Government of South Australia
Department for Housing
and Urban Development

TECHNICAL MANUAL

Draft for Consultation

Infrastructure for Growth Areas and Greenfield Developments

2026

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1 Administration

The *Technical Manual – Infrastructure for Growth Areas and Greenfield Developments* (Technical Manual) is published by the Chief Executive of the Department of Housing and Urban Development.

1.1 Objective

The objective of the *Technical Manual – Infrastructure for Growth Areas and Greenfield Developments* (Technical Manual) is to set out the expected quality and level of detail for design documentation, and to establish baseline standards that reflect contemporary best practice in the planning, design and construction of infrastructure for growth area and greenfield land division developments.

1.2 Application

This Technical Manual supports *Design Standard 1 – Engineering Requirements for Land Divisions* (Design Standard 1). Unless expressly required by a mandatory development authorisation condition, as outlined in *State Planning Commission Practice Direction 12 - Conditions*, the provisions of this Technical Manual are intended to be used as guidance only.

The relevant authority for determining a development application for which Design Standard 1 applies may approve infrastructure solutions that differ from the guidance in this Technical Manual where appropriate. Similarly, service providers may impose requirements specific to their assets or services, that vary from the guidance in this Technical Manual.

Applicants are responsible for consulting with the relevant authority, applicable service providers, and the Department for Infrastructure and Transport (DIT) to confirm project-specific requirements, which may vary between asset owners and according to site conditions.

1.3 References

References in this Technical Manual to a ‘Standard Drawing’ or ‘Standard Drawings’ is a reference to a drawing or drawings in Annexure A: Standard Drawings of this Technical Manual, unless otherwise specified.

References to guidance documentation outside of this Technical Manual, are references to the most up to date versions of that document, or a document that has replaced that document.

2 Definitions

Alignment – the geometric form of the centreline (or other reference line) of a carriageway in both horizontal and vertical directions.

Annual Exceedance Probability (AEP) – the probability that a particular storm or flood event will be equalled or exceeded in any year.

Austroads – the national association of road traffic authorities in Australia.

Auxiliary Lane – a portion of the carriageway adjoining the through traffic lanes, used for purposes supplementary to the through traffic movement.

Average Recurrence Interval (ARI) – a statistical approximation of how likely an event of a given magnitude will occur, usually expressed in years.

Barrier Kerb – a kerb with a profile and height sufficient to prevent vehicles moving off the carriageway.

Batter Slope – receding of a wall, structure, or earthwork to ensure stability.

Carriageway – the portion of a road or bridge devoted to the use of vehicles, inclusive of shoulders and auxiliary lanes.

Catchment – an area of land from which all run-off water flows to a low point.

Catchment Management Plans – strategic documents that outline how water resources within a specific catchment area will be managed, addressing water quality, flood mitigation, and environmental sustainability.

Centreline – the line which defines the axis or alignment of the centre of a road.

Checking Vehicle – a service vehicle, such as a waste disposal or emergency response vehicle, used to confirm that a road layout can be safely and practically navigated.

Coefficient of Runoff – the ratio of peak runoff rate of an ARI to average rainfall.

Cross Fall – the slope, measured at right angles to the alignment of a carriageway.

Crown – the highest point on the cross section of a carriageway with a two-way crossfall.

Department for Infrastructure and Transport (DIT) – the South Australian government agency responsible for the management of infrastructure planning, construction, and maintenance, including roads, public transport, and water systems.

Design Vehicle – a hypothetical road vehicle whose mass, dimensions and operating characteristics are used to confirm that a road layout can be safely and practically navigated.

Development – has the same meaning as under the *Planning, Development and Infrastructure Act 2016.*

Drainage Easements – proprietary rights attached to land whereby another parcel of land has the right to use all or part of the land for the purpose of draining water.

Drainage Reserves – designated land designed to capture and prevent further flow paths of stormwater, vested in and maintained by a council.

DRAINS – a software package used for stormwater modelling.

Exceedance Year – a year in which a defined design threshold (such as rainfall amount) or risk level is exceeded at least once.

Freeboard – the height between the water level and the base of a building structure or top of an embankment/channel wall.

Floodway – a section of road or area that has been designed to be overtopped by floodwater during high annual exceedance probability flood events.

Grades – the rate of longitudinal rise (or fall) of a carriageway with respect to the horizontal, expressed as a percentage (%) or ratio (V:H).

Gross Pollutant Trap (GPT) – a device which intercepts and retains coarse sediment, trash and debris and acts as the initial water pollution control measure typically located on the trunk drainage system.

Gross-pollutant – debris items larger than five millimetres, including litter and vegetation, transported by stormwater runoff.

Hydraulic Grade Line (HGL) – a graphical representation of the pressure head in a fluid system, indicating the energy level available to overcome elevation and friction losses in a pipeline.

Intensity Frequency Duration (IFD) – a hydrological metric used to predict the likelihood and severity of rainfall events over a specific duration and frequency.

Longitudinal Section – a vertical section, that shows the elevation levels in the direction of road travel.

Low Flow Pipes – a pipe within a drainage system designed to carry minor or base stormwater flows during low rainfall conditions to minimise erosion and impact on landscaped areas.

Major/Minor Approach – a methodology for the management of stormwater, in which the minor system manages 18% AEP storm events (1-in-5 year ARI) through underground pipes and pits, and the major system manages 1% AEP storm events through overland flow paths to minimise flood risk to people, property and infrastructure.

Median – a strip of road, not normally intended for use by traffic, which separates carriageways for traffic travelling in opposite directions.

Median Opening – a gap in a median provided for crossing and turning traffic.

MUSIC – 'Model of Urban Stormwater Improvement Conceptualisation' software developed by eWater, used to assess water quality treatment trains, as well as water balance analyses.

Orifice – an opening that is sized to restrict stormwater flow to a desired rate, in order to reduce runoff.

Outfall – a point of discharge from a sewer or drain to a water body.

Regulated Tree – has the same meaning as under the *Planning, Development and Infrastructure Act 2016.*

Scour – erosion of a surface by concentrated water flows conveyed through piped systems.

Services Easements – proprietary rights attached to land whereby another parcel of land, or rightsholder has the right to access or use part of the land for the purpose of containing one or more service.

Significant Tree – has the same meaning as under the *Planning, Development and Infrastructure Act 2016.*

Splitter Island – a raised island on the centre line of the main carriageway.

South Australian Power Networks (SAPN) – South Australian electricity provider.

Stormwater – rainfall that runs off all urban surfaces such as roofs, pavements, carparks, roads, gardens and vegetated open spaces.

Stormwater Detention – a stormwater management method for the capture and release of stormwater volumes during rainfall events without long-term storage.

Stormwater Drainage Reserve – an designated area where stormwater is diverted to prevent flooding and may incorporate water quality protection elements.

Stormwater Management Plan – a document that outlines the methods proposed to manage, convey, treat and discharge stormwater runoff from a development area.

Stormwater Quality Improvement Device (SQID) – a device that removes pollutants and improves water quality.

Stormwater Retention – a stormwater management method for the capture and long-term storage of stormwater.

Superelevation – a slope on a curved pavement to assist vehicles maintaining a circular path.

Swales – a landscaped open channel designed to intercept and convey surface runoff to a drainage network inlet, promote infiltration and detain particulate material.

Swept Path – The area or space that a vehicle occupies while performing a turning manoeuvre.

Tactile Ground Surface Indicators (TGSI) – raised tactile features, such as truncated cones or bars, installed on surfaces to assist blind or vision-impaired individuals with navigation and hazard awareness.

Technical Manual – this *Technical Manual – Infrastructure for Growth Areas and Greenfield Developments,* as published from time to time.

Trunk Drains – the stormwater drainage system that links property, inter-allotment and street drainage with the receiving waters.

Unplasticised Polyvinyl Chloride (uPVC) – a durable, rigid material commonly used in construction for pipes and fittings due to its strength, corrosion resistance, and longevity.

Verge – the area between an allotment boundary and the nearest road shoulder, kerb or edge of carriageway.

Vertical Alignment – the longitudinal profile along the centreline of a road.

Vertical Curve – a curve (generally parabolic) in the longitude profile of a carriageway to provide for a change of grade at a specified vertical acceleration.

Water Industry Entity – has the same meaning as under the *Water Industry Act 2012.*

Water Sensitive Urban Design (WSUD) - an approach to urban planning that integrates water cycle management into the design and construction of urban environments.

3 Documentation

3.1 Introduction

This Chapter sets out the documentation requirements for detailed design of infrastructure related to land divisions. It provides guidance to ensure that design documentation is prepared to a consistent standard, contains sufficient detail to enable effective assessment, and supports the coordinated planning, design and delivery of infrastructure associated with land division and development.

Clear, accurate and well-structured documentation is critical to an efficient assessment process and high-quality development outcomes. Documentation prepared in accordance with this Chapter supports timely decision-making by relevant authorities, facilitates coordination with service providers, and ensures that designs can be accurately assessed, approved, constructed and maintained. This Chapter promotes consistent documentation practices to improve clarity, reduce ambiguity, and support the long-term integrity and performance of infrastructure delivered as part of growth area developments.

3.2 Plans

(a) Plans should be prepared with sufficient details to address each matter set out in the relevant chapters of this Technical Manual.

(b) Electronic plan submissions should be provided in a format that enables accurate reproduction, such that any hard copy produced from the electronic files is an exact duplicate of any submission.

(c) Electronic file formats that are accepted for uploading in the SA planning portal are listed in **Table 3-1 File Types**.

Table 3-1 File Types

Read Only	Image Files	Editable Documents	Excel and Comma-Separated Values
PDF	PNG	DOC	XLS
	JPG	DOCX	XLSX
	JPEG	RTF	CSV
	GIF	TXT	

3.3 Scales

(a) Plans should be submitted with the following maximum scales in accordance with **Table 3-2 Sheet Scales**.

(b) For ‘As Constructed’ information, plans should be submitted with the following scales in accordance with **Table 3-3 ‘As Constructed’ Sheet Scales**.

Table 3-2 Sheet Scales

Plan	Scale
Lot Layout	1:2000
Roads Plan	1:1000
Intersection Plans	1:500
Stormwater Drainage Plans	1:1000

Table 3-3 ‘As Constructed’ Sheet Scales

Plan	Scale (Horizontal)	Scale (Vertical)
Layout Plans	1:500	
Longitudinal Sections	1:250	1:50
Cross Sections	1:100	1:50 or 1:100
Intersection Plans	1:200 or 1:100	
Details	1:10 or 1:25	

3.4 Survey Control

(a) Survey Control for drawings should be based on the Geocentric Datum of Australia (GDA) current at the time of preparation. Vertical datum and level shall be refenced in accordance with the Australian Height Datum (AHD).

3.5 Standard Details

(a) All construction details should be consistent with the standard detail drawings in **Annexure A: Standard Drawings**.

(b) Where special structures or modifications to standard drawings to suit the site-specific requirements are necessary, details of such works should be submitted with the detailed construction plans.

4 Stormwater Design

4.1 Introduction

This Chapter sets out the standard design criteria for the design of stormwater drainage. It provides guidance to ensure runoff is managed appropriately, natural drainage patterns are maintained, property is protected from flooding, and adverse downstream impacts are avoided.

Effective stormwater design is critical to protecting public infrastructure, minimising environmental harm and building resilient neighbourhoods.

Aspects of stormwater design not specifically addressed in this Chapter should be in accordance with the following, as updated from time to time:

- *Australian Rainfall and Runoff: A guide to flood estimation,* Commonwealth of Australia (2019);
- *Australian Runoff Quality: A guide to Water Sensitive Urban Design*, T. H. F. Wong (2006);
- *Guide to Road Design – Part 5: Drainage – General and Hydrology Considerations*, Austroads (2021);
- *Guide to Road Design – Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface*, Austroads (2021);
- *Guide to Road Design – Part 5B: Drainage – Open Channels, Culverts and Floodway Crossings*, Austroads (2013);
- *Water Sensitive Urban Design in Greater Adelaide – Technical Manual*, Water Sensitive SA (2019);
- *Queensland Urban Drainage Manual*, Queensland Government (2017);
- *Storm Drainage Design in Small Urban Catchments: A Handbook for Australian Practice*, Argue, J.R. (2004);
- AS/NZS 3500.3 – Plumbing and Drainage;
- AS/NZS 4058 – Precast Concrete Pipes;
- AS/NZS 3725 – Design for Installation of Buried Concrete Pipes; and
- AS 1597 – Precast Reinforced Box Culverts.

4.2 Stormwater Management Plan

(a) A stormwater management plan should be prepared in accordance with the following principles:

(i) Stormwater drainage design and management of runoff should be consistent with any applicable stormwater management strategies or existing development-based Stormwater Management Plans for the relevant area.

(ii) Where stormwater drainage design is prepared for one or more stages of a development, the design should take into account the entire stormwater drainage catchment, once all stages of the development are complete.

(iii) Stormwater drainage design should consider the potential impacts of climate change and the contribution of stormwater outcomes to broader urban design objectives.

(iv) The determination of design parameters should be informed by the best available climate data and recognised guidance, including the climate change provisions of Australian Rainfall and Runoff, when determining design parameters.

(v) Infrastructure should be designed to allow for future modification, augmentation or adaptation as climate data and development conditions evolve.

(b) A stormwater management plan should include the information set out in **Table 4-1 Stormwater Management Plan**.

Table 4-1 Stormwater Management Plan

Component	Requirements
Existing conditions	• existing allotment boundaries • existing stormwater infrastructure • existing watercourses • easements and reserves on or adjacent to the site
Proposed land division	• allotment boundaries • roads and verges (including pavement surfaces) • open space and drainage reserves
Hydrology	• consideration of impacts upon catchment and sub-catchments • contours • digital drainage model using DRAINS software
Hydraulic modelling	• consideration of storm events and adoption of the major/minor approach for stormwater drainage including the Annual Exceedance Probabilities (AEPs) used for the minor (underground) and major (overland flow) systems • hydraulic modelling and calculations using DRAINS software
Flood management	• detail of infrastructure to protect residential areas in a 1% AEP storm event • appropriate finished floor levels
Stormwater design	• location of stormwater discharge points • expected flow rates • location of any detention/retention infrastructure for stormwater • impact of the development on surrounding catchment areas • demonstration that post-development flows match pre-development flows or other set discharge value
Stormwater infrastructure	• notations of where infrastructure will be vested in council • provision of easements • erosion and scour controls
Water quality	• Gross Pollutant Traps • other methods to ensure water quality treatment

4.3 Hydrology

(a) Stormwater management plans should include a catchment plan identifying the total catchment area and relevant sub-catchments, with clearly defined contours, together with a digital drainage model, such as DRAINS. Where a regional stormwater strategy has been adopted, the stormwater design should be consistent with that strategy.

(b) Partial catchment areas must be considered when determining peak flows, particularly where the catchment contains sub-catchments, (such as reserves) that may have an overall impact on the coefficient of runoff.

(c) The stormwater drainage system should be designed to cater for the existing maximum flow occurring downstream of the connection point.

4.4 Runoff Estimation

(a) Runoff estimation should be undertaken using rainfall–runoff modelling parameters derived in accordance with *Australian Rainfall and Runoff*, including appropriate initial and continuing loss values and relevant catchment characteristics.

4.5 Annual Exceedance Probability (AEP)

(a) Design rainfalls are probabilistic or a statistically based estimate of the likelihood of a specified rainfall depth being recorded at a particular location within a defined duration.

(b) AEP calculations should be based on local climatic conditions and topography, informed by appropriate reference data, including:

- Bureau of Meteorology Intensity Frequency Duration (IFD) rainfall data; and
- Department of Environment and Water topographic and cadastral mapping.

(c) Stormwater drainage systems should be designed using the applicable localised AEP.

(d) AEP design criteria for higher-gradient and lower-gradient terrain are set out in **Table 4-2 Average Exceedance Probability.**

(e) The applicable AEP and associated design requirements should be confirmed through hydraulic modelling, having regard to local topography and resulting hydraulic grade line (HGL).

Table 4-2 Average Exceedance Probability

Stormwater Drainage System	Capacity (Minor Event)	Capacity (Major Event)
Residential areas	18% AEP (1-in-5 ARI)	1% AEP
Areas prone to local flooding	1% AEP (Unless agreed otherwise)	1% AEP

4.6 Major and Minor Stormwater Drainage Systems

(a) The stormwater drainage system, including conveyance, should be designed in accordance with the current versions of the following:

- *Australian Rainfall and Runoff: A guide to flood estimation, Australian Rainfall and Runoff,* Geoscience Australia (2019)
- *Australian Runoff Quality: A Guide to Water Sensitive Urban Design,* T. H F. Wong (2006)
- *National Construction Code (NCC) 2022, Volume 3 – Plumbing Code of Australia* (PCA); and
- AS/NZS 3500.3 Plumbing and drainage – Part 3: Stormwater drainage.

(b) The Major/Minor Approach as outlined in *Australian Rainfall and Runoff* should be adopted when designing stormwater drainage system:

(i) **The 'Minor' system** refers to the underground pipeline system with sufficient capacity to intercept and collect the flows from nominated design storm events. These pipelines manage risks by minimising stormwater damage to properties and limiting the frequency and quantity of surface water to a level, that is acceptable to the community.

(ii) **The 'Major' system** refers to overland flow paths that are to be designed to convey the major storm flows when the capacity of the minor system is exceeded. A major stormwater drainage system caters for the runoff from storms of higher intensity than for which the minor stormwater drainage system has been designed. On rare occurrences, it may be necessary for the major stormwater drainage system to hold water.

4.7 Hydraulic Design

(a) The stormwater management system should be designed based on hydraulic grade line (HGL) analysis using appropriate pipe friction and stormwater drainage head-loss coefficients. The HGL should satisfy the following criteria:

(vi) for minor storm events, the HGL should be at least 150mm below the kerb invert;

(vii) for major storm events, the HGL should be contained within the road carriageway for major flows; and

(viii) where pipes are flowing partially full, the HGL may be disregarded and assumed to coincide with the pipe obvert.

(b) Pipe designs should be undertaken using HGL analysis and appropriate pipe roughness parameters, through applying the Manning's formula (N) for partial full pipes and applying the Colebrook – White formula (K) for full pipe flow under pressure as shown in **Table 4-4 Pipe Roughness Values.**

(c) Where surcharge resulting from blockage of the primary (minor) stormwater drainage system may cause flooding of existing or future buildings, a secondary (major) protective stormwater flow path shall be provided, in addition to any rear of allotment stormwater drainage system, by provision of a double side-entry pit.

Table 4-4 Pipe Roughness Values

Pipe Material	N	K
Spun precast concrete	0.013	0.600
UPVC	0.009	0.060
For other materials, refer to the manufacturer's specifications for appropriate values.		

4.8 Minor System – Pipes

4.8.1 Minimum Pipe Grades

(a) For piped stormwater systems, DN375mm pipes should be designed to ensure that water velocities are sufficient for self-cleansing, with an absolute minimum grade of 0.4%

(b) For pipes that are 750mm or greater, this grade may be reduced where the model is able to demonstrate that self-cleaning velocities are able to be achieved. In such instances, pipe grades are used to achieve a cleaning velocity of 0.7m/s and be no lower than 0.15%

4.8.2 Pipe Velocities

(a) The design pipe velocities should be in accordance with **Table 4-5 Pipe Velocities.**

Table 4-5 Pipe Velocities

Parameter	Velocity
Pipes Running Partially Full	
Absolute minimum	0.7m/s
Desirable minimum	1.2m/s
Desirable maximum	4.7m/s
Absolute maximum	7.0m/s
Pipes Running Full	
Absolute minimum	0.6m/s
Desirable minimum	1.0m/s
Desirable maximum	4.0m/s
Absolute maximum	6.0m/s
Minimum flow velocities apply to 1EY storm events and apply to all pipe materials.	
Maximum flow velocities apply to concrete pipes. For other pipe materials, refer to the manufacturer's advice.	

4.8.3 Pipe Class

(a) Pipe classes should be determined having regard to the proposed cover and loading to be encountered during construction and in accordance with **Table 4-6 Minimum Pipe Class**.

Table 4-6 Minimum Pipe Class

Location	Minimum Pipe Class
Within a Road Reserve	Class 3
Crossing a Road	Class 4
In all other circumstances	Class 2

4.8.4 Pipe Alignments at Pits

(a) The pipes at junctions should be aligned such that the centreline of the upstream pipe is to align with the centreline of the downstream pipe. The projected area of the upstream pipe is to be wholly contained within the downstream pipe unless unable to be practically achieved.

4.8.5 Pipe Material

4.8.5.1 Reinforced Concrete Pipes & Culverts

(a) Reinforced concrete pipes should have a spigot-and-socket profile, secured by a rubber ring joint and be manufactured to meet the following requirements:

- AS/NZS 4058 – Precast concrete pipes (pressure and non-pressure);
- AS 1597 – Precast reinforced box culverts; and
- AS 2041 – Buried corrugated metal structures.

(b) Pipes with a diameter of 750mm or less should have rubber ring joints.

(c) Pipes with a diameter greater than 750mm and culverts may be flush jointed, with the installation of rubber ring joints, with additional external bands installed in accordance with the manufacturer's recommendations.

(d) Reinforced concrete pipes should installed in accordance with:
- AS 3725 – Design for installation of buried concrete pipes, which outlines allowable crack widths; and
- Any guidelines published by the Concrete Pipe Association of Australasia.

4.8.5.2 UPVC Pipes

(a) The maximum permissible size of a uPVC pipe shall be 225mm.

(b) Pipe Class shall be as required and recommended by the manufacturer for the pipes intended application and shall achieve a minimum SN8.

(c) Predominantly, these pipes will be used as property connections in alignment with **Standard Drawings DH-SW-3050, DH-SW-3055** and **DH-SW-3060**.

(d) uPVC pipes shall be used and installed in accordance with AS/NZS 3500.3:2003 – Plumbing and Drainage.

4.8.6 Pipe Diameters

(a) The minimum pipe diameters for outlet servicing should comply with **Table 4-7 Pipe Diameters**.

Table 4-7 Pipe Diameters

Location	Minimum Pipe Diameter
Single residential allotment	90mm uPVC
2 or more residential allotments	225mm uPVC
Non-residential allotment	225mm uPVC
Conveying runoff from a road or street and to be vested in council	375mm

4.8.7 Trunk Drains

(a) Pipes with a diameter of 750mm or more should be designed as trunk drains, with large direction changes through standard pits to be avoided.

(b) Special manholes, additional pits and benching at changes of direction should be used to improve hydraulic capacity.

4.8.8 CCTV

(a) Prior to vesting the installed drainage system in council, a CCTV inspection should be carried out in accordance with *WSA 05-2020 Conduit Inspection Reporting Code of Australia Version 4.1,* Water Services Association of Australia (2020) as updated from time to time. The inspection should cover all pipes and pits within the network.

(b) The CCTV inspection should only occur once all heavy machinery has left site to avoid potential damage to pipe work following completion of CCTV inspections (usually following completion of base course gravels). Timing of CCTV inspections should be confirmed with the council.

4.8.9 Minimum Pipe Cover

(a) The minimum pipe cover will be the greater of:
   (i) 600mm;
   (ii) the manufacturer's recommendation.
   (iii) the minimum cover requirements specified in the following standards and drawings as applicable:
   - AS/NZS 3500.3 – Plumbing and Drainage;
   - AS/NZS 4058 – Precast Concrete Pipes;
   - AS/NZS 3725 – Design for Installation of Buried Concrete Pipes; And
   - As 1597 – Precast Reinforced Box Culverts.

(b) Where a reduced pipe cover is proposed, the appropriate pipe class should be determined using the Concrete Pipe Association of Australasia PIPECLASS design software.

(c) The minimum vertical and horizontal clearances between stormwater pipes and other services must be in accordance with the requirements of the relevant service provider.

4.9 Minor System – Structures and Devices

4.9.1 Splays and Bandage Joints

(a) Where a pit is not proposed to be used, selection of joining structures should be in accordance with the following **Table 4-8 Joint Structures**.

Table 4-8 Joint structures

Joint structure	Horizontal or vertical deflection
Splay	<2%
Bandage joint	2-10%

(b) Joint structures are not to be used for changing pipe sizes – in these instances, a pit should be used.

(c) A pit is to be provided wherever there is a significant change in the horizontal or vertical alignment of stormwater pipes, where the change in direction cannot be accommodated through standard pipe joint deflection.

(d) For further information refer to **Standard Drawing SH-SW-5100**.

4.9.2 Pits

(a) In all cases, pit location and pit inlet capacities should be designed in accordance with the following **Standard Drawings**:

(i) **DH-SW-5000**;
(ii) **DH-SW-5005**;
(iii) **DH-SW-5010**;
(iv) **DH-SW-5015**;
(v) **DH-SW-5020**;
(vi) **DH-SW-5025**;
(vii) **DH-SW-5030**;
(viii) **DH-SW-5035**; and
(ix) **DH-SW-5040**.

(b) Pit losses should be accounted for and calculated in accordance with *Guide to Road Design Part 5: General and Hydrology Considerations*, Austroads (2021) or suitably demonstrated using DRAINS software.

4.9.2.1 Side Entry Pits

(a) Side entry pits should be designed and installed in accordance with the following:

- (x) located –
  - A. at least one metre from road tangent points and driveways;
  - B. one metre upstream of kerb and pedestrian crossings and clear of kerb returns and kerb crossings; and
  - C. at intervals that achieve any of the following:
    - I. the length of flow in water tables does not exceed 80 metres;
    - II. the “depth x velocity” does not exceed safe levels ($0.4m^2/s$ in major events); or
    - III. or flow width into carriageways is less than 2.5 metres in a minor storm.
- (xi) deflectors are to be used where the grade of the water table exceeds 2%.
- (xii) channel flow approaching an intersection is to be captured for the minor storm event in a side entry pit before the tangent point, except where it can be demonstrated that adequate capacity is available in the kerb and channel to carry water around the return.

4.9.2.2 Double Side Entry Pits

(a) double side entry pits are to be used where approach grades to intersections are more than 6% and at all low points in roads, unless demonstrated that a single side entry pit provides sufficient inlet capacity for the pipes to operate.

4.9.2.3 Grated Pits

(a) Grated pits are to be used where surface water interception is required from overland flow paths or sag points. They are to be located clear of vehicle wheel paths and designed to be safe for cyclists.

(b) Grated Pit functions and capacities should be in accordance with *Guide to Road Design Part 5A: Drainage – Road Surfaces, Networks, Basins and Subsurface*, Austroads, and any DIT Supplement to those guidelines.

(c) Pit construction should be in accordance with the following **Standard Drawings**:

- (i) **DH-SW-5000**;
- (ii) **DH-SW-5005**;
- (iii) **DH-SW-5010**;
- (iv) **DH-SW-5015**;
- (v) **DH-SW-5020**;

(vi) **DH-SW-5025**;
(vii) **DH-SW-5030**;
(viii) **DH-SW-5035**; and
(ix) **DH-SW-5040**.

(d) All pits should be designed for the road class and should be precast concrete with either steel or fibre reinforced polymer.

4.9.2.4 Pit Covers

(a) Pit covers should be of the minimum classes specified in **Table 4-9 Pit Cover Classes.**

Table 4-9 Pit Cover Classes

Location	Pit Cover Class
Within a road reserve	Class D
Exposed kerb areas	Trafficable load-bearing covers
Non-trafficable areas (not within the road corridor)	Class B lock down

(b) Pit covers should be in accordance with the following **Standard Drawings:**

(i) **DH-SW-5000**;
(ii) **DH-SW-5005**;
(iii) **DH-SW-5010**;
(iv) **DH-SW-5015**;
(v) **DH-SW-5020**;
(vi) **DH-SW-5025**;
(vii) **DH-SW-5030**;
(viii) **DH-SW-5035**; and
(ix) **DH-SW-5040**.

4.9.3 Junction Boxes

(a) Junction boxes should be provided at all junctions and at intervals not exceeding 120 metres to access pipes where side entry pits are not provided. As far as reasonably practical junction boxes should be located outside of road carriageways to allow safe access.

4.9.4 Outfall Structures

(a) Outfall structures or discharge points should be designed and constructed to meet the following requirements:

- (i) scour protection components are to be designed for the design discharge volume and velocity of the outlet structure in accordance with Austroads guidelines.
- (ii) energy dissipation is provided where required in accordance with Austroads guidelines.
- (iii) provision shall be made for safe access/maintenance.
- (iv) slopes behind wing walls shall be considered and provided with adequate measures to protect from erosion.
- (v) provision for safety barriers where fall heights present a risk to the public; and
- (vi) be designed to avoid the creation of 'dead space' which has low passive surveillance, or which is difficult to access.

4.9.5 Gross Pollutant Traps

(a) Gross Pollutant Traps (GPTs) should be installed:

- (i) near endpoints of any stormwater drainage line that discharges to a watercourse and/or a stormwater drainage basin; and
- (ii) where overland flow paths discharge downstream onto a public road or open space to capture debris and manage pollutant loads conveyed by surcharge flows.

(b) The type of GPT installed should be specified within the stormwater management plan and based on an overall assessment of the drainage catchment both upstream and downstream off the site.

(c) GPTs should be used for primary treatment only, with the Total Suspended Solids (TSS) removal rate to be met with further means.

(d) The TSS removal rate shall be in accordance with Environment Protection Authority (EPA) minimum standards or the load reduction target of 80%, whichever is the greater requirement in the circumstances.

(e) GPTs should be capable of treating the peak 98% AEP storm event, with flows up to the peak able to bypass the GPT through the minor system.

(f) All GPTs should be accessible from an all-weather access track to allow safe and convenient access for vacuum combination vehicles with hardstand areas clear of the road carriageway to enable cleaning.

4.9.6 Subsoil Drainage

(a) Consideration should be given to appropriate sub-surface stormwater drainage installation where ground water, excessive moisture or overland flows may adversely affect infrastructure or the use of public open spaces or reserves.

4.9.7 Allotment Drains

(a) A stormwater connection point should be provided for every allotment. The connection point should be designed and constructed to:

  (i) accommodate stormwater from the entirety of the respective allotments post-development in the occurrence of a 1 Exceedance Year (1 EY) storm event.

  (ii) have a minimum pipe diameter of 225mm.

  (iii) include a grated inlet pit/junction box, comprising a –

    A. 600mm x 600mm slab; and

    B. 100mm x 100mm grate located at the lowest corner of each respective allotment.

  (iv) comply with the standards drawings for stormwater connection points in **Annexure A: Standard Drawings**; and

  (v) **Table 4-10 Allotment Drains**.

Table 4-10 Allotment Drains

Allotment Type	Drain type
Allotments graded towards the street	Galvanised steel kerb adaptor should be cast into the kerb on the lower side of the allotment frontage, taking into consideration location of other services and street trees and provided in accordance with the standard drawings in **DH-RD-1015 Standard Stormwater kerb outlet**
Allotments graded away from the street	rear of an allotment stormwater drainage is to be provided in accordance with the standard drawings in **DH-SW-3060 Stormwater allotment connection in easement**
Allotments that abut a reserve	Stormwater drainage may be directed toward the reserve with easements in favour of the relevant council for all connected allotments, with one allotment's easement specifying a requirement for unobstructed access for the asset owner to inspect and conduct maintenance.

4.10 Stormwater Drainage Easements

(a) Stormwater easements should only be utilised where discharge to the road reserve or existing drainage reserve is not feasible. Where necessary, stormwater infrastructure easements over allotments should be:
   (i) clearly marked on plans.
   (ii) over the length of pipe that crosses the allotment.
   (iii) over where the drain is located; and
   (iv) in favour of the future stormwater infrastructure asset owner.

(b) Where possible, easements should align with existing easements on adjacent allotments.

(c) Stormwater easements should comply to the dimensions specified in **4-11 Stormwater Drainage Easements**.

4-11 Stormwater Drainage Easements

Drain/Pipe Type	Width
Single drain or pipe less than 900mm	3 metres
Multiple drains and pipes	4 metres, pipes to have 1 metre spacings

4.11 Major System - Principles of Design

(a) The major stormwater drainage system (Major System) should be designed in accordance with the following principles:
   (i) the Major System should collect runoff of a catchment from a major storm event in excess of the capacity of the minor stormwater drainage system and convey that runoff to receiving waters with minimal nuisance, risk to public safety or damage to property and infrastructure.
   (ii) Major flows may be conveyed by one or more of the following:

      A. a road reserve, where it is safe to convey flows within the road reserve and floor levels are not adversely affected; and/or
      B. a stormwater drainage reserve, where conveyance within a road reserve is impractical or unsuitable; and/or
      C. a recognised watercourse, as identified under the *Landscape South Australia Act 2019.*

(iii) the Major System should be based on the critical major storm, determined by routing storms of varying duration to identify the peak major peak flows.
(iv) consideration should be given to rarer storm events (0.5% AEP) for critical infrastructure such as hospitals.
(v) HGL analysis should be used for design of floodways, low-flow pipes and detention/retention basins. The width of major floodways should be governed by the greater of:
   A. hydraulic requirements; or
   B. the width required to facilitate maintenance, including mowing of grassed swales and drains.
(vi) the Major System should not cause soil erosion, bank destabilisation of a watercourse or lake, or erosion of a floodplain
(vii) in urban areas, overland flow depths should be controlled through freeboard to properties and/or compliance with maximum depth/velocity criteria for public safety as set out in *Guide to Road Design – Part 5A: Drainage – Road Surfaces, Networks, Basins and Subsurface,* Austroads and any applicable DIT supplement.
(viii) The Major System should provide continuous and clearly defined flow paths to a lawful point of discharge.
(ix) The Major System should be designed to maintain safe pedestrian and vehicle access, limits flooding of private and public property and minimise watercourse erosion and the inflow of pollutants to receiving waters.
(x) The Major System should not result in adverse flooding impacts upstream or downstream due to the development.

4.12 Major System – Finished Floor Levels

(a) Finished floor levels should comply with the minimum requirements set out in **Table 4-12 Finished Floor Levels**.

4-12 Finished Floor Levels

Allotment Type	Finished Floor Level
Residential allotment graded towards the road	Minimum 300mm above the 1% AEP
Residential allotment graded away from the road	Minimum 300mm above the 1% AEP for frontages and driveways to provide freeboard
Allotments intended for more sensitive uses (including emergency services, schools)	Minimum 300mm above the 1% AEP
Sites adjacent watercourses	Minimum 300mm above the 1% AEP

4.13 Major System – Floodway Design and Flowpaths

(a) A major floodway may comprise engineered open channels and waterways, as well as roadways, swales and sheet flow through public open spaces.

(b) Major floodways are generally to be accommodated within road reserves, stormwater drainage reserves or public open space. Major floodways (and conveyance of major flows) through easements on private land should be avoided wherever practicable.

(c) Documentation for major floodways should include:

(i) hydraulic modelling and analysis where active floodways are present;
(ii) details of compensatory works where overland flood paths and/or flood storage are altered post-development, to ensure no detrimental effect on adjoining landowners;
(iii) a risk assessment demonstrating that the flood conveyance and storage approach minimises potential for loss of life, risk to health, and damage to property;
(iv) post-development overland flow depth and velocities; and

(v) details of any proposed alteration to an existing watercourse or wetland, (noting that such alteration should only be considered after all other alternatives have been considered).

(d) Design and treatment of floodways, open unlined drains, and swales should comply with the following minimum requirements:
   (i) floodway depth should not exceed 2.5 metres;
   (ii) the minimum bed width should be 2.5 metres;
   (iii) batters should not be steeper than 1-in-5 (20%), with an absolute maximum of 1-in-3 (33.33%).
   (iv) invert crossfall should be at least 1-in-40 (2.5%);
   (v) the longitudinal grade of major floodways should not exceed 1-in-500 (desirable) to minimise ponding and siltation, with an absolute minimum grade of 1-in-1000;
   (vi) maximum longitudinal grades should be governed by permissible scour velocities and the applicable depth/velocity criteria for public safety;
   (vii) flexible structures, rock gabions, rock mattresses and geotextile fabric should be used for grade control, minor energy dissipation, and major erosion/scour protection where required;
   (viii) where low-flow pipes are provided, they should be sized for the full major AEP design flow on the assumption that the low-flow pipe is fully blocked during major storm events;
   (ix) where low-flow pipes cannot be provided due to insufficient longitudinal grades or level constraints, a lined low-flow invert or trickle channel should be provided where practicable; and
   (x) pipes discharging to major floodways should be connected to a low-flow pipe, with surcharge pits provided where necessary.

(e) Where low-flow pipes are incorporated into the design, the pipes should meet the following minimum requirements:
   (i) a minimum diameter of 375mm;
   (ii) a grade sufficient to generate self-cleansing velocities;
   (iii) capacity to convey, as a minimum, flows from a 3 EY storm event;
   (iv) alignment of pipes, pits and associated structures to minimum hydraulic losses, unless the pits and structures are specifically designed to dissipate energy;
   (v) for low-flow outlet pipes from detention basins, invert levels set to provide positive drainage and to command all connecting pipes within the basin;
   (vi) minimum cover in accordance with the manufacturer’s requirements; and
   (vii) pipe class selection appropriate to the design circumstances, with due regard to maintenance plant/vehicle loads.

4.14 Major Systems – Stormwater Drainage Reserves

(a) When designing stormwater drainage reserves, the following minimum design requirements should be met:
   (i) the reserve location and area should be clearly identified on the plans, with notation that the land is to be vested in the relevant council;
   (ii) the reserve should have a minimum width of 3 metres and be designed with sufficient capacity to convey major storm events;
   (iii) safe and convenient maintenance access should be provided; and
   (iv) pump stations, electrical equipment, water quality treatment infrastructure and any other service infrastructure should be sited to provide adequate clearance for construction and maintenance activities, including vehicle access and turning movements, at an appropriate location.

4.15 Major Systems – Retention/Detention

(a) Where retention and detention systems are incorporated into the design, these should be provided to ensure that development does not adversely affect the capacity or performance of existing stormwater infrastructure.

(b) Where retention and detention systems are proposed, the design should be informed by the following principles:
   (i) reduce runoff volumes and peak discharge rates to receiving waters;
   (ii) consider the likely cumulative effects of surrounding developments on the existing stormwater network;
   (iii) reduce the need and cost for downstream stormwater infrastructure by moderating peak flows;
   (iv) minimise, where practicable, the number of basins servicing an area to reduce long-term maintenance;
   (v) incorporate stormwater treatment measures (including sedimentation and litter traps where required by the development authorization);
   (vi) be maintainable and represent a cost-effective solution over the asset life;
   (vii) be visually appropriate and responsive to the surrounding context;
   (viii) integrate with the open space network where practicable;
   (ix) avoid adverse amenity impacts including odour and mosquito nuisances;
   (x) integrate with the existing drainage network and any applicable regional stormwater strategies; and
   (xi) achieve discharge limits that do not exceed pre-development flows or any nominated discharge rates identified in an applicable regional stormwater management plan.

4.15.1 Detention Basins

(a) Detention basins provide temporary storage of stormwater during rainfall events and drain down with no permanent water level.

(b) Detention basins should be designed in accordance with the following principles:

- (i) outflows should be restricted so that post-development flows do not exceed pre-development flows, or any nominated discharge rates, for the relevant design AEP events;
- (ii) storage volume should be determined from the difference between inflow and allowable outflow across critical storm durations;
- (iii) a safe overflow path should be provided for events exceeding basin capacity, to avoid property damage and public safety hazards; and
- (iv) design should account for blockage risk, maintenance access, freeboard, and integration with the broader drainage system.

(c) Detention basins should comply with the following minimum requirements:

- (i) detention basins should not be located within areas affected by existing riverine flooding;
- (ii) detention basins should not be located within, or directly interact with, active floodways;
- (iii) a suitable overflow system (e.g. weir or spillway) should be provided with appropriate scour and erosion protection, and overflow should be directed away from buildings and associated infrastructure;
- (iv) all-weather maintenance access tracks should be provided with:
  A. a minimum width of 2.5 metres; and
  B. suitable turning areas for maintenance vehicles.
- (v) where pumps are required, provision should be made for connection to a nearby electricity supply;
- (vi) detention basins should be designed for the critical major storm. Where basins are located upstream of established areas and no clear and safe overland flow path is available, the design should also consider a 1% AEP event;
- (vii) a minimum freeboard of 300mm should be provided;
- (viii) the top water level resulting from the minor storm event should not exceed the invert level of any high-level overflow structure;
- (ix) major overland flow paths should be designed on the basis that the minor system contribution is included (i.e. the inlet pipe is assumed blocked);

(x) DRAINS software should be used to account for upstream pipe and pit storage, and long-term storage within the minor system should be avoided;

(xi) a minimum self-cleansing velocity of 0.7 m/s should be achieved.

(xii) inlet headwalls should incorporate appropriate energy dissipation, wing walls and barriers where required for safety;

(xiii) outlet structures should comprise a grated pit and orifice plate arrangement;

(xiv) detention basin design should consider impacts on existing stormwater infrastructure (including upstream and downstream flooding behaviour).

(xv) cut and fill batters should not be steeper than 1-in-5 (20%);

(xvi) the basin floor should be graded to the outlet point with an absolute minimum crossfall of 1-in-400;

(xvii) any overflow system should be designed so that maximum overflow depth remains at least 300mm below the lowest floor level of any affected dwelling;

(xviii) excavations should be limited to at least 0.5 metres above any localised elevated groundwater table;

(xix) a detailed landscape plan should be provided for all basins and drainage reserves, incorporating WSUD principles in accordance with **Chapter 11: Water Sensitive Urban Design**; and

(xx) where a detention basin discharges to a watercourse, a multilevel outlet control structure should be considered to limit post-development peak flows to pre-development levels for:

A. 1% AEP (major)
B. 10% AEP (minor)
C. 63% AEP (frequent)

and to return diverted water to the natural watercourse within timeframes required by any relevant water allocation plan under the *Landscape South Australia Act 2019*.

4.15.2 Retention Basins

(a) Retention basins are typically bespoke to their catchment and site context and are therefore not addressed in detail in this Technical Manual.

(b) Where an existing or proposed future retention basin is proposed to be used as part of a development, the applicable design standards should be confirmed with the relevant council.

(c) Where a retention basin is proposed, the design should be informed by the following principles:
   (i) retention basins should be designed to provide permanent storage for water quality treatment and flood attenuation, with due regard to the balance between these functions;
   (ii) outlet structures, storage levels and detention behaviour should be configured to achieve the relevant performance targets for the basin and receiving environment;
   (iii) basin layout and treatment measures should respond to site-specific ecological, landscape and amenity objectives; and
   (iv) basin sizing and configuration should consider evaporation, infiltration and opportunities for stormwater reuse, where practicable.

5 Road Corridor Design

5.1 Introduction

This Chapter sets out the design requirements for road corridors. The different requirements for road corridors are based on the type of the road. Road types are determined by the anticipated maximum traffic volumes. The designation of road types within this Chapter relates to the design and construction of new or upgraded roads and does not affect or change pre-existing road requirements.

Aspects of road corridor design not specifically addressed in this Chapter should be in accordance with the following, as updated from time to time:

- *Guide to Road Design*, Austroads;
- *Road design standards and guidelines*, DIT; and
- *South Australia's Transport Strategy,* DIT.

5.2 Road Hierarchies

(a) Road hierarchies establish the structural framework for organising the road network within a development area and are fundamental to integrating new road infrastructure with the broader transport system. They define the function, capacity and performance role of each road type, ranging from higher-order movement corridors that accommodate through-traffic and regional distribution, to local streets that provide property access and support place-based outcomes.

(b) The hierarchy guides the application of appropriate geometric design standards, cross-sections, intersection treatments, and operating speed environments to ensure each road performs its intended role within the network efficiently, safely and consistently.

5.3 Road Types

(a) Road types should be determined in accordance with the indicative maximum traffic volume in column 2 of **Table 5-1 Metropolitan Roads – Design Considerations**.

(b) Road type cross sections should be in accordance with the typical road cross section in **Standard Drawing DH-RD-3000-3004**.

Table 5-1 Metropolitan Roads – Design Considerations

Road Type	Maximum Traffic Volume	Minimum Carriageway Width	Minimum Reserve Width	Minimum Verge Width	Parking Provision within Carriageway	Footpath Requirements
Rear Access Lane (secondary road abutting rear of residential allotments that is no more than 100m in length)	N/A	5.5 m	8.0 m	0.5 m	No	No footpath unless a pedestrian link
Residential Road	1500 veh/day	7.2 m	15.0 m	2.6 m	Yes (both sides)	Footpath on one side
Level 1 Collector/Connector Road	3000 veh/day	11.0m	18.0 m	3.5 m	Yes (both sides)	Footpath on both sides
Residential Cul-de-sac	1500 veh/day	12.5 m radius	18.0 m	2.6 m	No	Footpath on one side

5.4 Traffic Reports

(a) A traffic report should be prepared to demonstrate that the proposed road types are suitable to support the anticipated maximum traffic volumes.

(b) For previously undeveloped areas, maximum traffic volumes to determine road type and consequently future road design should be informed by, and calculated in accordance with, the following:

- (i) average Annual Daily Traffic volumes, as calculated by the DIT;
- (ii) 10 vehicle movements per day per residential allotment;
- (iii) pre-development traffic count data for areas surrounding the site (may be obtained from council); and
- (iv) adjustments for traffic volume and type that is seasonal.

(c) A traffic report should detail the methodology used to determine maximum traffic volumes, including reasoning for any adjustments to calculations.

5.5 Carriageway widths

(a) In addition to the minimum carriageway widths required based on the road type, road carriageway design should also account for the following:
   (i) volume of heavy vehicles.
   (ii) provision for on-street parking where applicable, including where not otherwise required for other road types.
   (iii) provision of cycle lanes where roads form commuter routes or connect with existing transport route strategies.
   (iv) provision of cycle lanes where narrower footpaths are provided in lieu of designated cycle paths or shared paths.
   (v) provision of central medians to facilitate safe crossings and/or water sensitive urban design elements.
   (vi) intersection treatments.
   (vii) bus stop locations.
   (viii) for bus routes, a minimum lane width of 3.5 metres.

5.6 Road verges

(a) In addition to the minimum road reserve and verge widths as required based on the road type, road verge design should also account for the following:
   (i) footpath widths should be in accordance with the footpaths section of this Chapter;
   (ii) road verge widths should allow for the safe and convenient access to services, street trees, public lighting, roadside waste collection and footpaths;
   (iii) shared paths should be considered where there is no provision for cycle paths within the carriageway;
   (iv) street trees should each have a minimum clearance radius of 2.4 metres to allow for growth and pruning;
   (v) landscaping and street trees should incorporate water sensitive urban design principles as outlined in **Chapter 11: Water Sensitive Urban Design**;
   (vi) Master Specification Part RD-PT-D1 – Bus Infrastructure Design, DIT; and
   (vii) **Standard Drawings**.

5.7 Footpaths

(a) Footpaths should be designed in accordance with *Guide to Road Design – Part 6A: Paths for Walking and Cycling,* Austroads and designed to comply with the following minimum requirements:
   (i) shared paths, and footpaths adjacent to a bus stop and in front of commercial buildings and activity centres, should have a minimum width of 3.0 metres.
   (ii) all other footpaths should have a minimum width of 1.5 metres.
   (iii) footpaths should achieve adequate drainage and have a maximum crossfall of 2.5%.
   (iv) where new footpaths connect to existing footpaths, crossfalls should match the existing path, and widths should either match or taper to meet the minimum requirements.
   (v) footpaths should be constructed of either reinforced concrete, hot-mix asphalt or block pavers.

(b) Further detail on footpath design is provided in the following **Standard Drawings**:
   (i) **DH-RD-2005**;
   (ii) **DH-RD-2010**;
   (iii) **DH-RD-2015**; and
   (iv) **DH-RD-2020**.

5.8 Nature Strips

(a) Nature strips should be designed in accordance with the following minimum requirements:
   (i) a maximum crossfall of 1-in-20 (5%); and
   (ii) where battered slopes are provided adjacent to a 'keep clear' zone of a road, the desirable slope is 1-in-6 (16.7%), with an absolute maximum slope of 1-in-4 (25%).

6 Road Design

6.1 Introduction

This Chapter sets out the standard design criteria for the design and construction of roads and allotment access requirements. It provides guidance to ensure roads are designed to safely and efficiently accommodate all users, support access to allotments, and integrate with surrounding infrastructure and movement networks.

Effective road design is fundamental to the function, safety and amenity of new neighbourhoods. Roads must balance vehicular movement with the needs of pedestrians, cyclists, public transport and service vehicles, while responding to site conditions, topography and future network requirements. This Chapter supports consistent, fit-for-purpose road outcomes that protect public safety and facilitate movement and contribute to the long-term resilience and liveability of growth area developments.

Aspects of road design not specifically addressed in this Chapter should be in accordance with the following, as updated from time to time:

- *Guide to Road Design: Part 3 – Geometric Design,* Austroads
- *Guide to Road Design: Part 4 – Intersections and Crossings,* Austroads
- *Guide to Road Design: Part 4A – Unsignalised Intersections,* Austroads
- *Guide to Road Design: Part 6 – Roadside design, safety & barriers,* Austroads
- *Manual of Legal Responsibilities and Technical Requirements for Traffic Control Devices,* DIT and Transport South Australia;
- *Active Travel Design Guide,* DIT;
- *AS 1428 – Design for access and mobility*;
- *AS 1742 – Manual of uniform traffic control devices*; and
- DIT supplements to Austroads' Guides.

6.2 Design Criteria

6.2.1 Design Speed

(a) The geometric design of each road type should be based on the maximum design speeds specified in **Table 6-1 Design Speeds**.

(b) Maximum design speeds for Collector Level 2 and arterial roads should be determined in accordance with the requirements of the relevant road authority, being the council or the DIT.

Table 6-1 Design Speeds

Road Type	Maximum Design Speed*
Access Lane	30km/hour
Residential Road	60km/hour
Level 1 Collector Road	60km/hour

6.2.2 Design and Checking Vehicles

(a) The Design Vehicle(s) and Checking Vehicle to be adopted should be selected in accordance with the current version of Austroads' Design Vehicles and Turning Path Templates.

6.2.3 Vehicle Turning Movements

(a) Turning movement design should be undertaken in accordance with the Austroads' Design Vehicles and Turning Path Templates and should meet the following requirements:
   - (i) intersecting roads should be designed to accommodate the nominated Design Vehicles and Checking Vehicles specified in **Table 6-2 Design Vehicles and Turning Radii**;
   - (ii) where a median is present, sufficient road space should be provided to allow both Design Vehicles and Checking Vehicles to complete a left-turn movement from the left lane without encroaching across the median;
   - (iii) the Design Vehicle should be able to complete a left-turn movement from the left lane without encroaching into opposing traffic lanes;

(iv) the Checking Vehicle may encroach into opposing traffic lanes where adequate sight distance is available and where it is consistent with the sight distance requirements set out in this Chapter;

(v) all turning movements should be achievable wholly within the road reserve and should not rely on the use of vehicle accesses and driveways; and

(vi) where above-ground structures are present at intersections, a minimum additional clearance of 600mm should be provided at intersections, measured from the full swept path of the Design Vehicle rather than the wheel path.

(b) Where it is appropriate to design for passenger vehicles only, the Austroads design passenger vehicle based on the B99 dimensions in AS/NZS 2890.1-2004 – Parking Facilities, Part 1: Off-Street Carparking, should be adopted.

Table 6-2 Design Vehicles and Turning Radii

Intersecting Road Types	Design Vehicle	Checking Vehicle
Arterial / Arterial	Single articulated (19.0m) turning radius 15m	Long single articulated (25m) turning radius 15m
Arterial / Collector	Single unit truck/bus (12.5m) turning radius 12.5m	Single articulated (19m) turning radius 15m
Arterial / Local (Residential)	Service vehicle (8.8m) radius 12.5m	Single unit truck/bus (12.5m) turning radius 12.5m
Collector / Collector (Residential)	Single unit truck/bus (12.5m) turning radius 12.5m	Single articulated (19m) turning radius 15m
Collector / Local (Residential)	Service vehicle (8.8m) radius 9.0m	Single unit truck/bus (12.5m) turning radius 12.5m
Local / Local (Residential)	Service vehicle (8.8m) radius 9.0m	single unit truck/bus (12.5m) turning radius 12.5m

6.2.4 Active transport

(a) Road design should incorporate principles of active transport, as outlined in the *Active Travel Design Guide* published by the DIT.

(b) Road design should prioritise safe, direct and convenient movement for people walking, wheeling and cycling, ensuring active travel routes are legible, continuous and integrated with the surrounding street network and land uses.

(c) Active transport infrastructure should be designed to provide universal access, including appropriate widths, gradients, surface treatments and crossing points, to accommodate people of all ages and abilities.

(d) Road layouts should support active travel by providing safe and attractive connections to key destinations, including public transport stops, open spaces, schools and local centres, and by incorporating measures that improve personal safety, comfort and amenity for active users.

6.3 Sight Distance

(a) Sight distance requirements for all roads and intersections should be in accordance with the current *Guide to Road Design,* Austroads and the relevant DIT supplements to the following parts of the *Guide to Road Design*:

- *Part 3: Geometric Design*
- *Part 4A: Signalised and Unsignalised Intersections*
- *Part 4B: Roundabouts*

6.4 Horizontal Alignment

(a) Horizontal alignment refers to a series of straights (tangents) and circular curves, with or without transition curves, as appropriate to the design context.

(b) Where horizontal curves are used to change direction or respond to topography, curve radii must be sufficient to permit operating speeds consistent with those expected on adjoining straights and across the length of the road section being designed.

(c) The horizontal alignment of all roads should be designed in accordance with the requirements of *Guide to Road Design – Part 3: Geometric Design*, Austroads.

6.4.1 Speed Control

(a) Local roads that provide direct access to residential allotments should be designed to discourage high operating speeds and establish a low-speed environment, while maintaining appropriate connectivity across the road network. This should be achieved through the incorporation of horizontal curves or intersections within the road layout (curvilinear horizontal design).

(b) Curvilinear horizontal design elements should be provided at intervals not exceeding 150 metres.

(c) Additional speed management measures that may be incorporated into road design include:
   (i) deflected tee intersections with raised mountable islands;
   (ii) slow points incorporating raised mountable islands at regular intervals;
   (iii) raised wombat crossings or speed bumps; and
   (iv) visual pavement treatments, including variations in colour, texture or material.

(d) Speed management measures should generally not be applied to collector roads and arterial roads due to their higher operating speeds and traffic volumes.

6.4.2 Superelevation

(a) Superelevation is the transverse slope applied to a curved pavement to assist vehicles in safely negotiating a horizontal curve.

(b) Superelevation should generally be applied on higher-speed roads and where curve radii are constrained such that the required operating speeds cannot be safely achieved through crossfall alone.

(c) Superelevation should be discouraged on low-speed local roads, particularly within residential areas, where operating speeds are low and alternative speed management measures can be used.

(d) Any low points in kerb and channel created by superelevation must be designed to ensure free and unrestricted drainage to avoid the ponding of water.

6.5 Vertical Alignment

(a) The vertical alignment of a road refers to the longitudinal profile measured along the centreline and is affected by grades and curvature. Variations in cross-section and crossfall associated with the vertical alignment should also be considered in the design.

6.5.1 Longitudinal Grades

6.5.1.1 Road Grades

(a) The desirable longitudinal grades for the vertical alignment of roads are set out in **Table 6-3 Longitudinal Grades.** Where these grades cannot be achieved due to topographical constraints, the specified 'absolute' grades should be adopted.

Table 6-3 Longitudinal Grades

Grade Type	Road Longitudinal Grade
Desirable minimum grade	0.5%
Absolute minimum grade	0.3%
Desirable maximum grade	10%
Absolute maximum grade	15%

6.5.1.2 Kerb Return Grades

(a) Kerb returns should be designed with a desirable minimum longitudinal grade of 1.0%. Where this cannot be achieved due to site constraints, an absolute minimum grade of 0.5% should be adopted.

6.5.2 Vertical Curves

(a) Vertical curves should be provided at all changes in road centreline grade greater than 1.0%, and at all changes in kerb and channel grade greater than 1.0%.

(b) Vertical curves should be designed in accordance with the requirements of *Guide to Road Design – Part 3: Geometric Design*, Austroads as well as any applicable DIT supplement.

(c) Where a road is intended to be extended in the future, road grading should be carried a minimum of 50 metres beyond the end of the constructed road to facilitate any future connection.

6.6 Cross Sections and Cross Falls

6.6.1 Standard Cross Section

(a) Standard road cross sections should be designed in accordance with the following requirements in the **Table 6-4 Standard cross sections**.

Table 6-4 – Standard cross sections

Road Type	Standard Cross Section
Two-way roads	The cross-section should be graded with the crown located on the pavement centreline, falling to channels on both sides.
Divided roads	Each carriageway should be graded to fall from the median towards the outer channels.
Roads with steep side slopes	The pavement crown may be offset toward the higher side of the road to achieve better conformity with the natural ground profile.
Rear Access Lane	The cross-section should be graded towards a central spoon drain for connection to the drainage system.

6.6.2 Standard Cross Fall

(a) The standard crossfall for road pavements should be a minimum of 3.0%.

(b) One-way crossfall may be permitted where it reduces the extent of the earthworks or is required to accommodate WSUD cross-sections.

(c) One-way crossfall should not be used on roads with a posted speed greater than 60 km/h due to the increased risk of aquaplaning.

6.6.3 Maximum and Minimum Cross Fall

(a) Where pavement crossfalls steeper or flatter than the standard are required, such as at the approach to intersections or cul-de-sac turning areas, the maximum and minimum permissible pavement cross fall should comply with requirements of:

- *Guide to Road Design – Part 3: Geometric Design,* Austroads*;* and
- *Guide to Road Design – Part 4: Intersections and Crossings,* Austroads.

6.6.4 Reverse Cross Fall – Divided Roads

(a) Reverse crossfall on the uphill carriageway of divided roads may be permitted in exceptional circumstances, provided that adequate drainage capacity is available within the uphill median channel and appropriate measures are installed to intercept flows at median openings.

6.6.5 Median Cross Fall

(a) Median crossfalls on divided roads should desirably not exceed 16%, with an absolute maximum of 33%. Crossfalls exceeding the desirable maximum should only be adopted where a retaining wall is provided and no median openings are proposed.

(b) Pavement crossfall at median openings provided for traffic movements should not exceed 5%.

6.7 Road Drainage Infrastructure

6.7.1 Kerb and Channel

(a) Concrete kerb and channel should be provided on both sides of all roads, and should comply with the following minimum requirements:

(i) kerb types and kerb and channel profiles should be in accordance with **Standard Drawing DH-RD-1000**;
(ii) kerb ramps should be provided at every corner radii where footpaths are proposed and should be designed in accordance with this Chapter;
(iii) kerb outlet sleeves should be provided to accommodate stormwater discharge from each allotment that drains to the road;
(iv) upright kerbs or barrier kerbs should be used within residential areas, adjacent to reserves, at intersections, and at other locations where vehicular traffic is to be confined within the roadway;

(v) kerb and channel longitudinal grade should not be less than 0.5%. Where grades below this value are proposed, grated trench drainage should be provided; and
(vi) kerb radii should be designed to allow the nominated Design Vehicle to negotiate the swept path without obstruction.

(b) Minimum kerb return radii, or edge-of-seal radii measured from the face of kerb at intersections, should be designed in accordance with the following:

- **Table 6-5 Kerb Returns**;
- *Guide to Road Design – Part 3: Geometric Design, Austroads*; and
- Austroads Design Vehicles and Turning Path Templates.

Table 6-5 Kerb Returns

Road Type	Width
Residential Road	6.0 metres
Collector Road	12.5 metres

6.7.2 Concrete Edge Strips and Spoon Drains

(a) Concrete edge strips and/or spoon drains may be used in lieu of kerb and channel infrastructure for rear access lanes.

(b) Spoon drains may be used to connect kerb and channel to facilitate drainage of roadside parking bays.

(c) Concrete edge strips should be in accordance with **Standard Drawing DH-RD-1000**.

(d) Road drainage infrastructure should be designed having regard to WSUD principles, as outlined in **Chapter 11: Water Sensitive Urban Design**.

6.8 Road interfaces

6.8.1 Kerb Ramps

(a) Where not otherwise specified in this section, kerb ramps should be designed in accordance with AS 1428 – Design for Access and Mobility.

(b) Kerb ramps should incorporate tactile ground surface indicators in accordance with **Standard Drawing DH-RD-1025**, including at mid-block crossings and high-use vehicle crossovers, unless the following conditions are met:

(i) the distance between the building line or allotment boundary and the top of the kerb ramp is less than 3.0 metres;
(ii) the change in gradient between that of the pedestrian surface at the top of the kerb ramp and the kerb ramp surface is no greater than 12.5%; and
(iii) the kerb ramp is aligned with the building line and the direction of pedestrian travel across the carriageway.

(c) Where the kerb ramp is not in a typical alignment, directional tactile ground surface indicators should be provided to guide pedestrians to the location of the kerb ramp. An example of a typical alignment is detailed in **Standard Drawing DH-RD-2000**.

6.8.2 Vehicle Crossovers

(a) Vehicle crossover design should be designed and constructed in accordance with the following:

(i) **Standard Drawings DH-RD-2025**, **DH-RD-2030** and **DH-RD-2035**;
(ii) AS/NZS 2890.1 – Parking facilities, Part 1: Off-street Car Parking; and
(iii) **Table 6-6 Vehicle Crossover Requirements**.

Table 6-6 Vehicle Crossover Requirements

Crossover Element	Requirements
Provision and location	• Vehicular access should be provided to all residential allotments • Vehicle crossovers to corner allotments must be located: o at least 6 metres from the tangent point of the kerb return at the intersection of roads; and o at least 1.0 metre clear of pedestrian kerb crossings, street trees, signs, bollards and other street furniture. • Vehicle crossovers should, where practicable, be aligned opposite each other to minimise impacts on on-street parking
Geometry and gradients	• The maximum longitudinal grade of a vehicle crossing must not exceed 10% • Where the vehicle crossing grade exceeds 6.7%, vehicle movements must comply with the requirements of AS/NZS 2890.1 – Parking facilities, Part 1: Off-street Car Parking • Layback sections must be provided for all vehicle crossings.
Materials and accessibility	• Vehicle crossovers must be constructed of an all-weather surface • Crossovers must be graded consistently with adjoining footpaths, be constructed of the same material and comply with AS/NZS 1428.1 - Design For Access And Mobility
Number and width of crossovers	• A maximum of two vehicle crossovers may be provided to any residential allotment • Where a single crossover is provided, the minimum width is 3 metres, and the maximum width is 5 metres • Where two separate crossovers on the same allotment are provided:

- each crossover should have a minimum width of 3 metres and must not exceed 4 metres in width; and
- a minimum separation of 9 metres must be provided between the crossovers.

- Vehicle crossover for adjacent allotments must either be:
  - combined to a maximum total width of 6 metres; or
  - separated by a minimum of 6 metres to allow for on-street parking between crossovers.

6.9 Intersection Design

(a) Intersections should be designed in accordance with the following, as amended from time to time:

- *Guide to Road Design*, Austroads:
  - Part 4: Intersections and Crossings – General
  - Part 4A: Non-Signalised and Signalised Intersections
  - Part 4B: Roundabouts
- *Manual of Legal Responsibilities and Technical Requirements for Traffic Control Devices,* published by the DIT, including any applicable supplements.
- The standard drawings for roundabouts in **Standard Drawings DH-RD-2050** and **DH-RD-2055**.

(b) Intersection design should comply with the following minimum requirements:

(i) intersections should be designed to be free-draining and to avoid ponding of water.

(ii) vehicular access to individual residential allotments should be set back a minimum of 6 metres from the kerb tangent point.

(iii) landscaping within roundabout islands should not exceed a height of 200mm, unless adequate sight lines are demonstrated through a vehicle sight-line assessment.

(iv) corner cut-offs or truncations of sufficient dimensions to achieve adequate sight distance should be provided at all corners of new and upgraded intersections as follows:

A. Where the design speed is less than 50km/h, a minimum truncation of 3 metres x 3 metres.

B. Where the design speed is greater than 50km/h, a minimum truncation of 5 metres x 5 metres.

6.10 Cul de Sacs

(a) Cul-de-sacs should be designed to accommodate a standard 12.5 metre service vehicle undertaking a three-point turn wholly within the pavement area, excluding vehicle crossovers.

6.11 Line marking and Signage

(a) All roads should be designed with line marking and signage in accordance with:

- AS 1742.2 – Manual for uniform traffic control devices; and
- all relevant road design guidelines and standards published by DIT, including any applicable supplements.

7 Pavement Design

7.1 Introduction

This Chapter sets out the standard design criteria for pavement design within growth area and greenfield developments. It provides guidance to ensure pavement structures are designed to safely and efficiently accommodate anticipated traffic loads, including construction traffic, over their intended design life, while responding to site specific ground conditions and future maintenance considerations. It promotes consistent, fit for purpose pavement outcomes that support road function, durability and long-term asset performance, and ensures pavement designs are integrated with broader road corridor, drainage and service infrastructure requirements.

Aspects of pavement design not specifically addressed in this Chapter should be in accordance with the following, as updated from time to time:

- *Guide to Pavement Technology – Part 2: Pavement Structural Design*, Austroads
- Master Specification Part RD-PV-D1 – Pavement Investigation and Design, DIT.

7.2 Pavement Design Documentation

(a) Pavement design documentation should include the following information, with detail as set out in this Chapter:
  - (i) design traffic, expressed in equivalent standard axels used to inform pavement design;
  - (ii) subgrade soil sampling and assessment undertaken to inform pavement design;
  - (iii) pavement thickness;
  - (iv) pavement stabilisation methods (where applicable);
  - (v) any adjustments to design traffic and the corresponding adaptation of pavement design;
  - (vi) pavement materials, including sub-base, base, and wearing course (where applicable); and
  - (vii) demonstration that based on the above, that all roads will achieve a 30 year design life.

7.3 Design Traffic

(a) Equivalent standard axels (ESAs) for determining pavement design should be adopted in accordance with **Table 7-1 Design Traffic**:

Table 7-1 Design Traffic

Road Type	Design Traffic (ESAs)
Rear Access Lane	4×10^3
Cul-de-sac	6×10^3
Residential Road with no buses	6×10^4
Residential Road with buses	1×10^5
Level 1 Collector Road with no buses	6×10^5
Level 1 Collector Road with buses	1×10^6

(b) To account heavy vehicle traffic generated during construction of the land division, the design traffic, based on equivalent standard axles, used for flexible pavement design should be increased by not less than the values specified in **Table 7-2 Design Traffic – Flexible Pavement Adjustment for Heavy Vehicle Traffic**.

Table 7-2 Design Traffic – Flexible Pavement Adjustment for Heavy Vehicle Traffic

Road Classification	Design Traffic (ESAs) percentage increase
Rear Access Lane	5%
Cul-de-sac	4%
Residential Road	4%
Level 1 Collector Road	3%

7.4 Sub-Grade

(a) Pavement design should be informed by the results of sub-grade analysis. Sub-grade test results, including core samples, should be submitted as part of the pavement design documentation.

(b) Sub-grade soil sampling should:
   (i) include four-day-soaked Californian Bearing Ratio (CBR) testing undertaken by a laboratory accredited by the National Association of Testing Authorities (NATA);
   (ii) be undertaken at locations representative of the development area to have regard for the local soil conditions, geology, terrain, presence of fill and any existing pavement (where applicable); and
   (iii) be carried out at an appropriate frequency and spacing to adequately characterise the sub-grade conditions across the site.

(c) Assessment of sub-grade soil should:
   (i) Consider all sub-grade test results when determining the design CBR, with a conservative value adopted; and
   (ii) account for environmental influences that may affect pavement performance, including moisture, ground water and soil reactivity.

(d) The sub-grade should be compacted to a minimum of 98% standard maximum dry density in accordance with AS 3798 – Guidelines on Earthworks for Commercial and Residential Developments.

7.5 Pavement and Shoulder Thickness

(a) All roads are to have a minimum thickness of 300mm based on unbound granular pavement configurations and are to be designed in accordance with:
   (iii) **Table 7-1 Design Traffic**; and
   (iv) **Table 7-2 Design Traffic – Flexible Pavement Adjustment for Heavy Vehicle Traffic**.

(b) Pavement thickness less than 300mm may be appropriate for full-depth asphalt or rigid pavements where it can be demonstrated that a 30-year design life will still be achieved.

(c) Pavement thickness less than 300mm may be appropriate for carparks where it can be demonstrated that a 30-year design life will still be achieved.

(d) Pavement thickness for Level 1 Collector Roads to be vested in the DIT should be determined in accordance with the *Guide to Pavement Technology – Part 2: Pavement Structural Design*, Austroads, and any supplementary DIT standards and specifications.

(e) While desirable for all roads to be kerbed, where roads are non-kerbed, the pavement should extend at least in accordance with the minimum shoulder widths nominated within the Chapter and have a minimum thickness of 180mm.

7.6 Pavement Stabilisation

(a) Where pavement stabilisation is proposed, details of the stabilisation methods to be used to strengthen the pavement should be included in the design documentation. Stabilisation methods may include:
   (i) the addition of lime, cement or foamed bitumen; and
   (ii) the use of geotextiles and geogrids.

(b) Pavement stabilisation methods should be designed in accordance with the following, as updated from time to time:
- *Guide to Pavement Technology – Part 5: Pavement Evaluation and Treatment Design*, Austroads; and
- Master Specification Part RD-PV-C3 Insitu Pavement Stabilisation, DIT.

7.7 Pavement Materials

7.7.1 General Principles

(a) Pavement material selection should comply with Master Specification Part RD-PV-S1 – Supply of Pavement Materials, DIT.

(b) Recycled pavement materials, such as PM 2/20RG and PM 2/30RG may be used for sub-base layers or working platforms but should not be used as a base material directly beneath a seal. PM3 (Class 3) materials may be used for the formation of working platforms.

(c) For a residential road, Fine AC10 mix as detailed in Master Specification - Part ED-BP-S2, DIT, is recommended as a wearing course.

(d) For a collector road, deep-lift asphalt may be used to resist fatigue of the wearing course where required.

(e) The use of polymer modified binders in asphalt is encouraged, particularly for heavy-duty pavements. Use of polymer modified binders should be in accordance with the DIT's supplementary documentation to *Guide to Pavement Technology – Part 2*, Austroads.

7.7.2 Flexible Sealed Pavements

7.7.2.1 Sub-Base

(a) Where using the typical quarried pavement material (PM2/20QG), the sub-base should be compacted to a minimum of 96% relative modified maximum dry density in accordance with AS 1289.5.2.1:2017 – Methods of testing soils for engineering purposes.

(b) The sub-base layer should extend a minimum of 300mm either side of the rear faces of the kerbs.

7.7.2.2 Base

(a) Where using the typical fine crushed rock (PM1/20QG), the base should be compacted to a minimum 98% relative modified maximum dry density in accordance with AS 1289.5.2.1:2017 – Methods of testing soils for engineering purposes.

7.7.2.3 Pavement Wearing Course

(a) For collector roads, and residential roads with traffic volumes exceeding 400 vehicles per day, the wearing course should be AC10M or AC10H asphaltic concrete. The wearing course thickness should be selected to suit the design traffic and should be not less than 40mm.

(b) All roundabouts should be sealed with AC10M heavy-duty mix asphaltic concrete preferably incorporating a polymer-modified binder (A5E) and constructed to a thickness appropriate for the design traffic and should not be less than 40mm.

(c) The surface of the wearing course should be constructed 5mm proud of the concrete water table. At footpath kerb crossings, the wearing course should be flush with the lip of the kerb and channel to eliminate trip hazards.

(d) The wearing course should not be considered as part of the structural pavement formation.

(e) Use of asphalt should comply with Master Specification, Part RD-BP-S2 – Supply of Asphalt, DIT and RD-BP-C3 – Construction of Asphalt Pavements, DIT.

(f) The design of hotmix, including aggregate size and any additives, such as colour additives, should be specified in the design documentation.

7.7.3 Concrete Pavements

(a) Concrete pavement design, including sub-base and basecourse, should be undertaken in accordance with the following as updated from time to time:
- *Guide to Pavement Technology – Part 2,* Austroads; and
- *Master Specification Part RD-PV-D3 – Concrete Road Pavements,* DIT.

7.7.4 Interlocking Pavers

(a) Interlocking pavers may be used for traffic calming treatments and to incorporate WSUD outcomes.

(b) Interlocking pavers are not recommended for use on clay or reactive sub-grades.

(c) Paver thickness is to be treated as a wearing course only and should not to be included in the structural pavement design thickness.

(d) The design and installation of interlocking pavers design should comply with the following requirements:
(i) be designed in accordance with:
- *Permeable Interlocking Concrete Pavements – Design and Construction Guide (PE01);*
- Documents published by the Construction Masonry Association of Australia; and
- AS/NZS 4455.2 Masonry Units, Pavers, Flags and Segmental Retaining Wall Units – Part 2: Pavers and Flags.

(ii) achieve a minimum design life of 30 years.
(iii) provide a minimum thickness of 80mm for trafficable areas.
(iv) utilise a 'type A' paver laid in a herringbone pattern.
(iv) be limited to road gradients not exceeding 10%, and where gradients exceed 5%, incorporate suitable drainage measures to minimise sand and water migration.
(v) specify paving bedding sand that is washed or unwashed pit, river or quarry material and compliant with the DIT's Master Specification R178 and R179.

(vi) ensure bedding sand is free from pebbles, clay lumps, organic or deleterious matter, soluble salts or other contaminants likely to cause efflorescence or reduce skid resistance.
(vii) use of a proprietary silicone-based sand product for paver joint filling.
(viii) achieve finished surface levels within a tolerance of +3mm/-0mm from the design levels.
(ix) set paver edge levels between 5mm and 10mm above the lip of the adjacent concrete gutter, to ensure effective surface drainage; and
(x) achieve a skid resistance at least equivalent to that of the adjoining asphalt surfaces.

8 Earthworks Design

8.1 Introduction

This Chapter sets out the standard design criteria for earthworks associated with growth area and greenfield developments. It provides guidance to ensure earthworks are planned and developed in a manner that supports safe and functional development outcomes, manages flood risk, and protects adjoining land, infrastructure and the environment.

Earthworks design plays a critical role in establishing suitable finished landform, enabling effective stormwater management, and ensuring development does not result in adverse impacts such as increased flooding, erosion, sediment discharge or instability of land. Earthworks must be designed to respond to site conditions, including topography, soil characteristics, groundwater conditions and existing drainage patterns.

This Chapter supports consistent, fit-for-purpose earthworks outcomes that facilitate orderly development, protect public and private assets, and contribute to the long-term resilience and sustainability of growth area developments.

8.2 Design of Earthworks

(a) Earthwork design should be undertaken to ensure that:

- (i) buildings are located on natural ground or approved fill above the 1% AEP flood level;
- (ii) earthworks, lot filling and development do not cause or exacerbate flooding of adjoining land, including by maintaining existing runoff storage areas and overland flow paths;
- (iii) appropriate measures are implemented to prevent erosion, dust, mud, or debris from leaving the site or entering a watercourse during earthworks and filling activities; and
- (iv) the privacy and security of neighbouring landowners are protected.

(b) Design related to earthworks not specifically addressed in this Chapter should be carried out in accordance with AS 3798 – Guidelines on Earthworks for Commercial and Residential Developments, as amended from time to time.

8.3 Fill

(a) The use of fill in design should comply with the following minimum requirements:
  - (i) fill material should comply with AS 3798 – Guidelines on Earthworks for Commercial and Residential Developments and be placed and compacted to a Level 1 in accordance with that Standard;
  - (ii) fill should not include unsuitable materials, including topsoil, organic matter, high plasticity clays or materials with excessive moisture content;
  - (iii) the extent and depth of all proposed lot filling should be clearly shown on the construction plans;
  - (iv) areas where depths of fill on allotments exceeds 300mm should be clearly identified and distinguished from areas where fill depths of 300mm or less;
  - (v) a site-specific engineering assessment should be undertaken where fill depths greater than 5 metres are proposed;
  - (vi) where reasonably practicable, the use of retaining walls should be minimised in favour of batters;
  - (vii) retaining walls should be provided where fill results in a level difference greater than 300mm or where maximum batter slopes are exceeded;
  - (viii) fill should be placed in uniform horizontal layers, with each layer compacted before the placement of the next; and
  - (ix) fill forming the finished surface of any allotment should be equal to or above the 1% AEP flood level.

8.4 Grading

(a) Earthworks should be graded away from structures and directed toward approved drainage paths and infrastructure.

(b) New allotments on sloping sites should be graded, cut, or filled to achieve a minimum grade of 1-in-200 (0.5%) along the low side of the allotment, draining toward the nominated stormwater drainage outlet.

9 Service Infrastructure

9.1 Introduction

This Chapter identifies the applicable design standards and relevant agency requirements to be adopted for the provision and coordination of service infrastructure for growth area and greenfield developments. It provides guidance to support the consistent application of these standards, ensuring essential services are planned, designed and installed in a coordinated and efficient manner that supports safe, functional and orderly development outcomes.

Service infrastructure includes electricity distribution and street lighting, water supply, wastewater disposal, gas and communications networks. This Chapter promotes the undergrounding and co-ordinated placement of services within road reserves and verges to minimise conflicts, protect the public realm and facilitate safe access for construction, operation and maintenance.

9.2 Design of Infrastructure

(a) All residential allotments should be able to be connected to electricity, communications and broadband, gas, water supply and wastewater services.

(b) Streetlights should be installed for all growth areas and greenfield developments.

(c) Provision should be made so that all service infrastructure can be installed underground and located in accordance with **Table 9-1 Service Infrastructure**.

(d) Service Infrastructure should be designed in accordance with the standards and requirements set out in **Table 9-1 Service Infrastructure**.

(e) Common service trenches should be located within the verge, towards the rear-face of the kerb edge.

(f) Services should not be installed within:
   (i) a 750mm radius of newly planted trees; or
   (ii) the tree protection zone (TPZ) of regulated or significant trees.

(g) Where services are installed within close proximity to trees, tree root barriers should be provided for:

(i) newly planted trees maintaining a minimum clearance of 750mm measured from the trunk; and
(ii) established trees maintaining a minimum clearance equivalent to the extent of the tree's canopy.

(h) Where service pipelines, conduits and infrastructure is provided, easements should be created in accordance with the requirements of the relevant service authority and duly registered with the Lands Titles Office.

Table 9-1 Service Infrastructure

Service	Infrastructure Location	Installation Standards and Requirements
Electricity	Common service trench	• Underground electrical power should be provided to each allotment in accordance with a design approved by SAPN
Communications and broadband	Common service trench	• standards and requirements set by the nominated service provider
Gas	Common service trench	• standards and requirements set by the nominated service provider • *Gas Act 1997* • *Gas Regulations 2012* • AS 4645 – Gas distribution networks
Water supply	Carriageway	• standards and requirements set by the nominated water industry entity • Where to be located within an existing road, approval must be obtained from the relevant council under section 221 of the *Local Government Act 1999* • *Water Industry Act 2012* • Water Services Association of Australia Codes
Wastewater	Carriageway	• standards and requirements set by the nominated water industry entity • *South Australian Public Health Act 2011* • *Water Industry Act 2012* • the Water Services Association of Australia Codes

Street Lighting	Within the verge, setbacks consistent with the following **Standard Drawings:** **DH-RD-3000** **DH-RD-3001** **DH-RD-3002** **DH-RD-3003** **DH-RD-3004**	• Streetlights to be provided to all developments • All streetlights and poles should be of a type approved by SAPN and should comply with AS1158 – Lighting for roads and public spaces
Pad-mounted transformers	Efficiently accessible from a road, other than a collector road. Where located within a reserve, ideally located on a reserve corner.	• Located in accordance with SAPN requirements • Should not be located on council land without prior approval • Screening to minimize visual impact

10 Street Trees

10.1 Introduction

This Chapter sets out the standard design requirements for the planning, selection and integration of street trees within growth area and greenfield developments.

Street trees are a fundamental component of high-quality streetscapes. They contribute to the character and legibility of streets, can form local landmarks, and play a critical role in improving urban amenity and resilience by providing shade, reducing urban heat, and supporting local microclimates through transpiration.

To achieve successful and enduring street tree outcomes, careful consideration must be given to species selection, plant stock quality, and the provision of adequate soil volumes and water.

Street trees must be planned and designed to integrate with surrounding infrastructure, support long-term health and growth, and minimise conflicts with services, lighting and movement networks.

This Chapter supports consistent, fit-for-purpose street tree outcomes that enhance the public realm, improve environmental performance, and contribute to the long-term liveability of new neighbourhoods.

10.2 Design of Street Landscaping

(a) Street Landscaping Plans should include the following information in relation to street trees:
  - (i) An existing tree survey conducted by an arborist, and whether each tree is proposed for retention or removal;
  - (ii) a tree protection plan for existing trees being retained;
  - (iii) accurate location of each new tree proposed;
  - (iv) botanical names;
  - (v) annotation of tree height and canopy diameter; and
  - (vi) Notional Root Zones (NRZs) for the tree at maturity.

10.3 Existing Trees

(a) An existing tree survey should be prepared by a suitably qualified arborist for all existing trees on the site. The survey should include the following information:
  (i) botanical names;
  (ii) accurate tree locations;
  (iii) tree height, canopy diameter and trunk circumference;
  (iv) Notional Root Zones (NRZs) for each tree;
  (v) Regulated Trees;
  (vi) Significant Trees; and
  (vii) in relation to Regulated and Significant Trees:
    A. circumference measured at 1 metre above ground level;
    B. the condition of the tree; and
    C. estimated remaining lifespan.

(b) Where existing trees are proposed to be retained, tree protection measures should be established in accordance with the requirement of AS4970 – Protection of trees on development sites.

Note – Regulated and Significant Trees are protected under the Planning, Development and Infrastructure Act 2016. Any tree damaging activity is an offence unless a development approval has been granted.

10.4 Street Tree Design Layout

(a) Street tree layout and design should:
  (i) retain existing trees wherever practicable, and in accordance with AS 4970 – Protection of trees on development sites;
  (ii) retain existing Regulated and Significant Trees;
  (iii) specify deciduous tree species for streets with an east-west orientation, and evergreen tree species with a north-south orientation;
  (iv) minimise conflicts with infrastructure and street function including obstruction of street lighting by tree canopies, and interference with vehicle access and door opening zones;
  (v) provide ecological linkages between open space and vegetation to support the movement of native fauna and birdlife;
  (vi) optimise opportunities for passive irrigation, including through the use of sub-soil drainage connections to kerbs;
  (vii) ensure adequate surface permeability to promote passive irrigation; and
  (viii) provide sufficient soil volume to support the intended mature root zone of street trees.

(b) Street tree should be located in accordance with **Table 10-1 Street Tree Location**.

(c) Trees planted near overhead and underground powerlines must be in accordance with SAPN distances and species requirements.

Table 10-1 Street Tree Location

Location	Number to be provided
Street trees located in verges adjacent residential allotments	• 1 tree per single frontage allotment with a frontage of 10 metres or less • 1 tree every 7 metres for single frontage allotments greater than 10 metres
Street trees located in verges adjacent of non-residential allotments	• 1 tree will be planted every 7 metres
Corner allotments/secondary street boundaries	• 3 trees or more
Under existing powerlines	• Tree plant near overhead and underground powerlines must be in accordance with SAPN distances and species requirements.

10.5 Species Selection and Planting of Trees

(a) Street tree species selection should promote diversity, reduce risk of pest infestation, improve resilience to pest and disease and ensure suitability to the local climatic conditions.

(b) Selected species should be suitable for the planting location and have a mature canopy size that avoids conflicts with infrastructure while providing adequate shade.

(c) Trees should have a minimum height of 2 metres at the time of planting, be double staked with 50mm hardwood stakes installed parallel to the road and be loosely tied and be planted within a mulched bowl with a minimum diameter of 1 metre to facilitate watering and moisture retention.

(d) All tree stock supplied for installation should comply with Australian Standard AS 2303 – Tree Stock for Landscape Use.

10.6 Protection of Trees

(a) An impact assessment report should be prepared by a qualified arborist to:
   (i) determine Tree Protection Zones (TPZs) to inform the development; and
   (ii) assesses whether any proposed infrastructure or building envelopes encroach upon TPZs and confirm whether the extent of encroachment is acceptable in accordance with AS 4970 – Protection of trees on development sites.

(b) Prior to any demolition or construction commencing, the following measures should be implemented:
   (i) any recommendations outlined in a report prepared by an arborist for the site; and
   (ii) measures outlined in AS 4970 – Protection of trees on development sites.

(c) All construction plans including earthworks, drainage and service drawings, shall show all regulated/significant trees and their TPZs.

11 Water Sensitive Urban Design

11.1 Introduction

This Chapter sets out the design requirements for Water Sensitive Urban Design (WSUD) in growth area and greenfield developments. It provides guidance to ensure WSUD initiatives are integrated into development design to protect and enhance the natural and built environments, preserve natural hydrological behaviours, and manage stormwater quality to meet applicable pollutant load targets and water quality objectives.

Aspects of WSUD design not specifically addressed in this Chapter should be developed in accordance with relevant contemporary guidance, including the *Environment Protection (Water Quality) Policy 2015* and the *Water Sensitive Urban Design Technical Manual* (Water Sensitive SA), as updated from time to time. Treatment train design, device selection and performance demonstration should be supported by appropriate modelling, including use of the *South Australian MUSIC Guidelines* and *MUSIC Auditor*, where relevant.

11.2 Treatment Train Design and Device Selection

(a) The proposed treatment train conceptual design and sizing should be appropriate for the site-specific conditions and be modelled in accordance with the latest version of *The South Australian MUSIC Guidelines* and *MUSIC Auditor*, both developed by Water Sensitive SA.

(b) Stormwater quality improvement devices (SQIDs) forming part of a treatment train should be selected based on their suitability for the site conditions.

(c) This Chapter addresses the following SQIDs, as commonly used stormwater treatment measures:

    (i) bioretention systems (including at-source and end-of-line);
    (ii) constructed wetlands;
    (iii) Gross Pollutant Traps (GPTs);
    (iv) infiltration systems;
    (v) litter baskets; and
    (vi) pervious pavement.

(d) The use of alternative or additional SQIDs may be supported where their suitability and performance can be demonstrated.

(e) The selected SQID(s) ability to achieve the desired WSUD objectives, including the pollutant load reduction targets, should be demonstrated through modelling using the MUSIC.

11.2.1 Bioretention Systems

(a) Bioretention systems typically comprise vegetation and filter media through which stormwater run-off is treated before infiltrating to underlying soils or being conveyed via subsoil drainage pipes. These systems are commonly incorporated into streetscapes to provide flow control, water quality treatment and urban greening benefits.

(b) Bioretention systems are generally classified into the following two categories:

(i) **At-source bioretention systems** – which include bioretention pods and bioretention tree pits, and receive runoff directly from its source such as overland flow from adjacent roads, car parks, hardstand areas and allotments; and

(ii) **End-of-line bioretention systems** – which are commonly referred to as bioretention basins, these systems receive runoff at or near the downstream end of a drainage network and typically have lower ongoing maintenance requirements than at-source systems.

(c) Prior to the selection and design of either at-source or end-of-line bioretention system, the following should be considered:

(i) the quantity of runoff from rainfall and the catchment;
(ii) downstream vegetation within long swales, particularly in end-of-line systems, may die off without enough runoff;
(iii) submerged or saturated zones at the bottom of a filter profile is recommended for the South Australian climate to account for periods of low rainfall;
(iv) use of either a permeable or impermeable liner underneath the system;
(v) conveyance of flows needs to allow for the roughness associated with vegetation proposed within the swale invert;
(vi) where subsoil drainage and riser pipes are proposed within filter layer of the bioretention system, slotted PVC pipes should be used for drainage conveyance and non-slotted standard PVC pipes should be used for riser pipes;
(vii) systems that have extended detention depth should not have ponding of surface water for longer than 48 hours;

(viii) the extended detention depth should range from 100mm (for at-source systems) to a maximum of 300mm (for end-of line systems) to provide sufficient storage of runoff for treatment but not be detrimental to vegetation health;

(ix) bioretention swales should have a slope of not more that 4% to prevent scour and erosion during periods of sparse vegetation, or during establishment of vegetation;

(x) the use of end-of-line bioretention basins are suitable for where sufficient fall exists to enable the drainage network to discharge onto the surface of the filter and freely discharge from the basin;

(xi) conversely to the above, where a site is constrained by grade the use of at-source systems may be required;

(xii) where soils are classified as acid sulphate soil, sodic or dispersive, a sealed impermeable liner to prevent exfiltration should be used;

(xiii) where achievable, basins should be able to function and not be damaged for up to the 5% AEP flood level;

(xiv) systems should be of a maximum length of 40 metres and a maximum width of 13m to ensure vegetation health;

(xv) where maintenance access can be provided on one side only, system maximum width should be 10 metres, and 20 metres where accessible from more than one side; and

(xvi) for basins with a filter area of greater than $800m^2$, the filter is broken up into cells (with inflows distributed to each cell) with a maximum cell size of $800m^2$.

11.2.2 Constructed Wetlands

A constructed wetland comprises a sediment pond or ponds that removes coarse sediment, which leads to both a high flow bypass, to bypass the macrophyte zone, and the macrophyte zone itself, which forms the majority of the system, contains an inlet pool, outlet pool, and outlet controls. Constructed wetlands can provide a central point for treatment of runoff and may also include a water storage function.

(a) The following should be considered prior to selecting, and when designing a constructed wetland:

(i) gross pollutant traps should be installed upstream of sediment ponds;

(ii) sediment ponds should be located immediately upstream of the inlet pool;

(iii) a junction should be designed to ensure the high-flow bypass from sediment ponds does not enter the macrophyte zone;

(iv) an emergency spillway or weir may be necessary in addition to the main high-flow bypass, to prevent upstream flows from entering the sediment pond once the extended detention volume has been reached. Accordingly, the level of the spillway should be the same level as when the extended detention volume has been reached;

(v) piped inflows from the inlet pond into deeper pools of the macrophyte zone are not to exceed 0.5m/s;

(vi) an extended detention depth should be between 350mm and 500mm;

(vii) South Australian native vegetation should be prioritised, with other marsh vegetation being selected for its appropriateness for its filtering capabilities and climate suitability;

(viii) velocities through the macrophyte zone must not exceed 0.5m/s in a 1% AEP event or 0.05m/s during a 3-month event; and

(ix) ensure backflow into the macrophyte zone or sediment pond is prevented, taking into account a 1% AEP scenario.

11.2.3 Infiltration Systems

An infiltration system typically comprises of vegetation, media and geotextile fabric to prevent litter from passing, before the runoff filtrates through the soil and into the ground. Infiltration systems can play an important part of urban stormwater management through the recharge of groundwater and assist with the management of flows.

(a) The following should be considered prior to selecting, and when designing infiltration systems:

(i) the potential for infiltration systems to become clogged by sediment and organic matter (including pre-treatment);

(ii) the infiltration capacity and hydraulic conductivity of the soil, avoiding dispersive/sodic soils;

(iii) existing groundwater conditions (noting that high groundwater can result in leaching of groundwater into infiltration systems and potentially backing up into other stormwater infrastructure);

(iv) infiltration systems should be located away from utility services or infrastructure that may be adversely impacted by infiltration; and

(v) whether stormwater can be treated prior to infiltration to meet water quality targets and improve the lifespan of the infiltration system.

(b) Infiltration systems should not be included within MUSIC modelling for treatment trains as a device contributing to achieving necessary water quality objectives. Infiltrating nutrients into the groundwater does not remove them from the environment.

11.2.4 Litter Baskets

Litter baskets are commonly installed within field inlets and kerb pits and are designed to capture at-source gross-pollutants.

(a) The following should be considered prior to selecting, and when designing litter baskets:

- (i) incorporation of an internal high-flow bypass, suitable for the minor storm event and the basket is blocked;
- (ii) ensure no interference with the performance of the drainage network.
- (iii) the bottom of the basket must be 100mm clear of pipe flows (minor storm event) through the pit;
- (iv) ensure permanent ponding within the pit causing anaerobic decomposition of collected matter, will not occur; and
- (v) downstream backflow prevention in areas of tidal influence to prevent the resuspension and bypass of captured matter (litter and organic matter).

11.2.5 Pervious Pavements

Pervious pavement, also known as porous or permeable pavement, has the benefit of reducing the rate and volume of runoff, and may be used for pedestrian areas and low-speed trafficable areas.

(a) The following should be considered prior to selecting, and when designing pervious pavement areas:

- (i) subgrade stability and ensuring underlying soils do not weaken under load;
- (ii) the filter lining and underdrainage should be designed based on the underlying soil type;
- (iii) ensuring potential shrinking and swelling of pavement does not cause structural damage to structures in the vicinity;
- (iv) ability to withstand intended traffic loads without deformation or failure;
- (v) adequate permeability to prevent ponding of surface water;
- (vi) the slope must not exceed 1-in-25 (4%);
- (vii) adequate access to undertake maintenance;

(viii) surface and underdrain (if present) is to drain flows to the receiving stormwater drainage network, other SQIDs or receiving waterway;
(ix) ability to withstand heavy rainfall events (where rainfall may exceed infiltration capacity);
(x) the use of pre-treatment measures (i.e. sediment traps, buffer strips) to minimise the amount of sediment reaching the pavement; and
(xi) avoid installation in areas likely to receive high sediment loads.

(b) The design of pervious pavement should be in accordance with Chapter 7: Pervious Pavements of the *Technical Manual for Water Sensitive Urban Design in Greater Adelaide*, Water Sensitive SA.

11.3 Off-site Stormwater Solutions

An off-site stormwater solution involves directing runoff downstream or to a separate discharge location where it is treated to achieve the required water quality outcomes.

(a) Design and documentation for off-site stormwater solutions should demonstrate the following:

(i) all development areas being offset must be located within the same local catchment as the off-site treatment device;
(ii) where an existing public drainage system is utilised to connect the development run-off to the offsite treatment area, water quality objectives for total suspended solids (TSS) and gross pollutants (GP) shall be achieved prior to discharge from the development site;
(iii) locations of drainage easements;
(iv) all stormwater to be treated offsite to arrive without entering the natural environment (i.e. via piped drainage or a constructed open channel drainage system); and
(v) details of quantity of run-off during peak-flows, where an off-site treatment area is also providing a peak-flow mitigation function.

(b) Use of an off-site solution should demonstrate, including through MUSIC modelling, that this does not result in damage (or reduced performance) to the surrounding environment, infrastructure or property.

(c) Use of or integration with an existing off-site stormwater solution are not suitable where there is an environmentally sensitive area between the point of discharge and the treatment device/system.

(d) Where these areas are separated by existing local infrastructure, demonstration of capacity in existing systems, or detail relating to the required infrastructure upgrades will be required for assessment.

(e) Where it is proposed that water runoff quality is sought to be improved through integration into an existing offsite stormwater quality solution, it should be demonstrated that the device has capacity to treat additional runoff.

(f) Where it is proposed that water runoff quality is sought to be improved through a new offsite treatment device, the device should be operational prior to the upstream pollutant source being enlivened, i.e. the commencement of construction works.

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Appendix A: Standard Drawings