AUS-SPEC

Infrastructure Specifications

0074 Stormwater Drainage (Design)

0074 STORMWATER DRAINAGE (DESIGN)

IMPORTANT: This document has been adapted from the NATSPEC suite of specification templates for use in the MidCoast Council area by both Council and industry. NATSPEC regularly updates the base templates (currently in April and October each year), and Council may incorporate changes into its version of AUS-SPEC from time to time. To assist in highlighting any changes made by Council to the NATSPEC templates, the following conventions are used.

- ANNEXURE M – MIDCOAST COUNCIL SPECIFIC CLAUSESSee ANNEXURE M at the end of this document which contains (where practical) MidCoast Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown in brown text like this.
- Where content is deleted or excluded from the main body of the document, it is to be shown ~~struck through like this~~. Such clauses are to have no effect.

Where there is a conflict between main body text and MidCoast Council specific clauses, Council's specific clauses shall prevail.

1 GENERAL

1.1 INTRODUCTION

Worksection application

This worksection is applicable to the design and documentation requirements for stormwater drainage systems for urban, regional and rural areas. It covers hydrology and hydraulic design for a total stormwater drainage system and includes Water Sensitive Urban Design principles of stormwater harvesting and re-use.

1.2 RESPONSIBILITIES

General

Requirement: Provide design and documentation for stormwater drainage systems.

1.3 CROSS REFERENCES

General

Requirement: This is not a self-contained design document, conform to the following worksection(s):

- *0010 Quality requirements for design*.
- *0022 Control of erosion and sedimentation (Design)*.
- *0041 Geometric sealed road design*
- *1121 Open drains, including kerb and gutter.*
- *1351 Stormwater drainage (Construction).*

1.4 STANDARDS

General

Standard: Conform to the following:

- Rainfall and runoff: To ARR.
- Water sensitive urban design: To EA ARQ.

1.5 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- AEP: Annual exceedance probability.
- ~~ARI: Average recurrence interval.~~
- EA ARQ: Australian Runoff Quality, A Guide to Water Sensitive Urban Design (Engineers Australia)

- DCP: MidCoast Council Development Control Plan
- GPT: Gross pollutant trap.
- IFD: Intensity-frequency-duration.
- HGL: Hydraulic grade line.
- NWQMS: National Water Quality Management Strategy Guidelines
- OSD: On-site detention.
- SQID: Stormwater quality improvement devices.
- WSUD: Water sensitive urban design.

Definitions

General: For the purposes of this worksection the following definitions apply:

- Annual exceedance probability: The probability of an event being ~~equalled or~~ exceeded within a year.
- ~~Average recurrence interval: The average time period between occurrences equalling or exceeding a given value.~~
- Catchment: A topographically defined area drained by a stream where all outflow is directed to a single point.
- Catchment area of any point: The limits from where surface runoff will make its way, either by natural or man-made paths, to this point.
- Dual drainage: The major/minor approach to street drainage.
- Legal point of discharge: one or more places to which stormwater runoff is required to be directed to drain from an allotment so as not to cause a nuisance (e.g. due to discharge volume) for the downstream environment, as confirmed or accepted by the consent authority as part of any DA. In urban areas it is usually an existing or permissible point of connection (junction) to the existing piped drainage network. In undeveloped or low density areas discharge to an existing gully or watercourse may be acceptable, subject to design of appropriate outlet and scour protection works.
- Major system: The network of planned and unplanned drainage routes providing safe, well-defined overland flow paths for rare and extreme storm runoff events. It includes roads, natural channels, streams, culverts, community retention/detention basins and other facilities.
- Minor system: The gutter and pipe network capable of carrying and controlling flows from frequent runoff events. It includes kerb and channels, inlet structures, open drains and underground pipes and on-site detention facilities.
- Primary treatment SQID: Removal of the majority of gross pollutants and coarse-medium grained sediments by screening or sedimentation, e.g. GPT's, trash racks, sediment trap.
- Redevelopment site: A site that had (or was originally zoned to have) a lower density development than is proposed.
- Secondary treatment SQID: Removal of the majority of coarse, medium and fine grained sediments, as well as a significant proportion of the pollutants attached to sediments, by enhanced sedimentation and filtration, e.g. infiltration basins and wet ponds.
- Stormwater management plan: A plan to manage the stormwater quantity and quality within a catchment and protect receiving water features, such as the protection of existing waterways, lakes and wetlands.
- Sub-catchment: A topographically defined area drained by a tributary or branch drain of a primary stream, river or main draining catchment.
- Tertiary treatment SQID: Removal of the majority of sediments, attached pollutants and dissolved pollutants by sedimentation, filtration and biological uptake, e.g. constructed wetlands.
- Time of concentration: The time required for storm runoff to flow from the most remote point on the catchment to the outlet of the catchment or to the inlet of a drainage structure within the catchment.
- Treatment train: Sequencing of SQID's to optimise treatment performance.
- Trunk drains: Large capacity channels or conduits which carry runoff from local street drainage systems to receiving waters including natural or artificial channels, transitions and hydraulic structures, culverts and road crossings, naturally occurring ponds and lakes, artificial detention or retention storages.
- Water sensitive urban design: Design principles aimed at improving the sustainable management of the urban water cycle. It integrates the planning and design of urban water cycle, water supply,

waste water, stormwater and groundwater management, urban design and environmental protection.

2 PRE-DESIGN PLANNING

2.1 PLANNING

Stormwater management

Reference: See www.stormwater.asn.au/storm.asp for further information on stormwater management systems and techniques.

Requirement: Integrate management activities at the catchment, waterway and local development level in conformance with the NWQMS Document 10 and the following:

- Restore existing stormwater systems.
- Minimise the impacts of stormwater from new developments.
- Hydrological: Minimise the impacts of urbanisation on the hydrological characteristics of a catchment including wet weather and low flows. Mitigate pre-development inappropriate flows where practical.
- Water quality: Minimise the amount of pollution entering the stormwater system and remove residual pollution by implementing stormwater management practices.
- Vegetation: Maximise the value of indigenous riparian, floodplain and foreshore vegetation.
- Aquatic habitat: Maximise the value of physical habitats to aquatic fauna within the stormwater system.
- Processes for management: Document infrastructure and processes for management for the following as applicable:
  - Runoff.
  - Water quality.
  - Riparian vegetation.
  - Watercourse and aquatic habitat.
  - Urban bushland.
  - Bridges and culverts across waterways.

Water sensitive urban design: Plan and design stormwater drainage using WSUD principles including the following:

- OSD.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- Use of vegetation for filtering purposes.
- Water-efficient landscaping.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for re-use.
- Localised wastewater treatment systems.

2.2 CONSULTATION

Council and other Authorities

Requirements: Consult with the Council and other relevant authorities during the preparation of design. In addition to the requirements of this worksection, identify the specific design requirements of these authorities.

Public consultation

Requirements: Undertake public consultation on design in conformance with Council policy.

Utilities service plans

Existing services: Obtain service plans from all relevant utilities and other organisations whose services exist within the area of the proposed development. Plot these services on the relevant drawings including the plan and cross-sectional views.

Location of subsurface utilities: To AS 5488.1 and AS 5488.2.

Requirements for utility services: To the SOCC *Guide to codes and practices for streets opening*.

DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia to identify underground pipe and cables. See www.1100.com.au.

Calculations

Certified design calculations: Engage a qualified hydrologic and hydraulic design professional to perform all required calculations.

Major structures

Certified structural design: Engage a professional engineer for all bridges, major culvert structures and specialised structures in conformance with *0010 Quality requirements for design*.

3 DESIGN CRITERIA – STORMWATER DRAINAGE SYSTEMS

3.1 GENERAL

Design life

Stormwater infrastructure: Design the stormwater water infrastructure for the following effective service life expectancy:

- Concrete kerb and gutters: 70 years.
- Stormwater pipes, pits and other structural elements: 100 years.
- Open ~~concrete-lined~~ stormwater channels: 100 years.

Reference: ARR Book 1 Chapter 5 Table 1.5.2.

Risk based design

General: To ARR Book 1 Chapter 5.

Design objective

Requirements: Design stormwater drainage for the development with the following objectives:

- Reduced frequency of flooding of private and public buildings in flood-prone areas.
- Control of surface flows to prescribed velocity/depth limits.
- Control of surface flows to minimise the effect on pedestrians and traffic in more frequent stormwater conditions.
- Retention of incident rainfall and runoff consistent with the planned use of the area, within each catchment.
- Efficient conveyance of stormwater and surface runoff from public and private property to ensure public safety and property protection.
- Controlled rate of stormwater discharge to reduce downstream flooding and environmental impacts by making maximum use of open spaces and other available areas to detain drainage.
- Ensure that the design capacity of downstream drainage systems is not compromised.
- Minimise construction and maintenance costs and avoid the need for future property acquisition;
- Protection of the environment from adverse impacts of development by stabilising the landform, controlling erosion and maintaining/enhancing regional water quality.
- Climate change considerations to ARR Book 1 Chapter 6.
- Protection of aquatic biota and riparian vegetation.
- Meet water quality objectives and incorporate the principles of Water Sensitive Urban Design.
- Ensure low maintenance and economically sustainable in the long term in relation to operation, maintenance and replacement costs.
- Conformance with the Australian Rainfall & Runoff (ARR) major/minor system concept.
- A constant ARI for existing and reconstructed works.

Control of erosion and sedimentation

Requirement: To *0022 Control of erosion and sedimentation (Design)*.

Design for stormwater harvesting and re-use

Reference: The Commonwealth Department of Environment provides *Australian guidelines for water recycling – stormwater harvesting and reuse*. Also see NSW Department of Conservation *Managing urban stormwater – harvesting and reuse*.

General: Design for re-use of locally generated roof water, stormwater.

Stormwater re-use scheme: Design the re-use scheme for ease of operation and maintenance. Consider the following when designing for collection, storage, treatment and distribution:

- End use requirements for water quality and quantity.
- Reliability of supply.
- Estimated demand for water with regard to peak flow.
- Assessment of water balance for sizing and storage.
- Storage requirements considering average annual volume and diversion flow rates.
- Treatment system based on:
  - Diversion flow rates before storage.
  - Distribution flow rates both before and after storage.

Statutory approvals: As required by any DA consent conditions.

Roof water: Provide an integrated design with rainwater tanks, coordinate with the appropriate engineering consultation and conform to Statutory and local authority requirements.

Materials: Consider quality of runoff from the roof which depends on:

- Roofing materials.
- Types of materials deposited on the roof.
- Roof maintenance.

Stormwater runoff: Design for the utilisation of stormwater runoff at the following scales:

- Allotment scale.
- Subdivisional/regional scale. This includes conveyance of water through controls such as grass swales, bioretention strips, natural waterways, open ponds, and constructed wetlands.

Stormwater collection

Requirement: Design the stormwater collection (harvesting) system to meet the following objectives:

- Extraction of sufficient water to meet the end use requirements without compromise to downstream aquatic eco systems.
- Ability to stop collection in the event that stormwater is contaminated by an incident within the catchment (e.g. first flush capture and treatment or bypass, manual shutoff or bypass valve).
- Minimisation of the risk and/or impact of upstream flooding.

Stormwater storage

Requirement: Design the stormwater storage system to meet the following objectives:

- Storage of sufficient water to balance supply and demand.
- Minimisation of mosquito habitat (virus control), risks to public safety and risks to water quality in above-ground storage.
- Maximisation of dam safety.
- Consider storage design elements including the following:
  - Location.
  - Storage type.
  - Water quality in storage.
  - Human health and safety risks.
  - Operations and maintenance.
  - Spillway design and dam safety.

Stormwater treatment

Treatment: Design appropriate stormwater treatment techniques to meet the following objectives:

- Minimisation of public health risks for the adopted public access arrangements.
- Minimisation of environmental risks.
- Additional end use requirements and stormwater quality criteria: as required by any applicable DCP clauses for the type of development (e.g. residential, irrigation use, industrial, drainage to watercourse or aquifer recharge) and the DA consent conditions.

Reference: Also see Austroads AP-R232 on treatment for stormwater runoff from roads and infrastructure.

Stormwater distribution

Requirement: Minimise the potential for:

- Contaminant inputs downstream of the final treatment facilities.
- Public exposure to untreated stormwater.
- Cross-contamination with mains water distribution networks or confusion with mains water supplies.

Irrigation: Design the irrigation system to the following requirements:

- Minimise run off, groundwater pollution and soil contamination.
- Minimise spray to areas outside the access control zone to reduce public health risks, if access control is adopted.
- Application rate of stormwater: Uniform for the irrigation scheme and less than the nominal infiltration rate to avoid surface runoff.

3.2 HYDROLOGY

Design rainfall data

Flood estimation: Use rainfall-based procedures to ARR Book 1 Table 1.3.2.

Design IFD: Derive rainfall relationships for a particular catchment from the below:

- ARR Book 2, Chapter 3.
- AS/NZS 3500.3 Appendix E.
- Bureau of Meteorology IFD tool website www.bom.gov.au.
- Geoscience Australia website www.ga.gov.au.

Record IFD: Document the adopted IFD data used in the hydrological calculations to the sample summary sheet in Annexure A.

Design ARI: To the Road Classification Tables in **AUS-SPEC 0041 Geometric sealed road design** worksection (if applicable) and the following:

- ARR.
- Austroads AGRD05.

Minor system AEP design: Design the public drainage minor system to cater for storm events with annual exceedance probabilities as follows:

- In residential, industrial and commercial zones: To the AEP given in the Road classification Table 1 at Annexure M5 in the *0041 Geometric sealed road design* worksection.
- Road reserves in rural and rural-residential zones: To Road classification Table 2 in worksection 0041 Annexure M5.
- 1 year for parks and recreation areas.

Major systems: are to be designed for an event with AEP of 1%.

Record ARI: Document the adopted ARI data in the hydrological calculations to the sample summary sheet in **Annexure A – Record of design requirements** (or a design report) and submit with the design.

Catchment area

Catchment definition: To Austroads AGRD05A clause 2.6.3. If detailed survey of the catchment is not available, determine the extent of the catchment area from current topographical mapping, aerial photographs or field survey. Verify whether the catchment area has been modified by roadworks or earthworks.

Site inspection: Verify catchment boundaries by site inspection.

Catchment area land use: Establish catchment area land use based on current available zoning information.

Record: Document the design to the **Catchment areas plan**.

Methods of analysis

Peak flows: Determine ~~using Rational Method Calculations~~ in conformance with ARR Book 3 and the requirements of this worksection.

Regional flood frequency estimation: To ARR Book 3, Chapter 3.

Flow studies: Prepare flow studies including the following:

- A relevant range of AEPs for each sub-catchment.

- Calculation of total flows at junctions of existing drainage works.
- Assessment of allowable flows from catchment/sub-catchments for release to downstream areas or drainage systems.
- Assessment of release from dams/detention works affecting capacity of drainage works to avoid surcharge/inundation.
- For large catchments determine accurate levels of predicted flow rates, peak flow rates using a recognised runoff routing computer model to produce hydrographs.

Run-off coefficients: To the following:

- ARR.
- AS/NZS 3500.3 clause 5.4.6.

Record: Document details of adopted coefficients in the hydrological calculations summary sheet in Appendix A.

Percentage impervious: To the ARR for specific locations and zonings.

Time of concentration: Conform to the following:

- Minimum: 5 minutes.
- Maximum in a urban area: 20 minutes unless sufficient evidence is provided to justify a greater time.

Note: ARR Book 5 Chapter 6 gives guidance on calculating time of concentration. Provide local data and/or computation method to be used in estimating this component of the design. The time of concentration varies in urban and regional areas and it includes:

- Overland flow time across natural and paved surfaces.
- Time of flow in gutters and natural channels.
- Time of flow in pipes and channels.

Flow time: If the flow path passes through areas having different flow characteristics or includes property and roadway, calculate the flow time of each portion of the flow path separately.

Flow paths to pits: Document the flow path for each collection pit for the fully developed catchment on the catchment area plan. Consider the following:

- Fencing.
- Potential locations of buildings.
- Changes to individual flow paths due to the full development of the catchment.
- Proposed detention works.

Pipe and channel flow: Calculate pipe flow using the following:

- Mannings formula: To Austroads AGRD05A clause 6.6.11 or AS/NZS 3500.3 Table 5.4.9.
- Colebrook-White formula To Austroads AGRD05A clause 6.6.11 or AS/NZS 3500.3 Table 5.4.11.2.

Note: Colebrook-White formula is used in computer modelling where conduits are designed to act under pressure. HGL must not be above the surface level at any pit otherwise overflow will occur. Minimum freeboard: 150 mm.

Mannings roughness co-efficient (‘n’) for specific zonings: To the following.

- ARR Book 6 Chapter 2 Table 6.2.1.
- Austroads AGRD05A Table 5.3.

Modelling

Model type required for design: As per any applicable DA consent conditions.

Hydrologic parameters

General: Define hydrologic parameters in models, considering the following:

- Select all parameters used in hydrological models, including antecedent conditions, initial and continuing losses, Areal Reduction Factors, Design rainfall information (IFD depths), percent imperviousness and temporal patterns, in conformance with the values adopted as part of Council’s catchment wide Flood Study for the study area.
- Consider likely changes to individual catchment areas due to the development of the catchment. Base catchment area land use on current available land zonings or proposed future land zonings where applicable.
- Submit documentary evidence of the all selected parameters.

- Submit a hydrological report stating all the parameters used to calculate the flows.

Alternative models and computer analysis

General: Use of other hydrological models or computer analysis is permitted. If using alternative models or computer analysis, conform to the following:

- Satisfy the requirements of ARR.
- Submit summaries of calculations.
- Submit details of all program input and output together with accompanying catchment and layout plans, for hydrological, hydraulic and water quality models with the detailed engineering plans.
- Submit copies of the final data files. Provide justification if the values other than those recommended are used.
- Calibrate all computer models against the results of Councils adopted design flood information if available, otherwise against other historical flood information available within the catchment.

3.3 HYDRAULICS – GENERAL

General

Major/minor drainage concept: To ARR Books 6 and 9 and Austroads AGRD05A.

Hydraulic calculations: Engage a suitably qualified Hydraulic Engineer for the hydraulic design and the impacts of hydraulic grade line adopted for the design.

Hydraulic grade line (HGL)

General: Use the HGL analysis to design the stormwater drainage system for the following:

- All existing and proposed street, public and inter-allotment stormwater drainage system.
- Any extension, relocation, diversion of existing public/council's stormwater drainage system.
- Any connection to the existing public/council's stormwater drainage system.
- Conduct the analysis as an overall system and not in isolation.
- Consider the hydraulic influences of the upstream and downstream system and the hydraulic losses, as a result when stormwater passes through conduits, inlet structures, junctions and outlet structures.

Calculations: To ARR Book 9 Chapter 5.

Record: Document hydraulic calculations to the sample summary sheet given in Appendix A including the following:

- A summary of design calculations.
- Detailed drawings of the grade line.
- Listing of all program input and output.

Downstream control: Adopt the appropriate downstream water surface level requirements from the following options:

- Known HGL level from downstream calculations including pit losses at the starting pit in the design event.
- If the downstream starting point is a pit and the HGL is unknown, adopt a level of 150 mm below the invert of the pit inlet in the downstream pit.
- If the outlet is an open channel and the design storm is a minor event, the top of the outlet pipe is the downstream control.
- If the outlet is an open channel, the design storm is a major event and downstream flood levels are not known, the top of the outlet pipe is the downstream control.
- If the outlet is an open channel, the design storm is a major event and downstream flood levels are known, the downstream control is the ARI 100 years flood level.

Water surface limits: Limit the water surface in drainage pits as follows:

- Inlet pits: To 150 mm below the gutter invert.
- Junction pits: To 150 mm below the underside of the lid.

3.4 HYDRAULICS – MINOR SYSTEM

Criteria

Gutter flow width:

- Minor systems: To Austroads AGRD05A Table 5.1.

- Major systems: To Austroads AGRD05A Table 5.2.

Conduit sizes: Minimum conduit sizes as follows:

- Pipes: 375 mm diameter.
- Box culverts: 600 mm wide x 300 mm high.

Velocity limits: To Austroads AGRD05A Table 6.2.

Note: Velocity > 4 m/sec may affect pipe surface and generate friction losses increasing backwater levels. Consult with pipe manufacturer.

Pits

Inlet pit spacing: To Austroads AGRD05A clause 5.3.4 and as follows:

- Inlet efficiency is not effected by adjacent inlet openings.
- Locate at the upstream side of allotments, if possible.

Inlet capacity: Kerb inlet lengths to side entry pits as follows:

- Preferred maximum: 3.0 m.
- Maximum 5.0 m where the grade is 10% or more.
- Maximum 4.0 m where the grade is less than 10%.

Note: For information on inlet capacities refer to industry guides and for information on pit relationships refer to ARR.

Allowable inlet capacities for pit blockage table

Condition	Inlet type	Percentage of theoretical capacity allowed
Sag	Side entry	80%
Sag	Grated	50%
Sag	Combination	100% Side inlet capacity only – Grate assumed completely blocked
Continuous Grade	Side entry	80%
Continuous Grade	Grated	50%
Continuous Grade	Combination	90%
Source: ARR Book 9 Table 9.5.1 or Austroads AGRD05A Table 5.4.		

Access chambers with integrated surface inlet gully pits: Provide as follows:

- For maintenance access.
- At changes of direction, grade level or class of pipe.
- At junctions.

Access chamber spacing table

Condition	Pipe size (mm)	Maximum spacing (m)
Generally	Less than 1200	100
	Greater than 1200	150
In tidal influence	All	100
Source: Austroads AGRD05A clause 6.3.1.		

Hydraulic losses

Pressure change coefficient K: To ARR and industry guides, including adjustments for the following variables:

- Reduction due to benching.
- Pipe bends.
- Clashes with existing sewer mains.
- Pipe junctions without an inlet structure.

Computer program default pressure change coefficient: Do not use unless consistent with the coefficient given in ARR or industry guides.

Record: Document the chart adopted and relevant coefficients to the hydraulic summary sheet included in Appendix A and on the final design drawings.

Submissions: Before detailed design, submit for approval with sufficient information to permit evaluation the following:

- Proposed pipe bends.
- Pipe junctions without an inlet structure.
- ~~Contraction from larger upstream to smaller downstream pipes.~~

Pipe friction: Design drainage pipe systems as follows:

- An overall system including upstream and downstream systems, not as individual pipe lengths.
- A gravity system flowing full at design discharge. Pressurise with the use of appropriate pits and joints.

Pipe sizing: To the Colebrook-White formula and roughness coefficients to ARR Book 6 Chapter 2 Table 6.2.3 or AS 2200.

Service entry requirements: For roof and subsoil pipes from private properties entering Council's system, conform to the following:

- Pipe inlets larger than 225 mm: Enter the main pipe system at junction pits, finish flush and grout the sideline into the pit wall.
- Smaller inlets: Break into the drainage pipes for interconnection with the main line, finish flush and grout the sideline into the main line.

3.5 HYDRAULICS - MAJOR SYSTEM

Criteria

Surcharging of drainage systems: Not permitted where the water depth is above the top of kerb, except for the following:

- Storm frequencies greater than ARI 20 year event and only across the road centreline where the road pavement is below the natural surface of the adjoining private property.
- Flow across footpaths, where there is no flooding of private property, if approved by Council.

Velocity/depth criteria: Conform to the following for the design of velocity depth product flow across the footpath and within the road reserve:

- For safety of children and vehicles:
  . Maximum depth of water: 0.2 m.
  . Maximum velocity x depth product flow: 0.4 m^2/s.
- For safety of vehicles only:
  . Maximum velocity x depth product flow: 0.6 m^2/s.
- Open channels: Use the maximum velocity x depth product criteria and provide safe egress points from the channel for the safety of children.

Freeboard: Design for minimum freeboard for floor levels and levee bank levels from flood levels in roadways, stormwater surcharge paths and open channels as follows:

- Roadways:
  . 0.3 m freeboard between the 100 year flood level and floor levels on structures and entrances to underground car parks.
  . 0.1 m freeboard between the ponding level of water in the road and the high point in the footpath if the road is in fill or overtopping of kerbs and flow through properties may occur.
- Stormwater surcharge paths: 0.3 m freeboard between the 100 year flood level and floor levels on structures and entrances to underground car parks.
- Open channels: 0.5 m freeboard between the 100 year flood level and floor levels on structures and entrances to underground car parks.

Roadway reserve capacity flows: Calculate roadway reserve capacity flow for each carriageway used in the catchment and apply storage correction for each type to Austroads AGRD05A clause 2.6.3.

Open channels

Design criteria: To ARR Book 6 Chapter 2, Austroads AGRD05B and the following:

- Contain the major system flow less any flow in the minor system allowing for blockage of the minor system.
- With smooth transitions and adequate access provisions for maintenance and cleaning.
- Open channels are permitted as follows:
  . To form part of the trunk drainage system.
  . To convey flows from a development site to the receiving water body, only if Council has approved the use of an open channel.

Channel roughness: Determine friction losses in open channels using Mannings ‘n’ values to ARR Book 6 Chapter 2 Table 6.2.1.

Safety of persons: Avoid the average velocity x depth product flow for the design flow rate being greater than 0.4 m^2/s. If a higher velocity x depth product is absolutely necessary, design in conformance with ARR to provide for the safety of persons (potentially including children) who enter the channel.

Side slopes on grassed lined open channels:
- Prefer 6H:1V.
- Maximum 4H:1V.

Channel inverts: Minimum cross slopes of 20H:1V.

Low flow provisions in open channels (man-made or altered channels): Provide as follows:
- Contain flows within a pipe system or concrete lined channel section at the invert of the main channel.
- Subsurface drainage in grass lined channels to prevent waterlogging of the channel bed.
- Width of concrete lined channel section equal to the width of the invert or at least to accommodate the full width of a tractor.

Hydraulic jumps: Design transition in channel slopes to avoid or accommodate hydraulic jumps without generating erosion.

3.6 MAJOR STRUCTURES

Criteria

Design ARI for major structures in urban areas, including bridges and culverts: 100 year ARI storm event without afflux.

Afflux and upstream inundation: Permitted if the increased upstream flooding is minimal and does not inundate private property.

Minimum clearance for passage of debris without blockage: 0.3 m between the 100 year ARI flood level and the underside of the superstructure.

Minimum floor levels of dwellings: 0.5 m freeboard above the 100 year ARI flood level in the basin.

Routing: Model flood routing to ARR.

Pipe and culvert bedding: Design to minimise permeability and provide cut off walls and anti-seepage collars as required.

Harvesting: Design stormwater harvesting options in locating diversion or detention systems.

Culverts

Culverts (either pipe or box section): To ARR and industry guides and for the following:
- Inlet and exit losses.
- Inlet and outlet control.
- Scour protection.

Basins

Critical storm duration: For each ARI, consider a range of storm events to determine the critical storm duration, the peak flood level and discharge from the retarding basin. Provide a graph showing the range of peak flood levels in the basin and peak discharges from the basin for the storms examined.

Storm patterns: Adopt storm patterns given in ARR and review the sensitivity to storm pattern by reversing the storm patterns.

Public safety issues: Design for the following:
- Side slopes: Maximum 1V:6H to allow easy egress.

- Water depths: Maximum 1.2 m in the 20 year ARI storm event. If greater depths are required, submit for approval, including the design of safety refuge mounds.
- Depth indicators for maximum depth in the basin.
- Protection for the low flow intake pipe to reduce hazards for any person trapped in the basin and prevent blockages.
- Signage of the spillway to indicate the hazard.
- No ponding of water on private property or roads.
- No planting of trees in basin walls.
- No basin spillway located directly upstream of urban areas.
- Safety fence design to AS 1926.1.

Approval by the dam safety committee: as required by DA consent conditions.

High level outlet:

- Capacity capable: To contain a minimum of 100 year ARI flood event.
- Hazard category: To ANCOLD Guidelines.
- Spillway design: To Clause 3.5 **Open channels**.
- Stilling basin dissipaters: Provide appropriate dissipaters at high velocity outlets to prevent erosion.

Salinity prevention:

- Design basins to prevent surface drainage water leaking to the subsurface, recharging groundwater in areas known to be affected by high water tables and/or salinity of ground water.
- If discharging to natural watercourses, conform to the requirements of the land and water resources authority for salinity levels
- Design the pipe system to contain the minor flow through the retarding basin wall.
- Outlet pipes: Provide rubber ring jointed with lifting holes securely sealed.

On-site stormwater detention

Stormwater detention: Required on work sites or redevelopment sites where under capacity drainage systems exist, or where required by DA consent conditions e.g. to ensure downstream post-development flows do not exceed pre-development flows.

Salinity prevention: Locate basins for stormwater detention, stormwater treatment or sedimentation purposes to avoid known areas of permanent or seasonal groundwater discharge to reduce recharge into the groundwater.

3.7 INTERALLOTMENT DRAINAGE

Criteria

Requirement: Provide interallotment drainage as follows:

- For every allotment that does not drain directly to the frontage street or a natural watercourse.
- Within an easement, minimum 1.0 m wide, in favour of the upstream allotments.
- Capacity for concentrated drainage from buildings and impervious surfaces on each allotment for flow rates to the design ARI for the minor street drainage system.

Runoff contribution to interallotment drains table

Development type	**% of lot area impervious surfaces**
Residential (Zone R2 Low Density)	40
Residential (Zone R1 General)	70
Industrial	80
Commercial	90

Pipes

Requirement: Design pipes to flow full at the design discharge without surcharging inspection pits.

Minimum longitudinal gradient: 0.5%.

Pipe materials: To the following:

- Fibre reinforced concrete pipes: Not acceptable within the road reserve. Where permitted, conform to AS 4139.

- Precast concrete pipes: To AS/NZS 4058.
- PVC pipes: Not acceptable within the road reserve. Where permitted, conform to AS/NZS 1254.
- Polypropylene pipes: Not acceptable within the road reserve. Where permitted, conform to AS/NZS 5065.
- Buried flexible pipes: Not acceptable within the road reserve. Where permitted, conform to AS/NZS 2566.1 and AS/NZS 2566.2.

Pipe joints: Rubber ring joints.

Pits

Requirement: Design pits as follows:

- Locate interallotment drainage pits at all changes of direction.
- Minimum 600 x 600 mm internal plan dimensions.
- Concrete with 100 mm thick walls and floor and 100 mm concrete lid finished flush with the surface of works.
- Depressed grated inlets are acceptable.
- To resist flotation for high water tables areas.

Sewer mains relationship

Interallotment drainage and sewer mains laid adjacent to each other: Design as follows:

- If the pipe inverts are approximately equal, space 1.5 m apart between pipe centrelines
- If the pipe inverts are not equal, submit the spacing for approval. Consider the zone of influence so that maintenance of one pipe need not affect the other. Detail crossing points to ensure both pipes are supported e.g. using brick/masonry spacers.
- Document sewer mains on the interallotment drainage plan.

3.8 GROSS POLLUTANT TRAPS (GPT) AND SEDIMENT TRAPS

Usage: GPTs and sediment traps (trash racks also) serve as a component of traditional conveyance drainage networks. Often GPTs are installed to address specific problems in existing drainage networks and must accommodate existing constraints. A WSUD approach to stormwater management reduces the need to employ GPTs. In a WSUD, approach GPTs are used as pre-treatments for measures such as wetlands and bioretention systems.

Types of GPTs include:

- Drainage entrance treatments.
- Direct screening devices.
- Non-clogging screens.
- Drainage pit inserts
- In-line filtration devices
- Outlet filtration devices
- Trash racks
- Sediment traps.

General

GPT/sediment trap location: Determine location and catchment size in conformance with EA ARQ clause 8.4 and the following:

- Complementary with the strategic catchment treatment objectives.
- Available space.
- Proximity to pollutant source areas.
- Outlet approach: Use a single device to treat a whole development precinct or large subdivision (nominally up to 20ha).
- Distributed approach: Target smaller individual catchments with many traps.
- Site constraints: Including topography, soils and geology, groundwater, space, access, odour problems, visual impacts, safety concerns and vermin.

GPT/sediment trap performance and type

Performance: To EA ARQ clause 8.5 including the following:

- Treatment objectives:

  . Gross pollutants: Remove litter and vegetation larger than 5 mm.
  . Sediment: Remove 90% of all material greater than 0.125 mm.
- Operating design flows: Treatable flow rate to be equivalent to 4EY flow. The inlet to the GPT shall be designed to bypass flows exceeding the 4 EY flow.
- Flood capacity: Analyse hydraulics of the drainage system including the headloss of the GPT and diversion weir under flood conditions. Review the design of the bypass system for impacts on the local drainage system and consequences on flooding.
- Trapped pollutant storage: Assess the pollutants that are likely to be collected and determine the holding capacity with respect to the maintenance operations and frequency.
- Maintenance requirements: Design the GPT for maintainability and operability including the following considerations:
  . Ease of maintenance and operation, minimising the requirement for multiple specialised expensive maintenance vehicles and equipment.
  . All weather access to the pollutant storage area for the most efficient maintenance vehicles and equipmentFrequency of maintenance.

Disposal of solid waste and management of liquid wastes during cleaningAssessment of GPT performance: Include in the maintenance program requirements for validating the GPT performance by field monitoring, physical laboratory models or computer simulation.

Selection of the GPT: To the EA ARQ Appendix 8A checklist and the following:
- Life cycle costing.
- Footprint and depth of the unit.
- Hydraulic impedance and requirements.
- Disposal costs.
- Occupational health and safety.

Hydrocarbon management: If required, design and size water/oil separators or interception devices in conformance with EA ARQ clause 9.7.

3.9 CONSTRUCTED WETLANDS

General

Treatment process: Determine in conformance with EA ARQ clause 12.3 and the following:
- Sedimentation.
- Filtration.
- Adsorption.
- Biological uptake.
- Pollutant transformation.
- Pollutant storage.

System design: Design the system in conformance with “Wetland Technical Design Guidelines – May 2017’ prepared by Water by Design, including the following:
- Hydrological effectiveness: Quantify the effects of the interaction between the following:
  . Volume of the detention system.
  . Hydraulic capacity of the outlet structure of the system.
  . Variability of runoff inflow to the system.
- Hydraulic efficiency: Control the flow patterns for uniform distribution throughout the system to provide optimal treatment on the inflow.
- Notional detention time: Not less than 48 hours.
- Facilitate and optimise water quality treatment processes.
- Locate ponds and wetland systems.
- Select treatment device or treatment train.
- Provide suitable pre-treatment GPT or sediment forebay
- Select wetland vegetation.

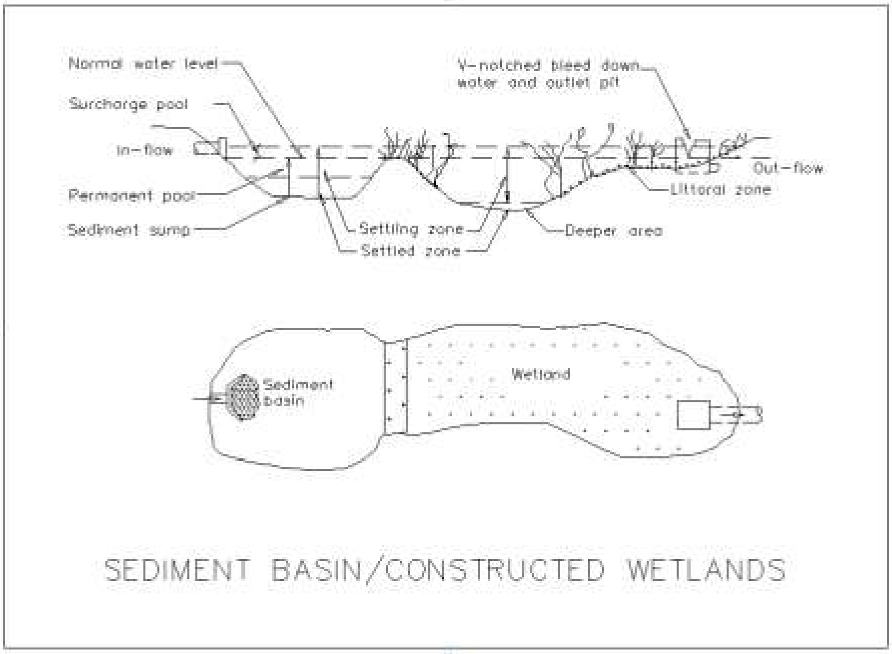

Figure: Sediment trap/constructed wetlands

3.10 BUFFER STRIPS, VEGETATED SWALES AND BIORETENTION SYSTEMS

Usage: Buffer strips and vegetated swales and bioretention systems help attenuate flow, reduce the frequency and volume of runoff delivered to receiving waters and remove pollutants.

Buffer strips

Urban catchments: Grassed areas that direct runoff from adjoining impervious areas to the stormwater discharge location.

Design: To “Water Sensitive Urban Design – Technical Design Guidelines for South East Queensland”, South East Queensland Healthy Waterways, or the latest version published by Water by Design and consider the following:

- Maximum slope: 5%.
- Maximum velocities: 0.4 m/s.
- Flow spreaders at locations where stormwater inflows are concentrated. .
- Vegetation density.
- Distribution/spread of stormwater over the buffer strip.
- Prevention of rill formation through properly designed entry conditions and vegetation.

Vegetated swales

Design: To “Water Sensitive Urban Design – Technical Design Guidelines for South East Queensland”, South East Queensland Healthy Waterways, or the latest version published by Water by Design.

Location: At any point in the catchment and as follows:

- At the top of a catchment to serve minor drainage requirements.
- Downstream in the catchment with a parallel underground pipe network.

Geometry: Trapezoidal or parabolic shapes.

Side slopes: No steeper than 1V:4H.

Longitudinal slope: 1 – 4%. If greater or less than 1 – 4%, conform to the following:

- Slopesbetween 4 and 7% design for check dams.
- Slopes less than 1%: Design for subsoil drains to prevent boggy conditions.

Maximum swale width: 2.5 m with a minimum base width of 1m.

Maximum flow velocity: Conform to the following:

- For 1 year ARI: 0.5 m/s.
- For 100 year ARI: 1.0 m/s.

Mannings 'n' value for turfed swales:

- For flow conditions where depth of flow is below the height of the vegetation: 0.15 to 0.3.
- For 100 year event: 0.03.

For other vegetation species e.g. native grasses, 'n' should be selected based on the type and density of the vegetation

Bioretention systems

Terminology: Bioretention systems are also called biofiltration systems or biofilters.

Design: To 'Bioretention Technical Design Guidelines Version 1.1 2014' prepared by Water by Design with 2 or 3 subsurface layers as follows:

- Base or drainage layer: Coarse and poorly graded material, placed to encase the perforated drainage pipe (no geofilter sock).
- Transition layer: Prevents filtration media washing into the perforated pipes.
- Filtration layer: Media through which water is filtered, typically consisting of sandy loam, consistent with the specifications contained in Adoption Guidelines for Stormwater Biofiltration Systems, Faculty for Advanced WATER Biofiltration, (Monash University, June 2009).

3.11 INFILTRATION SYSTEMS

General

Design: To 'Basic procedures for source control of stormwater – A handbook for Australian practice-, Argue et al, 2013, for the following:

- Unsuitable soils: Test soils for permeability and assess for suitability.
- Clearance distances to building footings and boundaries: To EA ARQ clause 11.3.1 for each soil classification.
- Shallow soil cover over rock: Test for permeability and assess geology for weathered or fractured rock.
- Steep terrain: Check soil depth on a downslope and assess suitability.
- Watertable interaction with infiltration systems: Check watertable stability and salinity for suitability and the presence of any aquifers that may interact.
- Watertable effected by upstream infiltration devices: Assess geology for any likely upstream infiltration devices that may limit retention.
- Aquifer recharge/retrieval annual balance: Assess for continual equilibrium of local potentiometric levels.
- Water quality inflows to infiltration devices: Runoff proposed to be infiltrated shall be treated to meet Council's targets prior to infiltration.

Flood control: On-site storage for flood control to EA ARQ clause 11.6.

Requirement: Submit calculations demonstrating the effectiveness of the infiltration device for successions of storms and hydrological effectiveness to EA ARQ clause 11.4.

3.12 DETAILED DESIGN

Conduits

Pipe bedding and cover: Conform to the following:

- Reinforced and fibre reinforced concrete pipes: To AS/NZS 3725.
- PVC pipes: To AS/NZS 2032.
- Polyethylene and polypropylene pipes: To AS/NZS 5065.
- Buried flexible pipes: To AS/NZS 2566.1 and AS/NZS 2566.2. Submit for approval for use.

Reference: The minimum cover over the pipe is based on the maximum superimposed loading for a particular application. Refer to AS/NZS 3725 Appendix B for RC pipes for further guidance on superimposed live loads due to construction traffic.

Location: Locate drainage lines in:

- Road reserves behind the kerb line and parallel to the kerb.
- Easements over private property centrally within the easement.

Bulkheads: Design bulkheads on drainage lines where the pipe gradient exceeds 5%, including details of the size and position in the trench and the spacing along the line.

Pits

Design: To Council's Standard Drawings.

Requirement: Provide as follows:

- Benching to improve hydraulic efficiency and reduce water ponding.
- Step irons and bicycle-safe grates for safe access and safety.
- Ventilation for pits and other confined structures requiring access for maintenance, inspection or repairs.

Stormwater discharge

Salinity prevention: Locate stormwater discharge to avoid recharging groundwater and creating or worsening salinity degradation of adjacent land.

Kerb and channel (gutter) termination: Extend kerb and channel (gutter) to drainage pit or natural point of outlet. Provide protection to prevent scour and dissipate the flow if outlet velocity is greater than 2.5 m/s or the kerb and gutter discharge would cause scour.

Recreation reserves: For piped stormwater drainage discharging to recreation reserves, conform to the following:

- Discharge through an outlet structure to a natural water course.
- Discharge into the nearest trunk stormwater line.

Drainage discharge onto area under the control of another statutory authority: Conform to the design requirements of that statutory authority.

Easements

Requirement: Identify points of discharge of gutters or stormwater drainage lines or any concentration of stormwater onto adjoining properties. Where third party properties are affected, obtain written permission to the discharge of stormwater drainage over the properties and the required easements prior to DA consent.

See also Clause M4.

Easement width:

- Minimum: 3.0 m.
- Maximum: To contain the full width of overland flow or open channel flow in the major system design event.

Trench subsoil drainage

Subsoil drainage in pipe trenches: If pipe trenches are backfilled with sand or other pervious material, provide the following:

- 3 m length of 100 mm diameter agricultural pipes, butt jointed with joints wrapped with geotextile, or slotted PVC pipe of subsoil drain in the bottom of the trench immediately upstream from each pit or headwall.
- Seal the upstream end of the subsoil drain with cement mortar.
- Discharge the downstream end through the wall of the pit or headwall.

Durability

Service life expectancy: To match or exceed the service life of the road, or as required by any DA consent conditions (whichever is greater).

Requirement: Design for the service life of the drainage system including the following:

- Thickness and type of base material of drainage structures including pipes and culverts.
- Life expectancy of the coating.
- pH and resistivity of water and backfill material.
- Presence of impurities including chloride, sulfate and aggressive CO_2 in the groundwater or soil.

Soil chemical testing: Determine as follows:

- pH level: Test backfill, soil and water to AS 1289.4.3.1.
- Resistivity: Test backfill, soil and water to AS 1289.4.4.1.
- Chloride, sulfate and aggressive CO_2 concentration: Test groundwater or soil extract to AS 1289.4.2.1.

Resistivity and pH: The severity of corrosive attack on steel structures may depend on the pH value and electrical resistivity of the soil surrounding the structure and on the pH value of the water in the stream.

Note: if the testing for pH and resistivity of water and the concentration of impurities is carried out at the design stage and it is deemed by the Principal Certifier to be current at the time of construction then the testing within **1351 Stormwater drainage (Construction)** worksection may not be necessary.

4 DOCUMENTATION

4.1 GENERAL

Approvals

Requirements: Document the approval conditions advised by the appropriate authority which contribute to the basis of the design of the stormwater drainage.

Design reports

Requirements: Provide a design report including the following:

- Design criteria.
- Site investigation reports supporting the design.

Calculations

Design: Provide a design report incorporating the criteria, computer studies, calculations and references supporting the design of the stormwater drainage.

Design certification

Requirement: Provide a signed and dated design certificate.

Final certification of completed works

Requirement: See Clause M3M3 in regard to the completion and handover process.

4.2 DRAWINGS

General

Requirements: Provide drawings and/or computer output defining the works and assumed operating and maintenance procedures.

Catchment areas plan

Catchment area drawings: Provide drawings showing the following:

- Contour interval: 1 – 2 m (closer if the area is very flat).
- Grade direction for kerb and gutter.
- General layout of the drainage system with pit locations.
- Catchment limits.
- Any other information necessary for the construction of the drainage system.

Scale 1:1000 or 1:5000.

Drainage system layout

Drainage system layout drawings: Provide drawings showing the following:

- Drainage pipeline location.
- Drainage pit location.
- Number and road centreline chainage.
- Size of opening.
- Drainage easements.
- Reserves and natural water courses.
- Location of buffer strips, vegetated swales and bioretention systems.
- Location and details of infiltration systems.
- Any other information necessary for the construction of the drainage system.
- If appropriate, combine with the road layout plan.

Scale 1:500.

Longitudinal section

Drainage system longitudinal sections: Provide drawings showing the following:

- Pipe size, class and type.
- Pipe support type to AS/NZS 3725 or AS/NZS 2032.
- Pipeline and road chainages.
- Pipeline grade.
- Hydraulic grade line.
- Any other information necessary for the construction of the drainage system.

Horizontal scale: 1:500.

Vertical scale: 1:50.

Open channels

Open channel cross sections: Provide drawings showing the following:

- The direction of the view of cross sections, normally downstream.
- Reduced levels to Australian Height Datum.
- Provide a data input file for the design flow rates.

Scale: 1:100.

Other documentation

Detailed drawings: Provide details including standard and non-standard pits and structures, pit benching, open channel designs and transitions to scales appropriate to the type and complexity of the detail being shown.

Submit hydrology and hydraulic summary sheets, in both PDF and native formats able to be interrogated using DRAINS, Microsoft Excel or WaterRide as appropriate.

Computer data files and output: Submit final hydrological and hydraulic computer data files.

Landscape plans and planting plans: Provide for buffer strips, vegetated swales and bioretention systems.

Work-as-executed drawings

General: Provide an additional set of final construction drawings for the purpose of recording the work-as-executed by the contractor. Mark up variations from the approved design using red pen.

Work-as-executed drawing format: in open digital (not requiring specific software) CAD format (DXF), as well as DWG and PDF copies.

4.3 SPECIFICATIONS

Construction documentation

Requirement: Prepare technical specifications using the AUS-SPEC Construction Templates from the National Classification System workgroups 02, 03, 11, 13.

5 ANNEXURE A

5.1 DRAINAGE DESIGN CRITERIA

Record of design requirements

General: The following table outlines the design criteria referenced in this worksection, and can form a checklist for information typically required to be documented.

Council's Handbook for drainage design criteria table

Design requirements	Worksection clauses
Design IFD rainfalls for specific locations and individual zonings	**HYDROLOGY / Design rainfall data**
Average recurrence interval (ARI)	**HYDROLOGY / Design rainfall data**
Sample summary sheet for hydrological calculations	**HYDROLOGY / Design rainfall data**
Run-off coefficients for specific locations and individual zonings	**HYDROLOGY / Method of analysis**
Percentages impervious for specific locations and	**HYDROLOGY / Method of analysis**

Design requirements	Worksection clauses
individual zonings	
Mannings roughness co-efficient ('n') for specific zonings	**HYDROLOGY / Method of analysis**
Sample summary sheet for hydraulic calculations	**HYDRAULICS - GENERAL / Hydraulic gradeline (HGL)**
Inlet capacities	**HYDRAULICS - MINOR SYSTEMS / Pits**
Pressure change coefficient K charts	**HYDRAULICS - MINOR SYSTEMS / Hydraulic losses**
Allowable reductions in coefficient K due to benching	**HYDRAULICS - MINOR SYSTEMS / Hydraulic losses**
Pit pressure change coefficient K at bends	**HYDRAULICS - MINOR SYSTEMS / Hydraulic losses**
Road reserve capacity flows to Austroads AGRD05A	**HYDRAULICS - MAJOR SYSTEMS/ Criteria**
Culvert Design Charts—inlet and exit losses, inlet and outlet control and scour protection	**MAJOR STRUCTURES / Culverts**
Pit design	**DETAILED DESIGN / Pits**
Service life expectancy	**DETAILED DESIGN / Durability**

6 ANNEXURE B - REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS/NZS 1254	2010	PVC (UPVC) pipes and fittings for storm and surface water applications
AS 1289		Methods of testing soils for engineering purposes
AS 1289.4.2.1	1997	Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1289.4.3.1	1997	Soil chemical tests - Determination of the pH value of a soil - Electrometric method
AS 1289.4.4.1	2017	Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials
AS 1926		Swimming pool safety
AS 1926.1	2012	Safety barriers for swimming pools
AS/NZS 2032	2006	Installation of PVC pipe systems
AS 2200	2006	Design charts for water supply and sewerage
AS/NZS 2566		Buried flexible pipelines
AS/NZS 2566.1	1998	Structural design
AS/NZS 2566.2	2002	Installation
AS/NZS 3500		Plumbing and drainage
AS/NZS 3500.3	2018	Stormwater drainage
AS/NZS 3725	2007	Design for installation of buried concrete pipes
AS/NZS 4058	2007	Precast concrete pipes (pressure and non-pressure)
AS 4139	2003	Fibre-reinforced concrete pipes and fittings
AS/NZS 5065	2005	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
AS 5488		Classification of Subsurface Utility Information (SUI)
AS 5488.1	2019	Subsurface utility information
AS 5488.2	2019	Subsurface utility engineering
ANCOLD	2017	Guidelines on acceptable flood capacity for dams
Austroads AGRD		Guide to road design
Austroads AGRD05	2013	Drainage – General and hydrology considerations
Austroads AGRD05A	2013	Drainage – Road surface network, basins and subsurface
Austroads AGRD05B	2013	Drainage - Open channels, culverts and floodways

Austroads AP-R232	2003	Guidelines for treatment of stormwater runoff from the road infrastructure
ARR	2019	Australian rainfall and runoff (ARR) - A guide to flood estimation
CPAA		Hydraulic design manual for precast concrete pipes.
EA ARQ	2006	Engineers Australia - Australian runoff quality: a guide to water sensitive urban design
SOCC Guide	2018	Guide to codes and practices for streets opening
NWQMS Doc 10	2000	National Water Quality Management Strategy: Australian guidelines for urban stormwater management

7 ANNEXURE M – MIDCOAST COUNCIL SPECIFIC CLAUSES

M1.	Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's *Development Engineering Handbook*. Acceptance is to be obtained in writing from: a) an authorised representative of Council's Director of Infrastructure and Engineering Services, or b) an accredited certifier where they are the Principal Certifier and hold the relevant accreditation category for the type of work.	**Variation procedure**
M2.	This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail.	**DA conditions**
M3.	Refer to the MidCoast Council *Development Engineering Handbook* for final inspection, works-as-executed and handover requirements.	**Completion**
M4.	(See Clause *3.12 Easements*) Easements and drainage reserves must be wide enough to fully contain the major system (overland) design flow, to avoid potential impacts on future buildings or sensitive uses. Concept (DA) plans are to demonstrate that easements will be able to meet all detailed design requirements.	**Easement flow widths**

8 AMENDMENT HISTORY

0	30/11/2020	First Published