view of all new roads to be constructed
- Civil earthworks drawing showing finished reduced levels (RLs)
- Proposed stormwater drainage system and solution including any subsoil drainage (if required)
- Detailed drawing showing road pavement cross-section composition and the geometry of the road and reserve
- Detailed drawing showing any non-standard signage and details
- Drawing notes shall identify the design criteria, including:
    - Design Life in years
    - Design traffic load in Equivalent Standard Axles (ESA)
    - Design stormwater Intensity Frequency Duration (IFD).

General Requirements

Engineering drawings submitted to the City of Karratha for approval shall, in general, contain the following:

- Title page
- Locality plan
- Layout and stage plan
- Longitudinal sections
- Standard cross-sections
- Cross-sections every 20m along the chainage
- Stormwater management plan and design including a culvert schedule
- Pavement design

Design drawings shall be submitted to the City of Karratha for approval. Drawings shall include the following information as a minimum:

Plan View

- Road reserve and allotment boundaries
- Existing services and structures including underground services and structures
- Road centrelines and chainages
- Co-ordinates of major points and offsets
- Structures set-outs
- Road curve and kerb radii
- Pavement width and thickness
- Edge of pavement
- Pavement width and thickness
- Drainage locations, pipe diameters, RLs, ILs, fill materials and thickness including bedding layers
- Location and details of signage and markings

Longitudinal Sections

- Existing topography and contour elevation lines
- Final levels to enable cut and fill estimation
- Design gradients and falls

- Road chainages including chainage of tangent points and departures
- Vertical curve radii

Road Cross-Sections

- Widths of road reserves, pavement and footpath
- Crossfall gradients
- Pavement depth
- Kerb & channel detail specification
- Pavement construction details and thickness
- All other services and structures located within the area of the cross-section

Drainage

- Horizontal and vertical alignment
- Chainages
- Existing and finished surface levels
- Design invert levels
- Hydraulic grade line
- Access chamber chainages, including inlet and outlet invert levels
- Distances between access chambers
- Pipe and other stormwater structure details – diameter, class, gradient including a Culvert Schedule.

2.6 Road Hierarchy

Local government roads shall be classified in accordance with Table 1.

Table 1: Classification of Roads

Classification of Road	Purpose
District Distributor	To carry traffic between industrial, commercial and residential areas and generally connect to primary distributors which are managed by Main Roads WA.
Regional Distributor	To provide connection between significant destinations and are designed for efficient movement of people and goods within and beyond regional areas.
Local Distributor	To carry traffic within a cell and connect district distributors or regional distributors at the boundary to access roads.
Access Roads	To provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function.

3. ROAD PAVEMENT

Road pavement design is the process of selecting appropriate materials and designing the layer thicknesses and composition of a pavement system to support the expected traffic loads and environmental conditions over its design life.

The total unbound granular pavement depth (the subbase + basecourse thickness) shall be determined based on materials' strength and geotechnical testing results including the soaked CBR values, Particle Size Distribution (PSD) including information on AS sieve size, percent passing and specification limits, Liquid Limit, Plastic Limit, Plasticity Index, Linear Shrinkage and the number of repetitions of ESAs for the life of the pavement. CBR design values of the subbase and basecourse have been provided in this document.

The following sections cover sealed roads. The components of a road pavement consist of subbase, basecourse and surface courses which are all placed on a prepared or improved subgrade.

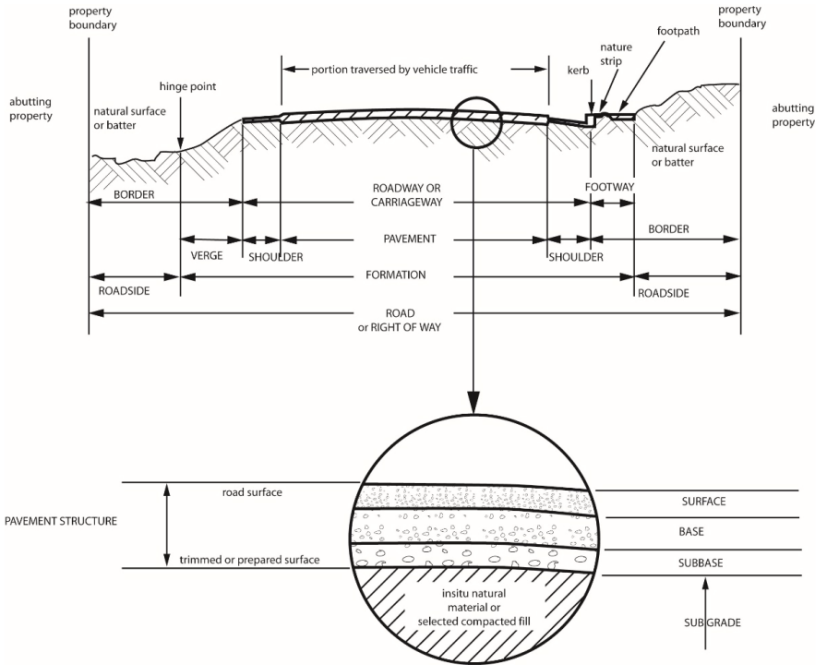


Figure 1: Components of a Road Pavement - Extract from MRWA ERN 9

3.1 Traffic Estimation

Traffic shall be estimated to determine pavement thickness. Traffic estimates shall be estimated based on:

- Number of Heavy Vehicle Axle Groups
- Exponential growth rate estimation
- Normalising traffic in number of Equivalent Standard Axles (ESA) (Single Axle Dual Tyre 80kN load).

3.2 Pavement Design Requirements

The design consultant shall follow a flexible or rigid pavement design method that ensures sufficient pavement thickness and integrity for the anticipated number of vehicles over its design life.

Road pavement structural design determines the minimum thickness and course material selection based on traffic loads and existing subgrade properties. Profiling may be required to confirm correct road finish levels.

Table 2: Minimum pavement thicknesses for different design subgrades and vehicle volumes using empirical procedure. (A minimum 200mm basecourse thickness has been allowed).

Design Subgrade CBR (%)	Design Vehicles over pavement lifetime (Equivalent Standard Axles)	Minimum Basecourse Thickness (CBR 100%) (mm)	Minimum Sub-base Thickness (CBR 80%) (mm)	Minimum Total Basecourse + Subbase thickness required (mm)
3	Lightly Trafficked Residential Roads $<10^5$	200	Not required	200
3	1,000,000 (10^6)	200	320	520
3	10,000,000 (10^7)		450	650
3	100,000,000 (10^8)		580	780
6	Lightly Trafficked Residential Roads $<10^5$		Not Required	200
6	1,000,000 (10^6)		150	350
6	10,000,000 (10^7)		240	440
6	100,000,000 (10^8)		330	530
10	Lightly Trafficked Residential Roads $<10^5$		Not Required	200
10	1,000,000 (10^6)		60 (Adopt 100 for minimum layer thickness for compaction)	260
10	10,000,000 (10^7)		120	320

10	100,000,000 (10^8)		190	390

3.2.1 Subgrade

The site subgrade is to be classified and tested prior to commencing design in accordance with AGPT02-17 Clause 5. The subgrade CBR and Modulus (in MPa) shall be determined from testing to enable basecourse, subbase and wearing course thicknesses to be calculated.

Loose soil or soil containing organic materials shall be removed. Any stormwater and sewer pipes and other services or utilities under the proposed pavement shall be protected from damage during construction works.

Moisture content of the subgrade and fill shall be adjusted to ensure adequate compaction.

Subgrade levels should be prepared to the levels in accordance with the design drawings, to achieve the final finished levels.

A City Engineer shall approve if subgrade improvements are required on a case-by-case basis.

If subgrades required improvement, the following quality shall be achieved. The subgrade shall be compacted to 95% MMDD. Local soft spots shall be rectified to achieve levels of strength and stiffness similar to the remainder of the subgrade. Backfill for service trenches shall be compacted in layers no greater than 200mm to provide levels of strength and stiffness similar to the subgrade. The unconfined compressive strength of the subgrade shall be in the range of 1.0-1.5MPa tested unsoaked after 28 days of curing in accordance with AGPT02-17 Clause 5.3.8. The subgrade may be stabilised by adding lime to achieve these properties.

The area to be paved shall be cleared of trees, roots, highly reactive clay known locally as “gilgai”, rock and debris to at least 400mm below subgrade level or as per direction provided by the Geotechnical Engineers and backfilled with approved fill. Unsuitable material is to be removed and disposed of off-site by the Contractor or stockpiled at a site nominated by the City.

3.2.2 Subbase and Basecourse Materials

Subbase and Basecourse Materials shall comply with Table 3.

Table 3: Subbase & Basecourse Material Requirements

Pavement Layer	Material	Material Specification (MRWA Spec 501)	CBR (%)
Subbase Option 1	Pilbara Gravel Subbase *(also referred locally as “Type B” materials)*	501H.01	Minimum 60 (Soaked 4 days with 4.5 kg Surcharge at 96% of MDD and 100% of OMC)
Subbase Option 2	Crushed Rock Base Subbase (*also referred locally as “Type B” materials)*	501.09	Minimum 70 (Soaked 4 days with 6.75 kg Surcharge) at 96% of MDD and 100% of OMC)
Subbase Option 3	Recycled Crushed Concrete	501C.03	Minimum 100 (Soaked for 4 days) at 94% of MDD and 100% OMC
Basecourse Option 1	Pilbara Gravel Basecourse *(also referred locally as “Type A” materials)*	501H.02	Minimum 80 (Soaked 4 days with 4.5 kg Surcharge) at 98% of MDD and 100% of OMC

Basecourse Option 2	Crushed Rock Base Basecourse *(also referred locally as "Type A" materials)*	501.11	Minimum 100 (Soaked 4 days with 4.5 kg Surcharge) at 99% of MDD and 100% of OMC

3.2.3 Crushed Recycled Concrete Subbase

- Crushed Recycled Concrete (CRC) shall only be sourced from premises that are licensed under Part V of the Environmental Protection Act 1986 to accept, store and process construction and demolition waste. The premises must have been approved by the Department of Water and Environmental Regulation (DWER) to supply CRC in accordance with the Waste Authority Roads to Reuse (RtR) Specification.
- The Contractor shall provide to the City with a copy of the Supplier's letter of approval from DWER confirming that the Supplier has management systems compliant with RtR Specification. A copy of this document shall be included in As-Constructed records.
- Crushed Recycled Concrete shall not be used in the following locations:
  - Any location not covered by Full Depth Asphalt pavement.
  - Within 0.5 m of the maximum groundwater level; or
  - Within the following locations in Public Drinking Water Source Areas including but not limited to Priority 1 (P1) areas, wellhead protection zones or reservoir protection zones.
- The Contractor shall ensure that it is aware of its responsibilities under Work, Health and Safety (WHS) legislation and implement appropriate controls to protect its employees and other persons in relation to the use of recycled construction products from construction and demolition material.
- CRC shall be clearly identified and referred to as 'Crushed Recycled Concrete' in Laboratory Test Requests, Test Reports and in As-Constructed records.
- Prior to placement of CRC, the Contractor shall certify to the City that the material supplied by the Contractor fully complies with the specified requirements, including in relation to health and safety and limitations on usage.
- Foreign material content shall be limited to the values shown in MRWA's Table 501C.A. Testing for foreign material other than asbestos and hazardous metals is to be undertaken by visual identification of each foreign material type retained on a 4.75 mm sieve. The percentage by mass of each foreign material type shall be calculated to the nearest 0.1% as the mass of all that material type identified compared to the total sample mass.
- If any asbestos or hazardous metals are identified as exceeding the maximum permissible limits in Table 501C.A, the supply of CRC must be immediately suspended, and not resumed until resolved and agreed with the City.
- All deliveries, stockpiles and unsealed sections of CRC must be kept watered to prevent airborne dust.

3.3 Surface / Wearing Course

The City of Karratha's preference for carparks, regional distributors, local distributors, rural roads and access roads for a wearing course as a minimum is one of the following two (2) options:

Option 1 – Bituminous double/double Spray Seal

- Prime Coat: Cutback Bitumen Prime (design to be determined by the Consultant's or Contractor's Pavement Engineer).

- Double/double seal (AS 2008 Class 320 bitumen binder). Aggregates size and other bitumen binder type to be designed by the Consultant's or Contractor's Pavement Engineer on a case-by-case basis.
- Tack Coat in accordance with AS 2150.

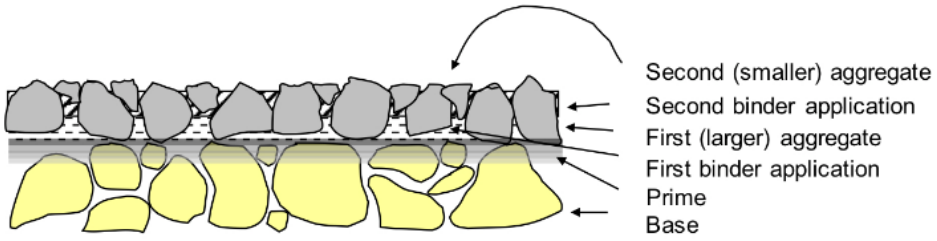


Figure 2: Dual Coat Bitumen Seal (AGPT04K-18 Figure 3.5)

Option 2 – Asphalt

Asphalt Wearing Course shall be a minimum 30mm thick *AS 2150* AC10 Asphalt with *AS 2008* Class 320 bitumen binder.

Intersections shall have a wearing course of dense graded 10mm size asphalt (Hot-mixed) intersection mix laid to a minimum thickness of 40mm unless otherwise specified on the drawings. Intersections require MRWA intersection grade asphalt.

Asphalt shall be traceable via a delivery docket record containing the following information as a minimum (as required by *AS2150:2020 Clause 8.4*):

- Date and time of dispatch
- Type of mix
- Mass in tonnes
- Identification of truck/trailer
- Temperature of the asphalt

Asphalt shall be core sampled in accordance with *AS 2891.1.2* and *MRWA Specification WA 701.1*. Core samples shall be 95mm diameter x 1 layer maximum deep in accordance with *AS 2891.1.2 Clause 6*.

Asphalt core samples shall be sent to a NATA-accredited laboratory, and its constituents analysed in accordance with *AS 2150 Clauses 5 & 9*:

Table 4: Asphalt Sampling and Testing Methods

Property	Test	Acceptance Criteria
Marshall Method – Mechanical Properties	AS/NZS 2891.5	AS 2150 Table 10
Bulk Density	AS/NZS 2891.5 AS /NZS 2891.8 AS/NZS 2891.9.1 AS/NZS 2891.9.2 AS/NZS 2891.9.3 AS/NZS 2891.7.3 AS/NZS 2891.14.5	AS 2150 Clause 14.4
Air Voids	AS/NZS 2891.8	AS 2150 Tables 5 to 9

3.4 Unsealed Roads

Unsealed roads constructed from a vegetation cleared subgrade shall be designed only in situations as directed by the City. Unsealed roads are only permitted for low traffic volume roads for access to remote areas with less than 10 vehicles per day up to 60km/h in accordance with *AGPT06-09*.

4. GEOMETRIC DESIGN

4.1 General Requirements

New roads shall be designed to suit the natural ground conditions and minimise the volume of cut and fill earthworks. Geometric design of new roads, reconstructions or renewals or other roadworks requiring excavation or ground disturbance must consider all above and underground services and ensure any modifications or relocations of the existing services or structures are designed in accordance with the relevant standard and specifications and is satisfactory to the asset owner's requirements. Liaison with all impacted assets/utilities owners are essential at early design to ensure compliance.

Roads shall be designed with the following requirements:

- Provide stormwater drainage solutions conveying water away from buildings or other structures
- Maximum gradient of 10%
- Minimum gradient of 0.5%
- Minimum crossfall in accordance with Table 5
- Verge grading +2% to property boundary
- Maximum earth cut batter 1:2, maximum earth fill batter 1:4

Table 5: Minimum Crossfalls Required - AGRD03 Table 4.2

Road Pavement Surface	Minimum Crossfall Gradient (%)
Gravel, Water bound macadam	4
Bituminous Sprayed Seal	3
*A*sphalt	3
Concrete	3

Roads shall be speed limited depending on the terrain type and horizontal curve radius in accordance with table 5 and table 6.

Table 6: Desired Speed for different terrains and horizontal curve radii (AGRD03 Table 3.3)

Approximate range of horizontal curve radii (m)	Desired speed (km/h) Terrain Type			
	Flat	Undulating	Hilly	Mountainous
Less than 75	-	-	75	70
75 – 300	-	90	85	80
150 – 500	-	100-110	95	90
Over 300 – 500	-	110	-	-
Over 600 - 700	-	-	-	-

The maximum crossfall for turning movements at intersections shall be 5%.

The minimum crossfall on curved roads shall be in accordance with Table 5.

Curved roads with an adverse crossfall of 3% shall have a minimum curve radius in accordance with Table 7.

Table 7: Minimum Horizontal Curve Radii when adverse crossfall of 3% exists.

Design Speed (km/h)	Minimum Radii (m)
30	95
40	170
50	270
60	520
70	850
80	1250
90	1700
100	2250
110	3000

4.2 Road Width

Lane widths shall be in accordance with Table 8.

Table 8: Road Width Requirements

Lane Type	Minimum Width (m)
General Traffic	3.5
Wide kerbside lane Where motorists and cyclists use the same lane, or there are high truck volumes	4.2
Shoulder adjacent to a safety barrier	3.0
Left Shoulder	1.5
Width of road adjacent to Median	1.0

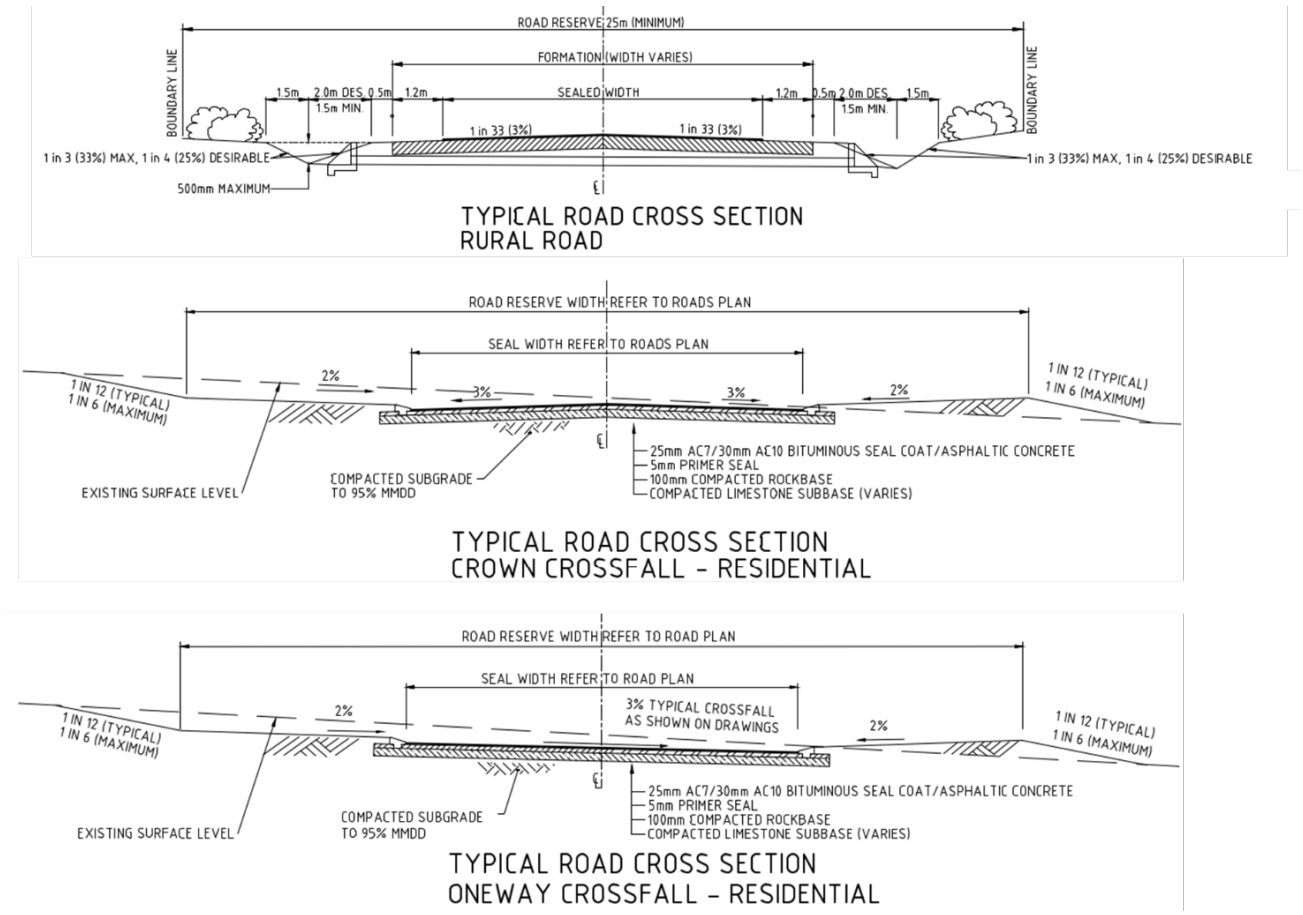


Figure 3: Rural and residential road design cross-sections for the City of Karratha

Industrial roads in light industrial areas shall be in accordance with ***Figure 4*** and ***Figure 5***. The City shall direct the designer if a stopping bay is required.

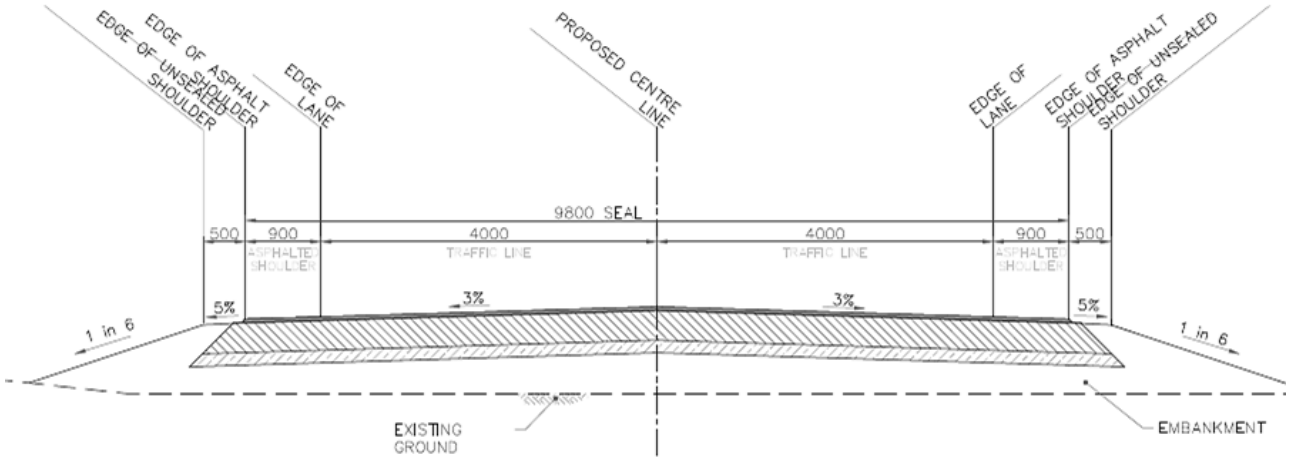


Figure 4: Industrial Roads without Stopping Bay – 9.8m wide

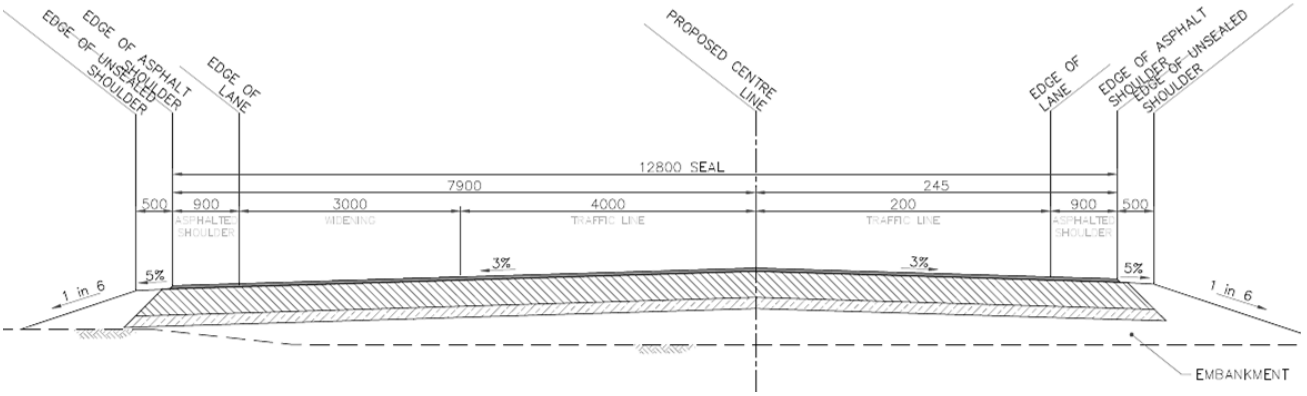


Figure 5: Industrial Roads with Stopping Bay – 12.8m wide

4.3 Cul-de-sacs

Road designers shall refer to *IPWEA LGGSD 2017* and *Austroads Guide to Road Design* for guidance on the geometric design of cul-de-sacs but in general they should be designed to the following criteria:

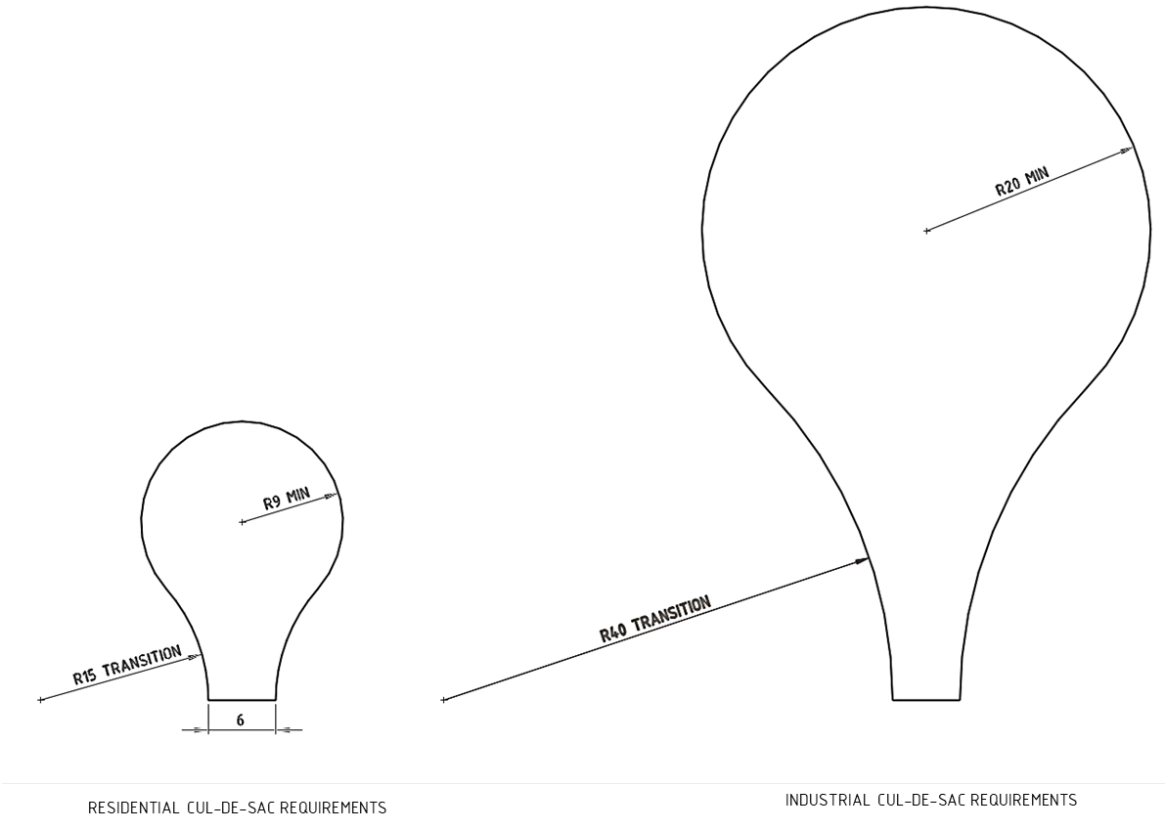


Figure 6: Cul-de-sac requirements

- Cul-de-sac turning circles shall have a minimum radius of 9m with 15m transitions in residential areas and 20m radius with 40m transitions in industrial areas.
- Design vehicle in residential areas for the City's garbage collection vehicle and in industrial areas the largest design vehicle.

4.4 Intersections

Intersections shall be designed for the vehicles in column 2 of Table 9.

Table 9: Design vehicles for intersections – extract from AGRD04 Table 5.1

Intersecting Road Types	Design Vehicle	Design Check Vehicle
Arterial/Arterial	19m single articulated 15m Radius	25m Single/B-double/Road Train 15m Radius
Arterial/Collector	12.5m Truck/Bus 12.5m Radius	19m Single articulated 15m Radius
Arterial/Local – Residential	8.8m Service Vehicle 12.5m Radius	12.5m Single unit truck/bus 12.5m Radius
Collector/Collector – Industrial	12.5m Truck/Bus 12.5m Radius	19m Single articulated 15m Radius
Collector/Local - Residential	8.8m Service Vehicle 9m Radius	12.5m Single unit truck/bus 12.5m Radius
Local/Local – Industrial	19m single articulated 12.5m Radius	25m B-double / long single articulated / Road train
Local/Local - Residential	8.8m Service Vehicle 9m Radius	12.5m Single unit truck/bus 12.5m Radius

Approach sight distances shall be in accordance with Table 10.

Table 10: Approach sight distance – from AGRD04A Table 3.1.

Design Speed (km/h)	Minimum Required intersection Approach distance in m (Reaction Time 2.0s)	Desirable intersection approach distance in m (Reaction Time 2.5s)
40	40	-
50	55	-
60	73	-
70	92	-
80	114	-
90	139	151
100	165	179
110	193	209

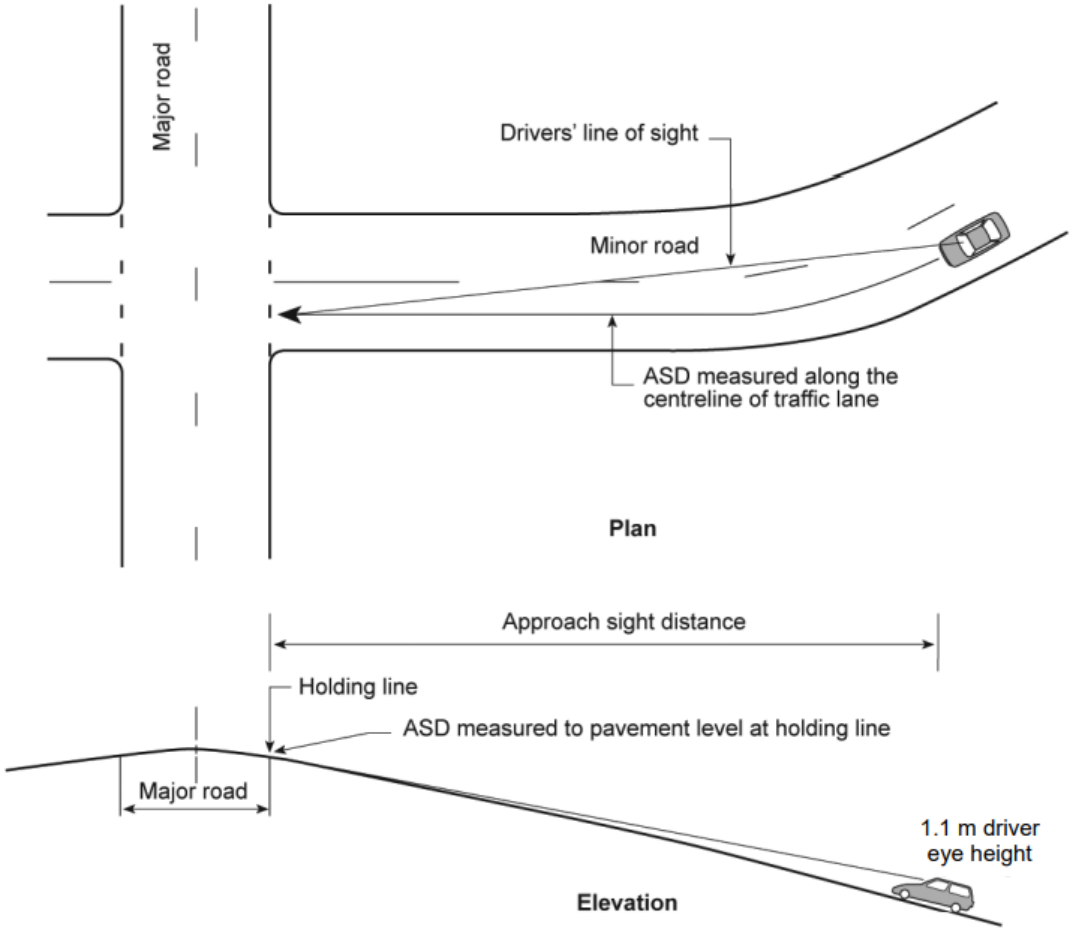


Figure 7: Approach Sight Distance guide for intersections (from AGRD4A Figure 3.1).

Vehicles continuing to travel on a major road shall have a minimum Safe Intersection Sight Distance (SISD) from intersecting minor roads (refer Figure 8).

Table 11: Safe intersection sight distance (SISD) for sealed roads – from AGRD04A Table 3.2

Design Speed (km/h)	Minimum Safe Intersection Sight Distance (SISD) in (m)	Desirable Safe Intersection Sight Distance (SISD) in (m)
40	73	-
50	97	-
60	123	-
70	151	-
80	181	-
90	214	226
100	248	262
110	285	300

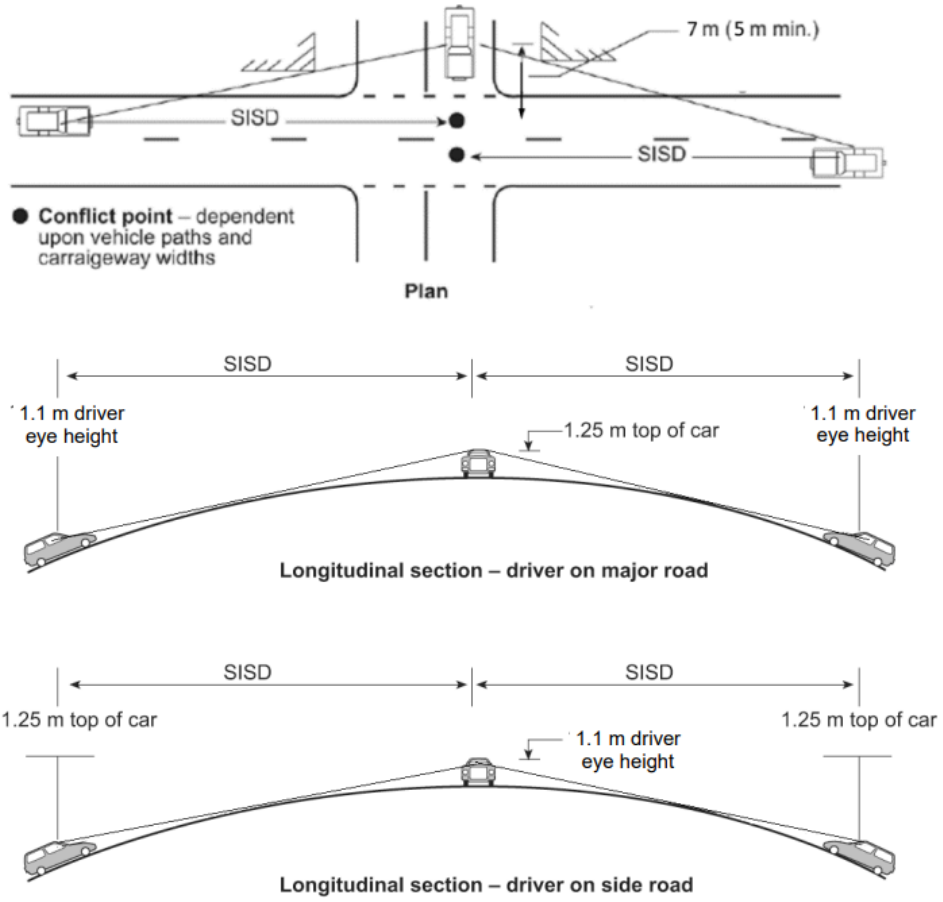


Figure 8: Safe intersection sight distance guide - AGRD04A Figure 3.2.

Approach distances and SISDs should be corrected for gradient in accordance with AGRD04A.

Median island widths at urban intersections are given by Table 12.

Table 12: Residual median island widths at urban intersections (extract from AGRD4A Table 6.4).

Median Function	Desirable Minimum Width
Separate traffic flows and a safety barrier	3.7
Shelter a small sign	1.2
Shelter signal pedestals or lighting poles	2.0
Shelter pedestrians and traffic signals	2.5
Shelter pedestrians and tactile ground surface indicator provision in median cut-through	2.5
Shelter turning vehicles and traffic signals	6.0
Shelter crossing cars	7.0

Intersections shall be marked in accordance with *AS1742.2* and *AGTM Part 10*.

Intersection sight distances shall be in accordance with the requirements in *AGRD04 Clause 3* and *MRWA Supplement to AGRD04A*.

4.5 Roundabouts

Roundabouts shall be designed based on the approach speed of the entry legs.

A roundabout serving a two-lane approach must be designed with two (2) entry lanes.

The number of circulating lanes must be greater or equal to the number of entry lanes. Roundabouts with different numbers of lanes for entries shall comply with Figure 9.

Roundabouts with single lanes shall be designed to be upgraded to a dual carriageway to suit future traffic volumes, this is typically achieved by reducing the central island to enable a second lane.

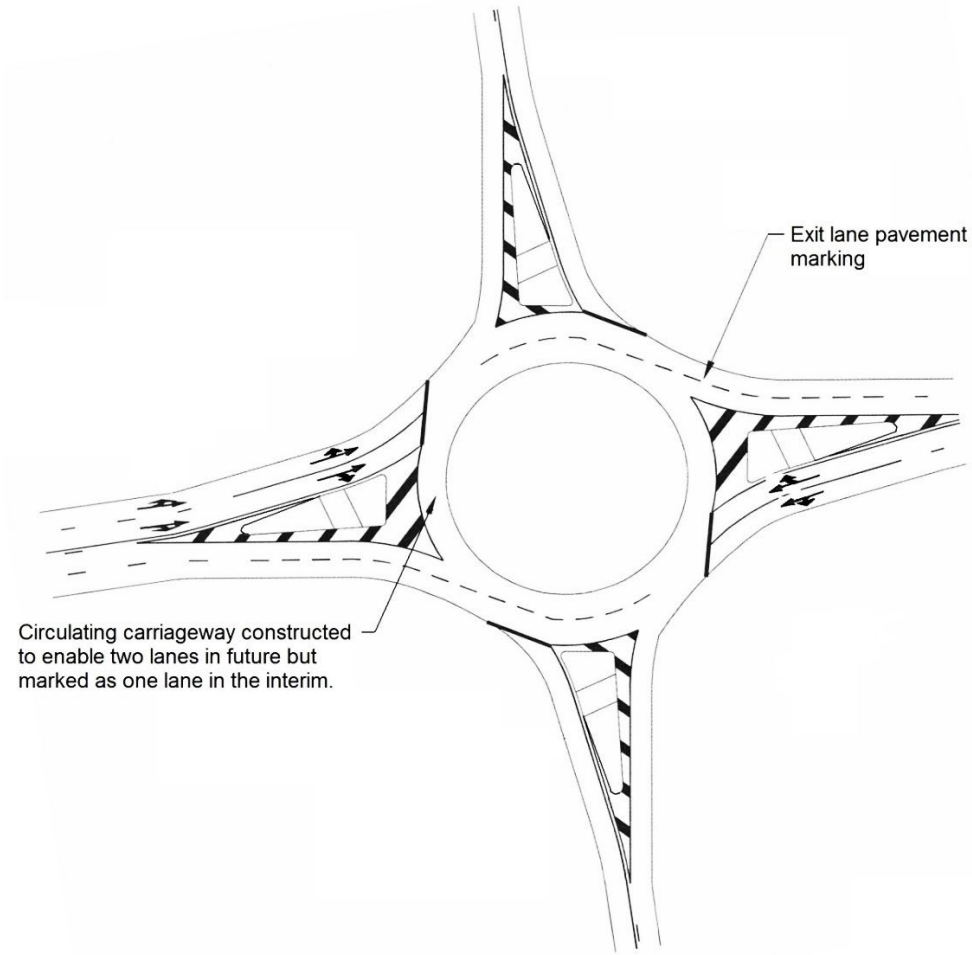


Figure 9: Multilane roundabout with a reduction to one lane, enabling future upgrade to dual carriageway

Roundabout splitter islands shall be designed to slow down entry speed, guide traffic into the roundabout, deter wrong way movements and provide crossing pedestrians with a safe space to wait for clear traffic. Splitter islands and line markings should be long enough to provide a comfortable speed to decelerate to zero in accordance with.

Table 13: Splitter Island & marking length requirements (AGRD04B Clause 4.5.4)

Approach Speed (km/h)	Splitter Island & Line Marking Length (m)
50	40
60	55

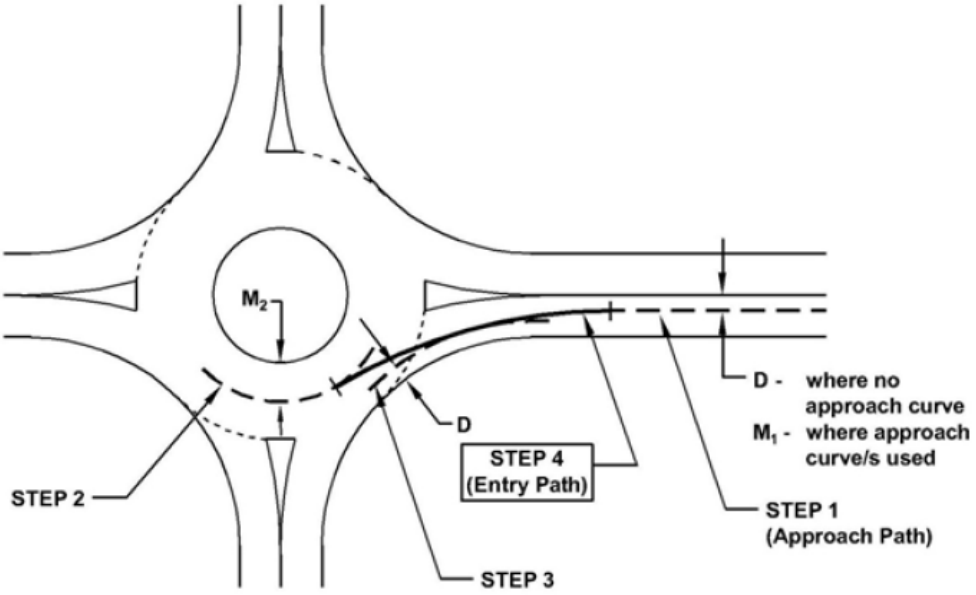
70	75
80	100
90	125
100	155
110	185

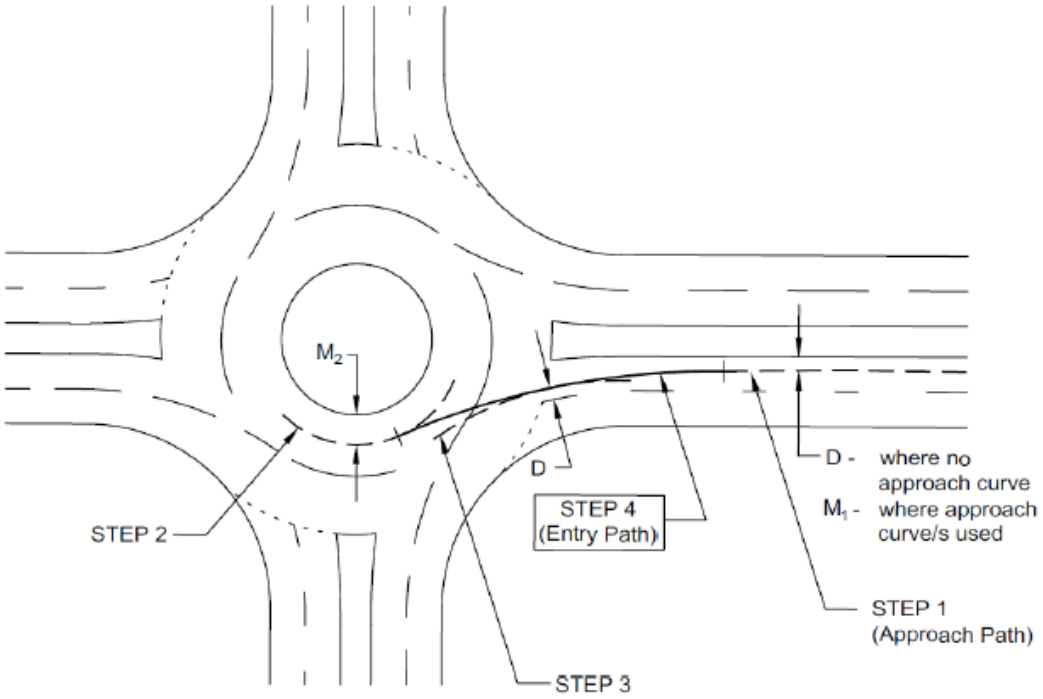
Standard roundabouts with four legs and kerbs shall be designed in accordance with Table 14. Non-standard roundabouts with more than four legs, legs that are offset from the roundabout centreline, or requiring semi-trailer access will require further design.

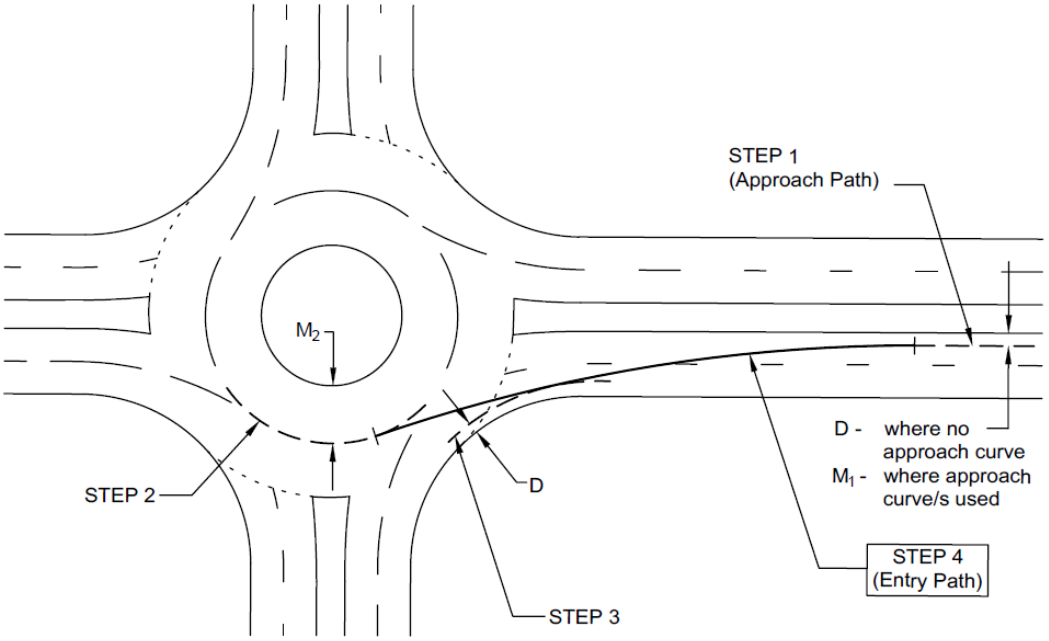
Table 14: Roundabout Central Island Radius – from AGRD04B Table 4.1

Approach speed on fastest leg (km/h)	**Central Island Radius for Single Lane Roundabouts (m)**		**Central Island Radius for Single Lane Roundabouts (m)**	**Central Island Desirable Radius for Two Lane Roundabout (m)**	**Maximum Entry Path Radius (m)**	
	Minimum	Desirable	Minimum	Desirable	Single Lane & Two-Lane staying in correct lane	Two lane entry – cutting across lane
40	7	10	8	12	55	1.9x actual entry path radius when staying in the correct lane
50	8	11	8	12	55	1.8x actual entry path radius when staying in the correct lane
60	10	12	14	16	55	1.6x actual entry path radius when staying in the correct lane
70	12	18	18	20	55	1.5x actual entry path radius when staying in the correct lane
80	14	22	20	24	55	1.5x actual entry path radius when staying in the correct lane

90	14	22	20	24	55	1.5x actual entry path radius when staying in the correct lane







D = 1.5m when measuring from a road centreline or kerb face, 1.0m when measuring from a lane line or edge line.
M_1 = Half the width of the right approach lane.
M_2 = Half the width of the inner circulating lane.

Figure 10: Entry Path Radius - Extract from AGRD04B Figures 4.4 to 4.6.

Roundabouts with an approach speed of 80km/hr will require approach and entry speed treatment in accordance with *AGRD04B Clause 4.5.2*:

- Successive reverse curves
- Long median island and a kerb on the left side of the approach
- Rumble strips
- Warning signage

Roundabout centre islands shall be landscaped in accordance with the *City's Landscaping Guidelines*, and *Stormwater Drainage Guidelines*.

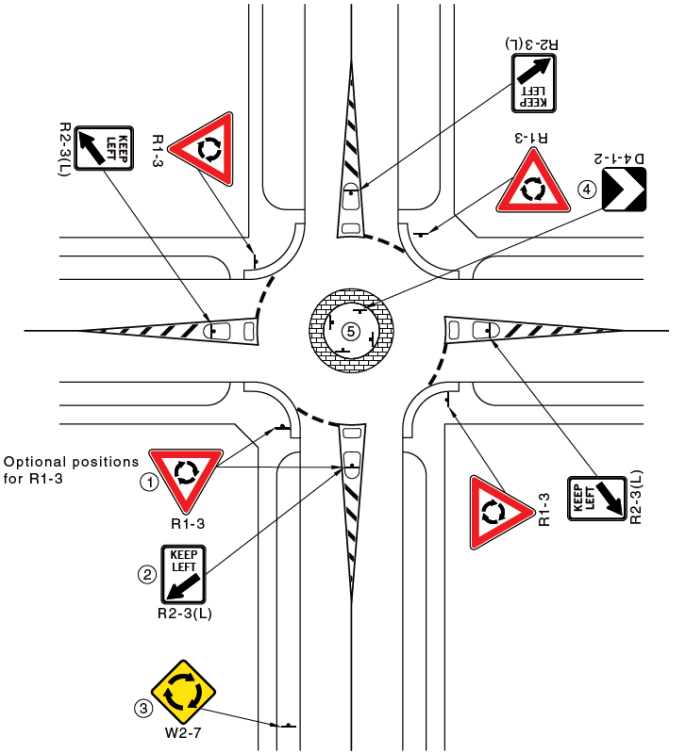


Figure 11: Roundabout Signage - Local street roundabout - extracts from figure 2.7, AS1742.2

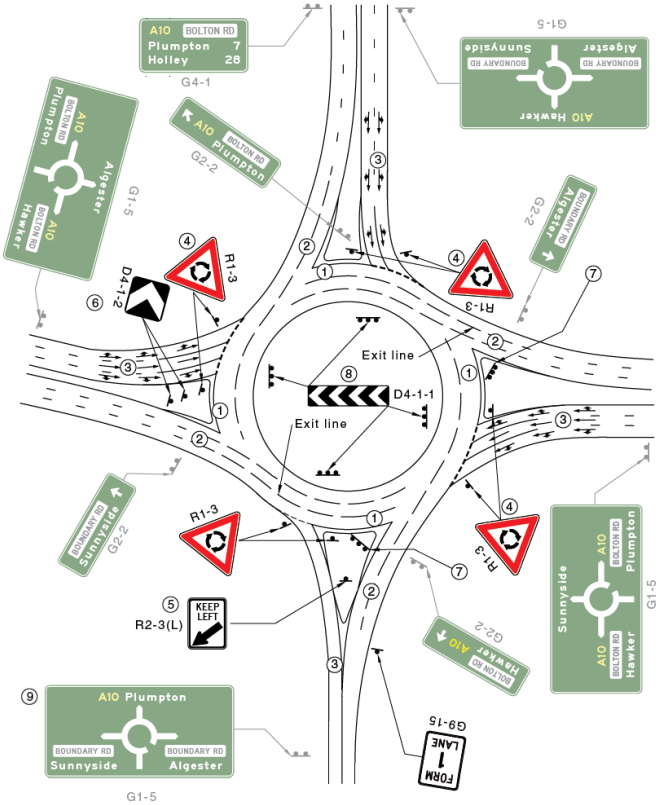


Figure 12: Roundabout Signage – Right: Large roundabout – extracts from figure 2.8, AS 1742.2

On-street and off-street parking should be designed and constructed in accordance with the City's *CKS-600 Parking Guidelines*.

4.6 Footpath

Footpaths, including provision for pedestrian and cyclists shall be designed in accordance with the City's *CKS-200 Footpath Design Specification.*

4.7 Subsoil Drainage

Subsoil drainage shall be designed in accordance with the City's *CKS-500 Stormwater Design Guidelines.*

4.8 Services and Utilities

Services shall be buried with a minimum clearance from other services in accordance with *AS 5488.2 Appendix D.*

Direct buried services shall have adequate burial depth in accordance with *AS 2566.1* and *AS 3725.* If inadequate burial depth cannot be achieved, a suitable concrete structure in accordance with *AS 3600* shall be designed to reduce loads on the services.

Table 15: Indicative depths of underground utility infrastructure - AGRD Part 6B Table 4.1

Utility	Context	Cover below surface level (mm)
Gas distribution	Street mains Consumer mains	750 600
Gas – high pressure	Street mains Consumer mains	1200 1200
Electricity	Power	750
Telecommunications	Excavation installations Trenchless installations	450 600
Water	Distribution mains Reticulation mains Consumer service	750 600 450
Sewer	Sewer mains Consumer services	900 900
Main drainage	In verge Under road pavement	750 900
Street drainage	Street main or consumer service – in verge or under road	600
Road lighting	Lighting poles and high masts, electricity supply conduits and pits	600
Traffic signals	Power supply	500-800
Road lighting	Detector cables in conduit	300
Traffic signals	Intelligent transport systems (ITS) cables in conduit	500

Metallic services shall be buried with non-detectable tape complying with *AS/NZS 2648.1* buried 330mm below the surface.

Non-metallic services shall be buried with *AS/NZS 2648.2* & *AS/NZS 4275* compliant detectable warning tape 150mm wide, with tracer wires.

4.9 Lighting

Lighting shall comply with the City's *CKS-800 Streetscape Design Guidelines.*

4.10 Concrete Pavement

Concrete roads shall be designed with the recommendations in *AGPT04C*.

4.11 Inspection & Testing

Contractors shall submit an inspection test plan (ITP) for all roads constructed within the City. Roads shall be inspected and tested in accordance with Table 16.

Table 16: Inspection and Testing hold points

No	Stage	Details / Principal's Requirements
1	Selection of Pavement Materials	a) Review and approval of material specifications including test certificates. b) Material Test Certificates must clearly outline the following: • Type of Road base (whether it is MRWA Type A or Type B). • Outlines the following information as a minimum: – AS Sieve Size (mm), percent passing and specification limits. – PSD Graph – Liquid Limit (%) – Plastic Limit (%) – Plasticity Index (%) – Linear Shrinkage (%) – CBR Soaked (%) c) Comply with the City's pavement materials specification as outlined below: • Basecourse MRWA Road Base Type A only. • Subbase MRWA Road Base Type B only.
2	Completion of earthworks	a) Completion of set-out and prior to clearing. b) Completion of earthworks prior to respreading of topsoil.
3 – a	Completion of drainage infrastructure	a) Visual inspection of the subgrade level and proof-roll post compaction (95% MMDD min.). b) Review and approval of compaction test certificates. c) Visual inspection of the bedding layer and proof-roll post compaction (95% MMDD min.). d) Review and approval of compaction test certificates. e) Photographs documented for the following: • Dewatering (if required) • Trenching • Installation of culverts • Restoration and adjacent work f) Visual inspection of the road base fill material above box culverts (95% MMDD min.) g) Review and approval of compaction test certificates. h) Approval of compaction results and approval of string line / as constructed levels.
3 – b	**If no drainage**	a) Visual inspection of the subgrade level and proof-roll post compaction (95% MMDD min.).

		b) Review and approval of compaction test certificates. c) Approval of as constructed levels, compaction results, and satisfactory subgrade surface condition.
5	Completion of subbase	a) Visual inspection of the subbase level and proof-roll post compaction (96% MMDD min.). b) Review and approval of compaction test certificates. c) Approval of as constructed levels, compaction results, and satisfactory subbase surface condition.
6	Completion of basecourse	a) Visual inspection of the basecourse level and proof-roll post compaction (99% MMDD min. for Crushed Rock Base Basecourse and 98% for other Basecourse materials). b) Review and approval of compaction test certificates. c) Approval of as constructed levels, compaction results, and satisfactory basecourse levels. d) Visual inspection, approval of surveyed string line and departure from 3.0m straight edge.
7	Completion of seal	a) Review of seal design/mix or test certificate and approval. b) Visual inspection of finished seal surface, levels and approval. Photographic records including: • Preparation of surface • Application of seals/asphalt • Application of tack coat (if sprayed seal and if required) • Placing of material, including joints • Compaction • Protection of work c) Approval of as constructed levels, compaction results, and satisfactory basecourse levels. d) Visual inspection, approval of surveyed string line and departure from 3.0m straight edge.
8	Completion of line marking and signage	a) Certificate of Compliance that the paint complies with the relevant Australian Standards or APAS specification. b) Visual inspection.
9	Completion of landscaping (where required)	a) Review and approval of design and drawings. b) Inspection of subsoil drainage (if any) as per drainage construction requirements above. c) Inspection and approval post planting (before acceptance).
10	Pre-Practical Completion Inspection	Site walk through no later than four (4) weeks prior to the intended Practical completion date to identify defects for repair.
11	Practical Completion	Site walk through prior to reopening, identification of defects for repair.

5. KERBING

5.1 General

Cast in-situ kerbing shall be constructed using extruded concrete machine and finished in accordance with *AS 2876*. Concrete shall be Class N32 supplied and shall have a maximum aggregate size of between 6.7mm and 19mm.

All kerbing shall be laid to achieve correct levels considering the design level of the road.

Transitions from one kerb profile to another shall be made uniformly and neatly over 5m length in accordance with *AS 2876 Appendix A Note 2.*

5.2 Geometric Requirements

Kerbing shall be constructed from the preferred profiles *as* specified in City's Standard drawings.

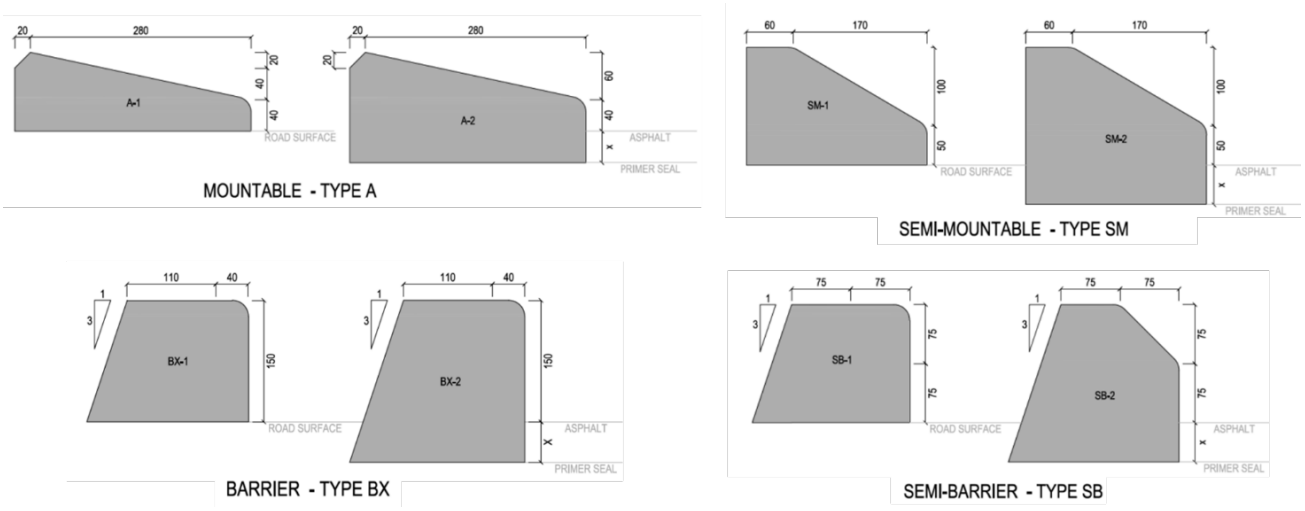


Figure 13: Figure 12: Preferred Kerb Profiles – Extract from City of Karratha Kerb Profile Drawing 2011-021-01.

Kerbing design shall be detailed on the project drawings and submitted to the City of Karratha and approved prior to construction.:

- Maximum kerbing radius shall be 9m in residential areas and 12m in industrial areas.
- Barrier kerbing shall be used next to Public Open Spaces to prevent vehicle entry.
- Kerb face line or pavement edges to be a minimum of 700mm from fence lines or other building structures
- Where kerb face line or pavement edge is within 1m of the corner of a building or structure, a 100mm diameter bollard is to be provided at a minimum distance of 300mm away from the building or structure corner.
- For residential streets, the following kerbing is preferred by the City of Karratha:
    - Semi-mountable – type SM – SM2 along the verge.
    - Keyed in Mountable – Type A – A2 at crossovers.

5.3 Placement

The Contractor shall clean the area between the receiving surface and the new kerb of all loose sand, stones, dust and other foreign matter and shall wet the surface with water immediately prior to placement of the new kerbing.

Kerbs alignments exceeding 10m and on curves of radii exceeding 3m shall be placed by an extruded kerbing machine. Non-mechanical kerb installation requires approval by the Principal. 28-day compressive strength of 32 MPa. Where the kerb is on a straight line of 10m or less, or on a radius of 3m or less, or where the lack of clearance prevents the kerb being placed by an extrusion machine, the section of kerb may be hand placed. Hand placed kerb shall be rodded and shaped, to give a finished kerb meeting the requirements of this Specification.

The extruded kerb shall be laid on either a primer sealed pavement or keyed into a compacted pavement. Intended subbase material to be approved by Principal and will be accepted no less than 95% MMDD compaction prior to key trench installation. The surface is to be swept clean of all foreign or loose and broken pavement material.

Finish to top and road face of kerb shall be uniformly smooth and free from voids and air pockets.

The line of the kerbing shall be parallel to the centre line of the road and the kerbing on both sides of the road shall be exactly parallel to each other, unless shown otherwise on the drawings.

All kerbing on radius less than 30m shall be fully keyed into the pavement.

All kerbing shall be protected by the Road pavement Contractor from marking and from bitumen overspray.

5.4 Curing

Kerbs shall be sprayed with Calcure "D" or equivalent curing membrane within two hours of surface finishing of the concrete.

5.5 Joints

Contraction joints shall be formed by grooving the exposed faces of the kerbs, immediately after placement. Contraction joints are to be installed at 2m spacings.

Kerbs' expansion joints shall be cut through the full cross section of the kerb using a suitable cutting wheel to achieve a 6mm wide expansion joint in accordance with *AS 2876 Clause 11.1.3*. The expansion joints are to be installed at 6m centres at all changes in direction, not less than 24 hours nor more than 72 hours after placing of concrete. They shall be filled with an approved joint filler such as that a 12mm deep space remains to the top of concrete surface. The preferred joint filler for kerbing is polyurethane foam or polyurethane backing rod and sealed with an approved joint sealant such as Sikaflex construction polyurethane or equivalent approved by the City and used as per manufacturer's instructions.

Expansion joints shall be left on either side of all road drainage gullies and tangent points of all curves.

Where the kerb adjoins a footpath the contraction and expansion joints are to coincide with the footpath joints.

All failed and surplus material shall be removed from the Site. On no account are these materials to be disposed of within the Contract area.

5.6 Backfilling

Backfill material shall be of suitable fill, free from stones greater than 100mm as approved by the City. Backfill shall be compacted to a minimum dry density ratio of 92% when tested in accordance with AS1289 E2.1. The road verge shall be graded from top of kerb to the profile shown on project drawings.

Backfilling shall not proceed before 48 hours after the initial concrete pour.

6. ROAD MARKINGS & SIGNAGE

Road pavement markings shall be in accordance with *AS 1742.2:2019*, MRWA specifications, the Austroads Harmonisation of Pavement Markings and National Pavement Marking *Specification*. Final designs and plans for linemarking and signage are to be submitted to MRWA for approval prior to issuance of IFT.

Road signage shall comply with *AS 1743*.

Temporary road marking should be installed no longer than 48 hours after pavement completion.

Permanent road marking should be installed no longer than 2 weeks after road works completion.

Figure 14: City of Karratha existing drainage philosophy; extract from KRS 2015 Figure 3.5

7. APPENDIX

Standard Number:	**CKS-400**
Previous Standard/Number:	**Specification for Subdivision – Construction of Roadworks and Drainage 2014**
Last Reviewed:	**January 2025**
Next Reviewed:	**January 2026**
Responsible Officer:	**Principal Engineer Coordinator**