Snowy Valleys Council

PLANNING AND DESIGN MANUAL

Adopted – 27 September 2019

DOCUMENT CONTROL SHEET

Snowy Valleys Council 76 Capper Street Tumut NSW 2720 Telephone: (02) 6941 2555 www.svc.nsw.gov.au	**Document:** Planning and Design Manual
	Title: Planning and Design Manual **Project Manager:** John Maxwell, Manager Assets & Design **Authors:** Terry Alford
	Synopsis: The document sets out the planning processes and design standards for the construction of subdivisions and civil infrastructure within the Snowy Valleys Council.

CONSULTANTS DISTRIBUTION SCHEDULE

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Draft 1		Ben Lawson by email, 9 July 2009	
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SCHEDULE OF ADOPTION

Version No.	Date	Comment	File Reference

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0011 DEVELOPMENT & SUBDIVISION OF LAND

Foreword

This Guideline is divided into five sections:

- Introduction
- Application Process
- Council Requirements
- Engineering Requirements
- Provision for Sale of Allotments

Each section has a description of the processes and requirements necessary to progressively taking the reader from the decision to subdivide and develop land to the stage where land allotments can be sold.

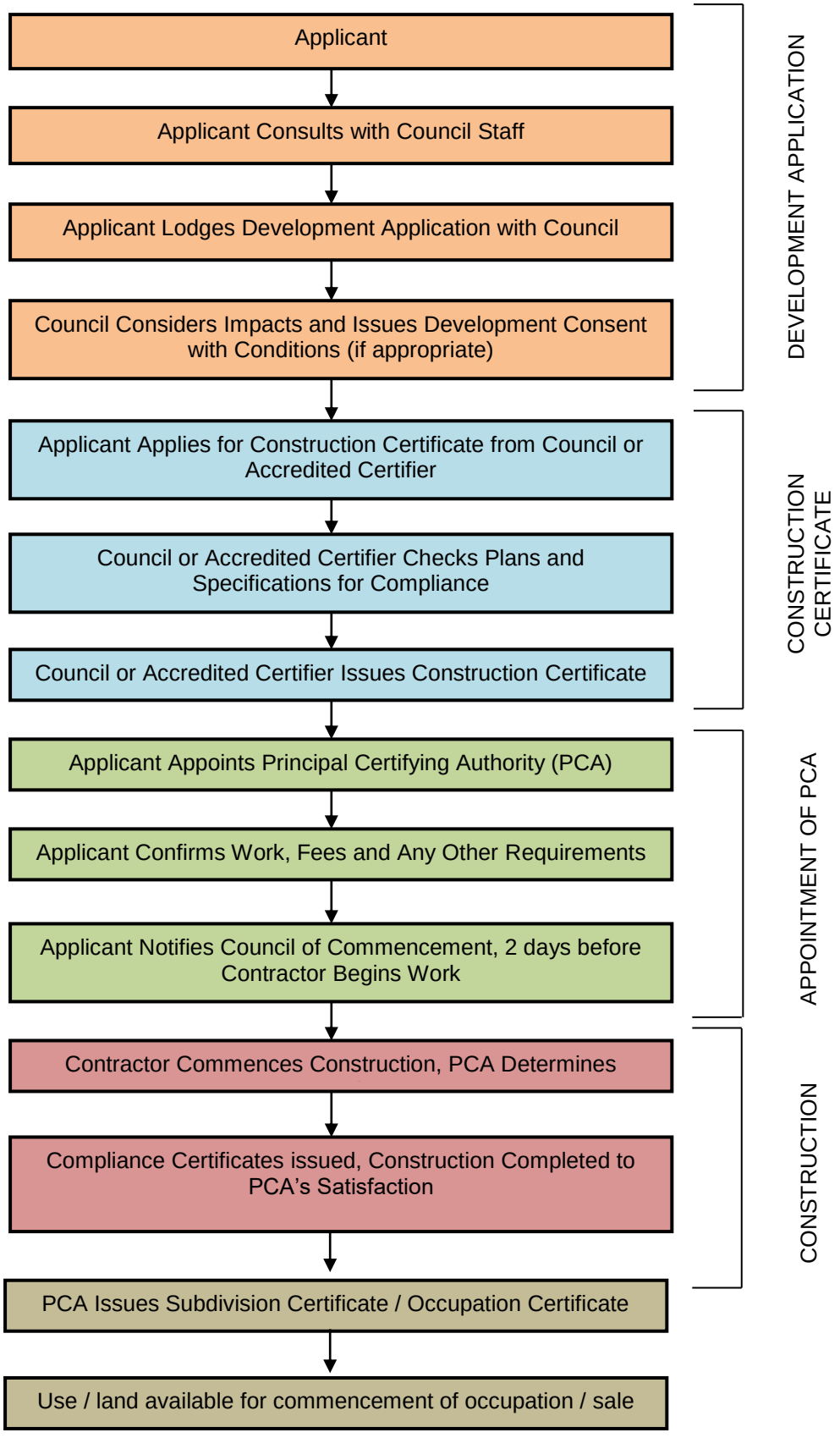
This Guideline provides an introduction to other documentation prepared to manage Development/Subdivision matters. Other documents include:

- Department of Urban Affairs and Planning (DUAP)
  - . Guiding Development – better outcomes
  - . State Environmental Planning Policies (SEPPs)
  - . Regional Environmental Plans (REPs)
- Council
  - . Local Environmental Plans (LEPs)
  - . Section 94 Contribution Plans
  - . Development Control Plans (DCPs)
  - . Councils Policy Manual
  - . Strategic Development Control Guidelines
  - . Development Application Form
  - . Construction Certificate Application Form
  - . Subdivision Certificate Application Form
  - . AUS-SPEC Development Design Specifications (*Planning and Design Manual*)
  - . AUS-SPEC Development Construction Specifications (*Construction – Road and Subdivision* and *Construction - Water and Wastewater*)

Subdivision development was previously controlled by the Local Government Acts of 1919 and 1993. In 1998 this control was incorporated into the Environmental Planning and Assessment Act (as amended) and coincided with the introduction of private certification by accredited certifiers. This edition reflects these changes.

This Guidelines provides an outline of the procedures to be followed and refers to most standards and requirements. It is not intended to be comprehensive or totally definitive. Council's Local Environmental Plan, Development Control Plan, Policies, various State Legislation, Design Specifications and Construction Specifications, as well as DUAP's publication 'Guiding Development', provide necessary additional information.

1 INTRODUCTION



FLOW DIAGRAM I – OVERALL PROCESS

1.1 COUNCIL'S AIMS, OBJECTIVES, ETC.

Council has the following objectives in providing for the development and subdivision of land:

(1) The principal aims of the Local Environment Plan (LEP) are to provide planning controls for the Council to update and consolidate into one instrument the various planning instruments which applied to this area when this plan commenced.

(2) The general aims of the LEP are:

(a) to encourage the proper management, development and conservation of natural and man-made resources within Council by protecting, enhancing or conserving:

(i) prime crop and pasture land,

(ii) timber, minerals, soil, water and other natural resources,

(iii) areas of high scenic, recreational or nature conservation value, and

(iv) places and buildings of archaeological or heritage significance, including Aboriginal relics and places, and

(b) to help facilitate growth and development of the Council in a manner which is consistent with the aims specified in paragraph (a) and which:

(i) minimises the cost to the community of fragmented and isolated development of rural land,

(ii) facilitates the efficient and effective delivery of amenities and services,

(iii) facilitates a range of residential and employment opportunities in accordance with demand,

(iv) facilitates farm adjustment, and

(v) ensures that the efficiency of arterial roads is not adversely affected by development on adjacent land.

(3) The particular aims of the LEP are:

(a) to divide land into the zones referred to in clause 8 and to achieve in respect of land within each of those zones the objectives specified for that land in the Table to clause 9,

(b) to protect the agricultural production potential of rural land, particularly where land is designated as being of prime crop and pasture potential,

(c) to provide for the continued needs of tourism,

(d) to encourage the provision of employment opportunities for local residents,

(e) to provide a variety of residential environments to cater for differing lifestyles and needs,

(f) to promote and enhance the viability of existing commercial and industrial centres within the Council

(g) to recognise the financial constraints likely to be encountered by the Council in the provision, maintenance and augmentation of additional and existing services required for an expanding and relocating population, and

(h) to ensure that the Council gives due regard to the effect of natural hazards upon development.

1.2 COUNCIL'S AUTHORITY

Council is the authority responsible for consent to development and approval of developments and subdivisions within the Snowy Valleys Council area.

Council has declared Development Control Plans (DCPs) and Local Environmental Plans (LEPs) that set out Council's necessary provisions for development and subdivision.

In some circumstances Council is required to obtain the concurrence of the Department of Urban Affairs and Planning, and Council must also comply with particular legislative requirements.

Compliance with the provisions of Council's DCPs and LEPs does not necessarily imply that Council is required to consent to, or approve, an application.

1.3 RESTRICTIONS TO COUNCIL'S ACTIVITIES

Restrictions to Council's powers to approve the subdivision of land are set out in the various planning instruments, Local Environmental Plans (LEPs), State Environmental Planning Policies (SEPPs), etc which are applicable throughout Council's Area. Advice as to which of these restrictions apply to a property should be initially obtained from Council's Planning/Engineering/Environmental/Services Section.

1.4 DEVELOPMENT AND SUBDIVISION PROCESSES

Development Application and Consent

A Development Application is a requirement of the Environment Planning and Assessment Act (1979) requesting consent for the proposed development in relation to Council's controls and requirements, e.g., land use, community facilities, traffic generation, environmental considerations, etc. It is important to understand that development consent is required before land can be developed or subdivided. Council in some cases identifies minor development as Complying or Exempt Development. Detail of these minor developments and the requirements of the approval process may be obtained from Council.

Engineering Construction Certificate (ECC)

Following Development Consent being issued by Council, the more detailed requirements of the development or subdivision are investigated during the preparation of construction/engineering designs and other matters for completion as tabled in Council’s conditions of consent. A Construction Certificate is required before any works may be commenced.

Construction Certificates are issued by a consent authority (Council or the Minister for Planning) or an accredited certifier and allows Developers to nominate Council or a private certifier as the Principal Certifying Authority (PCA).

Compliance Certificates

Compliance Certificates are issued in relation to the completion of all or various components of a development. The PCA shall identify each stage of work to be provided with certification.

Occupation Certificates

Prior to the occupation of a new building (excluding a Class 1a or 10 building under BCA), an Occupation Certificate is to be acquired. The PCA shall upon receiving a Compliance Certificate for the various aspects of the development, provide an Occupation Certificate.

Subdivision Certificates

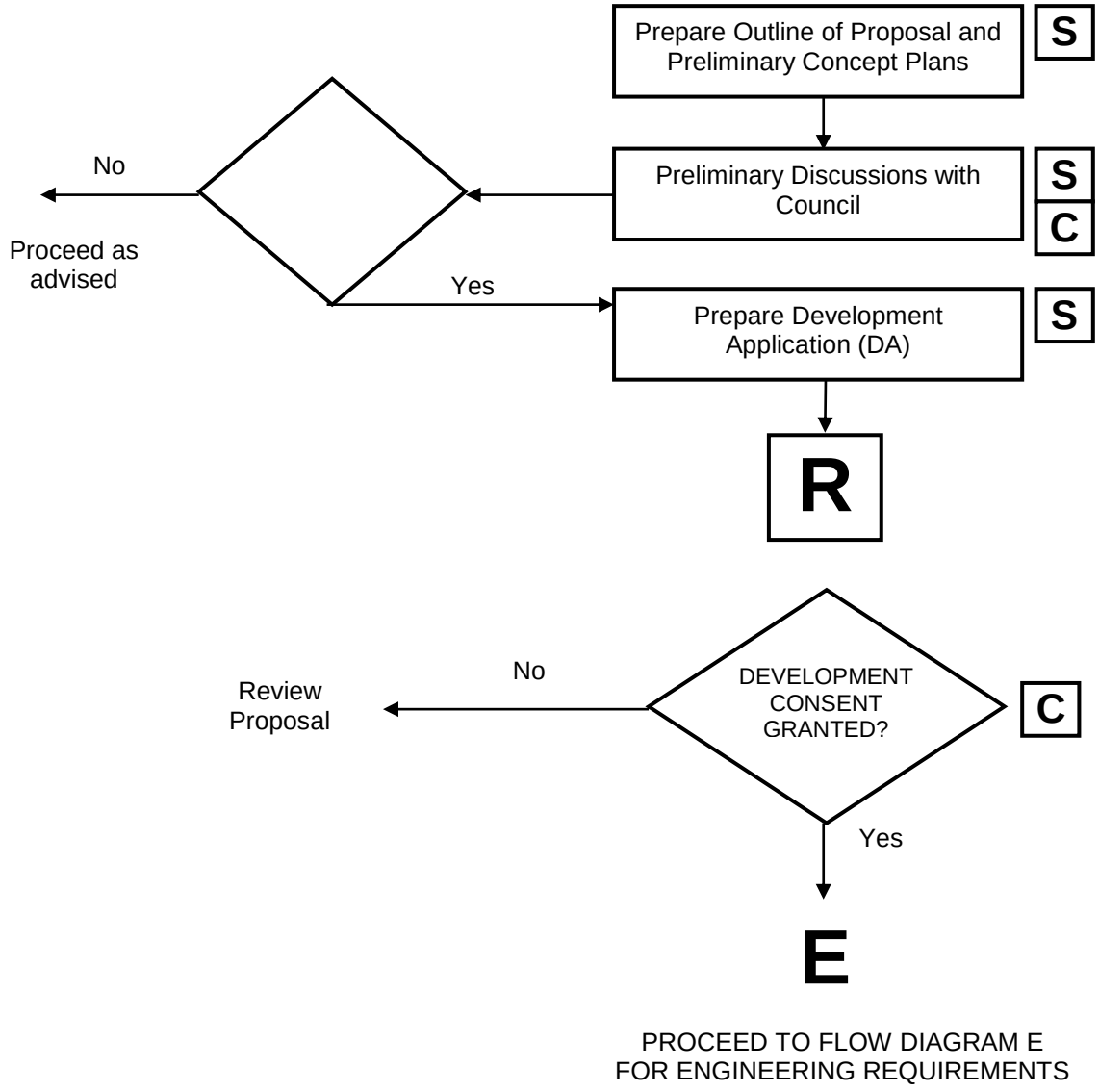
In the case of subdivision, a Subdivision Certificate is issued by the PCA endorsing the plan of subdivision and any associated instruments when all aspects of the Development Consent have been satisfied including the Plan Registration and the Title Issue. The issue of a Subdivision Certificate occurs upon completion of all conditions and payment of fees/levies as required in the Development Consent.

Councils have varying standards for the strict compliance of works or staging of developments. Council's DCP's, Policies and Standards identify any departures that may be accepted.

Plan, Registration and Title Issue

Following endorsement of the final plan of subdivision, the Developer may lodge the plan for registration by the Land Titles Office at Land and Property Information NSW. Separate titles for the new lots created will subsequently be issued.

2 APPLICATION PROCESS



LEGEND

S denotes Applicant (Developer / Subdivider) responsibility

C denotes Council responsibility

R denotes proceed to Flow Diagram R for consideration of Council's Requirements (R)

FLOW DIAGRAM A - APPLICATION PROCESS

2.1 FORMULATING A DEVELOPMENT/SUBDIVISION APPLICATION

Development Application Form

A person or company making application to develop and/or subdivide an area of land within Snowy Valleys Council's area will be required to lodge a Development Application on Council's standard application form, and accompany this form with supporting information that is detailed in **Council requirements for the Development Application**.

Site Information

Before formally applying to Council to develop and/or subdivide, a considerable amount of information about the site needs to be sought. The Applicant should be aware of the nature of title of the land, easements, items of heritage significance, topography, slope and aspect, stormwater flows, surrounding development, vegetation, trees, road and traffic situations and other physical characteristics pertinent to the design of the development.

Early Consultation

It is recommended that a preliminary consultation with Council will enable the Applicant to determine what Council and State environmental planning instruments (SEPP, REP or LEP) are applicable, what zone classification applies and which legislative requirements are applicable and most importantly whether professional assistance is required.

Concept Plan

It is advantageous to prepare a preliminary Concept Plan at this early stage indicating the location, aspect and size of the various elements of the development including subdivision patterns surrounding the site. Appendix 2 is an example of a Concept Plan. The more information shown on the preliminary Concept Plan, the more likely the consultations with Council and others will give a true indication of possible success with a subsequent formal application.

Purpose of Consultation

The purpose of consultation about preliminary Concept Plans/proposals (which may be accompanied by explanatory reports or background material) is to:

- Assess whether any modifications to the proposal are necessary prior to its being formally submitted;
- Identify Council's requirements in regard to the particular Development Application;
- Identify any problems which may necessitate the Applicant reviewing his/her approach;
- Indicate Council's likely subsequent requirements (eg financial contributions for services and amenities, standards for construction, for the asset to be accepted by Council, etc.).

Consultation is Not Mandatory

While consultation with Council at this early stage and the preparation of preliminary Concept Plans is not mandatory, it is obviously in the Applicant’s interest. It will reduce costs in preparing plans, increase the likelihood of Development Consent, and reduce the time the Council needs to consider the formal application. Similarly early consultation with Public Utility Authorities is also advantageous to ascertain their requirements, eg , gas, telephone, electricity.

Fees/Contributions

Fees for Development Applications are prescribed in the Environmental Planning and Assessment Regulations. A fee schedule can be obtained from Council including fees/contributions that are not prescribed, but are likely to be required as a condition of Development Consent.

2.2 MAKING APPLICATION FOR DEVELOPMENT/SUBDIVISION

Development Application Information

A Development Application is only required if stated in the environmental planning instrument(s) applying to the land (SEPP, REP or LEP). Minor development and subdivisions such as boundary adjustments that meet specified standards do not require consent. All the necessary information should have been compiled in consultation with Council. Whilst formulating the application and preparing the development/subdivision Concept Plan, a description of the existing and proposed site and a statement of environmental effects should be included.

Owner's Approval

The written authority of the owner is required to be submitted with the application form if the application is not by the owner of the land to be developed.

Development Application Form

A Development Application is required for all types of subdivision and all forms of building construction not identified by Council as being Exempt or Complying Development. Development Applications are made on Council's standard Development Application form that is included in these Guidelines as Appendix 1.

Number of Plan Copies

Development Applications are to be accompanied by three (3) copies of development/ subdivision Concept Plans drawn on one of the following paper size sheets, A1, A2, A3 or A4. For Concept Plan requirements, refer to Section R of these Guidelines.

Details of Consultation with Public Authorities

In addition, the Applicant may be required to provide details of consultation with public authorities responsible for provision, alteration or amplification of utility services required by the proposed development/subdivision.

Additional Information

Council may require additional information about the proposed development to be provided where that information is essential to the assessment of the Development Application.

Additional information required may include:

- principles, assumptions and calculations behind stormwater drainage and on-site detention (OSD) proposals;
- rationale for the design of utilities, roads, open space, bicycle and pedestrian ways, bus routes, etc;
- a contamination assessment. (SEPP 55)
- evaluation of housing types, house type distribution, building lines, fencing, building materials etc.

R During preparation of the Application, the Applicant must incorporate the Council requirements. Refer to **Council requirements for the Development application** for more detailed information.

2.3 COUNCIL'S CONSIDERATION OF APPLICATIONS FOR DEVELOPMENT AND SUBDIVISION

Assessment Criteria

Council will deal with each application on its merits, however, the assessment criteria in the Environmental Planning and Assessment Act 1979 (Section 79C) shall be applied.

These criteria relate to site specific relevant matters such as:

- The provisions of any environmental planning instruments, development control plans and regulations pertaining specifically to the subject site;
- Natural and built environmental impacts;
- Social and economic environmental impacts;
- Suitability of the site;
- Public interest.

Design Standards

Council's LEP, DCPs and other planning instruments incorporate minimum design standards for different types of developments. These standards should not be interpreted as relieving the Applicant of the responsibility to properly address all criteria and to use sound planning and engineering practices in the development of designs. Council is prepared to consider alternative approaches to development/subdivision design where the Applicant satisfies Council that its objectives have been achieved.

Determination within 40 days

Planning legislation requires Council to determine applications within 40 days of receipt of the application, or 60 days where the application requires referral to other authorities. Upon determination of any application, a written notification will be sent to the Applicant stating that consent has been granted subject to detailed conditions, or that consent has been refused (with reasons).

Re- consideration

Where an Applicant is dissatisfied with the determination of an application, a request for review of the application or of particular conditions of consent may be lodged by the Applicant as specified in Section 82A of the EP & A Act 1979. The request for reconsideration must be lodged within 28 days of determination. A reconsideration fee will be required and details of the reasons for reconsideration must be submitted with the request.

Appeal to Court

Alternatively (and preferably as a last resort), the Applicant may lodge an appeal with the Land and Environment Court. Such an appeal is required to be lodged with the Court within twelve months of receipt of Council's determination of the application.

Appeal by Third Party

Applicants are reminded that any third party person may lodge an appeal to the Land and Environment Court where they believe a breach of the EP & A Act (1979) has occurred (Section 123 of the EP & A Act).

Revocation of Consent

Council can revoke or modify consent in circumstances where there is fraud or failure to comply with the Local Government Act (1993) or conditions of consent. The Environmental Planning &

Assessment Act 1979, Orders also allows Council to issue orders for breaches of the EP&A Act such as non compliance with conditions of consent.

Development Consent Received

Once an application for development or subdivision receives consent, the Applicant becomes the Developer.

2.4 TIME REQUIREMENTS FOR DEVELOPMENT/SUBDIVISION WORKS

Maximum 5 Year Limit on Development Consent

A Development Consent for development/subdivision requires works to be commenced within the consent period of five years (or such other shorter period stipulated in the consent). The development/subdivision should be fully completed within a reasonable period or as directed by Council.

Staged Development

In some cases a development may be of sufficient magnitude that it requires staging. Where staged development is proposed, the Applicant should prepare a Concept Plan showing the complete concept so that Council can see the various stages in the overall context. Each stage should comply with the standard requirements.

Subdivision Final Survey Plan and Original Plan Release Fees

When all conditions of Development Consent and Construction Certificate approval have been satisfied, the Developer will arrange for a Registered Surveyor to prepare the final survey plan. This "original" plan, plus 3 copies, together with any Section 88B Instrument under the Conveyancing Act (detailing easements, restrictions, etc.) is submitted to the PCA with the appropriate fees for the PCA's endorsement of the Subdivision Certificate.

Private Certification

Council may allow the private sector to issue subdivision certificates by identifying, in its Local Environmental Plans, the type of subdivision that can be privately certified.

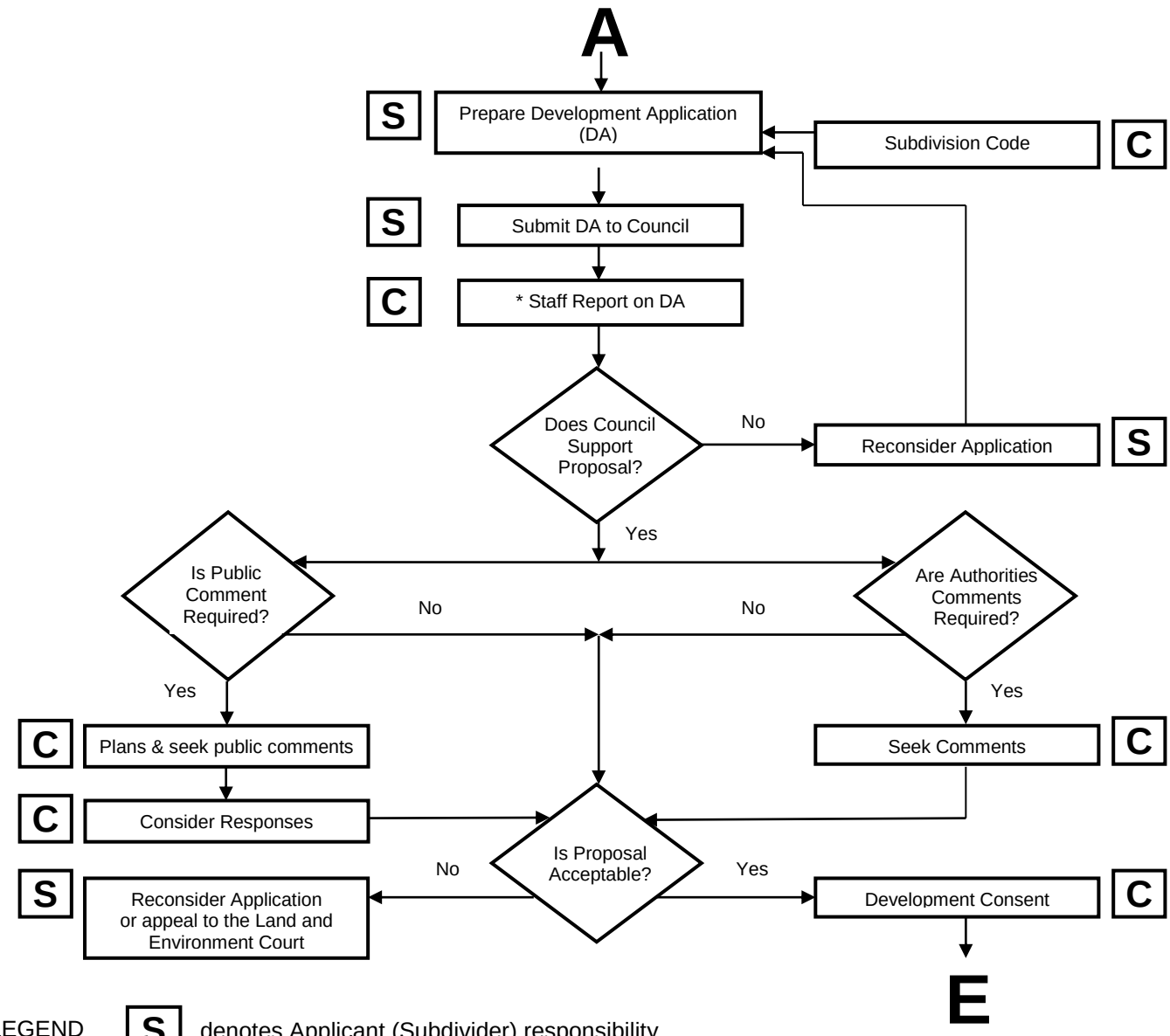
Section 88B Instrument

The original plan plus one copy, together with any Section 88B Instrument, all personally signed by the PCA, are then released to the Developer.

Issue of New Titles

In order to effect plan registration and the issue of new titles for the proposed subdivision lots, the documents released should be lodged promptly with Land and Property Information NSW (Land Titles Office).

3 COUNCIL REQUIREMENTS FOR THE DEVELOPMENT APPLICATION



LEGEND

S denotes Applicant (Subdivider) responsibility

C denotes Council responsibility

E denotes proceed to Flow Diagram E for Engineering Requirements (E)

NOTE: * Council's Staff Report Considerations include.

- Environmental Assessment
  - . is an Environmental Impact Statement (EIS) or Review of Environmental Factors (REF) required?
  - . is a geotechnical or hydrological report required?
  - . is a tree preservation or heritage preservation an issue?
- Zoning requirements.
- Infrastructure requirements (roads, water, sewer, drainage).
- Easements.
- LEP & DCP compliance

FLOW DIAGRAM R - COUNCIL DEVELOPMENT APPLICATION CONTROL AND REQUIREMENTS

3.1 ENVIRONMENTAL CONSIDERATIONS

Statement of Environmental Effects

A Statement of Environmental Effects is required for most development applications for development / subdivision. This statement normally addresses such matters as:

- Suitability of the land
- Access
- Traffic generation
- Risk of flooding or other natural hazard
- Flora and fauna
- Local amenity
- Waste management
- Threatened Species Act
- Filling/earthworks
- Erosion and sediment control/soil and water management

For further details contact the Development & Environment Department of Council.

Tree Preservation

The development/subdivision Concept Plan shall identify vegetation that is significant to the overall landscape of the area. Trees to be removed shall also be identified on the Concept Plan.

Trees are not to be pruned, damaged or removed without the prior consent of Council.

Lodging of Bond

Any significant tree/s identified by Council shall be protected at all times during excavation and/or construction, and Council may require the Developer to lodge a bond at the time of Construction Certificate approval, to be forfeited in the event that the trees are either damaged or removed. Any such bond is to remain in force for a period of six (6) months after the issue of the Compliance Certificate for a component of the work, Occupation Certificate or Subdivision Certificate whichever is applicable. Bonds will only be granted in accordance with Council's Development and Maintenance Bond Policy No. 3.66.

Heritage Items - Aboriginal and other Relics

In general any sites of Aboriginal carvings or relics or sites significant to heritage for other reasons shall be identified in the application. The National Parks and Wildlife Service should be contacted for details and verification.

All recognised heritage items, including natural features of the site and man-made buildings, works and sites are to be identified and retained, wherever possible. For Heritage items identified in Council's LEP development consent is required for alterations, additions or development. The Heritage Council should be contacted for details and verification. Adequate curtilage is to be retained around any heritage item to protect its setting.

3.2 DEVELOPMENT / SUBDIVISION REQUIREMENTS - URBAN RESIDENTIAL AREAS

Full Service including Kerb & Gutter (Channel)

Urban residential land is defined as land within areas zoned residential, village or township. Applicants will be required to provide fully serviced subdivisions including the provision of a sealed road system with drainage, and kerb and gutter to adequately and safely provide both vehicular and pedestrian access to each allotment.

The Applicant will be required to meet the full cost of kerb and guttering across all existing road frontages of any development/subdivision in urban areas except where direct vehicular access is restricted.

Roads adjoining a reserve are to be provided with kerb and gutter to adequately and safely provide both vehicular and pedestrian access. Footpaths may also be required as tabled within Councils standards.

Lot Size

There are statutory requirements and Council requirements pertinent to lot sizes, lot widths, building line setbacks etc, and the supply of services to allotments. Council sets out these requirements for each zone type. The designer of a subdivision is required to provide for the requirements of Council's LEP/DCPs. Council will have requirements on access to developments/subdivisions with the objectives of:

- Providing for flow of through traffic with least disruption;
- Establishing a hierarchy of roads in accordance with function and usage;
- Providing a variation in alignment to allow for existing natural features and create interest in the streetscape;
- Providing a network of safe pedestrian and cycle paths.

Legal easements of width as determined by the Council Codes are to be provided over stormwater drains and watercourses.

Water and Sewerage

Applicants will be required to augment and meet the full cost of water and sewerage reticulations, as arranged with Council, within developments/subdivisions plus the cost of connecting to existing services.

Electricity/Gas

Electricity/gas services are to be extended to the development/subdivision in accordance with the requirements of the relevant electricity/gas Authority and at full cost to the Applicant. Underground electricity services will be required except where it can be shown that it is not appropriate.

Communication

Applicants will be required to provide for Communication facilities within the design. Where underground electricity is used, underground telephone facilities are also to be provided by the applicant.

Stormwater Runoff

Urban stormwater runoff will need to be assessed in terms of satisfactory performance both within the development and external to the development to a legal point of discharge.

3.3 DEVELOPMENT / SUBDIVISION REQUIREMENTS - RURAL RESIDENTIAL AREAS

Kerb & Gutter

Rural residential land defined as rural homesite and hobby farm land may require kerb and guttering and underground stormwater drainage in accordance with Council’s Kerb and Gutter Policy No. 3.22. Concrete lined table drains shall be required where scour velocities are exceeded and/or the soils are susceptible to erosion from stormwater.

Lot Size

There are statutory requirements and Council requirements pertinent to lot sizes, lot widths, building line setbacks etc and the supply of services to allotments. Council's DCPs, LEP or other adopted standard set out these requirements for each zone type. The designer of a subdivision is required to comply with the requirements of Council's Development Control Plans (or Interim Development Orders) LEP and various Acts of State Legislation.

Sewerage

Where the development is in near proximity to an existing sewered area or where, in the opinion of the Department of Health or Council's Health and Building Department, the land is unsuitable for site disposal of effluent, sewerage will be required. A geotechnical report to support sewerage treatment proposals is to accompany an application for this type of development. Effluent disposal will normally be by way of an appropriate on-site method.

Natural Features

The configuration of the subdivision is to have consideration for natural features such as rivers, creeks, topography of the land, tree groupings and prominent natural features. The design should also consider buffers for conflicting land uses, water courses, etc.

Sensitive Environments

Sites considered to be environmentally sensitive, such as estuarine wetlands, rainforests, dunal areas, steep slopes and flood prone lands will not be considered for subdivisional development.

SEPP 46 identifies the protection and management of native vegetation in rural areas, in addition to the Threatened Species Act.

3.4 DEVELOPMENT / SUBDIVISION REQUIREMENTS - RURAL DEVELOPMENT AREAS

Rural Land

Rural land is defined as that land other than urban and rural residential and land generally comprising larger holdings. Applicants will be required to provide an approved road system to provide a functional and safe vehicular access to the development or each allotment.

The designer of a development / subdivision is required to provide for the requirements of Council's Subdivision Code and Development Control Plans.

Sealing of Roads

Bitumen sealing of the road system will be required on all new roads and existing roads which will be an extension of existing sealed roads unless specified otherwise by Council. Council will not approve the development / subdivision of lands proposing non-dedicated road access (ie. right-of-ways will not be permitted where subdivision to create new allotments with an entitlement to erect a dwelling house is proposed irrespective of the type of access arrangements currently servicing the land.

Minor subdivisions in isolated rural areas require a reasonable standard of all-weather access road suitable for all year round access for essential services, i.e., school bus, ambulance, etc. Each proposal will be considered on its merits in accordance with the following guidelines:

- The status of the road.
- Existing road surface condition.
- Cost of upgrading.
- Flooding frequency and hazards of creek or river crossings.
- Potential population catchment.

- Bush Fire Hazard.

Electricity

The extension of electricity mains to each allotment within the subdivision is required. However, subdivisions in areas remote from electricity mains may be relieved of this requirement, if special circumstances prevail and details of such circumstances are submitted to Council by the Applicant, together with the written agreement from the electricity supply authority.

3.5 DEVELOPMENT / SUBDIVISION REQUIREMENTS – INDUSTRIAL/ COMMERCIAL AREAS

LEP

The Local Environment Plan identifies various types of commercial and industrial zones. All proposed commercial and industrial subdivisions would be anticipated to be located in these zones. It is essential that early consultation with Council Officers is sought to determine that the proposed development/subdivision is in an allowable zoning and is in conformity with Council's planning principles for the area.

Lot Size

The Applicant should provide for a range of lot sizes for the needs of large as well as small developments. Any lot should be large enough for parking and landscaping as well as the specific industrial or commercial use. Industrial developments/subdivisions should generally comply to the standards suggested in the State Planning Authority Technical Bulletin No. 6 "Design and Standards for New Industrial Areas" (June 1974). Both commercial and industrial subdivisions will need to comply with the Development Control Plan (DCP) for the area.

Pavement for Heavy Traffic

Engineering Road Design and Pavement Design will need to provide for heavy traffic conditions as specified in Austroads publication AGPT02/08 *: Guide to Pavement Technology - Part 2: Pavement Structural Design*. Parking to be provided in accordance with DCP3.

Water and Sewerage

Applicants will be required to meet the full cost of water and sewerage reticulations within developments/subdivisions plus the cost of connecting to existing supplies in accordance with the Council requirements.

Electricity

Electricity services are to be extended to the developments/subdivision and in accordance with the requirements of the relevant electricity supply Authority at full cost to the Applicant. Determination of the maximum loading of the electricity service, and whether the service is provided above ground or underground, will be made by the relevant electricity Authority and Councils acceptance. Street lighting shall be provided when required by Council.

Communications

Applicants will be required to provide for communication facilities within the development. Where underground electricity is used, underground telephone facilities are also to be provided by the Applicant.

Street Lighting

All roads created by the subdivision, intersections, and any traffic management devices shall be provided with street lighting in accordance with the requirements of AS 1158.1.1-1997, Road Lighting, Vehicular Traffic (Category V) Lighting, and AS 1158.1.3-1999, Road Lighting, Pedestrian Areas (Category P) Lighting.

When it is proposed to use street lighting poles and lanterns other than the standard poles and lanterns installed by the Electricity Supply Company, all such non standard lighting must accord with Snowy Valley Council Policy for Non Standard Lighting.

3.6 DEVELOPMENT/SUBDIVISION REQUIREMENTS - NATURAL HAZARD AREAS

Policies

The subdivision of flood prone land is to comply with the requirements of Council's Floodplain Management Policy and the New South Wales Government's Floodplain Development Manual, the Management of Flood Liable Land, 2001.

Adequate Flood Free Areas

Council will only support development/subdivisions of rural properties, part of which are flood prone, if in Council's opinion there are adequate flood free homestead and stock-holding areas on each allotment as well as access to higher ground. Development will not be allowed to significantly alter flooding patterns, accordingly development of internal roads etc will not be permitted to form significant embankments. Each case is to be treated on its merits.

Flooding in Urban Areas

The development/subdivision of urban land, other than boundary adjustments, will only be considered where it can be clearly demonstrated that flood free building sites/allotments can be provided and that the creation of these developments/allotments will not adversely affect flood patterns or levels in the area.

Bushfire Protection

Applicants will be required to provide suitable protection zones and access for fire fighting vehicles and maintenance vehicles so as to minimise the risk of bushfire damage as approved by the NSW Rural Fire Service and/or the NSW Fire Brigades.

3.7 PROVISION OF OPEN SPACE AND SECTION 94 CONTRIBUTIONS PLAN

Council's authority

Council's authority to impose conditions of contribution is derived from the Environmental Planning and Assessment Act 1997, Section 94. Accordingly Council's contribution requirements will be in accordance with an adopted "Section 94 Contributions Plan".

Public Reserve

In residential subdivision (both rural and urban) Council requires the creation of an area of public reserve (open space) useable for recreation, or payment of a monetary contribution in lieu of land or a combination of both.

Rural Public Reserve

Public reserve will not normally be required in rural subdivision, unless the subdivision contains significant areas of special scenic or public recreational value.

Contributions in Rural, Commercial, Industrial Subdivisions

In rural subdivisions, commercial or industrial subdivisions contributions of open space are less often required, however contributions towards upgrading roads, community facilities and bushfire protection will be required as determined by the appropriate "Section 94 Contributions Plan".

Applicants will also be required to contribute towards the augmentation of water supply and sewerage reticulation if reticulation is available to the development in the form of a Water and Sewerage Development Contribution Plan.

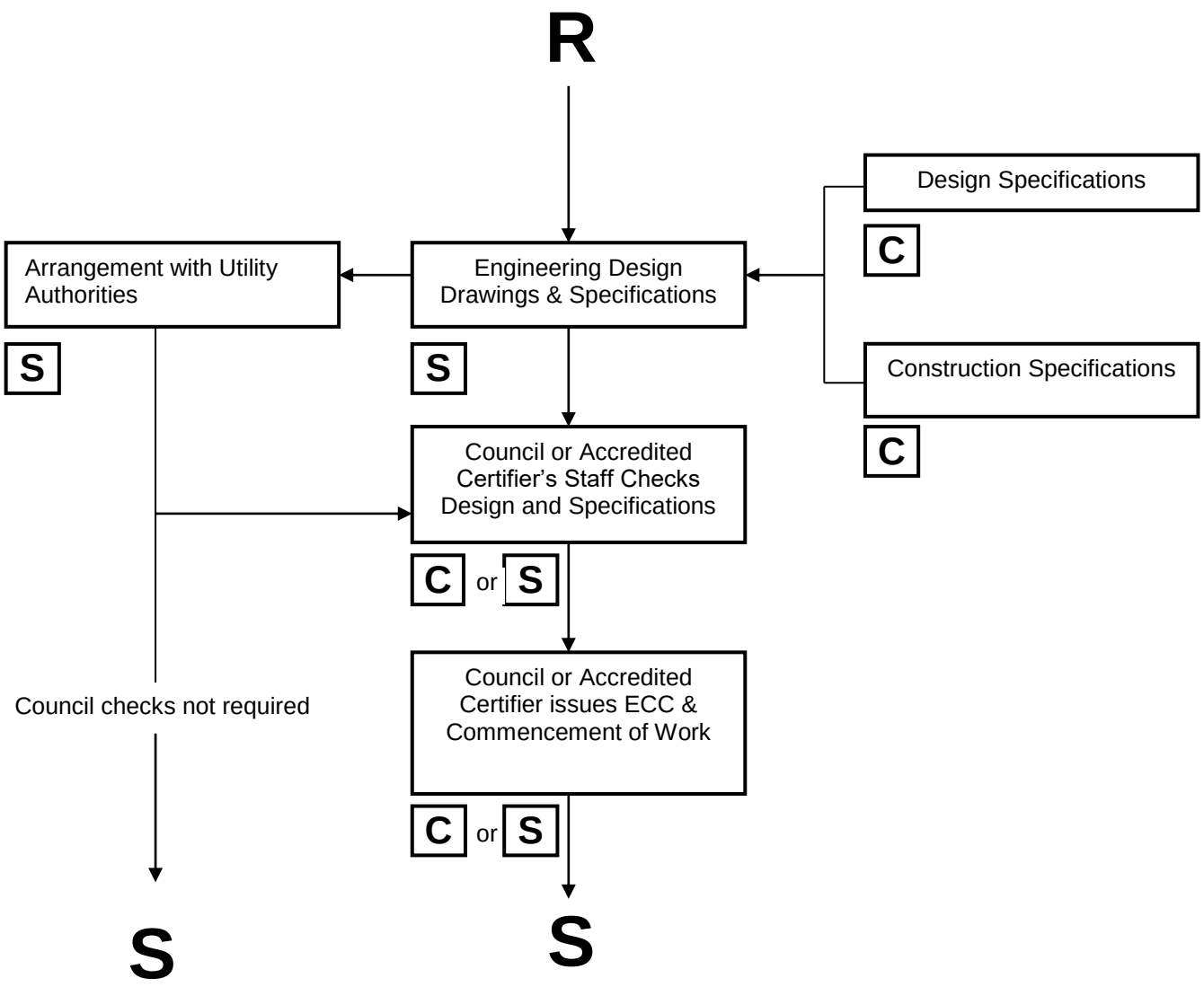
3.8 THE DEVELOPMENT/SUBDIVISION CONCEPT PLAN REQUIREMENTS

Plan Detail Required

The development/subdivision Concept Plans to accompany the Development Application Form shall show the following:

- Reduction ration (preferably 1:500 for subdivisions, 1:100 for structures/ developments).
- The location, boundary dimensions, site area and north point of the land.
- The existing vegetation and trees on the land (attention is drawn to Council's Tree Preservation Order).
- The location and uses of existing buildings on the land and adjoining properties. (Measured floor plans of existing buildings may also be necessary in order for Council to calculate floor space ratios.)
- Contours based on existing levels of the site (preferably one metre intervals drawn to Australian Height Datum).
- Any natural features of the site, including rock formations or cliffs, watercourses, flood levels, wetlands, forest areas and slip areas.
- Any existing drains, easements or rights-of-way affecting the site.
- Title description of land.
- Details of existing and proposed subdivision pattern (including the number of lots and location of roads).
- Any heritage items (buildings and sites), or relics defined by the Heritage Act or considered of local significance.
- Details of proposed access to the site and the legal status of that access.
- Other details relevant to consideration of the application.

4 ENGINEERING REQUIREMENTS



LEGEND

S denotes Applicant (Subdivider) responsibility

C denotes Council responsibility

S

FLOW DIAGRAM E - ENGINEERING REQUIREMENTS

4.1 ENGINEERING DRAWINGS AND SPECIFICATIONS

Qualification of Designers

All Drawings for earthworks (site regrading), roadworks, drainage works, water supply, and sewerage works are to be certified by a NPER Civil Engineer or Registered Surveyor accredited by the Institution of Surveyors for civil design in the appropriate area. All Drawings for bridgeworks, retaining walls, other major structures and pumping stations are to be certified by a Civil Engineer.

Council's Specifications

Standard Drawings, Design Specifications and Construction Specifications have been prepared by Council and are available for use in developments/subdivisions. Specifications other than those supplied by Council are required to be prepared by a Civil Engineer and will need to be submitted to the Principal Certifying Authority (PCA) for approval with each set of engineering Design Drawings. Such alternative specifications will be required to meet Council's minimum standards contained in Council's specifications.

In summary the requirements for Design Drawings are as follows:

- Earthworks (site regrading)
- Roadworks
- Road Pavement
- Road Furnishings
- Stormwater Drainage
- Water Supply Works
- Sewerage Works
- Landscaping Works
- Erosion Control Works

Works & Signage Management Plan (if required)

4.2 COMMENCEMENT OF WORKS

Necessary Conditions

No development/subdivision works are to be undertaken until the Design Drawings and Specifications are formally approved by Council or an Accredited Certifier with the issue of a Construction Certificate.

Quality Assurance

Development consent to the development/subdivision will stipulate that the development/subdivision is to be constructed as a "Quality Assured Contract" in which case a Quality Plan will need to be submitted to cover all construction works in accordance with Council's Contract Quality System Requirements Specification. Acceptance of the submitted Quality Plan will be required prior to commencement of Works.

Unauthorised Work for Water and Sewerage

The Developer must ensure that the Works are carried out in compliance with the Local Government Act 1993. Attention is drawn specifically to Chapter 16 Offences. Part 3 Clause 634(1) and (4) especially refer to unauthorised work for water and sewerage.

Water and Sewerage, Operating Requirements

The Developer must ensure that water and sewerage works abide by the Local Government Act and associated Regulations, in particular, Clauses 18 and 19 of the Local Government Act (Approvals) Regulation 1999 regarding complying with any operating requirements notified by the Council.

4.3 INSPECTIONS AND TESTING

Cost of Quality Testing

Whether the development/subdivision proceeds under Quality Assurance Contract or not, the full cost of all testing is to be met by the Applicant (Developer). Test results will be required to ensure that the material supplied and the Work carried out conforms with the approved specification.

Inspections

Similarly joint inspections at key stages of construction will be required to be carried out by representatives of both Works Certifier and the Developer/Contractor. All inspections shall require at least 24 hours prior notification to the Works Certifier. Key stages may include:

- Site regrading and clearing
- Installation of erosion control measures
- Preservation measures installed for trees, vegetation or heritage sites as determined
- Site sampling and testing
- Formwork and reinforcement prior to placing of concrete
- Drainage line installation prior to backfilling
- Water and sewer line installation prior to backfilling
- Subgrade preparation
- Establishment of line and level for kerb and gutter placement
- Road Pavement construction
- Road Pavement surfacing
- Final Inspection
- End of maintenance period

Records of Testing and Inspections

The Works Certifier will insist on uninterrupted access at all times so as to enable audit inspections or testing. Records of all test results required will be made available to the Works Certifier promptly when requested and tests will be undertaken strictly to prescribed test procedures by testing organisations approved by Council prior to work commencement. Certain stages of construction will be subject to a hold on works pending acceptable test results. See construction specifications for further details.

4.4 INSURANCES

Third Party Insurance Public Risk

The Developer's Supervising Consultant shall take out professional indemnity insurance indemnifying themselves. The Developer's Supervising Consultant will also provide the PCA with evidence that all Contractors have obtained appropriate third party and public risk insurance (minimum insured value $20 million) satisfactory to the PCA's requirements and prior to the commencement of any works.

4.5 WORK-AS-EXECUTED DRAWINGS

Certification

Following completion of the work, one full set of Work-As-Executed (WAE) Drawings in electronic format marked up in red showing any discrepancies from the design is to be submitted to and retained by Council. All WAE Drawings shall bear the Supervising Consultant's or Accredited Certifier's Certification stating that all information shown on the Drawings is accurate.

Council's Obligations, Water Services

For water supply WAE Drawings must allow Councils to meet their obligations under Clause 17 of the Local Government (Water Services) Regulation 1999.

4.6 QUALITY ASSURANCE PRINCIPLES

Quality Plan

The principles of Quality Assurance procedures will be applied by the Works Certifier to all subdivision works. In major or otherwise significant subdivisions the provisions of Australian Standard AS/NZS ISO 9001 (2000) will be required to be fully applied to the construction project. This will involve the submission of a Quality Plan for all Works associated with the project. The requirement to comply with AS/NZS ISO 9001 (2000) will be determined prior to the preparation of Design Drawings. In all cases the Works Certifier will require the Developer to organise and pay for inspection and testing services such that the Developer can validate the quality of all works and materials progressively during construction.

Accreditation for Water, Sewerage and Drainage

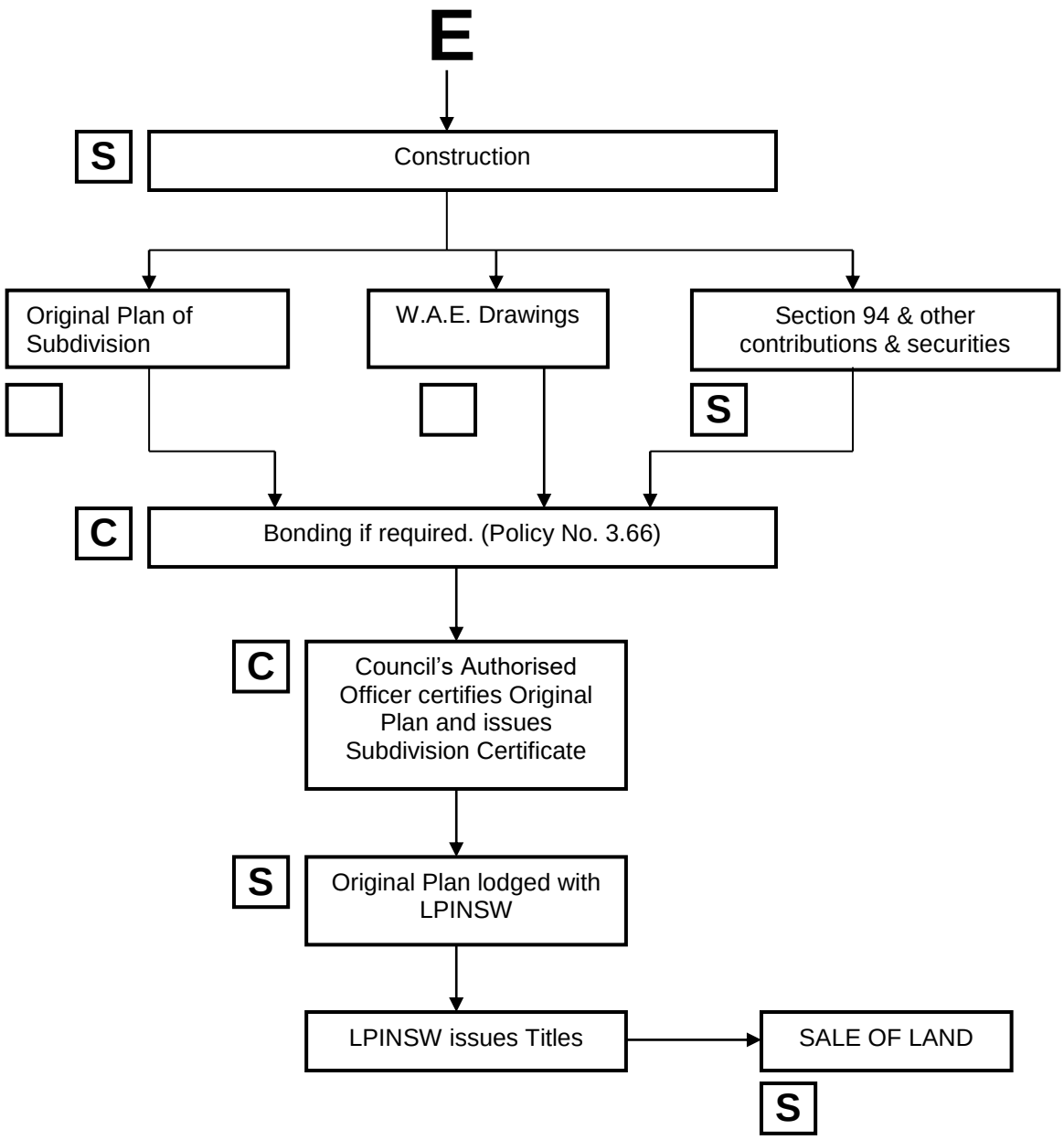
Accredited Certifiers are not empowered to certify water supply and sewerage Works. Only Councils can certify such Works and the process for their doing so is provided in Schedule 4, Clause 4.46 of the Environmental Planning and Assessment Amendment Act 1979.

Accredited Certifiers act where works are under Part 5 of the EP & A Act, 1979 (i.e., Development Consent not required).

Accredited Courses

Where the Specification requires the Contractor to carry out the Works within a Quality Control System, the Contractor may be required to detail those accredited courses applying to the Contractor or its employees as are appropriate for the execution of the Contract. The Contractor may be required to provide evidence of the accreditation acquired and satisfy accreditation requirements for the Developer during the tender stage.

5 ALLOTMENTS FOR SALE



LEGEND

S denotes Applicant (Subdivider) responsibility

C denotes Council responsibility

W.A.E. denotes Works-as Executed and describes plans and drawings showing as built details.

LPINSW denotes Land and Property Information NSW

FLOW DIAGRAM S - PROVISION OF ALLOTMENTS FOR SALE

5.1 COMPLETION OF WORKS AND CERTIFICATION

Construction Completion

On completion of construction works the Supervising Consultant is to advise the PCA to that effect in writing and certify that the whole of the works have been carried out in accordance with the approved Drawings and Specification.

Final Survey

At this stage the Developer's Surveyor completes the final property survey and prepares the final plan of subdivision which shall be submitted, for endorsement by the PCA as the "original plan", together with three (3) copies. This plan will later be lodged by the Developer with Land and Property Information NSW who will prepare title deeds and advise Council of a Deposited Plan (DP) number so that sale of allotments of land may proceed.

If the whole of the works are considered satisfactory the PCA will issue the Subdivision Certificate at which time the whole of the works are considered to have entered into the maintenance period.

Subdivision Certificate/ Maintenance Period

The maintenance period will commence for all components at the date of issue of the Subdivision Certificate and not beforehand. Maintenance will be subject to a bond as per Council's policy.

Sewerage and Water System Commissioning

Some components such as water supply and sewerage reticulation pumping stations may commence a maintenance period only after satisfactory commissioning and completion of pump performance tests. Typically the maintenance period for pumping stations and associated facilities will be six (6) months during which the Developer will meet all the maintenance costs associated with any failure of a component of the works.

5.2 EARLY RELEASE OF ALLOTMENTS BY APPLICATION OF ENGINEERING BONDS

Bonding Deeds for Development Works

Council may give consideration to the acceptance of a bond for the performance of engineering works to enable the early release of plans of subdivision. However, before Council will consider accepting a bond, providing an irrevocable work guarantee for the construction of engineering works within the subdivision, the following must apply: Refer to Development and Maintenance Bond Policy No 3.66.

Period of Bonds

Bonds for engineering works required as a condition of subdivision approval will generally be for a maximum period of six (6) months.

Bank guarantees and interest bearing deposits in the name of Council only will be accepted for works and shall be unconditional.

Bond Fee

A bond fee is payable where a bond has been lodged to guarantee the completion of engineering works. (The bond fee is set out in Council's Schedule of Fees and Charges.)

6 APPENDIX 1

6.1 COUNCIL'S DEVELOPMENT APPLICATION FORM

(Available on the Council Web Site www.svc.nsw.gov.au)

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0013 BUSHFIRE PROTECTION

1 SCOPE AND GENERAL

1.1 SCOPE

This work section covers the design of bushfire protection facilities.

Designs shall be carried out to satisfy requirements of the NSW Rural Fires Act 1997, Council and any guidelines published by the State's Rural Fire Service or equivalent.

1.2 OBJECTIVES

This work section's objective is to minimise bushfire hazard. The requirements are particularly pertinent to rural developments but should be an integral part of urbanised development as well. The concepts proposed need to be incorporated at an early stage of development design.

1.3 REFERENCED DOCUMENTS

The following documents referred in this work section are:**Other publications**

Environment Planning and Assessment Act 1979—Section 94

NSW Rural Fires Act, 1997

NSW Rural Fire Service

Planning for Bushfire Protection. A Guide for Councils Fire Authorities and Developers 2006.

1.4 BIBLIOGRAPHY

Work section

0281 *Perimeter tracks for bushfire protection*

Other publications

Department of Land and Water Conservation (formerly Land Management)

Soil Conservation Service 1994. Guidelines for Planning, Construction and Maintenance of Tracks

Ministry of Urban Affairs (formerly Environment) and Planning

Planning Guidelines for Subdivisions in Bushfire Prone Areas, 1985

NSW Department of Urban Affairs (formerly Environment) and Planning

Circular 74: Planning in Fire Prone Areas, 1984

Board of Fire Commissioners

Hazard Reduction for the Protection of Buildings in Bushland Areas, 1984

Californian Department of Forestry

Fire Safety Guides for Residential Development in California, 1980

Insurance Council of Australia

Bushfire Safety in Urban Fringe Areas

Luke, R.H

Luke, R.H. Before the Fires Start

2 DESIGN CRITERIA

2.1 GENERAL

Perimeter tracks

Where a subdivision will abut unimproved timber in a bushfire prone area (as classified by Council), perimeter tracks shall be located immediately between the created allotment and the bushland within a minimum cleared width of 6 m, and have a minimum formed width of 4 m. Such roads shall be adequately drained to provide all weather access for fire fighting vehicles.

Reservations and easements

The perimeter track shall be contained within a 20 m reservation or easement which borders those allotments abutting the bushfire prone area. Such a reserve shall serve as a basis for fire protection measures to be undertaken and will not be considered as part of the public reserve dedication applicable to the subdivision.

Access

Access is to be provided from the above described reservation from the local road system at regular intervals in a system of 'loops'.

Fire hydrants

For those subdivisions receiving reticulated water, fire hydrants shall be situated at appropriate intervals or near where potential fire hazard areas exist as determined by Council.

Consultation

Council shall be consulted for technical advice in relation to bushfire protection of subdivisions.

Fire protection zones access tracks and perimeter tracks shall be clearly indicated on the subdivision plan. Erosion control features and revegetation requirements shall also be indicated in the subdivision plan.

2.2 FIRE PROTECTION ZONES

Primary purpose

The primary purpose of FPZs is to ensure that a progressive reduction of fuel occurs between the bush fire hazard and any combustible structures within the development.

Location

The provision of Fire Protection Zones (FPZs) shall occur as part of the development of the subdivision pattern. Each individual allotment shall have adequate space for the main building (usually a dwelling), an area of open space (front, back or side yard) and the FPZ (which may include part of the yard area and/or neighbouring properties). Figure 2.1 illustrates a typical FPZ.

FPZs shall be required for any development fronting a bush fire hazard area, whether a single dwelling, a group of isolated dwellings or an urban subdivision. They act as a buffer zone between the development and the fuel.

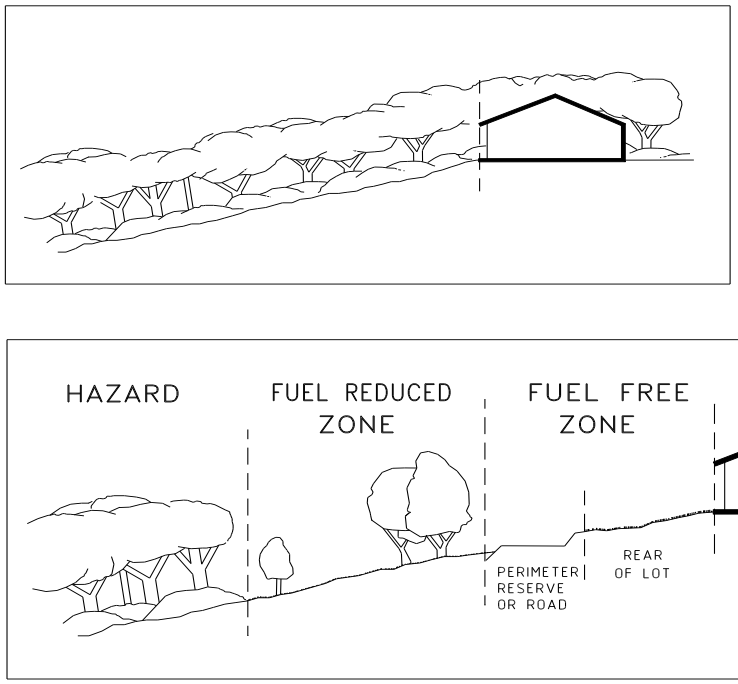


Figure 2.1 Fire protection zone

Other design considerations

Apart from its primary purpose the FPZ serves a number of other important purposes, dependent upon local fire fighting policy. The FPZ shall be designed to:

- maximise the separation distance between high intensity fire and any structure, thereby reducing the radiation and direct flame contact;
- provide an area where embers can fall with minimal opportunity to create further fire outbreaks;
- provide a safe access to a structure for fire fighters by reducing the heat level from the main fire;
- provide a safe retreat for fire fighters; and
- provide a clear control line from which to begin back burning or hazard reduction operations.

Safety requirements sometimes dictate that fires are fought from the property itself rather than along the perimeter track.

Components

The FPZ incorporates up to three separate components:

- Fuel Reduced Zone (FRZ); and
- Fuel Free Zone (FFZ) incorporating:
  . a perimeter road or reserve (which incorporates an access track); and
  . a set-back (currently defined by minimum lot depths), which is usually part of the allotment.

2.3 FUEL REDUCED ZONE

Location

The fuel reduced zone (FRZ) is located adjacent to the hazard.

Reduced fuel loadings

Fuel loadings can be reduced through thinning of vegetation, mechanical clearing, hazard reduction burning or location of suitable developments such as playing fields or car parks (provided it is wide enough).

Minimum fuel loadings

Fuel loadings within the FRZ shall be kept to a level where the fire intensity expected will not impact on adjacent developments. In the absence of any policy to the contrary, 8 tonnes per hectare of total fuel is commonly used.

Cost of fire protection

The FRZ should always be part of the development so that dedication of land or monetary contribution through Section 94 of the NSW Environment Planning and Assessment Act ensures that the cost of fire protection is met by the Developer, not by the general community.

Steep slopes

For slopes greater than 20 degrees, the environmental consequences of ground clearing (erosion) may not be acceptable. Developments abutting such slopes shall avoid both the ridge and the slope.

2.4 FUEL FREE ZONE

Location

The fuel free zone is located adjacent to, or is part of, the development and comprises a perimeter road and a set-back.

Perimeter roads and tracks

Location: The perimeter road or access trail lies between the FRZ and the boundary of the allotments.

Concept: The concept of a perimeter road requires that one side of the road has no fuel. Perimeter roads are not fire breaks in the same sense as used in fire fighting operations. Their main purpose relates to reduction of radiation and provision of access. Without a fuel source on the other side, perimeter roads can however prove very effective fire breaks.

Form: The form that the perimeter road or track takes will depend on Council policy in regard to both road construction and fire fighting. In many instances, a perimeter reserve will be preferred due to cost. The reserve should be a minimum of 20 m wide, with a 6 m access track and passing bays about every 200 m.

Width: In designing for a perimeter road or track, the distance required may not seem very great. Given that the probability of fire jumping a fire break increases as the width decreases, then areas where the highest intensity fires are likely should have fire breaks of greatest width.

Costs and benefits of perimeter roads and tracks:

- Perimeter roads can be less economic than roads which service two frontages unless some innovative designs are incorporated into the subdivision. Figure 2.2 illustrates perimeter roads and perimeter tracks.
- Perimeter roads that do not require clearing or maintenance (compared to tracks), can be cheapest in the long term. Ultimately the decision between a road or track depends on the Council's subdivision and bush fire fighting policies.
- Tracks shall be constructed to Soil Conservation Service (1983) guidelines.

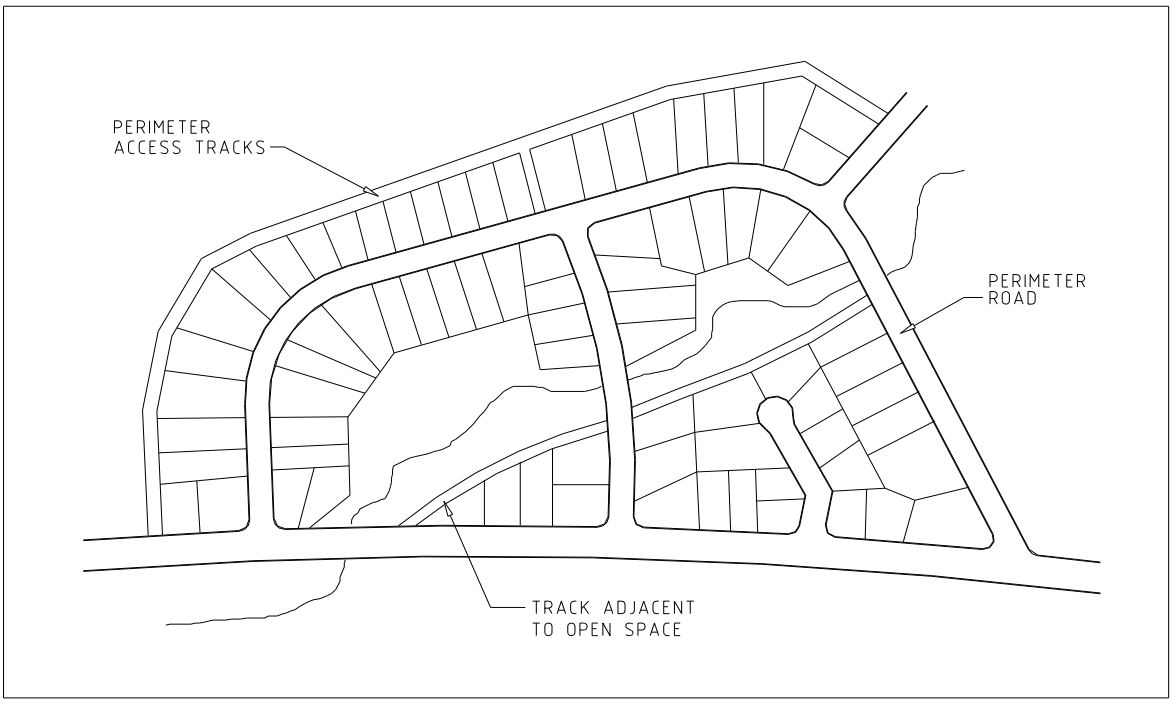


Figure 2.2 Perimeter road track

Set-back

Minimum lot depth: Part of the allotment can be used as a section of the buffer by setting a minimum lot depth and rear setback. This can ensure that sufficient room (30–35 m) is available to allow for erection of a dwelling that does not encroach upon the rear of the allotment.

Alternative policy: The policy previously required a minimum of 40 m lot depth in order to be consistent with the average minimum lot depth in bushland residential developments. Based on the requirement to maximise the distance between hazard and structures on reasonable grounds (as developed above) and a 30 m wide building envelope which includes the surrounding yard, there is no justification for a 40 m minimum lot depth in some instances.

2.5 MODIFICATIONS TO FUEL REDUCED AND FUEL FREE ZONES

Approval

Modifications to the width of either the FRZ or the FFZ shall only be made under written approval from both Council and the Rural Fire Service and based on an examination of the particular cases rather than according to any formula.

Adjacent development

Modifications would need to take account of adjacent or proposed development. Some difficulties arise where new development abuts existing development that is a fire hazard because of the nature of its usage (e.g. forests, parks etc.). The general principle is that fire protection should be shared by both users which may require a certain level of negotiation outside the planning system.

Even without an extensive area of fuel outside the FRZ, intense fires can develop if the FRZ has not been hazard-reduced and if the fire begins as a line ignition from spotting embers.

Under adverse conditions fires moving up a slope may not be slowed by the presence of rocky outcrops and ledges, even though the continuity of the fuel bed may be broken.

2.6 INTERNAL ACCESS FROM SUBDIVISION ROADS

The provision of adequate internal access is also controlled by subdivision design. Subdivision roads shall incorporate the following features:

- width, vertical clearances and any dips and crests which allow the two way movement of firefighting appliances;
- construction standards of roads and any bridges which allow for the carrying of fully loaded fire appliances (28 tonnes or 8 tonnes per axle);
- curves which have a minimum inner radius of 12 m and are minimal in number;
- maximum grades which do not exceed 15% (1:7) and preferably not more than 10% (1:10);
- clearly signposted roads;
- dead end roads which do not exceed 200 metres in length;
- dead ends which incorporate a minimum turning circle of 12.5 m diameter; and
- a road network which connects regularly to any access tracks.

2.7 STAGING WORKS

When considering the rate of development, designers shall provide for initial development to occur on the hazard perimeter of the development. A line of dwellings will tend to minimise the threat to the entire subdivision by limiting the hazard interface.

Scattered developments allow a continuous network of fuel to threaten individual buildings until development is substantially underway.

New developments should be ‘tacked’ onto old developments to minimise the hazard perimeter.

It is important that much of the bush fire protection is incorporated into the design of the development, rather than into individual allotments.

0021 SITE REGRADING

1 SCOPE AND GENERAL

1.1 SCOPE

This work section sets out requirements for the site regrading involved in Council works and Council land development and subdivision.

Conceptual requirements are presented as necessary considerations when preparing designs for site regrading.

This work section assumes that the Designer is familiar with requirements cited in the various construction specifications, specifically those related to earthworks, clearing and grubbing, erosion and sedimentation. Additionally the Designer needs to make reference to the associated design specifications related to stormwater drainage design, geometric road design and erosion control and stormwater management.

1.2 OBJECTIVES

This work section aims to assist the Designer in achieving:

- efficient and economical design
- enhancement of the environmental character of the site whilst maintaining the natural features of the site
- provision of safe conditions for construction commensurate with the proposed purpose of the works
- equality of building conditions for residential development
- a minimal impact on adjoining properties and other works.

1.3 REFERENCED DOCUMENTS

The following documents referred in this work section are:

Work sections

0041 Geometric road layout
0074 Stormwater drainage (Design)
0075 Control of erosion and stormwater management
0250 Open space – landscaping
1102 Control of erosion and sedimentation
1111 Clearing and grubbing
1112 Earthworks (Roadways)

Standards

AS 3798 Guidelines on earthworks for commercial and residential developments

1.4 BIBLIOGRAPHY

AS 2870 Residential slabs and footings—Construction

1.5 SITE REGRADING

Suitability of site

Areas of a site proposed for building or recreational purposes may not be suitable in their natural state for their intended function without improvement works to:

- Alleviate flooding of low-lying ground.
- Fill gullies or create emergency flowpaths after underground stormwater piping has been installed.
- Allow improved runoff from flat ground.
- Regrade excessively steep slopes that would preclude economical construction of building foundations.
- Allow effective recreational use or give reasonable access.

The Designer shall review the natural surface contours and where necessary shall design finished surface levels that ensure the land is suitably prepared.

Drainage

Where practical, areas should be regraded to minimise the necessity for underground drainage systems with surface inlet pits, and allow surface water to flow naturally to roads or drainage reserves without excessive concentration.

Natural environment

The Designer shall consider the implications of site regrading in relation to the existing natural environment. Generally site regrading shall be minimised in heavily treed areas.

Overland flow

Care shall be taken to provide depressions for overland flow from low points and over major drainage lines, to direct stormwater for storms up to a 100 year average recurrence interval (ARI).

Minimal road haulage

The design of site regrading areas in conjunction with the design of roadworks shall be considered with the objective of balancing cut to fill and achieving both an economical works and to minimise the haulage of imported fill or spoil to and from the works site.

Bulk haulage should always be considered an adverse effect on adjacent development, and infrastructure.

1.6 SPECIAL TREATMENT FOR PARTICULAR AREAS

Areas abutting the 100 year ARI flood levels

Areas abutting the 100 year ARI flood levels shall be site regraded to a minimum level of 0.5 metres above the 100 year ARI flood levels. In doing so, the Designer shall ensure that other areas are then not affected by flooding.

The site shall be identified on the Drawings with appropriate notation of site specific requirements.

Inundation areas

In the event that an area is known to be affected by or inundated by local stormwater flows, the Designer shall investigate the existing conditions as they relate to the proposed Works and advise the Council in the preliminary design report on all data obtained in the investigation and recommend appropriate contour adjustments.

The report should normally be accompanied by Concept Plans to clarify recommendations.

Restrictions on land use

Constraints either natural or otherwise may be required to be identified as a burden on the developed site. It is recommended that the Designer take this into account when preparing the design.

The property may ultimately be affected by a 'restriction as to user', which may be controlled by a legal instrument placed on title to the land advising prospective purchasers of any restrictions affecting the land.

Piped gullies or depressions

The finished surface of filled areas shall be designed to levels allowing an adequate cover depth over the pipeline (if piped) and permitting surface stormwater flow to be guided to inlet pits if depressions are retained in the finished surface contouring.

Site regrading plans

The location of features shall be clearly defined on the site regrading plans and defined by distance to corner boundaries, monuments, etc for purposes of relocation at the geotechnical testing stage for work as executed Drawings.

A geotechnical report specifying the site specific preparation and compaction requirements will be required to be incorporated with the site regrading plan. A description of the minimum acceptable quality of the fill shall also be specified on the plans, supported by geotechnical recommendations.

All documentation necessary from various authorities to support the filling of dams and watercourses shall be supplied with the Drawings.

Finished level of any building area

The finished level of any building area shall be designed to ensure a desirable surface grading of 1.5% (1% minimum) oriented in the direction of the drainage system designed to cater for its catchment.

Building areas containing natural ground slopes of an excessively steep nature, i.e., greater than 15% shall be brought to the attention of a Geotechnical Engineer for investigation of compatibility with the works proposed. Specific requirements shall be noted on the Drawings.

Salinity prevention

In known salt affected areas, or areas found to be salt affected by the geotechnical investigations, the Designer shall evaluate the existing conditions as they relate to the proposed development.

The Designer shall also take advice from the relevant land and water resource authority and advise the Developer, in the preliminary design report, of areas requiring action to prevent salinity development.

Appropriate regrading strategies aimed at lowering the groundwater table should also be included in the preliminary design report together with primary measures to prevent extension of salinity problems.

1.7 SITE PREPARATION

Clearing

Special requirements will apply where considered necessary by the Council but generally the site shall be cleared of low scrub, fallen timber, debris, stumps, large rocks and any trees which in the opinion of Council are approaching the end of their functional life or are dangerous or will be hazardous to normal use of the site.

Prior consultation with Council's Delegated Officer is necessary. Such requirements shall be shown on the Drawings.

Disposal

All timber and other materials cleared from the site shall be removed and legally disposed of. All roots, loose timber, etc which may contribute to drain blockage shall be removed. Such requirements shall be shown on the Drawings.

Overfilling area of trees

In areas to be filled over butts of trees, allowance is to be made for clearing of all trees and replanting with advanced species, the number and type of which shall be approved by Council.

All replanting is to be clear of probable future building locations, and not to be commenced until filling has been completed and graded, with provision for watering and maintenance for duration of the contract. These specific requirements shall be shown on the Drawings.

Preservation of trees

Selected trees shall be preserved by approved means to prevent destruction normally caused by placement of conventional filling or other action within the tree drip zone.

The Delegated Officer shall be consulted for advice and all specific requirements noted on the Drawings.

1.8 FILL

Special requirements clause

Items addressed below, shall be incorporated in the Special Requirements Clauses of *1112 Earthworks (Roadways)*.

Fill type

Filling is to be of sound clean material, reasonable standard and free from large rock, stumps, organic matter and other debris.

Placing of filling on the prepared areas shall not commence until the authority to do so has been obtained from the Council.

The above requirement shall be a notation on the relevant drawings.

Fill quality and compaction

All work shall be in accordance with AS 3798. Fill is to be placed in layers not exceeding 150 mm compacted thickness.

All fill is to be compacted to 95% standard maximum dry density. Maximum particle size shall be 2/3 of the layer thickness.

Restricted fill

Fill comprising natural sands or industrial wastes or by-products may only be used after the material type and location for its use is approved by the Council and will be subject to specific requirements determined by prevailing conditions.

It is essential that prior advice be given of intended use of restricted fill materials. It should be noted that failure to obtain the Council's approval may lead to an order for removal of any material considered by the Council or other relevant authorities as unsuitable or in any way unfit for filling.

Top dressing

All areas where filling has been placed are to be dressed with clean arable topsoil, fertilised and sown with suitable grasses. This work shall be carried out in accordance with *0250 Open space - landscaping*.

1.9 TEMPORARY DIVERSION DRAINS

Where temporary drains are required to divert surface flows away from the site regrading area, the location and silt/erosion control treatment shall be clearly identified on the Drawings. The scale of such works shall reflect the volume of water to be diverted.

The objective will be to ensure minimal soil disturbances and material loss off the site.

Control measures will include, but not be limited to:

- Provision of trench stops every 30 m along a trench, with provision for overtopping to be directed to the kerb.
- Placement of 'blue metal' bags along kerb and gutter at maximum 30 m spacings.
- Placement of 'blue metal' bags around downstream drainage pits.

The requirements identified in *0075 Control of erosion and stormwater management* should be addressed for any additional requirements.

1.10 CONCURRENCE WITH ENVIRONMENTAL PROTECTION AUTHORITY (EPA)

The Designer shall refer to the relevant State Environmental Protection Authority (EPA) with regard to any items requiring specific consideration when preparing a site regrading plan.

Such plans may need to incorporate sediment/siltation/erosion/salinity control devices with specific reference to the stage at which these are to be provided.

The responsibility shall rest with the Designer to make enquiries with EPA and subsequently obtain Council approval to proposed measures.

1.11 WORK-AS-EXECUTED DRAWINGS

The Designer shall annotate on the site regrading plan, the site specific detail to be shown on the Work-as-Executed drawings.

Such detail shall include a geotechnical report certifying the works to be suitable for the intended purpose and any other certifications, testing and survey data, as required in this specification.

1.12 CARTAGE OF SOIL

Acceptable haul route

The Designer shall refer to Council for acceptable haul roads with applicable load limits. This detail shall be shown on the site regrading plan.

The payment of a Bond may be required where Council has some concern about the ability of a haul road to sustain the loads without undue damage or maintenance requirements.

Re-use of topsoil

Unless otherwise approved by Council, the Drawings shall be annotated as follows – 'All topsoil shall be retained on the site and utilised effectively to encourage appropriate revegetation.'

1.13 ADJOINING PROPERTIES

Stormwater easement

Where it is proposed to divert or direct piped stormwater into adjoining properties, drainage easement rights shall be created over the adjoining lots in accordance with *0074 Stormwater drainage (Design)*.

Construction agreement

A written agreement shall also be sought to carry out construction work on adjoining properties and all such agreements are to be submitted to Council.

0041 GEOMETRIC ROAD LAYOUT

1 SCOPE AND GENERAL

1.1 SCOPE

This work section sets out a method for the geometric layout design of Council's roadworks, using principles of street design to ensure safety, improved amenity and to reduce pedestrian/vehicular conflicts.

1.2 OBJECTIVE

A road system shall be designed to achieve the following aims:

- Provide convenient and safe access for pedestrians, vehicles and cyclists.
- Provide appropriate access for buses, emergency and service vehicles.
- Provide for a quality road network that minimises maintenance costs.
- Provide a convenient way for public utilities.
- Provide an opportunity for street landscaping.
- Provide convenient parking.
- Have appropriate regard for the climate, geology and topography of the area.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this work section are:

Work sections

0021 Site regrading
0042 Pavement
0043 Subsurface drainage
0044 Footpaths and cycleways
0160 Quality (Design)
0061 Bridges and other structures
0074 Stormwater drainage (Design)
0075 Control of erosion and stormwater management

Standards

AS 1348 Roads and traffic engineering
AS 1348.1 Glossary of terms, road design and construction
AS 2890 Parking facilities
AS 2890.1 Off-street car parking
SAA HB 69.14 Guide to traffic engineering practice—Bicycles
AS/NZS 3845 Road safety barrier systems

Other publications

COUNCIL POLICIES

Carparking DCP 3 – Tumut Town Centre

Public Consultation Policy

Tumut Subdivision Codes

RTA Road Design Guide

AUSTROADS

Rural road design—guide to the geometric design of rural roads

AP-G69 Urban road design - Guide to the geometric design of major urban roads

AP-G11 Guide to traffic engineering practice:

PART 5: Intersections at grade

PART 6: Roundabouts

PART 10: Local area traffic management

PART 13: Pedestrians

PART 14: Bicycles

Design vehicles and turning templates

Design Single unit Truck/Bus template.

Commonwealth Department of Housing and Regional Development—1995: Australian Model Code for Residential Development. (AMCORD). A National Resource Document for Residential Development

Institute of Public Works Engineering Australia

Qld Division—1993 Design Guidelines for Subdivisional Streetworks

1.4 BIBLIOGRAPHY

The following documents provide additional information:

Workgroup

11 *Construction - Roadways*

Other publications

Council's Development Control Plans (DCPs)

Road Planning Guides of all State Road Authorities

1.5 DEFINITIONS

For the purpose of this work section the definitions of terms used to define the components of the road reserve shall be in accordance with AS 1348.1 and Australian Model Code for Residential Development (AMCORD).

The words 'street' and 'road' are interchangeable throughout all parts of this work section.

- Carriageway: That portion of the road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes.
- Footpath: The paved section of a pathway used exclusively by pedestrians.
- Pathway: A footpath, bicycle path, or other area constructed or developed by the Council for use by members of the public other than with a motor vehicle.
- Pavement: That portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
- Shoulder: The portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
- Verge: That part of the road reserve between the carriageway and the road reserve boundary. It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and plantings.

1.6 CONSULTATION

Council and other Authorities

Designers shall consult with the Council and other relevant authorities during the preparation of design. Designers shall, in addition to the requirements of this work section ascertain the specific requirements of these authorities as they relate to the designs.

Public consultation

Public consultation on designs shall be provided where such action is required by Council policy.

Utilities service plans

The Designer shall obtain service plans from all relevant utilities and other organisations whose services exist within the area of the proposed development. These services shall be plotted on the relevant drawings including the plan and cross-sectional views.

RTA Referral

Where a development is likely to generate a significant increase in traffic volumes it shall be referred to the RTA in accordance with Schedule 3 of the SEPP (Infrastructure) 2007.

1.7 PLANNING CONCEPTS

Road hierarchy

In new areas, as distinct from established areas with a pre-existing road pattern, each class of route should reflect its role in the road hierarchy by its visual appearance and physical design. Routes should differ in alignment and design according to the volume of traffic they are intended to carry, the desirable traffic speed, and other relevant factors.

Conformance with Development Control Plan

The road pattern and width shall conform with any relevant Development Control Plan (DCP). In areas not covered by these plans, the pattern and width(s) shall be determined by Council.

Legibility

The road network shall have clear legibility.

The following factors assist in achieving clear legibility:

- Differentiation: The road network should reinforce legibility by providing sufficient differentiation between the road functions (see road classifications in **Urban design criteria**).
- Landmark features: Distinct landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance the legibility.
- Introduced features: Whilst legibility can be enhanced by introduced physical features such as pavement and lighting details, the road network should by its inherent design and functional distinction provide the necessary legibility.

Salinity prevention

The following constraints apply to the design of roads through or adjacent to land known to be salt affected:

- Consultation: Consultation with the relevant land and water resource authority shall be undertaken.

- Early planning: Early planning shall consider avoiding detrimental interference with land known to be salt affected. Adjustments in horizontal and vertical line shall be considered to avoid recharge of subsurface water within or adjacent to the road reserve.
- Landscaping: Appropriate native deep-rooted species should be selected for plantings in association with road reserve works. Plantations should be of sufficient size and density, multiple row belts and relatively close spacings are recommended, to be effective in their desired role of lowering the groundwater table.

Integrated design principles

All relevant design principles shall be integrated in the development of the road network. A careful balance is required between maximising amenity, safety and convenience considerations and those related to the drivers' perception of driving practice.

Acceptable vehicle speed

A fundamental requirement of the design process is to determine the vehicle speed deemed acceptable for the particular section of road.

Intersection turning movements

The maximum number of turning movements at intersections or junctions that a driver should be required to undertake to reach a particular address within the development should be minimised.

1.8 DRAWING REQUIREMENTS

Reduction ratios

The reduction ratios for plans shall be as follows:

- All plans for council works 1:500, however, rural plans may be 1:1000
- Longitudinal Sections 1:500 Horizontal and 1:100 Vertical
- Cross Sections 1:100 Natural

Drawing sheets

The scope and sequence of drawing sheets shall comply with Annexure B of 0160 *Quality (Design).*

Separate sheets should be provided for:

- Cover sheets
- Plan views
- Longitudinal sections
- Cross sections
- Structural details
- Standard drawings

Drawing presentation

Drawings form part of the permanent record and are legal documents. Terminology should be kept in 'plain English' where possible, enabling drawings to be easily read and understood by those involved in the construction of the Works.

Drawings shall be presented on A1 sheets unless otherwise authorised. They shall be clear and legible and prepared in consistent lettering and style. All drawings shall be clearly referenced with notations and tables as appropriate.

Longitudinal Sections 1:500 Horizontal and 1:100 Vertical.

Compliance

The scope and sequence of drawing sheets shall be consistent with the example provided in Annexure B of 0160 *Quality (Design).*

Certification

Drawings shall bear the signature of the Council Designer or Council's Consultant and shall where required by Council be certified as complying with the appropriate design work sections.

The certificate shall be in the format detailed in 0160 *Quality (Design).*

2 URBAN DESIGN CRITERIA

2.1 HIERARCHICAL ROAD NETWORK

A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly.

The design should convey to motorists the predominant function of the road. A typical hierarchy is shown in Figure 2.1.

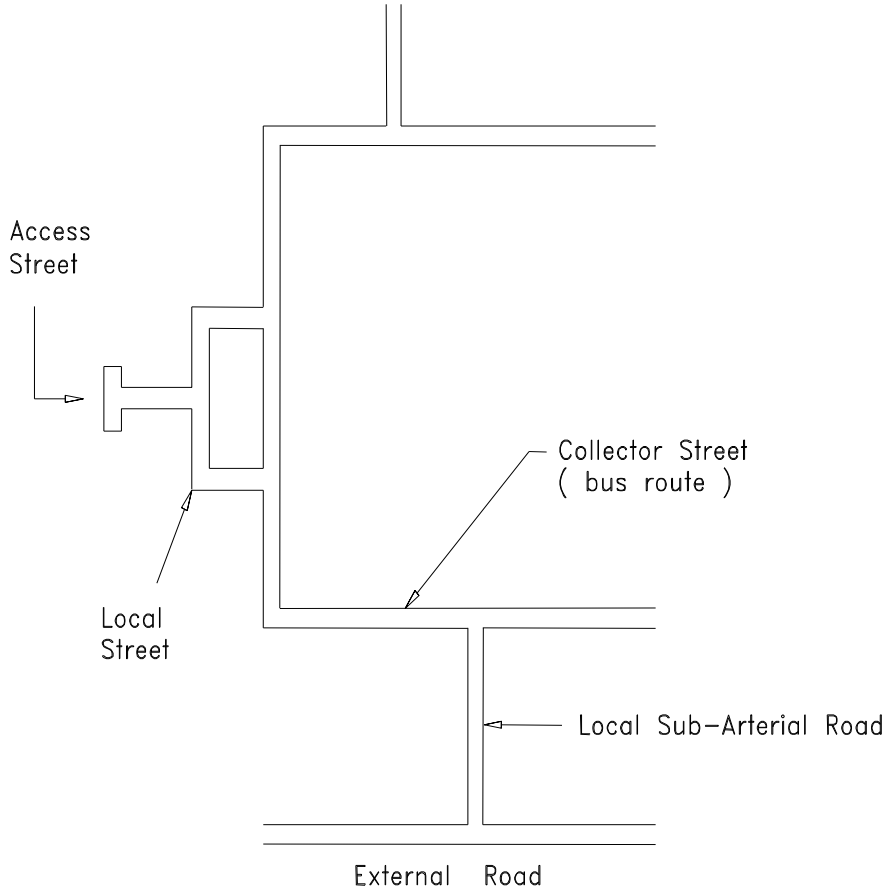


Figure 2.1 Typical road hierarchy

2.2 CLASSIFICATION

Terminology

The terminology used to describe each class of road varies from state to state. This work section uses the classes adopted by Snowy Valleys Council.

Minor Local street

Minor Local street is the lowest order road and has as its primary function residential space. Amenity features of minor local streets facilitate pedestrian and cycle movements, and vehicular traffic is subservient, in terms of speed and volume, to amenity, pedestrians and cyclists. The features of typical minor local street are shown in Fig 2.2**.**

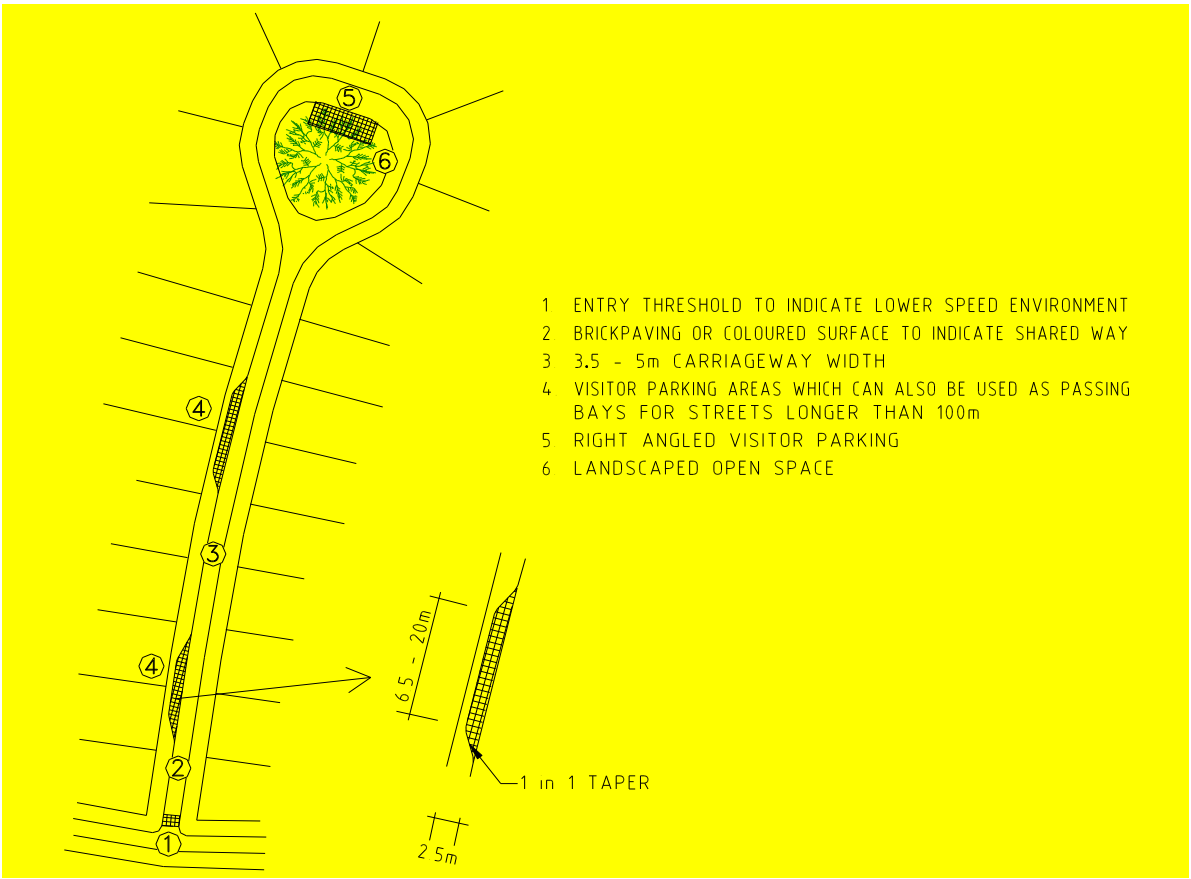
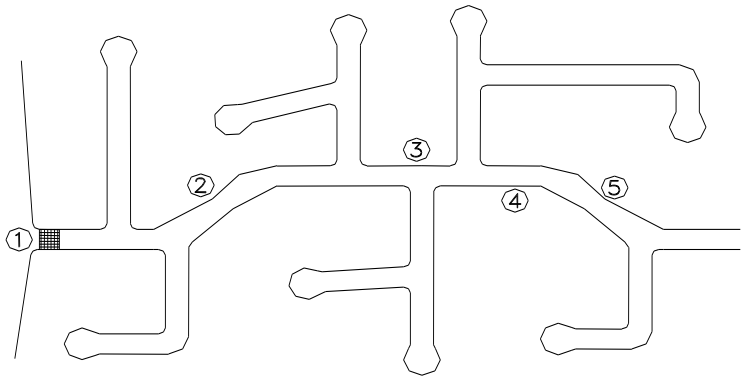


Figure 2.2 Typical local street

Local

Local is the next level road. As a local residential street, it should provide a balance between the status of that street in terms of its access and residential amenity functions. Resident safety and amenity are dominant but to a lesser degree than access streets. A typical local street is shown in Fig 2.3.



1. BRICK-PAVED ENTRY THRESHOLD SIGNIFIES ENTRY TO LOWER SPEED ENVIRONMENT
2. BENDS IN CARRIAGEWAY CONTROL SPEED
3. SHORT SECTIONS OF STRAIGHT CARRIAGEWAY CONTROL SPEED
4. CARRIAGEWAY WIDTH 7m
5. 1.2m FOOTPATH ON ONE SIDE

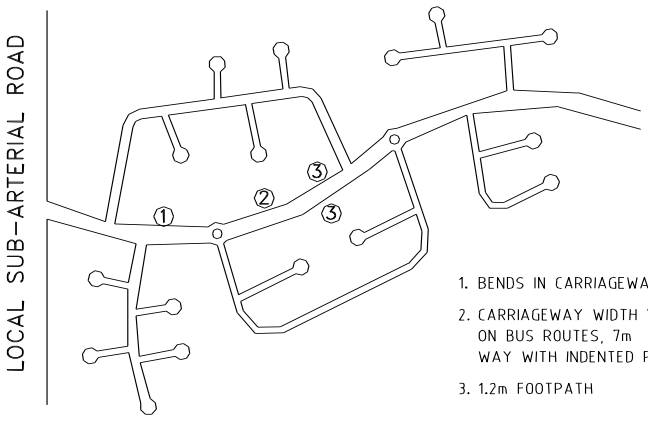
Figure 2.3 Typical local street

Collector street

Collector street is the second highest order road. It has a residential function but also carries higher volumes of traffic collected from lower order streets.

A reasonable level of residential amenity and safety is maintained by restricting traffic volumes and speeds, however, amenity and resident safety do not have the same priority as access or local streets. A typical collector street is shown Fig 2.4.

- MAXIMUM VOLUME 3000 VPD
- MAXIMUM SPEED 50 km/h
- CARRIAGEWAY SHARED BY VEHICLES AND CYCLISTS
- AS A CUL-DE-SAC ARRANGEMENT SERVES APPROXIMATELY 16 Ha



1. BENDS IN CARRIAGEWAY CONTROL SPEED
2. CARRIAGEWAY WIDTH 7 - 9m OR ON BUS ROUTES, 7m TRAVELLED WAY WITH INDENTED PARKING
3. 1.2m FOOTPATH

Figure 2.4 Collector street

Sub-arterial road

Sub-arterial road is the highest order road within a residential development and should have as its main function the convenient and safe distribution of traffic generated by the development.

Direct access should not be provided for single dwelling allotments but access can be provided to multi-unit developments and non-residential land uses.

The sub-arterial road should serve only the development and should not attract through traffic. Typical layout of sub-arterial road is shown in Fig 2.5.

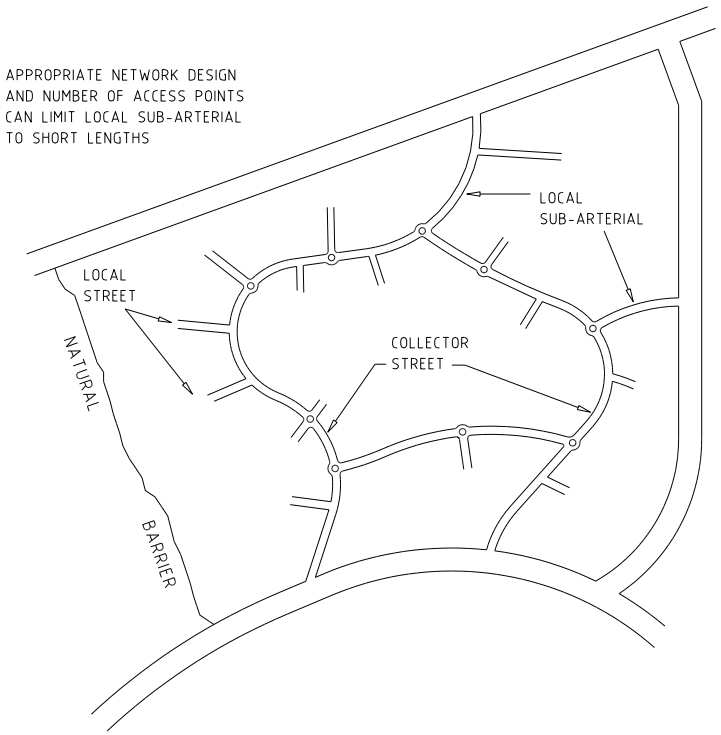


Figure 2.5 Sub-arterial road

2.3 ROAD NETWORK

Routing

The internal road system should not provide through routes that are more convenient than the external road network.

The external road network should be designed and located to provide routes that are more convenient for potential through traffic within the network.

Sub-Arterial roads should be provided at intervals of no more than 1.5km and should be complete and of adequate capacity to accommodate through network movements.

Road links

No road should link with another road that is more than two levels higher or lower in the hierarchy. In exceptional circumstances roads may link with others that are more than two levels apart.

No access street or local street shall have access to an access-controlled arterial road.

Traffic volumes and speeds

Traffic volumes and speeds on any road shall be compatible with the residential functions of that road.

Design features

The design features of each type of road should convey to the driver its primary functions and encourage appropriate driver behaviour.

Travel time

The time required for drivers to travel on all streets within the development should be minimised.

Internal road connections

Connections between internal roads should be T-junctions or controlled by roundabouts.

Local street

The maximum length of a local street should ensure its status as a residential place is retained. Its speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. Residential convenience should not be impaired as a result of speed restraints.

Collector streets

The length of Collector streets within a development should be minimised.

Pedestrian or bicycle network

Where local streets form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining local streets or open space systems so as to ensure such pedestrian and bicycle network are functionally efficient.

2.4 DESIGN SPEED

RTA guidelines

Design speed is generally used as the basic parameter in the Work section of road design. Some State Road Authorities base their current design standards on a travel speed rather than a design speed. Travel speed identifies a speed/horizontal radius relationship.

This approach is intended for roads of a minimum travel speed of 60 km/h. In difficult topography, the design speed may be reduced. Vehicular speeds are also limited by road intersections as well as changes in horizontal and vertical alignment.

The following minimum design speeds should be adopted:

- Local Street: 25 km/h
- Collector Street: 40 km/h
- Sub-Arterial Street: 60 km/h
- SubArterial Road: 70 km/h

Low speeds

Adoption of a low design speed discourages speeding. However, where vertical or horizontal curves of low design speed are located in otherwise high-speed sections (tangents) the result is a potentially dangerous section of road. It should be recognised that in low design speed roads, operating speeds will tend to be in excess of arbitrary speed standards.

Hazardous features

Potentially hazardous features shall be made visible to the driver. Traffic engineering measures that help a driver avoid errors of judgement should be adopted.

Road safety barriers

Road safety barriers shall be assessed and designed in accordance with AS/NZS 3845.

2.5 LONGITUDINAL GRADIENT

General

A general minimum gradient of 0.5% should be adopted. In very flat conditions it may be reduced to 0.3%.

Where underground drainage with gully pits or other special works are used it is preferable to allow near level grades rather than reverting to the unsatisfactory device of introducing artificial undulations. Variable crossfall may be necessary to produce the required grade in the gutter.

Maximum recommended grades are shown in Table 2.1.

Intersections

Longitudinal grade of the minor street on the approach to an intersection should not exceed 4%, the actual gradient being dependent on the type of terrain. Design of the road alignment and the grades used are interrelated. A steep grade on a minor side street is undesirable if vehicles have to stand waiting for traffic in the major road.

Cul-de-sacs

Turning circles in cul-de-sacs on steep grades should have grades less than 5 %.

Table 2.1 Recommended maximum gradients

Gradient	**Local road %**	**Collector road %**	**Sub-arterial road %**	**Arterial road %**
Desirable maximum*	12	10	10	8
Absolute maximum*	15	12	12	10
* Maximum length 150 m on straight alignment.				

2.6 HORIZONTAL CURVES AND TANGENT LENGTHS

Speed/radius relation

The horizontal alignment of a road is normally a series of tangents (straights) and curves connected by transition curves.

The choice of the horizontal alignment is normally determined from the design speeds for a particular street within the road hierarchy (see **Design Speed**).

Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers can safely negotiate the curve.

Curves that progressively tighten (e.g., parabolic curves) produce an uncomfortable sense of disorientation and alarm.

Sudden reverse curves that drivers cannot anticipate also have a potential to cause similar conditions.

2.7 VERTICAL CURVES

Criteria

Vertical curves should be simple parabolas and should be used on all changes of grade exceeding 1%. The desirable minimum design speed is 60 km/h. The length of the crest vertical curve for stopping sight distance should conform with RTA Road Design Guide.

These standards are based on 1.5 second's reaction time that provides a reasonable safety margin for urban conditions, where drivers' reaction time is usually considered to be lower than in rural conditions.

Riding comfort

For adequate riding comfort, lengths of sag vertical curves should conform with the State Road Authorities' Road Design Guides. As residential roads are usually lit at night, the criterion for designing sag vertical curves is a vertical acceleration of 0.05g for desirable riding comfort, and 0.10g for minimum riding comfort.

The minimum lengths for sag vertical curves are shown in Table 2.3.

Table 2.3 Minimum length of sag vertical curves

Curve	Local road (m)	Collector road (m)	Sub-arterial road (m)
Minimum vertical curve	25	35	50
Absolute minimum vertical curve (to be applied at road junctions only)	6	12	20

Side road junctions

Junctions of roads should be located at a safe distance from a crest, determined by visibility from the side road. Location of a side road at a crest should only occur if there is no suitable alternative.

Sag curves

Drainage poses a practical limit to the length of sag curves. A maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) is suggested. This will avoid water ponding in excessively flat sections of kerb and gutter.

A minimum grade of 0.5% should be maintained in the kerb and gutter. This may require some warping of road cross sections at sag points.

Horizontal and vertical alignment coordination

The three dimensional coordination of the horizontal and vertical alignment of a road should aim to improve traffic safety and aesthetics. Economic considerations often require a compromise with aesthetic considerations.

The following principles should be applied:

- The design speed of the road in both horizontal and vertical planes should be of the same order.
- Combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.
- Sharp horizontal curves should not be introduced at or near the crest of a vertical curve. A horizontal curve should leave the vertical curve and be longer than the vertical curve.
- A short vertical curve on a long horizontal curve or a short tangent in the grade-line between sag curves may adversely affect the road's symmetry and appearance.

2.8 SUPERELEVATION

Criteria

In general, curve radii larger than the minimum and superelevation rates less than the maximum should be used where possible.

The minimum radius of curves is determined by the design speed, the minimum superelevation (or maximum adverse crossfall) at any point on the circular portion of the curve, and the maximum coefficient of side friction which allows safe lane changing. This is 0.15 where there is positive superelevation and 0.12 where there is adverse crossfall.

The coefficient of side friction depends upon the type and condition of tyres, the pavement, and on speed.

Low design speed and crowned pavement

The use of superelevation in association with horizontal curves is an essential aspect of geometric design of roads with design speeds in excess of 60 km/h.

Local roads which are designed for speeds of 40 km/h or less, and with curves of 60 m radius or less, generally have the pavement crowned on a curve instead of superelevation.

Design standards for such curves have little meaning as drivers usually cut the corners and rely on friction to hold them on a curved path. As the radius of the curve falls, friction becomes more important than superelevation.

High design speed

The maximum superelevation for urban roads of higher design speeds should be 6%. Any increase in the longitudinal grade leading to excessive crossfall at intersections should be considered with caution. While it is desirable to super-elevate all curves, negative crossfall should be limited to 3%.

Curve radii

Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are shown in Table 2.4.

Table 2.4 Minimum radius of curvature

Superelevation/crossfall		**Design speed km/h**		
Type	**Percent**	**60**	**70**	**80**
		Minimum radius of curvature		
Minimum superelevation	5 4 3 2 1	145 150 160 170 180	195 205 215 230 245	255 265 280 300 315
Maximum Adverse Crossfall	0 1 2 3	190 260 285 315	260 355 390 430	340 460 505 560
(Source: *AUSTROADS, Guide policy for the geometric design of major urban roads*)				

Transitions, offset crowns

Plan transitions are desirable on superelevated curves for appearance and to provide a convenient length in which to apply the superelevation.

On urban roads, superelevation may be conveniently applied to the road cross section by shifting the crown to 2 m from the outer kerb.

The axis of rotation of the cross section for urban roads will normally be the kerb grading on either side which best enables access to adjacent properties and intersections.

On the outside of superelevation, or where the longitudinal grade of the gutter is less than 0.5%, a crossfall of 63 mm in a 450 mm wide gutter may be adopted.

2.9 ROAD RESERVE CHARACTERISTICS

Cross section

The cross section of the road reserve must provide for all functions that the road is expected to fulfil, including the safe and efficient movement of all users, provision for parked vehicles, acting as a buffer from traffic nuisance for residents, the provision of public utilities and streetscaping. Table 2.5 details characteristics of the road reserve. An alternative is set out in the table "Geometric Design" detailed in Special Requirements.

Operational aspects

The carriageway width shall allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway.

(Vehicles include trucks, emergency vehicles and, on some roads, buses (Refer to Hierarchical road network for bus routes)).

Pedestrians and cyclists

The safety of pedestrians and cyclists where it is intended they use the carriageway must also be assured by providing sufficient width.

Access to allotments

The carriageway width should also provide for unobstructed access to individual allotments. Drivers should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked on the carriageway opposite the driveway.

Table 2.5 Characteristics of roads in residential road networks

Road type	**Max traffic volume (vpd)(1)**	**Max speed (2) (km/h)**	**Carriageway width (m)(3)**		**Parking provision within road reserve**	**Kerbing (4)**	**Footpath require-ment**	**Bicycle path requirement**	**Verge width (each side)**
			Traffic Lane	Parking Lane					
Minor Local Street	150	25	Two Lane 7.0	Nil	Carriage-way	Roll-over	No	No	4.0 m See Note(6)
Local Street	400	40	Two Lane 8.0	Nil	Carriage-way	Rollover/ Barrier	1.2 m wide(7) footpath(s)	No	Min. 3.5 m
Collector Street	2,000 (with access to residential allotments)	0(8)6	Two Lane 6.0	2@2.5 m.0	Marked areas on Carriage-way	Barrier	1.2 m wide footpath both sides.	If required, 2.0 m bicycle path one side only in the verge, (13)	4.0 m
Arterial Road	>2,000 (no access to single dwelling residential allotments)	70(11)	Two Lane 7.0.0)	2@3.0 m	Marked areas on carriageway	Barrier	1.2 m wide footpath both sides.	If required, 2.0 m bicycle path one side only in the verge, (13)	5.0 m.
NOTES:									

(5) For single dwelling allotments apply traffic generation rate of 10 vehicles per day (vpd)/allotment (equivalent to approximately one vehicle per hour (vph) in the peak hour) unless a lower rate can be demonstrated. Lower rates can be applied to multi-unit dwellings based on locally derived rates.
(2) See **Design speed** and **Horizontal curves and tangent lengths** on designing for specific operating speeds.
(3) Widening required at bends to allow for wider vehicle paths (using AUSTROADS *Turning Templates*).
(4) Where kerbing is not required a flush pavement edge treatment can be used. Maximum carriageway widths required if barrier kerbing used.
(5) Requires:
. Provision for widening to 5.0 m if necessary in the future.
. Verge parking as noted with scope for additional spaces (see **Parking**)
(6) Minimum width required to provide for pedestrians, services, drainage, landscape and preservation of existing trees.
(7) A minimum of one footpath on one side of the street to be constructed initially with provision to construct a second footpath if required by residents in the future.
(8) Reduced speeds are required at designated pedestrian/bicycle crossing. A speed of 20 km/h is desirable, achieved by the road design principles outlined in this work section.
(9) Barrier kerbing may be used if required for drainage purposes without reducing the carriageway width.
(10) On bus routes, 7.0 m travelled way with 2.0 m wide indented parking and bus bays defined by kerbed protuberances. Where bicycle way can be anticipated, a bicycle lane is required along the kerb.
(11) Speed on sub-arterial road not to exceed legal limit.
(12) If required, to be provided in parking areas.
(13) Required only if part of a pedestrian/bicycle network and replaces 1.2 m footpath on one side only.

Derived from AMCORD

2.10 WIDTH OF CARRIAGEWAYS

Widths of carriageways, footpaths and road reserves are detailed in the Tables below and are generally established as part of the development consent. Minor variations however may be necessary as a result of engineering requirements.

Road Class	Lane width m	Shoulder width m	Shoulder seal width m	Final seal width m	Final formation width m
Rural Roads					
Local Class 1	3.0	0.5	0.0	6.0	7.0
Collector Class 2	3.0	1.0	0.5	7.0	8.0
Sub arterial Class 3	3.5	2.0	1.0	9.0	11.0
Arterial Class 4	3.5	2.0	2.0	11.0	11.0

Road Class	Lane width m	Shoulder width m	Shoulder seal width m	Final seal width m	Final formation width m
Urban Roads					
* Local Class 1 & 2	3.5	0.0	0.0	7.0	7.0
Collector Class 3	4.0	0.0	0.0	8.0	8.0
Sub arterial Class 4	3.0	2.5	2.5	11.0	11.0
Arterial Class 5	3.5	3.0	3.0	13.0	13.0

* May be reduced if off-street parking is provided.

2.11 CUL-DE-SAC AND HAMMER HEAD FACILITIES

The following minimum requirements will apply to turning facilities.

a Cul-de-sacs

- Urban Residential – 8.5m radius to face of kerb.
- Rural Residential – 8.5m radius to edge of seal with an additional 1.0m shoulder
- Urban Industrial – 13m radius to the face of kerb.
- Rural Industrial – 13.5m radius to the edge of seal with an additional 1.0m shoulder

Where concrete dish gutters or similar are required in rural areas the 1.0m shoulder width may be deleted.

b Hammer Heads

Are not permitted.

c Grades and Crossfalls

The following is to apply to all turning facilities.

i Absolute minimum 0.5%
ii Desirable minimum 0.75%
iii Desirable maximum 5%
iv Absolute maximum 7%

2.12 ANCILLARY REQUIREMENTS

Signposting and Pavement Marking

a Signposting and pavement marking should generally be provided to roads, intersections, traffic control devices, cycleways and carparks in accordance with Australian Standard 1742.1 – 13 and the RTA "Interim Guide to Signs and Markings".

b Street name plates are to be ordered through Council and of the standard type currently in use throughout Snowy Valleys Council.

Guardrail and Guideposts

a Where there is a warrant guardrails are to be provided in accordance with RTA specification, where shown on the approved engineering plans or as directed by the Engineer.

b Guideposts are to be provided in accordance with RTA requirements, where shown on the approved engineering plans or as directed by the Engineer.

Service Conduits

Service conduits shall be provided for future use by Council, Telecom etc. at locations determined by the Engineer, so that future disturbance to road pavements is minimised.

Footpaths

a Concrete, asphalt or grassed footpaths are to be provided where shown on the approved engineering plans in accordance with Councils standard offsets.

b The following should apply when designing footpaths:

i A minimum width of 1.2m

ii A desirable crossfall of:

- Concrete 2%
- Asphalt 2%
- Grass 5%

iii A maximum crossfall for sealed footpaths of 4%.

Pathways

a Concrete or Asphalt pathways are to be provided where shown on the approved engineering plans.

b Pathways are generally used to link cul-de-sacs and also used as overland flow paths. Where they are used as overland flow paths they shall be concrete.

c The following should apply when designing pathways:

i Paved for full width between fences

ii A desirable crossfall of:

- Concrete 2%
- Asphalt 2%

d The following shall apply when designing pathways:

i Have an integral 150mm kerb on the low side.

ii Have sufficient capacity to carry the overland flow with nominated freeboard.

iii Be provided with trail bike barriers at either end of the property boundary line.

iv Have a minimum grade of 0.5% and maximum grade of 16

v. Overhead lighting shall be provided in accordance with NSW Public Lighting Code.

Utility Providers

The Developer must provide all Utility Providers with finished surface levels and/or up and down measurements from the top of kerb at the proposed property boundary and/or the proposed location of the Utility Providers pit, marker, etc, to ensure that:

i. All Utility Provider conduits etc have correct cover.

ii. All Utility Provider pits, markers, etc, do not require future costly adjustments to suit driveways, footpaths, etc.

It is advisable the Developer liaise with Utility Providers at any early stage of the development process to ensure that engineering designs are compatible with Utility Provider's requirements.

Batter Details

Cut or fill batters should generally comply to the following requirements unless otherwise advised by Geotechnical Engineers or requested by Council's Engineer.

a Fill Batters

Six horizontal to one vertical	-	preferred.
Four horizontal to one vertical	-	desirable maximum
Two horizontal to one vertical	-	absolute maximum.

All fill batters to be stabilised in accordance with Appendix "A" Techniques of Erosion and Sediment Control.

b Cut Batters

Six horizontal to one vertical	-	preferred.
Four horizontal to one vertical	-	desirable maximum
Two horizontal to one vertical	-	absolute maximum.

All cut batters are to be stabilised in accordance with Appendix "A: Techniques of Erosion and Sediment Control.

Cuttings in rock may be steeper than 2 to 1, up to 1 to 4 only where geotechnical reports and in field testing proves the stable nature of the rock.

c Lot Batters and Accesses

All batters to lots are to commence at 600mm inside the property boundary. Variations may be approved under special circumstances.

Vehicle access must be obtainable to each lot within close proximity to the building line. Maximum vehicular access grade to be 25%.

Batters are generally to intersect with the natural surface prior to the proposed building line.

d Retaining Walls

Where batters intersecting the natural surface cannot be achieved within the building setback, retaining walls are to be constructed within the property. Retaining walls are to be constructed either in conjunction with or in lieu of batters where the Engineer deems that in all practicality a retaining wall is necessary for safety and/or ease of maintenance of a particular batter.

Walls shall be either concrete mass, reinforced concrete, concrete crib or proprietary blockwork systems. Stonework will also be permitted, but only if construction is carried out by a qualified stonemason.

Temporary Turning Facilities

a Bus Routes

When a proposed road being a designated bus route is constructed in stages and the accumulated or initial length warrants a bus service, a temporary turning facility is to be provided in accordance with this specification.

b Residential Streets

When there is the likelihood of a delay in the construction of a further stage of a subdivision which creates dead ends of minimum 90 metres in length, a temporary gravel turning facility is to be provided, preferably a turning circle in accordance with this Manual. Refer Clause 2.11.

Parking

a Generally parking areas should be designed in accordance with best industry practice and Council's Carparking Policy which refers to Australian Standard 2890 and AustRoads Guide to Traffic Engineering Practice.

b Particular attention should be made to the following design requirements.

i Grades and crossfalls to be an absolute minimum of 1% desirably 3% and an absolute maximum of 5%.

ii Drainage aspects, especially where the carpark area is used for onsite detention of stormwater.

iii Car space yield

iv Circulation and aisle length.

v Ingress and egress requirements.

c Parking in cul-de-sacs shall be provided such that there is one space for each block served by the cul-de-sac bulb.

Other Utility Services

The developer is to provide mains for the supply of electricity and telephone. Electricity and telephone wiring is to be supplied by underground mains, except where overhead wiring already exists and is not scheduled for replacement. Consideration will be given for bundled cable in the case of overhead wiring. The subdivider is to arrange for electrical reticulation and telephone cabling with the appropriate authorities.

New streets are to be provided with at least 40 watt fluorescent streetlights or equivalent, at not greater than 100 metre spacing.

Driveways

The following requirements are placed on access roads/driveways.

Refer to Council Standard Drawings as amended from time to time.

Discourage speeding

The design of the carriageway should discourage drivers from travelling above the intended speed by reflecting the functions of the road in the network. In particular the width and horizontal and vertical alignment should not be conducive to excessive speeds.

Verge width

Appropriate verge width should be provided to enable the safe location, construction and maintenance of required footpaths and public utility services (above or below ground) and to accommodate the desired level of streetscaping. Wherever possible services should be located in common trenches.

Sight distance across verge

The verge when considered in conjunction with the horizontal alignment and permitted fence and property frontage treatments should provide appropriate sight distances, taking into account expected speeds and pedestrian and cyclist movements.

Stopping sight distances and junction or intersection sight distances, provided by the verge, should be based on the intended speeds for each road type.

2.13 CROSSFALL

General

Desirably, roads should be crowned in the centre. Typical pavement crossfalls on straight roads are given in Table 2.6.

Table 2.6 Typical pavement crossfalls on straight roads

Pavement Type	Crossfall %
Bituminous seal coat:	3
Bituminous concrete pavement:	2.5
Cement concrete pavement:	2
(Source: AUSTROADS, *Guide policy for geometric design of major urban roads*)	

Offset crown lines

There are many factors affecting levels in urban areas that force departures from these crossfalls. Differences in level between road alignments can be taken up by offsetting crown lines or adopting

one way crossfalls. Sustained crossfalls should not exceed 4%, although up to 6% may be used where unavoidable.

Rate of change

The rate of change of crossfall should not exceed: 6% per 30 m for through traffic; 8% per 30 m for free flowing turning movements; or 12% per 30 m for turning movements for which all vehicles are required to stop.

Precedence of crossfall over grade

The crossfall on a collector or sub-arterial road should take precedence over the grade in minor side streets. Standard practice is to maintain the crossfall on the major road and adjust the minor side street levels to suit.

The crossfall in side streets should be warped quickly either to a crown or a uniform crossfall depending on the configuration of the side street.

2.14 VERGES AND PROPERTY ACCESS

Criteria

A suitable design for the verge will depend on utility services, the width of footpath, access to adjoining properties, likely pedestrian usage and preservation of trees. Low level footpaths will not be allowed.

Crossfalls in footpath paving should not exceed 2.5%, in accordance with AUSTROADS *Guide to traffic engineering practice*. Longitudinal grade usually parallels that of the road and this may be steeper than 5%.

Level differences across the road

Differences in level across the road between road reserve boundaries may be accommodated by:

- Cutting at the boundary on the high side and providing the verge at normal level and crossfall.
- Battering at the boundary over half the verge width with the half against the kerb constructed at standard crossfall.
- A uniform crossfall across the carriageway.
-

The above measures can be used singularly or combined. The verge formation should extend with a 0.6 m berm beyond the road reserve boundary.

Driveway profile

The Designer shall design a vehicular driveway centreline profile for the property access and check this design using critical car templates, available from Council, to ensure that vehicles can use the driveway satisfactorily.

2.15 INTERSECTIONS

Criteria

Intersections should be generally located in such a way that:

- The streets intersect preferably at right-angles and not less than 70º.
- The landform allows clear sight distance on each of the approach legs of the intersection.
- The minor street intersects the convex side of the major street.
- The vertical grade lines at the intersection do not impose undue driving difficulties.

- The vertical grade lines at the intersection will allow for any direct surface drainage.
- Two minor side streets intersecting a major street in a staggered pattern should have a minimum centreline spacing of 40 m where a left turn - right turn manoeuvre between the staggered streets is likely to occur frequently.

Traffic volumes

The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections or junctions on sub-arterial roads.

State roads and national highways

Intersection design for the junction of Council's roads with existing state rural or urban roads and national highways should generally be in accordance with the publication AUSTROADS *Guide to traffic engineering practice—Part 5.*

Approval of RTA

Intersections with state roads or national highways shall be designed, approved and constructed in accordance with the requirements of the RTA.

Sight distance

Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections.

Parking

Where required, appropriate provision should be made for vehicles to park safely.

Drainage

The drainage function of the carriageway and/or road reserve shall be satisfied by the road reserve cross-section profile.

Turning movements

All vehicle turning movements are accommodated utilising AUSTROADS *Design Vehicles and Turning Templates*, as follows:

- For intersection turning movements involving sub-arterial roads, the 'design semi-trailer' with turning path radius 15.0 m shall be used.
- For intersection turning movements involving local streets or collector streets, but not sub-arterial roads, the 'design single unit' bus with turning path radius 13 m shall be used.
- For intersection turning movements on local streets but not involving sub-arterial roads or collector streets , the garbage collection vehicle used by the Council shall be used.

Turning radii

Turning radii at intersections or driveways on sub-arterial road accommodate the intended movements without allowing desired speeds to be exceeded.

2.16 ROUNDABOUTS

Criteria

Roundabouts should generally be designed in accordance with the requirements of the publication AUSTROADS *Guide to traffic engineering practice—Part 6*. Designs adopting alternative criteria will be considered on their merits.

Approval

Roundabouts shall be approved by the Council and the RTA.

2.17 TRAFFIC CALMING

Criteria

Calming devices such as thresholds, slowpoints, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of AUSTROADS *Guide to traffic engineering practice—Part 10.*

Devices designs should generally comply with the following:

- Streetscape
  - . reduce the linearity of the street by segmentation
  - . avoid continuous long straight lines (e.g. kerb lines)
  - . enhance existing landscape character
  - . maximise continuity between existing and new landscape areas
- Location of devices/changes
  - . devices other than at intersections should be located to be consistent with streetscape requirements
  - . existing street lighting, drainage pits, driveways, and services may decide the exact location of devices
  - . slowing devices are optimally located at spacings of 100 m–150 m.
- Design vehicles
  - . emergency vehicles must be able to reach all residences and properties
  - . local streets with a 'feeding' function between arterial roads and minor local streets might be designed for a AUSTROADS *Design Single Unit Truck/Bus*
  - . where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers
  - . in newly developing areas where street systems are being developed in line with local area traffic management (LATM) principles, building construction traffic must be provided for
- Control of vehicle speeds
  - . maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds
  - . speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings)
  - . speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by 'segmenting' streets into relatively short lengths (less than 300 m), using appropriate devices, streetscapes, or street alignment to create short sight lines
- Visibility requirements (sight distance)
  - . adequate critical sight distances should be provided such that evasive action may be taken by either party in a potential conflict situation. Sight distances should relate to likely operating speeds

- . sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers
- . night time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting if practicable, and all street features/furniture should be delineated for night time operation. Additional street lighting shall be provided by the Developer at proposed new speed control devices located away from existing street lighting.

- Critical dimensions

Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:

- . pavement narrowings
- . - single lane 3.50 m between kerbs
- . - 3.75 m between obstructions
- . - two lane 5.50 m minimum between kerbs
- . bicycle lanes (including adjacent to pavement narrowings)—1.2 m absolute minimum (1.0 m in special circumstances in accordance with *AUSTROADS Guide to traffic engineering practice—Part 14*.)
- . plateau or platform areas—75 mm to 150 mm height maximum, with 1 in 15 ramp slope
- . width of clear sight path through slowing devices—1.0 m maximum (i.e. the width of the portion of carriageway which does not have its line of sight through the device blocked by streetscape materials, usually vegetation)
- . dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates.

Approval

Traffic calming devices shall be approved by Council.

2.18 PARKING

On-site

The parking requirements for normal levels of activity associated with any land use should be accommodated on-site.

All on-site parking should be located and of dimensions that allow convenient and safe access and usage.

The number of on-site parking spaces for non-residential land uses conforms to parking standards as determined by Council.

The layout and access arrangements for parking areas for non-residential land uses should conform to AS 2890.1.

Parking shall be provided in accordance with Council's DCP3.

3 RURAL DESIGN CRITERIA

All rural roads shall be designed in accordance with the RTA Road Design Guide.

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0042 PAVEMENT

1 SCOPE AND GENERAL

Scope

This work section covers the design of road pavement to meet the required design life, based on the subgrade strength, traffic loading, environmental factors, and includes the selection of appropriate materials for select subgrade, subbase, base and wearing surface.

1.1 APPLICATION

The work section contains procedures for the design of the following forms of pavement construction:

- flexible pavements consisting of unbound granular materials;
- flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;
- rigid pavements (i.e. cement concrete pavements);
- concrete or clay segmental pavements.

1.2 OBJECTIVES

The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs adequately and requires minimal maintenance under the anticipated traffic loading for the design life adopted.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this work section:

Work sections

0041 *Geometric road layout*
0043 *Subsurface drainage*
1131 *Rolled concrete subbase*
1132 *Mass concrete subbase*
1133 *Plain or reinforced concrete base*
1134 *Steel fibre reinforced concrete base*
1135 *Continuously reinforced concrete base*
1141 *Flexible pavements*
1143 *Sprayed bituminous surfacing*
1144 *Asphaltic concrete (Roadways)*
1145 *Segmental paving*
1146 *Bituminous microsurfacing*

Other publications

AUSTROADS
AP – R258/04 Sprayed Seal Design
Pavement design, a guide to the structural design of road pavements, 2007
APT36/06 Pavement design for light traffic: A supplement to Austroads Pavement Design guide.

Cement and Concrete Association of Australia

C&CAA—T51 Guide to Residential Streets and Paths.

Concrete Masonry Association of Australia

CMAA—T44 Concrete segmental pavements—Guide to specifying, 1997

CMAA—T45 Concrete Segmental Pavements—Design guide for residential access ways and roads, 1997

CMAA—T46 Concrete segmental pavements—Detailing guide, 1997

Clay Brick and Paver Institute

Design Manual 1 Clay paving, 1989.

Resource NSW

Specification for supply of recycled materials for pavements, earthworks and drainage, 2003

2 PAVEMENT DESIGN CRITERIA

2.1 DESIGN VARIABLES

Regardless of the type of road pavement proposed, the design of the pavement shall involve consideration of the following input variables:

- Design traffic
- Subgrade evaluation
- Environment
- Pavement and surfacing materials
- Construction and maintenance considerations

2.2 DESIGN TRAFFIC

Minimum pavement design life

The design traffic shall be calculated based on the following minimum design lives of pavement:

- Flexible, Unbound Granular—25 years
- Flexible, Containing one or more bound layers—25 years
- Rigid (Concrete)—40 years
- Segmental Block—25 years

Equivalent standard axles (ESA)

Design traffic shall be calculated in equivalent standard axles (ESAs) for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity.

For interlocking concrete segmental pavements, the simplification of replacing ESA's with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA—T45 is acceptable up to a design traffic of 10^6. Beyond this, ESAs should be calculated.

Traffic data

The pavement design shall include all traffic data and/or assumptions made in the calculation of the design traffic.

Design traffic volumes

In general, reference should be made to APT36/06 calculation of design traffic volumes up to 10^6 ESAs and AUSTROADS *Pavement Design* for design traffic volumes approaching or exceeding 10^6 ESAs.

Guide to design ESAs

In the absence of other traffic data, Table 2.1 gives traffic values (in ESAs) that may be taken as a guide to the design traffic, but shall be subject to variation depending on the circumstances for the particular project.

Table 2.1 Design ESA's 25 year design life

Street type	Design ESA's—25 year design life
Urban Residential - Access Street - Local Street - Collector Street Sub-Arterial	 6×10^4 3×10^5 1×10^6 2×10^6
Rural Residential	3×10^5
Commercial and Industrial	5×10^6

2.3 SUBGRADE EVALUATION

Design considerations

The following factors shall be considered in determining the design strength/stiffness of the subgrade:

- Sequence of earthworks construction
- The compaction moisture content and field density specified for construction
- Moisture changes during service life
- Subgrade variability
- The presence or otherwise of weak layers below the design subgrade level.

California Bearing Ratio (CBR)

Except where a mechanistic design approach is employed using AUSTROADS *Pavement Design* (or software designed for this purpose), the measure of subgrade support shall be the California Bearing Ratio (CBR).

Where a mechanistic design approach using linear elastic theory is employed for flexible pavements, the measure of subgrade support shall be in terms of the elastic parameters (modulus, Poisson's ratio).

Design CBR considerations

The subgrade Design CBR adopted for the pavement design shall consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration shall be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure.

Warrants for the provision of subsurface drainage are given in 0043 *Subsurface drainage (Design)*. If subsurface drainage is not provided, then the Design CBR adopted must allow for a greater variability in subgrade moisture content during the service life of the pavement, and hence a design moisture content above the optimum moisture content.

Calculation of design CBR

The calculation of the Design CBR shall be based on a minimum of three 4 day soaked CBR laboratory samples for each subgrade area, compacted to the relative density specified for construction, and corrected to allow for the effects of subsurface drainage (or lack of), climatic zone, and soil type if appropriate (as per the guidelines in APT 36/06) to give an estimated equilibrium in-situ CBR.

The Design CBR for each subgrade area shall be computed by using the appropriate formulae as follows:

Design CBR	=	Least of estimated CBRs, for less than five results
Design CBR	=	10th percentile of all estimated CBRs, for five or more results
	=	C – 1.3S

where

C	is the mean of all estimated CBRs, and
S	is the standard deviation of all values.

Field confirmation

Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades.

Summary of results

The pavement design shall include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR.

Accredited designers

Developers are responsible for all pavement designs required. Pavement designs must be undertaken by NATA Accredited laboratories and designers approved by Council.

2.4 ENVIRONMENT

Environmental factors

The pavement design shall include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength, or affect the choice of pavement and surfacing materials.

Moisture and temperature

The environmental factors which significantly affect pavement performance are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to AUSTROADS *Pavement design*, APT 36/06, and to AUSTROADS *Guide to control of moisture in roads*.

Moisture considerations

The following factors relating to moisture environment shall be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

- Rainfall/evaporation pattern
- Permeability of wearing surface
- Depth of water table and salinity problems

- Relative permeability of pavement layers
- Whether shoulders are sealed or not
- Pavement type (boxed or full width)

Evaluate CBR or modulus using highest moisture content

The effect of changes in moisture content on the strength/stiffness of the subgrade shall be taken into account by evaluating the design subgrade strength parameters (i.e., CBR or modulus) at the highest moisture content likely to occur during the design life, i.e., the design moisture content.

The provision of subsurface drainage may, under certain circumstances, allow a lower design moisture content, and hence generally higher Design CBR.

Temperature changes

The effect of changes in temperature environment must be considered in the design of pavements with asphalt wearing surfaces, particularly if traffic loading occurs at night when temperatures are low, thus causing a potential reduction in the fatigue life of thin asphalt surfacing. The effect of changes in temperature environment should also be considered for bound or concrete layers.

2.5 PAVEMENT AND SURFACING MATERIALS

Pavement classification

Pavement materials can be classified into essentially four categories according to their fundamental behaviour under the effects of applied loadings:

- Unbound granular materials, including modified granular materials
- Bound (cemented) granular materials
- Asphaltic Concrete
- Cement Concrete

Surfacing classification

Surfacing materials can also be classified into essentially five categories or types:

- Sprayed bituminous seals (flush seals)
- Asphaltic concrete and bituminous microsurfacing (cold overlay)
- Cement concrete
- Concrete segmental pavers
- Clay segmental pavers

Unbound granular materials, including modified granular materials, shall satisfy the requirements of 1141 *Flexible pavements*.

Due regard should be taken of the opportunity to use recycled materials for sub-base and base course of pavement (RESOURCE NSW—Specification for supply of recycled materials for pavements, earthworks and drainage. (See disclaimer in front cover of specification under ‘Important’ regarding liability)).

Bound (cemented) granular materials shall satisfy the requirements of the 1141 *Flexible pavements*.

Asphaltic concrete shall satisfy the requirements of the 1144 *Asphaltic concrete (Roadways)*.

Cement concrete shall satisfy the requirements of 1131 *Rolled concrete subbase*, 1132 *Mass concrete subbase*, 1133 *Plain or reinforced concrete bas*e, 1134 *Steel fibre reinforced concrete* or 1135 *Continuously reinforced concrete bas*e, as appropriate.

Sprayed bituminous seals shall satisfy the requirements of 1143 *Sprayed bituminous surfacing*.

Concrete and clay segmental pavers shall satisfy the requirements of 1145 *Segmental paving*.

Bituminous microsurfacing (cold overlay) shall satisfy the requirements of 1146 *Bituminous microsurfacing.*

2.6 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

The type of pavement, choice of base and subbase materials, and the type of surfacing adopted should involve consideration of various construction and maintenance factors as follows:

- Extent and type of drainage
- Use of boxed or full width construction
- Available equipment of the Contractor
- Use of stabilisation
- Aesthetic, environmental and safety requirements
- Social considerations
- Construction under traffic
- Use of staged construction
- Ongoing and long-term maintenance costs

For further information on how these factors are incorporated, refer to AUSTROADS *Pavement design.*

3 PAVEMENT THICKNESS DESIGN

3.1 PAVEMENT STRUCTURE

Minimum pavement thickness

The pavement thickness, including the thickness of surfacings, shall not be less than 250 mm for roads with kerb and guttering, 200 mm for unkerbed roads and 150 mm for carparks.

Notwithstanding subgrade testing and subsequent pavement thickness design, the thickness of subbase and base layers shall not be less than the following:

- Flexible pavement—subbase 100 mm, base 100 mm
- Rigid pavement—subbase 100 mm, base 150 mm

Subbase extent

The subbase layer shall extend a minimum of 150 mm behind the rear face of any kerbing and/or guttering.

Base extent

The base and surfacing shall extend to the face of any kerbing and/or guttering.

Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer shall also extend a minimum of 150 mm behind the rear face of the kerbing and/or guttering.

Unkerbed roads

For unkerbed roads, the subbase and base layers shall extend to the face of the batter..

Carparks

The pavement designer shall make specific allowance for traffic load concentrations within carpark areas (e.g. entrances/exits).

Drainage

The pavement designer shall make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur.

3.2 UNBOUND GRANULAR FLEXIBLE PAVEMENTS—BITUMINOUS SURFACED

Unbound granular flexible pavements with thin bituminous surfacings, including those with cement or lime modified granular materials, with design traffic up to 10^6 ESAs shall be designed in accordance with APT36/06, using **95% confidence limit curves**.

For design traffic above 10^6 ESAs, the design shall be in accordance with AUSTROADS *Pavement design* (or software designed for this purpose).

3.3 FLEXIBLE PAVEMENTS CONTAINING BOUND LAYERS—BITUMINOUS SURFACED

Flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than thin asphalt surfacings, shall be designed in accordance with AUSTROADS *Pavement design* (or software designed for this purpose).

As an alternative to AUSTROADS *Pavement Design* for design traffic up to 10^6 ESAs, bound layers may be assumed to be equivalent to unbound layers of the same thickness, and the pavement designed in accordance with APT36/06, using Figure 7 *95% confidence limit curves*.

3.4 RIGID PAVEMENTS

Rigid (concrete) pavements, with design traffic up to 10^6 ESAs shall be designed in accordance with either CACA-T51 or AUSTROADS Pavement design (or software designed for this purpose).

Rigid (concrete) pavements for design traffic above 10^6 ESAs, the design shall be in accordance with AUSTROADS Pavement design (or software designed for this purpose).

3.5 SEGMENTAL PAVEMENTS

Concrete and clay segmental pavements will not be allowed.

4 SURFACING DESIGN

4.1 SURFACE TYPE

Streets

Except where the pavement is designed for concrete surfacing, the wearing surface shall be a bituminous wearing surface as follows:

Urban residential streets and rural roads	• two coat flush seal; or • primer seal, plus one coat flush seal; or • tack coat primeal, plus asphalt
Commercial and industrial streets	• tack coat prime, plus asphalt.

Braking and turning zones

At intersection approaches and cul-de-sac turning circles on residential streets with flush seals, asphalt surfacing shall be provided within the vehicle braking and turning zones.

Approval

Variations to these requirements may be approved by Council in special circumstances.

4.2 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)

Seal design

The design of sprayed bituminous (flush) seals, including primer seals, shall be in accordance with the *AUSTROADS—Design of sprayed seals* or the relevant State Road Authorities' Bituminous Surfacing Manual.

Primer seal

7 mm primer seals shall be Indicated on the Drawings below all flush seals, bituminous microsurfacing, and asphalt surfacings. Where a 7 mm primer seal is impractical, a 10 mm primer seal shall be indicated in lieu.

Two-coat flush seals

Two-coat flush seals shall be double-double seals, comprising a minimum of two coats binder and two coats of aggregate. The preferred seal types are:

- 1st coat—14 mm
- 2nd coat—7 mm

Single coat flush seal

Single coat flush 14 mm seals shall be applied as the finished surface over a primerseal.

4.3 BITUMINOUS MICROSURFACING (COLD OVERLAY)

Minimum thickness

Bituminous microsurfacing, also referred to as 'cold overlay', shall be designed to provide a nominal compacted thickness of not less than 8 mm.

Primer seal and single coat seal

As a minimum, a 7 mm primer seal and a single coat flush seal shall be indicated on the drawings below the bituminous microsurfacing.

4.4 ASPHALTIC CONCRETE

Light to medium traffic

In urban residential access and local streets, rural or light trafficked commercial streets (design traffic up to approximately 3×10^5 ESAs), the asphalt mix design shall be either a 'high-bitumen content' mix or APT36/06 and 1144 *Asphaltic concrete (Roadways)*.

Medium to heavy traffic

In urban residential collector and sub-arterial roads, medium to heavily trafficked commercial streets and in all industrial roads, the asphalt mix design shall be a dense graded mix in accordance with the 1144 *Asphaltic concrete (Roadways).*

Minimum thickness

Asphaltic concrete surfacings shall be designed to provide a nominal compacted layer thickness of not less than 30 mm on light to medium trafficked residential, rural and commercial streets, and 40 mm on medium to heavily trafficked residential, rural or commercial roads and on all industrial and classified roads.

Primer seal

As a minimum, a tack coat prime shall be indicated on the drawings below the asphalt surfacing.

5 DOCUMENTATION

5.1 DESIGN CRITERIA AND CALCULATIONS

Submission details

All considerations, assumptions, subgrade test results, and calculations shall be submitted with the pavement design for approval by Council.

Drawings

The Drawings shall clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing.

6 SPECIAL REQUIREMENTS

6.1 CAR PARK PAVEMENTS

a Carpark pavements are to be designed in accordance with this chapter.

b Particular attention should be made to the following:

i. Carpark geometry does not place undue loading to bituminous surfacing. Modified asphalt may be warranted.

ii. Correct design traffic is used where aisles within carparks will service other adjacent commercial, retail, industrial centres or loading zones.

c All loading zones are to be constructed in concrete to resist damage from diesel and fuel spills.

6.2 DECORATIVE PAVEMENTS

Decorative driveways will not be permitted.

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0043 SUBSURFACE DRAINAGE (DESIGN)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this work section consists of the design of the subsurface drainage system for the road pavement and/or subgrade.

This work section contains procedures for the design of subsurface drainage, including:

- Subsoil and foundation drains
- Sub-pavement drains
- Drainage mats, including Type A and Type B mats.

1.2 OBJECTIVES

Control moisture fluctuations

The objective in the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or subgrade to within the limits assumed in the pavement design.

Salinity prevention

In the areas with a history of salinity problems, subsurface drainage may be prescribed to keep the groundwater table lower in the strata so as to avoid progressive deterioration of the health of topsoil and upper layers due to salinity levels increased by rising and/or fluctuating groundwater tables.

1.3 DEFINITIONS

For the purposes of this work section the following definitions apply:

Subsoil drains: are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings and fill areas.

Foundation drains: Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation.

Sub-pavement drains: are intended for the drainage of the base and subbase pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the subgrade.

Type A drainage mats: are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type B drainage mats: are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

1.4 REFERENCED DOCUMENTS

The following documents referred in this work section are:

Work sections

1171 *Subsurface drainage*

Standards

AS 2439 Perforated plastics drainage and effluent pipe and fittings
AS 2439.1 Perforated drainage pipe and associated fittings
AS/NZS 1477 PVC pipes and fittings for pressure applications

Other publications

ARRB Australian Road Research Board
ARR368 the collection and discharge of stormwater from road infrastructure.
RESOURCE NSW
Specification for supply of recycled materials for pavements, earthworks and drainage, 2003

1.5 BIBLIOGRAPHY

Work sections

1172 *Subsoil and foundation drains*
1173 *Pavement drains*
1174 *Drainage mats*

Other publications

AUSTROADS
Guide to the control of moisture in roads, 1983
APT36/06 Pavement design for light traffic: a supplement to the Austroads pavement design guide.

2 SUBSOIL AND SUB-PAVEMENT DRAINS

2.1 WHERE REQUIRED

Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents:

- Cut formations where the depth to finished subgrade level is equal to or greater than 400 mm below the natural surface level.
- Locations of known hillside seepage, high water table, isolated springs or, salt affected areas.
- Irrigated, flood-prone or other poorly drained areas.
- Highly moisture susceptible subgrades, i.e., commonly displaying high plasticity or low soaked CBRs.
- Use of moisture susceptible pavement materials.
- Existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture.
- At cut to fill transitions.

Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation.

The Drawings shall be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

2.2 LAYOUT, ALIGNMENT AND GRADE

Typical cross sections

Typical cross sections of subsoil and sub-pavement drains are shown in Figures 2.1 and 2.2.

Kerbed roads

In kerbed roads, the two acceptable alternative locations for the line of the trench are directly behind the kerbline. Pavement layers must extend to at least the line of the rear of the trench.

Unkerbed roads

In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers as shown in Figure 2.2.

Grade

The minimum longitudinal design grade shall be 1.0%. For non corrugated pipes, an absolute minimum grade of 0.5% is acceptable.

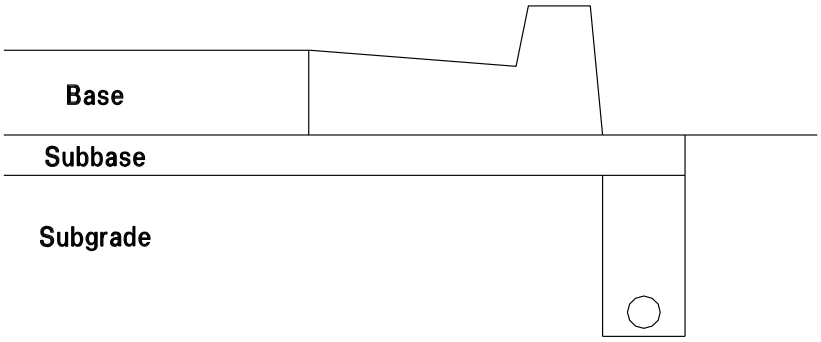

Figure 2.1 Typical subsoil drain

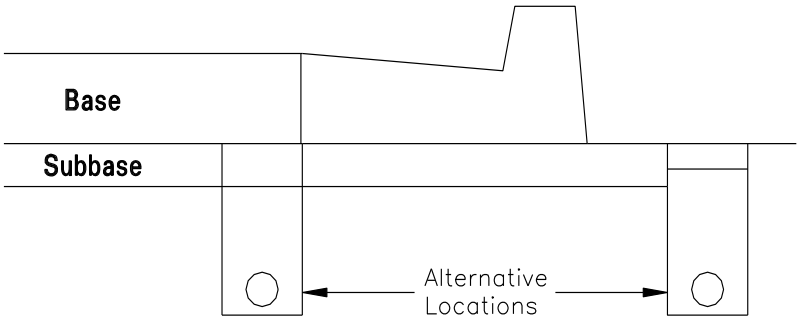

Figure 2.2 Typical sub-pavement drain

Trench dimensions

Trench widths shall be a minimum of 300 mm, with a minimum depth below finished subgrade level of 600 mm in earth and 450 mm in rock, and below the invert level of any service crossings.

Outlets and salinity prevention

Outlets shall be spaced at maximum intervals of 150 metres into gully pits or outlet headwalls. As a salinity prevention measure and where practical, discharge shall be on the downhill side of the embankment or in the cut-fill area so as to reduce the risk of recharge to the subsurface water table.

Unless otherwise authorised, where subsurface drains outlet through fill batters, unslotted plastic pipe of the same diameter as the main run shall be specified. A small precast concrete headwall shall be installed at the drain outlet with a marker post to assist maintenance and protect the end of the pipe.

Cleanouts

Cleanouts shall be provided at the commencement of each run of drain, and at intervals not exceeding 80 metres. Cleanouts shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

Salinity prevention

In salinity affected areas, the Designer should consider providing a separate drainage system for subsurface drains to discharge to a basin where controlled release or desiccation treatment and removal can be facilitated as a maintenance operation.

Saline subsurface drainage should not be routinely discharged directly into natural watercourses.

Reference to water quality targets for downstream watercourses is essential and the Designer shall provide advice on discharge operations and maintenance compatible with water quality targets and the requirements of the relevant land and water resource authority.

3 FOUNDATION DRAINS

3.1 WHERE REQUIRED

Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location shall be shown on the Drawings.

However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

Where the road formation traverses known swampy, flood-prone, salt affected areas or watercharged strata, the Drawings shall be suitable annotated to the potential need for foundation drains at various locations, in addition to those shown on the Drawings.

3.2 LAYOUT, ALIGNMENT AND GRADE

Typical cross section

Typical cross-sections of foundation drains are shown in Figure 3.1.

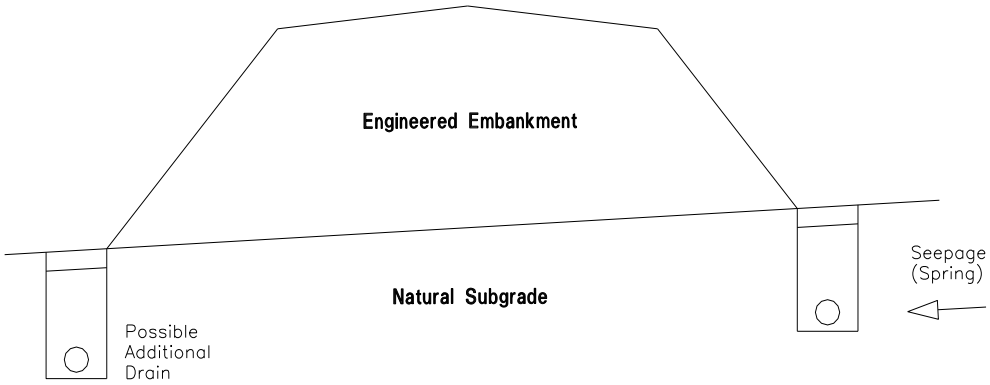

Figure 3.1 Foundation drains

Grade

The minimum design grade shall be 1.0%. For non corrugated pipes an absolute minimum grade of 0.5% is acceptable.

Trench dimensions

Foundation drains shall be a minimum trench width of 300 mm, with a variable trench depth to suit the application and ground conditions on site.

Outlets

Outlets shall be spaced at maximum intervals of 150 metres.

Cleanouts

Where practicable, cleanouts are to be provided at the commencement of each run of foundation drain and at intervals not exceeding 80 metres.

Where not practicable to provide intermediate cleanouts, outlets shall be spaced at maximum intervals of 100 metres.

4 DRAINAGE MATS

4.1 WHERE REQUIRED

The need to design for the provision of drainage mats (or blankets) should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

Type A mats

Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type B mats

Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.

5 MATERIALS

5.1 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

Pipes designated for subsoil, foundation and sub-pavement drains shall be 100 mm dia. slotted pipe except for cleanouts and outlets through fill batters which shall be unslotted pipe.

All pipe shall be slotted, and fitted with a suitable geotextile filter tube. Corrugated plastic pipe shall conform to the requirements of AS 2439.1. The appropriate class of pipe shall be selected on the basis of expected live loading at the surface. Joints, couplings, elbows, tees and caps shall also comply with AS 2439.1.

Slotted rigid UPVC pipe shall be of a type and class approved by Council.

5.2 INTRA PAVEMENT DRAIN PIPE

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses neither less than 150 mm nor more than 200 mm shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses exceeding 200 mm shall be slotted pipe of a type and class approved by Council.

Pipes for use in Type B drainage mats shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

5.3 FILTER MATERIAL

Acceptable types of filter material and their use shall be as follows:

- Type A filter material—use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats.
- Type B filter material—use in subsoil, foundation and sub-pavement (trench) drains.
- Type C filter material comprising crushed rock—use in Type A drainage mats.
- Type D filter material comprising uncrushed river gravel—use in Type A drainage mats.

Material requirements and gradings for each type of filter material are included in the 1171 *Subsurface drainage*.

5.4 BACKFILL FILTER MATERIAL

The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) shall depend on the permeability of the pavement layers and/or subgrade and the expected flow rate.

Generally, Type A filter material is used for the drainage of highly permeable subgrade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of subgrade and pavement layers of lower permeability such as clays, silts or dense graded gravels.

Further guidance to the selection of appropriate filter material is contained in *ARRB ARR368*.

5.5 GEOTEXTILE

To provide separation (i.e. prevent infiltration of fines) between the filter material in the trench and the subgrade or pavement material, geotextile shall be designated to encapsulate the filter material.

The geotextile shall comply with the requirements included in 1171 *Subsurface drainage*.

Geotextile shall also be designated for both Type A and Type B Drainage Mats.

6 DOCUMENTATION

6.1 DRAWINGS

The proposed location of all subsurface drains shall be clearly indicated on the Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement.

The location of outlets and cleanouts shall also be indicated on the Drawings.

6.2 CALCULATIONS

Assumptions and/or calculations made in the determination of the need or otherwise for subsurface drainage in special circumstances or as a variation to the requirements of this work section shall be submitted to Council for approval with the Drawings.

7 SPECIAL REQUIREMENTS

7.1 REQUIREMENTS FOR SUBSURFACE DRAINAGE

Further to clause 2.1, subsoil or sub pavement drains shall be provided at all locations where kerb and gutter is installed in a cutting in a rural location.

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0044 FOOTPATHS AND CYCLEWAYS

1 SCOPE AND GENERAL

1.1 SCOPE

This worksheet sets out requirements to be used in the design of various types of cycleways and footpaths.

This worksheet serves as a companion document to the *AUSTROADS Guide* extended to incorporate basic requirements for footpaths.

1.2 OBJECTIVES

This worksheet set standards and document requirements related to the provision of cycleways and footpaths which:

- encourage pedestrian activities and cycling for transportation and recreational purposes;
- are safe and convenient; and
- maintain a satisfactory level of service for all footpath users including users with disabilities and limited mobility.

1.3 REFERENCED DOCUMENTS

The following documents referred in this work section are:

Work sections

0041 *Geometric road layout*
0160 *Quality (Design)*

Standards

AS 1428	Design for access and mobility
AS 1742	Manual of uniform traffic control devices
AS 1742.9	Bicycle facilities
AS 1742.10	Pedestrian control and protection
AS 2890	Parking facilities
AS 2890.3	Bicycle parking facilities

Other publications

AUSTROADS
AP-11 Guide to Traffic Engineering Practice
Part 13: Pedestrians
Part 14: Bicycles
Planning and Designing for Bicycles—NAASRA (now AUSTROADS) Technical Report June 1988

1.4 BIBLIOGRAPHY

The following documents provide additional information:

AS 2156 Walking Tracks

AS 2156.1 Classification and signage

AS 2156.2 Infrastructure design

SAA HB 69.14 Guide to traffic engineering practice—Bicycles

Other publications

Ministry of Transport, Victoria—State Bicycle Committee

Planning and design of bicycle facilities

1.5 CONSULTATION WITH COUNCIL AND PUBLIC AUTHORITIES

The Designer shall consult with Council, relevant authorities, and, where applicable, project landscape architects/designers prior to, and during, the preparation of cycleway and footpath design.

1.6 PLANNING CONCEPTS

Planning

The design shall comply with requirements for cycleways and footpaths in any applicable Council regional or local strategic bicycle plan or subdivision code.

Geometric design

The design shall comply with *AUSTROADS Guide to traffic engineering practice Parts 13 and 14* in terms of:

- width
- grade
- stopping sight distance
- change in grade
- horizontal curvature
- crossfall and drainage
- superelevation
- sight distance on horizontal curves

Disabled access

The Designer shall incorporate all the requirements for disabled access as appropriate for footpath design in accordance with any Council Policy or Development Control Plan on Access and Mobility and AS 1428.

1.7 CYCLEWAY AND FOOTPATH TYPES

Cycleways

Cycleways can only be provided off road. *AUSTROADS Guide to traffic engineering practice Part 14* provides detailed descriptions, warrants, widths, pavement marking, etc., for the majority of these cycleways.

Relevant design principles contained in the *AUSTROADS Guide to traffic engineering practice Part 14* shall be integrated in the design of cycleways and associated infrastructure.

Common alternative cycleway types include:

- Off road
  - . Shared use bicycle/pedestrian footpath

. Separated footpath
. Exclusive cycleway

AUSTROADS Guide to traffic engineering practice Part 14 provides advice on the suitability of pavement conditions, drainage pit grates, etc., for on road cycleways.

Footpaths

Common footpath types include:

- Exclusive pedestrian footpaths
- Shared use bicycle/pedestrian footpaths

Footpaths diverge from the road alignment either within the road reserve or across land reserves. Footpaths can be provided in conjunction with overland floodways or retention basins.

Footpaths

By definition pedestrian footpaths are 'off road' in that pedestrian facilities, routinely designed adjacent to roadways, are termed footpaths and are designed to meet criteria outlined for instance in Council's Subdivision Code and typically related to road cross section detailing.

1.8 PROVISION FOR CYCLEWAYS AND FOOTPATHS AT STRUCTURES

Designers shall consider the best way to provide for the uninterrupted movement of cyclists and pedestrians at proposed and existing structures wherever possible. Structures include bridges and underpasses over rivers, roads or railways.

The reference and source documents provide information on:

- acceptable widths and clearances
- types of cycleways and footpaths
- handrails
- bicycle bridges
- approach ramps, etc.

1.9 SIGNAGE AND PAVEMENT MARKING

The Designer shall provide adequate signposting for cycleways and footpaths.

Signs and pavement marking shall comply with AS 1742.9 and AS 1742.10.

1.10 END OF JOURNEY FACILITIES

Consideration must be given to the design of adequate facilities at common destinations of cyclists and pedestrians so as to encourage cycleway and footpath usage.

Such facilities could include:

- seats
- standby areas
- secure bicycle parking
- picnic facilities

Bicycle parking installation design should meet appropriate criteria discussed in the *AUSTROADS Guide to traffic engineering practice Part 14* and be fabricated to meet AS 2890.3.

1.11 DESIGN CRITERIA

Notwithstanding the guidelines provided in this worksheet and referenced documents Table 1.1 gives minimum standards.

Table 1.1 Minimum design criteria for cycleways, footpaths and shared use footpaths

Feature		**Cycleway**	**Footpath**	**Shared use footpath/cycleway**
Path Width		1.8 m	1.2 m	1.8 m
Formation Width		2.4 m	1.2 m	2.4 m
Crossfall	min. max.	1:40 1:20	1:40 1:20	1:40 1:20
Grade	max.	2% for 450 m 5% for 90 m 10% for 30 m	NA	2% for 450 m 5% for 90 m 10% for 30 m

1.12 DOCUMENTATION

Drawings

All Drawings shall be in accordance with the minimum drafting requirements in 0160 *Quality (Design)*

Plans

The following shall apply:

- All plans for cycleways and footpaths are to be presented at the reduction ratio 1:500.
- The cycleway plan sheet may be incorporated into the road plan where clarity permits. Specific details are to be provided at reduction ratio 1:200.

Long sections

Longitudinal sections will:

- be required for all off-road cycleways where grades exceed 4%.
- have reduction ratios of 1:500 horizontal and 1:100 vertical.

Cross sections

The following shall apply:

- Cross sections will be presented at 1:100 reduction ratio (natural) and transition tables will be required where cross falls vary or superelevation is provided.
- A typical cross section will be detailed to indicate pavement materials and layer depths.

0061 BRIDGES AND OTHER STRUCTURES

1 SCOPE AND GENERAL

1.1 SCOPE

This work section sets out design of structural engineering elements for works including:

- Road traffic bridges
- Pedestrian bridges
- Structures other than bridges associated with roads (e.g., major culverts, arches, retaining walls, earth retaining structures and major sign support structures)
- Small earth dams and detention basins
- Structures used for public safety (road safety barriers, pedestrian safety rails, street lighting)
- Temporary works

Structures may be of concrete, timber or steel constructions. Emphasis is placed on low maintenance.

1.2 OBJECTIVE

The aim of design shall be that the structure remains fit for use during its design life, having regard to economic, physical, aesthetic and other relevant constraints.

1.3 BASIS OF DESIGN

The design shall be based on scientific theories, experimental data and experience, interpreted statistically as far as possible.

The safety and service performance of a structure depends also on the quality control exercised in fabrication, supervision on site, the control of unavoidable imperfections and the qualifications, experience and skill of all personnel involved.

Adequate attention shall therefore be given to these factors. In addition, adequate management control and supervision by experienced engineers shall be required at all stages of design and construction.

Specifications shall be notated on the drawings with sufficient detail to ensure that the above described strategies are able to be effectively implemented at the construction stage.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this work section shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Work sections

0074 *Stormwater drainage (Design)*

Standards

AS 1158	Lighting for roads and public spaces
AS 1428	Design for access and mobility
AS 1428.1	General requirements for access—New building work
AS/NZS 2041	Buried corrugated metal structures
AS/NZS 3845	Road safety barrier systems
AS 4678	Earth-retaining structures

AS 5100 Bridge design

Other publications

AUSTROADS
Bridge Design Code.
KD Nelson - Design and construction of small earth dams.

1.5 BIBLIOGRAPHY

The following documents provide additional information:

Work sections

0041 *Geometric layout*
0075 *Control of erosion* and stormwater management during construction

Standards

AS/NZS 1170 Structural design actions
AS 3600 Concrete structures
AS 3700 Masonry structures
AS 4100 Steel structures

Other publications

Engineers Australia
Australian Rainfall and Runoff (AR&R)—A guide to flood estimation

1.6 QUALIFICATIONS OF DESIGNERS

Road traffic and pedestrian bridges

Bridge design shall only be carried out by properly qualified persons whose Association of Consulting Engineers Australia (ACEA) listing includes structural design of bridges in its claimed area of competency. Such designers shall submit evidence of these qualifications to Council prior to approval of any bridge design.

Structures, other than bridges, associated with roads

Public utility structures, major culverts, arches, major sign support structures, retaining walls and earth-retaining structures shall be designed by an Engineer deemed to be suitably experienced in the relevant field by Council and eligible for Chartered Professional Membership of the Institution of Engineers, Australia.

Small earth dams and detention basins

The designer shall be a qualified civil or structural engineer having accreditation in the design of such structures.

Temporary works

The designer shall be a qualified Engineer experienced and accredited in the design of such structures.

Design by other persons

The above requirement does not preclude other persons undertaking bridge or structures design. In which case Council may refer the design calculations to an appropriate ACEA Consultant for checking.

1.7 ROAD TRAFFIC AND PEDESTRIAN BRIDGES

Design

The design of bridges shall comply with AS 5100.

Design life maintenance

Preventative maintenance is a key issue affecting the design life of the structure. The Drawings shall specify the design life of the structure together with the relevant maintenance programs to be adopted upon which the design life is based. Parameters used in the design shall also be shown on the Drawings.

Hydraulic design

Hydraulic design of bridges shall be in accordance with the requirements for major structures in 0074 *Stormwater drainage (design).*

Finishes

Bridges shall have low maintenance finishes. Adequate precautions shall be taken for protection of the materials used in the bridge design; for example, timber and steel require special consideration.

Heavy debris and bed loads

Heavy debris and bed loads may be characteristic of some streams so that large spans with slender piers are encouraged.

If overtopping is permitted, pedestrian safety rails and road safety barriers are usually omitted. Flood depth indicators and appropriate signposting will be provided in such cases.

Inundation

Where structures are designed to be inundated, the effect of the backwater gradient on upstream property shall be identified on the Drawings.

Freeboard

Where no inundation is permitted, appropriate afflux shall be adopted together with a 500 mm freeboard to the underside of the bridge deck.

Public utilities

Designers should enquire regarding current or likely provision for public utilities in bridges. These should be concealed for aesthetic reasons.

Lighting

Bridge approaches and crossings in urban areas shall be provided with street lighting in accordance with AS 1158.

1.8 PROVISION FOR PEDESTRIANS ON ROAD BRIDGES

Minimum provision

Provision for pedestrians on bridges is required in rural residential as well as urban areas. The minimum provision is a 1.5 m footpath with kerb at the road traffic edge and pedestrian safety rails at the external edge.

Separate footpaths

Council may require the provision of separate pedestrian footpaths in other situations should the anticipated traffic warrant it.

Disabled access

Access for the disabled shall be considered in the design in accordance with AS 1428.1.

Structures, other than bridges, associated with roads

The design shall be in accordance with relevant AUSTROADS codes, Australian Standards, and the requirements of any utility owners that may be relevant.

Where applicable, buried corrugated metal structures shall be designed in accordance with AS/NZS 2041 and earth-retaining structures in accordance with AS 4678.

1.9 SMALL EARTH DAMS AND DETENTION BASINS

Design

Small earth dams shall be designed following the guidelines in *Design and Construction of Small Earth Dams by K D Nelson* together with relevant geotechnical recommendations.

The structural design of weir outlets to resist failure shall be considered in design. Refer also to the Retarding Basin and Stormwater Detention sections in 0074 *Stormwater drainage (design)*.

Fencing

Childproof fencing shall be nominated where it is a requirement of relevant statutory regulations, Australian Standards or Council Specifications and where unacceptable risk exists due to the location of the dam/basin in relation to the urban nature of the area.

Risk of failure

The Designer shall carry out the design with recognition of the potential risk on existing and planned infrastructure downstream, assuming the probability of dam/basin failure.

Certification

The Designer shall be required to certify the design and ultimately certify the work-as-executed drawings for compliance with the design. All relevant details shall be shown on the drawings.

1.10 STRUCTURES USED FOR PUBLIC SAFETY

Barriers and rails

Since the requirement of road safety barriers and pedestrian safety rails on bridges are different, the design engineer shall consider whether separate traffic and pedestrian barriers can be detailed to satisfy the major functional requirements.

The AS 5100 and AS/NZS 3845 are recommended references in this regard.

It is essential that all safety barriers and rails have been fully tested and accredited for the intended use under quality assurance provisions.

Lighting

Bridge approaches and crossings in urban areas and rural residential areas shall be provided with street lighting in accordance with AS 1158. Such requirements will be noted accordingly on the Drawings.

1.11 TEMPORARY WORKS

Design

Structures which are proposed for the temporary support of roads, services and the like shall be designed in accordance with the AS 5100.

Construction programs

A construction program, indicating the sequence of events leading to the implementation and removal of the temporary structures shall be specified on the Drawings.

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0071 WATER SUPPLY RETICULATION AND PUMP STATIONS (DESIGN)

1 SCOPE AND GENERAL

Scope

This work section contains procedures for the design of a water reticulation system, including pump stations, either as a stand-alone project or part of a development.

Note: See Annexure A for incorporation of local requirements into this work section.

1.1 OBJECTIVE

The objective of a water supply system is to provide to the consumer a reticulated (either potable or dual potable/raw) water supply to meet the demands imposed upon it by both the consumers and fire fighting requirements. Consumer requirements shall be met by providing a water main and allowing an appropriate point of connection for each individual property.

1.2 COMPLIANCE

The design of reticulation and pump station components shall comply with the Water Services Association of Australia's publication Water Supply Code of Australia unless specified otherwise herein and should be constructed in accordance with 1341 *Water – reticulation and pump stations (Construction).*

1.3 SUBSIDISED SCHEMES

Where the Specification forms part of a contract attracting Government Grant funds, the Principal shall identify:

- Items which are not of the least cost option, that:
  - . Are intended to have a much longer design life than the normal asset service life detailed in the Asset Management Guidelines of the International Infrastructure Management Manual.
  - . Do not meet the project objectives and the requirements of the various Authorities for the least Net Present Value (NPV) but may become the preferred option for construction.
- Particular equipment which is procured without relevant competition through tendering
- Duplication of equipment or unit processes in a system configuration

1.4 WORK SECTIONS TO BE USED BY THE DESIGNER

In designing a water reticulation system it is assumed that the Designer shall possess, or have access to, the documents required to comply with this work section.

The Designer shall include the requirements of 1341 *Water – reticulation and pump stations (Construction)*

The Designer shall use the latest edition of the Australian Standards, including amendments and supplements, unless specified otherwise.

References to the Water Supply Code of Australia (WSAA 03-2002 Version 2.3) are identified by part and section numbers and enclosed in brackets thus (WSAA Part, Section).

Water Supply Code of Australia drawings shall be used in preference to DPWS standard drawings (WSAA 03 Part 4).

1.5 REFERENCED DOCUMENTS

The following documents referred to in this work section shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Work section

1341 *Water – reticulation and pump stations (Construction)*

Standards

AS 1102 series	Graphical symbols for electrotechnical documentation (various)
AS 1111 series	ISO metric hexagon bolts and screws
AS 1112 series	ISO metric hexagon nuts
AS 1214	Hot-dipped galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 1281	Cement mortar lining of steel pipes and fittings
AS 1432	Copper tubes for plumbing, gasfitting and drainage applications
AS 1579	Arc-welded steel pipes and fittings for water and waste-water
AS 1646 series	Elastomeric seals for waterworks purposes
AS 1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation
AS 2129	Flanges for pipes, valves and fittings
AS 2200	Design charts for water supply and sewerage
AS 2634	Chemical plant equipment made from glass-fibre reinforced plastics (GRP) based on thermosetting resins
AS 2837	Wrought alloy steels—Stainless steel bars and semi-finished products
AS 3571	Glass filament reinforced thermosetting plastics (GRP) pipes—Polyester based—Water supply, sewerage and drainage applications
AS 3688	Water supply—Metallic fittings and end connectors
AS 3691	Solvent cement and priming (cleaning) fluids for use with ABS pipes and fittings
AS 3996	Access covers and grates
AS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4087	Metallic flanges for Waterworks purposes.
AS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 1594	Hot rolled steel flat products
AS/NZS 2280	Ductile iron pipe and fittings
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 3500	Plumbing and drainage
AS/NZS 3500.1	Water services
AS/NZS 3518	Acrylonitrile Butadienne Styrene (ABS) pipes and fittings for pressure applications
AS/NZS 3862	External fusion-bonded epoxy coating for steel pipes
AS/NZS 4129	Fittings for polyethylene (PE) pipes for pressure applications.
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications.
AS/NZS 4131	Polyethylene (PE) compounds for pressure pipes and fittings.
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes

AS/NZS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 4765	Modified PVC (PVC–M) pipes for pressure applications

Other publications

NSW Department of Commerce

MEW E101 Electrical Services Minimum Requirements

WS-SPEC Technical Requirements (TRs) and Strategic products Specifications (WSAA)

Water Services Association of Australia (WSAA)

WSAA 03 Water Supply Code of Australia

Australian Building Codes Board

BCA Vol 1—PART E1, Fire fighting equipment.

1.6 BIBLIOGRAPHY

Standards

AS 1444	Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS 2638 series	Gate Valves for waterworks purposes
AS 3578	Cast iron non-return valves for general purposes
AS 3579	Cast iron wedge gate valves for general purposes
AS 3680	Polyethylene sleeving for ductile iron pipelines
AS 3735	Concrete structures for retaining liquids
AS 3952	Water supply—Spring hydrant valve for waterworks purposes
AS 4020	Testing of products for use in contact with drinking water
AS 4041	Pressure piping
AS 4100	Steel structures
SAA HB 48	Steel structures design handbook
AS/NZS 1260	PVC-U pipes and fittings for drain, waste and vent application

Other publications

Institute of Public Works Engineering Australia (IPWEA)

Guide to Codes and Practices for Streets Opening - Streets Opening Conference 2007 (Sections 5 and 6 detailing locations and depths of other services and preferred location for water reticulation pipes)

NSW Department of Commerce

PWD-WSIM Water Supply Investigation Manual

PWD Safety Guidelines for fixed ladders, stairways, platforms and walkways

2 DESIGN CRITERIA

2.1 GENERAL

Responsibility for design

Except where specified otherwise, the division of responsibilities between the Water Authority and the Designer shall be in accordance with WSAA 03 Part 1, Section 1.5.

Dual supplies

The Designer shall take into account the special requirements for dual water supplies where required by the Water Authority, including but not limited to, demand, size and location for each pipe system. Dual services shall not be installed unless part of a dual supply.

Valve type and location

The Designer shall take into account the location and type of valve required considering maintenance and repair requirements, the need for double air valves with integral isolating valve on mains or single air valve with isolating valve on reticulation mains, and scour points. Valves to be constructed underground shall be anti-clockwise closing (ACC) whilst above ground valves shall be clockwise closing (CC).

2.2 RETICULATION PRESSURE

Minimum static head

Reticulation systems shall be designed to supply peak instantaneous demand by gravity while maintaining a minimum static head of 200 kPa (20 m). (WSAA 03 Part 1, Section 2.4.3).

Water demand

A peak instantaneous demand of 0.15 L/s/tenement shall be used except that when supplying more than 1000 tenements, a demand of 0.10 L/s/tenement shall be used. Water demands for other industries shall be as detailed in the WSAA 03 Part 1, Section 2.2).

Maximum pressure

The maximum pressure applied to a component of a pipeline shall in-service not exceed the safe working pressure of the component. The effect of water hammer shall be taken into account for the maximum pressure.

The maximum pressure applied to a component for field testing, including water hammer, shall not exceed the field test pressure recommended by the component manufacturer.

The maximum pressure during field testing or in-service along a pipeline shall take into account the permitted forces that can be applied to pipeline support structures such as trust blocks.

Desirable maximum pressure

The desirable maximum pressure is 600 kPa. Zoning of the reticulation system by means of pressure reducing valves (PRV's) may be necessary to achieve these pressures across the development.

Fire fighting

Water mains required for fire-fighting purposes in the development shall be designed in accordance with the Building Code of Australia.

Network analysis

The Designer shall provide a network analysis of the reticulation system detailing the pressure and velocity distribution after consultation with the Water Authority.

2.3 PIPELINE

Trunk mains

Trunk mains directly supplying reticulation systems shall be designed as part of the reticulation system to carry peak instantaneous demands. (WSAA 03 Part 1, Sections 2.2 and 2.3)

Peak daily demand

Mains feeding service reservoirs shall be designed to carry peak daily demands over 24 hours in the case of gravity mains and 22 hours in the case of rising mains.

Looped mains

Reticulation mains shall be looped to eliminate dead ends unless permitted otherwise by the Water Authority.

Staged development

Where a dead end is permitted to provide for future extension from staged development, the end shall be fitted with a stop valve, hydrant bend and hydrant.

Loss of supply

Wherever possible, the development shall be serviced from two or more trunk mains to avoid the loss of supply in the event of maintenance or breakage.

Individual service

Each dwelling shall have an individual service tapped from the main and extending 300 mm inside the lot boundary unless otherwise permitted by the Water Authority.

Valve chambers

The Designer shall confirm with the Water Authority if valves are to be buried or housed in valve chambers.

The Designer shall show on the Drawings the type of cover and how the covers shall be seated. Where buried, the design shall be to WSAA 03 Part 1 Section 6, WAT-1301 to WAT 1306.

Access covers

Access covers shall be manufactured in accordance with AS 3996.

The Designer shall ensure that air valve covers have adequate openings for air exchange.

Valve closing

Stop valves shall be anti-clockwise closing.

Valve maintenance

The Designer shall provide for ease of valve maintenance within valve chambers, where provided, and select valve types such that servicing of the valve can be effected without removal from service, wherever possible.

2.4 LOCATION

In designing the reticulation system, standard locations shall be followed, as detailed below:

- Reticulation mains shall be laid in compliance with the Water Authority's standard footpath allocation for public utilities, or in the absence thereof, in conformity with the Streets Opening Conferences' protocols.
- Valves shall be located to avoid conflict with driveways, telephone house service pits and underground electrical boxes. Stop valves shall be located so that approximately 20 dwellings can be isolated for shutdowns.
- Hydrants shall be located on all reticulation mains at all high points and low points of the main and at dead ends. The interval between hydrants shall not exceed 60 metres.

Water mains located on private property shall be located in an easement of minimum width three (3) metres.

Unless there are compelling reasons to the contrary the water main shall be located in the centre of the easement. A Registered Surveyor shall survey easements and pipelines.

2.5 MINE SUBSIDENCE AREAS AND AREAS OF SLIPPAGE

Ground strain

The Designer shall accommodate the movement associated with the ground strain for the area, as advised by the Mine Subsidence Board for water reticulation jointing systems in proclaimed Mine Subsidence Areas, or in a known or expected area of subsidence or slippage.

The design ground strain for the development shall be detailed on the Drawings. (WSAA 03 Part 1, Section 5.5.4)

Pipe jointing system

The pipe jointing system selected shall be capable of accepting ground movements, without impairing the water tightness of the joint, for the ground strain as advised by the Mine Subsidence Board.

For non welded pipe systems in areas with high ground strains, a pipe jointing system using shorter effective length pipes and/or deep socket fittings shall be used.

The following action constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

Where the Mines Subsidence Board does not cover an area of known, or suspected, subsidence or slippage, the above requirements shall still apply.

3 MATERIALS

3.1 GENERAL

Working pressure

The working pressure of pipes, fittings, valves and hydrants shall be fit for the purpose in accordance with the relevant Australian Standard for the material and shall be at least 1200 kPa (120 m) unless otherwise specified by the water supply authority.

Class and standard

The Designer shall select pipe type, class and standard based on pumping design and in accordance with AS 2200 and site conditions.

All pipes shall be a minimum Class 12 unless otherwise determined by the Supply Authority (WSAA 03 Part 1, Section 3.7).

Type

Pipes and fittings for water reticulation shall be of unplasticised PVC (PVC-U), modified PVC (PVC-M), oriented PVC (PVC-O), ABS, ductile iron, steel, polyethylene, glass reinforced plastic (GRP), or copper. The material specifications for each pipe type are provided in the following Clauses 3.2 to 3.7 below.

Colour coding

Where water pipes are to be located in close proximity to other service pipes and in dual systems, or where there is the likelihood of the pipes not being recognised as water pipes, the Designer shall provide for the pipes to be colour coded in accordance with WSAA 03 and shown on the Drawings accordingly.

External protection

The Designer shall show on the Drawings the extent of external protection required. External protection shall be shown to comply with WSAA 03 Part 1 Section 4.12.

Piers

Piers for any above ground water main shall be in accordance with WSAA 03 Drawing WAT-1310.

Special allowances

The Designer shall allow for adequate working area, waste removal and transport arrangements where scouring points or pipe inspection locations are nominated (WSAA 03 Part 1, Sections 6.6 and 6.7).

Gauge locations

The Designer shall indicate the location of connections for gauges required on mains.

Diameter

The minimum diameter of all pipes shall be DN 100 unless otherwise specified by the Supply Authority. In areas zoned by the relevant planning authority for commercial, industrial or high-rise buildings the minimum diameter shall be DN 150, unless otherwise specified by the Supply Authority.

In all cases pipe sizes and residual pressures shall be designed to cater for fire fighting flows (WSAA 03 Part 1, Section 3.2 and particularly 3.2.2).

Limits of use

The Designer shall take regard of the limits of use for the pipeline system materials under consideration (WSAA 03 Part 1, Sections 3.5, 3.6, 3.7 Table 3.1, Part 2 Section 8.6, Table 8.2).

Valves

Where valves are specified and shown on the Drawings, they shall comply with the valve details in the Development construction specification—Water reticulation (WSAA 03 Part 1, Section 6).

Thrust blocks

The Designer shall design thrust blocks to resist maximum allowable operating pressure (MAOP) of the pipe and the designated field test pressure.

Surge control

The pipe material and class selection shall be appropriate for surge control.

3.2 PVC PIPES AND FITTINGS

Pipe and fittings

PVC (PVC-U) pipe shall comply with AS/NZS 1477 Series 2, blue in colour and with elastomeric seal spigot and socket joints.

Modified PVC (PVC-M) and oriented PVC (PVC-O) pipes and fittings shall comply with AS/NZS 4765 Series 2 and AS 4441 Series 2 respectively, and shall be blue in colour and with elastomeric seal spigot and socket joints. (WSAA 03 Part 2, Table 8.2).

Ductile iron compatible

Where Series 1 PVC-U pipe complying with AS/NZS 1477 or Series 1 PVC-M pipe complying with AS/NZS 4765 is used in conjunction with ductile iron fittings ensure elastomeric seals appropriate to the application are used.

Pre-curved for cul-de-sac

Where radii exceed allowable radii for bending on site, PVC pipes shall be pre-curved to suit the radius of any cul-de-sac road pavement in which they are to be installed.

Fittings

Fittings for use with PVC pipe shall be elastomeric seal jointed. Valves shall comply with **Materials (General).**

3.3 ABS PIPES AND FITTINGS

Acrylonitrile butadiene styrene (ABS) pipes and fittings shall be manufactured in accordance with AS 3518 and joined in accordance with the manufacturer's instructions using solvent cement to AS 3691.

Selection of pipe class shall take into account cyclic loading.

3.4 DI PIPES AND FITTINGS

Pipes and fittings

Ductile iron (DI) pipes and fittings shall be manufactured in accordance with AS/NZS 2280 and shall be minimum Class PN 20 for elastomeric seal joints.

Where ductile iron pipes are to be flanged, AS/NZS 2280 Flange Class shall be specified. (WSAA 03 Part 2, Table 8.2)

Corrosion protection

The Designer shall specify cement mortar lining in accordance with AS/NZS 2280, or fusion-bonded medium density polyethylene to AS/NZS 4158.

External protection shall be epoxy coating to AS/NZS 3862 where not otherwise specified as sleeved or wrapped, taking into account the type of corrosion protection required.

Joints

Generally, pipe and fitting joints shall be specified to be spigot and socket type using a elastomeric seal push in seal made of natural rubber, ethylene propylene rubber or nitrile rubber with compounds complying with AS 1646.

Restrained joints

The Designer shall take account of congested service corridors, poor soil conditions and the need for additional security for strategic mains with regard to the provision of restrained joints.

No restrained joint repair couplings were available at the time of publication of this work section. A repair using couplings may require independent anchoring.

Flanges

Flanges shall be specified to be manufactured in accordance with AS 4087 and AS 2129.

The Designer shall specify 316 grade stainless steel bolts and nuts for flanged joints in accordance with AS 2837 as for pumps specified in 1341 *Water – reticulation and pump stations (Construction)*.

3.5 STEEL PIPES AND FITTINGS

Pipes and fittings

Steel pipes and fittings shall be manufactured in accordance with AS 1579 and designed to AS/NZS 2566.1. (WSAA 03 Part 2, Table 8.2).

Joints

The Designer shall specify the jointing system where long-term corrosion resistance, ease of construction or special circumstances dictate the need.

The pipe jointing shall be either:

- Elastomeric seal jointed with seals complying with AS 1646, or
- Butt welded, welded spigot and socket, or welded using a welding collar and with the application of a polyethylene heat shrunk sleeve over the weld, or wrapped, or
- Flanged to comply with AS 4087 to the table specified on the Drawings. Bolts and nuts for flanged joints shall be in accordance with AS 2129 and galvanised in accordance with AS 1214, or stainless steel in accordance with AS 2837 as for pumps specified in 1341 *Water – reticulation and pump stations (Construction)*.

Position under power lines

Where the routes of continuously welded steel pipelines run in parallel with high voltage power lines sufficiently close to induce significant electrical currents in the pipeline, the Designer shall seek an alternate route or specify measures to prevent corrosion due o induced currents (WSAA 03 Part 1, Section 4.3.11 and Part 2, Table 8.2).

3.6 PE PIPES AND FITTINGS

Pipes

Polyethylene (PE) pipe shall be manufactured in accordance with AS/NZS 4130 and designed to AS/NZS 2566.1. (WSAA 03 Part 2, Table 8.2)

Fittings

PE Fittings shall comply with AS/NZS 4129.

3.7 GRP PIPES, COLLARS AND FITTINGS

Pipes and collars

Glass reinforced thermosetting plastics (GRP) pipes and collars shall be manufactured to AS 3571 and designed to AS/NZS 2566.1. (WSAA 03 Part 2, Table 8.2).

The Designer shall take into account surge cycles and refer to the manufacturer when the temperatures are likely to exceed 35°C.

Fittings

GRP fittings shall comply with AS 2634. Ductile iron fittings complying with AS/NZS 2280 with appropriate elastomeric seals complying with AS 1646 may also be used.

3.8 COPPER PIPE AND FITTINGS

Pipes

Copper tube shall be manufactured in accordance with AS 1432 in the range of DN 6 to DN 200 for Type A or Type B. The Designer shall take into account the requirements of AS/NZS 3500.1.

Fittings

Capillary and compression fittings shall be specified to comply with AS 3688 and de-zincification resistant. Capillary fittings shall have silver brazed joints or solder insert capillary joints.

4 PUMP STATIONS

4.1 GENERAL

Location

The Designer shall take into account site access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves or on private property.

The following action constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to confer on the locations is required.

Pump building

Pump units shall be secured under a purpose-designed building which shall be subject to the Development Approval (DA) of the Council.

The building shall match the aesthetics of the surrounding land use and shall accommodate any need for climate and/or acoustic control.

Occupational Health and Safety requirements shall be met especially with regard to clearance for maintenance, and avoidance of trip hazards.

Substructure

Where pumps are to be installed below ground level, the Designer shall provide for the pumps to be mounted on plinths and housed in a single pump well.

Conditions

The Designer shall provide for the construction of the pump well after taking into consideration the ground and site conditions.

Preformed components

Preformed components or systems, complying with the Drawings, if any, may be used in lieu of in-situ construction provided:

- Preformed concrete wall units are to be manufactured to AS 4058. The Designer shall take into account the cover requirements for the reinforcing steel.
- Joints shall be internal flush
- The Designer shall ensure components make a watertight system and have a satisfactory surface finish.

Protection against flooding

Where the pump station site is exposed to possible flooding, the Designer shall provide for the floor of the pump station or top of pump well, as appropriate, to be one (1) metre above the 1 in 100 year flood level or to such other level as provided by Council's planning instruments, whichever is the higher.

Protection against flotation

The Designer shall provide for the design of pump wells against flotation both during the construction/installation stage and whilst operating under flood conditions designed as above.

Pump capacity

Capacities of the pump unit shall be calculated from the intersection of the pump performance curve and the pipeline characteristic curve calculated at mid water level of the service reservoir involved with this duty point.

The pump station shall deliver the required transfer capacity over a period of 22 hours.

Standby pumping capacity shall be provided such that if one (1) pump is out of service, the pump station will remain able to supply the required transfer capacity.

The pump unit shall be capable of operating near optimal efficiency within the range of operating conditions.

Pump pipework

All pipework and fittings shall be in accordance with this work section. In addition, all steel bolts, nuts and washers shall comply with AS 1111 and AS 1112 and shall be galvanised in accordance with AS 1214 or stainless steel complying with AS 2837 Grade 316.

Pump prime

Where there is negative suction head at the pump inlet, provision shall be made to facilitate priming of each pump.

Alarms and signals

The Designer shall provide for alarms and signals systems with the concurrence of the Water Authority.

4.2 PUMPS

Pump type

Pumps shall comply with the WS-SPEC. The Designer shall take account of dismantling joints and valves provided in the pipework to facilitate removal of the pumps for maintenance and the need for surge control devices.

Inter-changeable

Pump sets are to be interchangeable within each pump station where standby pumps are installed.

Structural steelwork

The Designer shall design structural steelwork in accordance with HB 48.

4.3 ELECTRICAL

Specification

The works shall be designed in accordance with and subject to the provisions of MEW E101, except where modified by this work section.

Design responsibility

The Designer shall be responsible for the design of the equipment as suitable for the purpose. Equipment design shall comply with the requirements of the relevant standard specification.

SCA and electrical

The Designer shall provide for Switchgear Control Assembly (SCA), SCA housing and electrical requirements as detailed in 1341 *Water – reticulation and pump stations (Construction)*.

Inter-changeability

Where more than one (1) item of equipment is designed to form a particular function, all such items of equipment shall be identical and completely interchangeable (e.g. pilot lights, pushbuttons, relays, etc).

Switchboard

The switchboard shall be installed visibly and physically accessible above all areas at risk of flooding.

Ambient conditions

Ambient conditions shall be within the normally accepted limits of 0°C to 45°C.

The switchboard shall be connected to the local electricity supply system.

Connection to local supply

Nominal system parameters:

415 volt, 3-phase, 4-wire, 50 Hz, solidly earthed neutral system.

Prospective Fault Current: As specified by the Local Supply Authority.

Automatic operation

The pump station shall be designed for fully automatic operation in the unmanned condition.

4.4 POWER SUPPLY

Consumer mains

The consumer electrical mains shall be run underground where possible and commence at the point of attachment on a steel consumers pole (if applicable) installed near the property boundary and run in conduit to the switchboard.

The minimum size of the consumers mains shall be sized to satisfy the following requirements:

- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.
- Be sized for a voltage drop less than 1.5% of the maximum demand as calculated.
- Be single core PVC/PVC cables. XLPE insulated cable may also be used.
- Comply with the requirements of the Local Supply Authority.
- Pole termination method shall be determined in consultation with the Local Supply Authority.

4.5 TELEMETRY

Schedule

The Designer shall provide for telemetry requirements in accordance with the schedule supplied by the Water Authority.

Compatibility

The telemetry system is to be compatible with the existing system, if any, in use.

4.6 LADDERS

Specification

Ladders shall comply with AS 1657 and applicable Occupational Health and Safety legislation.

Ladder landings

If required, the Designer shall set intermediate landings in wells to achieve the minimum head room clearance. Wherever possible, the landing shall be located adjacent to fittings and machinery requiring maintenance.

Ladder cages

Ladder cages shall not be used on ladders in pump station wells.

4.7 OTHER APPURTENANCES

Lifting equipment

The Designer shall provide for machinery lifting equipment including pump chains as necessary.

Gauges

The Designer shall provide pressure tapping and gauges for all valves, including isolation and non-return valves as detailed in 1341 *Water – Reticulation and pump stations (Construction)*.

Covers

The Designer shall take account of the possibility of site flooding ingress and overflow, and Occupational Health and Safety requirements in providing for access and inspection covers.

5 DOCUMENTATION

5.1 RETICULATION

Approval

The Principal shall submit, to the relevant Water Authority for approval, four (4) copies of the proposed water main design, including calculations and network analysis, if appropriate, prior to commencement of construction. (WSAA 03 Part 1, Section 7).

The following action constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to direct the submission to the Water Authority is taken.

Drawings

The Drawings shall show to scale:

- Plan showing:
  - . Lot boundaries and lot numbers.
  - . Location and size of all mains, appurtenances and pump stations.
  - . Existing mains.
  - . Existing and proposed features and services.
  - . North point and scale bar.
  - . Easement locations.
  - . Arrangement of other utilities.
- Longitudinal section showing:
  - . Reduced levels for natural surface and design surfaces at all changes in grade.
  - . Mains, appurtenances and pump stations.
  - . Appurtenances numbered in accordance with the relevant Water Authority's Asset Register.
  - . Invert levels where necessary.
  - . Size, type and class and grade of pipe. Also, pipe grade where appropriate.
  - . Location, invert level and size of all drainage lines, sewer mains, and other utility services crossing the main.
  - . Notation regarding all joining lines.
  - . Property ownership.
  - . Note 'In road' trench conditions.
- Pump stations—Drawings showing general arrangement of pump stations with site plan; concrete outlines; number, make, model and details of pumps; inlet and outlet pipework details and levels; pump cut in; cut out and alarm levels; switchboard location; pump station access details; design starts per hour.
- Corrosion protection—Drawings showing details of corrosion protection required for pipes and fittings.
- Trenchless installation—Drawings showing areas designated for trenchless pipe installation.

Drawing scale, size and format

Detail plans shall be drawn to a scale of 1:500 and longitudinal sections to a horizontal scale of 1:1000 and a vertical scale of 1:100.

Drawings shall be 'A3' and/or 'A1' size after consultation with the relevant Water Authority.

Drawings shall also be provided in electronic format after consultation with the relevant Water Authority.

Location of fittings and fixtures

The Designer shall show locations of hydrants, stop valves, non-return valves, air valves and scour valves, tees, tapers, creek crossings, trench dimensions and backfill, thrust blocks, and other existing and proposed services and installations including chambers and covers and items of construction which are project specific.

5.2 PUMP STATION

Approval

The Principal shall submit, to the relevant Water Authority for approval, prior to commencement of the manufacture of any pumps and control equipment, four (4) copies of the following:

- Switch and Control Gear Assemblies (SCA)—Proposed fully dimensioned manufacturing details, general arrangement (showing internal/external details) and foundation/gland plate details.
- Common Control—Complete circuit diagram and description of operation.
- Schedule of Equipment—Completed as to the equipment to be provided.
- Other Engineering drawings as required fully describing the proposed equipment.

The submission of the documents constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to direct the submission to the relevant Water Authority is taken.

Chlorination and access hazards

The Designer shall take into consideration the technical requirements to minimise all risks associated with chlorination, and entry into confined space.

Drawing size and format

Drawings shall be on 'A3' and/or 'A1' size after consultation with the relevant Water Authority. All symbols used shall conform to AS 1102 and all wires and terminals shall be numbered.

Drawings shall also be provided in electronic form after consultation with the Water Authority.

Asset register

The Designer shall provide asset schedules and Drawings in a form consistent with the existing or proposed Asset Register after consultation with the relevant Water Authority (WSAA 03 Part 1, Section 7.3).

6 ANNEXURE A

6.1 INSTRUCTION FOR SPECIFICATION PREPARATION

Incorporation of local requirements for water reticulation design

- This work section recognises that each Council may need to vary the Specifications to meet local requirements. The items below may be taken into account in varying this design specification and 1341 *Water – reticulation and pump stations (Construction)* (Reticulation and pump stations).
- The Water Directorate, a close partner of the Institute of Public Works Engineering Australia (IPWEA) may provide additional information regarding the following:
  - . A complete list of Australian Standards relevant to Water Reticulation compiled as a result of a survey of Standards in use.
  - . A schedule of training organisations available to provide accreditation to Contractors and Superintendents.
  - . A schedule of organisations or Councils available to undertake disinfection of water mains together with guidelines for disinfection.
  - . A schedule of products in use compiled as a result of a survey of users.
  - . Advice on handling different requirements between the Council and any subsidising Authority. Differences identified include:
    - * Provision of more expensive materials, fittings and pumps.
    - * Water supply storage heads (20 m is called up compared to a minimum requirement of 12 m).
- The grading requirements called up for sand bedding may need to be checked where Council wishes to facilitate local acquisition 1341 *Water – reticulation and pump stations (Construction)* (**Pump bedding** and Table 4.2).

- Valve opening direction varies within and between Water Authorities. The requirements of the specifications may need to be checked against existing installations (**Pipeline** of this work section).
- Working pressures vary, especially between the inland and the coast. The requirements of the specifications may need to be checked against existing conditions (**Reticulation pressure** and **Materials** of this work section).
- Materials for PVC and PE fittings may be different for different size pipes. The requirements of the specifications may need to be checked against existing installations 1341 *Water – reticulation and pump stations (Construction) (***PVC pipes and fittings** and **Polyethylene**)**.**
- The requirement for the location of property services varies between Councils. The requirements of the specifications may need to be checked against existing installations (**Pipeline** of this work section).
- Each Council may wish to consider any special requirements for the installation of long length water service connections. (Expand on **Pipeline** of this work section).
- The method of marking access to fittings varies between Councils. The requirements of the work sections may need to be checked against existing requirements (1341 *Water – reticulation and pump stations (Construction)* **Marking Plates).**
- The number and timing for receipt of documents called up varies between Councils. The requirements of the specifications may need to be checked against existing requirements.
- Councils require varying lead times for notices to be given. The requirements of the specifications may need to be checked against existing requirements.
- Council may wish to consider the option for installation of curved pipes (e.g. in cul-de-sacs) (**PVC Pipes and Fittings** of this work section).

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0074 STORMWATER DRAINAGE (DESIGN)

1 SCOPE AND GENERAL

1.1 SCOPE

The work section sets out the design of stormwater drainage systems for urban and rural areas.

Note: Where a Council is not the asset owner or contract Principal carrying out the works, the term 'Council' may need to be replaced throughout this document by another term such as 'Superintendent'.

1.2 OBJECTIVES

The objectives of stormwater drainage design are as follows:

- To ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits.
- To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits.
- Retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.

1.3 DESIGN PRINCIPLES

General

Works are to provide a stormwater drainage system in accordance with the 'major/minor' system concept set out in Australian Rainfall & Runoff, (AR&R); that is, the 'major' system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the 'minor' system shall be capable of carrying and controlling flows from frequent runoff events.

Reconstruction

Where the proposed works replaces an existing facility, the on-site drainage system is to be designed in such a way that the estimated peak flow rate from the site for the design average recurrence interval (ARI) of the receiving minor system is no greater than that which would be expected from the existing facility.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this work section shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Work section

0160 Quality (Design)

Standards

AS/NZS 1254	PVC pipes and fittings for storm and surface water applications
AS/NZS 2032	Installation of PVC pipe systems
AS 2200	Design charts for water supply and sewerage

AS/NZS 3725	Loads on buried concrete pipes
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4139	Fibre reinforced concrete pipes and fittings
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 5065	Polyethylene and polypropylene pipes for drainage and sewerage applications

Other publications

Engineers Australia
Australian Rainfall and Runoff (AR&R)—A guide to flood estimation
Concrete Pipe Association of Australasia
Refer to www.concpipe.asn.au for the design of steel reinforced concrete pipelines.
Hydraulic Design Manual for precast concrete pipes.
Australian National Conference On Large Dams, Leederville WA.
ANCOLD, Guidelines on Acceptable Flood Capacity for Dams (2007).

1.5 BIBLIOGRAPHY

Work sections

1121 Open drains including kerb & channel gutter
1352 Pipe drainage
1353 Precast box culverts
1354 Drainage structures

Standards

AS 5100 Bridge design

Other publications

NSW RTA
Model Analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings, 1979
Queensland Urban Drainage Manual, Volumes 1 & 2, 1993
Sangster, WM., Wood, H.W., Smerdon, E.T. and Bossy, H.G. Pressure changes at storm drain junction, engineering series, Bulletin No. 41, Eng. Experiment Station, Univ. of Missouri 1958
Hare C.M. Magnitude of Hydraulic Losses at Junctions in Piped Drainage Systems. Transactions, Inst. of Eng. Aust., Feb. 1983
Henderson, F.M. Open Channel Flow, 1966
Chow, Ven Te Open Channel Hydraulics, 1959
John Argue—Australian Road Research Board Special Report 34 Stormwater drainage design in small urban catchments: A handbook for Australian practice

2 HYDROLOGY

2.1 DESIGN RAINFALL DATA

Intensity-Frequency-Duration (IFD) relationships

Design Intensity-Frequency-Duration (IFD)—Rainfall relationships shall be derived in accordance with Volume 1 of Australian Rainfall and Runoff (AR&R), for the particular catchment under consideration.

The nine basic parameters read from Volume 2 of AR&R shall be shown in the calculations as approved by the Designer, except where the Bureau of Meteorology provides a polynomial relationship for the catchment.

Average recurrence intervals

Design Average Recurrence Intervals (ARI) for minor systems are given below:

- 10 years for commercial/industrial areas
- 5 years for residential areas
- 5 years for rural residential areas
- 1 year for parks and recreation areas

Recurrence intervals for minor events depends on the zoning of the land being serviced by the drainage system.

Easements in private property

Where works are designed in such a way that the major system flows involve surcharge across private property, then the underground system (both pipes and inlets) shall be designed to permit flows into and contain flows having an ARI of 100 years from the upstream catchment which would otherwise flow across the property.

A surcharge path shall be defined for systems even where 100 year ARI flows can be maintained within the system. Easements are to be provided in private property over pipe systems and surcharge paths.

2.2 CATCHMENT AREA

The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or manmade paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.

Where no detailed survey of the catchment is available, 1:4000 orthophoto maps are to be used to determine the catchments and to measure areas.

Catchment area land use shall be based on current available zoning information or proposed future zonings, where applicable.

2.3 RATIONAL METHOD

General

Rational Method calculations to determine peak flows shall be carried out in accordance with Volume 1 of AR&R and the requirements of this work section.

Qualified person

All calculations shall be carried out by a qualified person experienced in hydrologic and hydraulic design.

Run-off co-efficients

Co-efficients of run-off shall be calculated as per Volume 1 of AR&R and full details of co-efficients utilised shall be provided.

Time of concentration

The time of concentration of a catchment is defined as the time required for storm runoff to flow from the most remote point on the catchment to the outlet of the catchment.

Flow time

Where the flow path is through areas having different flow characteristics or includes property and roadway, then the flow time of each portion of the flow path shall be calculated separately.

The maximum time of concentration in an urban area shall be 20 minutes unless sufficient evidence is provided to justify a greater time.

Flow paths to pits

Flow paths to pits shall be representative of the fully developed catchment considering such things as fencing and the likely locations of buildings and shall be shown for each collection pit on the catchment area plan. Consideration shall be given to likely changes to individual flow paths due to the full development of the catchment.

Surface roughness co-efficient ('n')

Surface roughness co-efficients 'n' shall generally be derived from information in Volume 1 of AR&R. Values applicable to specific zoning types and overland flow path types are given in Table 2.1.

Table 2.1 Specific zoning 'n' values

Type of flow	**'n'**
Across parks	0.35
Across rural residential land	0.30
Across residential (2a)	0.21
Across residential (2b)	0.11
Across industrial	0.06
Across commercial	0.04
Across paved areas	0.01
Across asphalt roads	0.02
Across gravel areas	0.02

2.4 ALTERNATIVE MODELS AND COMPUTER ANALYSIS

Other hydrological models may be used as long as the requirements of AR&R are satisfied, summaries of calculations are provided and details are given of all program input and output.

Where computer analysis programs are used, copies of the final data files shall be provided on submission of the design to the Superintendent and with the final Drawings.

3 HYDRAULICS

3.1 HYDRAULIC GRADE LINE

Calculations

The calculations shall generally be carried out in accordance with AR&R and shall substantiate the hydraulic grade line adopted for design of the system and shown on the Drawings.

Summaries of calculations are added to the plan and details of all calculations are given including listings of all programme input and output.

Qualified person

All hydraulic calculations shall be undertaken by a qualified person experienced in hydrologic and hydraulic design.

Major/minor systems

The 'major' system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the 'minor' system shall be capable of carrying and controlling flows from frequent runoff events.

Downstream control

The downstream water surface level requirements are given below:

- Known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event.
- Where the downstream starting point is a pit and the hydraulic grade line is unknown, a level of 0.15 m below the invert of the pit inlet in the downstream pit is to be adopted.
- Where the outlet is an open channel and the design storm is the minor event the top of the outlet pipe shall be the downstream control.
- Where the outlet is an open channel, the design storm is the major event and downstream flood levels are not known, the top of the outlet pipe shall be the downstream control.
- Where the outlet is an open channel, the design storm is the major event and downstream flood levels are known, the downstream control shall be the 1% probability flood level.

Water surface limits

The water surface in drainage pits shall be limited to 0.150 m, below the gutter invert for inlet pits and 0.150 m below the underside of the lid for junction pits.

3.2 MINOR SYSTEM CRITERIA

Gutter flow widths

The acceptable gutter flow widths in the 20% probability event is 2.5 metres maximum. Wider flow widths may be approved on roads with flat grades.

Conduit sizes

Minimum conduit sizes shall be as follows:

Pipes—Roadways - 375 mm diameter.

Interlot – 150 mm diameter.

Box culverts—600 mm wide × 300 mm high.

Velocity limits

Minimum and maximum velocity of flow in stormwater pipelines shall be 0.6 m/sec and 6 m/sec respectively.

3.3 PITS

Spacing

Inlet Pits shall be spaced so that the gutter flow width is limited in accordance with this work section and so that the inlet efficiency is not affected by adjacent inlet openings. Preference shall be given to the location of drainage pits at the upstream side of allotments.

Other pits shall be provided:

- To enable access for maintenance.
- At changes in direction, grade, level or class of pipe.
- At junctions.

The maximum recommended spacing of pits where flow widths are not critical are given in Table 3.1:

TABLE 3.1 PIT SPACING

	Pipe size (mm)	**Spacing (m)**
Generally	less than 1200	100
	1200 or larger	150

Inlet capacity

Kerb inlet lengths to side entry pits are to be a preferred maximum of 3.0 m, with an absolute maximum of 5.0 m where the grade is 10% or more, and an absolute maximum of 4.0 m where the grade is less than 10%

Information on pit capacities is available in the following sources:

- *Council's current Handbook of Drainage Design Criteria*.
- Pit relationships—Volume 1 of AR&R.
- Roads and Traffic Authority's "Model analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings", with due allowance to inlet bypass due to grade, for grade inlet pits, and recognised orifice or weir formulae for sag inlet pits.

Allowable pit capacities

None of the AR&R pit charts include any blockage factors. The percentage of theoretical capacity allowed in relation to type of pit is given in Table 3.2:

Table 3.2 Allowable pit capacities

Condition	**Inlet type**	**Percentage of theoretical capacity allowed**
Sag	Side entry	80%
Sag	Grated	50%
Sag	Combination	Side inlet capacity only Grate assumed completely blocked
Sag	'Letterbox'	50%

Condition	Inlet type	Percentage of theoretical capacity allowed
Continuous Grade	Side entry	80%
Continuous Grade	Grated	50%
Continuous Grade	Combination	90%

3.4 HYDRAULIC LOSSES

Pits

The pressure change co-efficient 'K_e' shall be determined from the appropriate charts given in council's current *Handbook of Drainage Design Criteria*.

Allowable reduction in 'K_e' due to benching is given in Council's current *Handbook of Drainage Design Criteria*.

Computer program default pressure change co-efficient 'K_e' shall not be acceptable unless they are consistent with those from the charts in Council's current *Handbook of Drainage Design Criteria*.

The chart used and relevant co-efficients for determining 'K_e' value from that chart shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

Bends

Bends may be permissible in certain circumstances and discussions with the Superintendent regarding their use is required prior to detailed design.

Appropriate values of pit pressure change co-efficient at bends are given in Council's current *Handbook of Drainage Design Criteria*.

Service entries

Where possible design should try to avoid clashes between services. However, where unavoidable clashes occur with existing sewer mains then the pressure change co-efficient Kp shall be determined from the chart given in Council's current *Handbook of Drainage Design Criteria*.

Requirements for private pipes entering Council's system are given below:

- All pipe inlets, including roof and subsoil pipes, shall where possible, enter the main pipe system at junction pits. These shall be finished off flush with and be grouted into the pit wall.
- If a junction has to be added which is larger than 225 mm then a junction pit shall be built at this location in accordance with this work section.
- For smaller inlets, the drainage pipes may be broken into to allow interconnection with the main line. In this case the sideline shall be finished flush with and be grouted into the main line.

Pipe junctions

Construction of a junction without an inlet structure should be avoided where possible. Permission to do this is required by Council prior to detailed design.

Where this is unavoidable the pressure change co-efficients K_u, for the upstream pipe and K_l, for the lateral pipe, shall be determined from the chart given in Council's current *Handbook of Drainage Design Criteria.*

Contraction/expansion

Going from larger upstream to smaller downstream conduits is not permitted without approval of Council prior to detailed design.

In going from smaller to larger pipes benching shall be provided in pits to enable a smooth flow transition. Losses in sudden expansions and contractions are given in Council's current *Handbook of Drainage Design Criteria.*

Pipe friction

Drainage pipe systems shall be designed as an overall system, with due regard to the upstream and downstream system and not as individual pipe lengths.

Drainage pipeline systems shall generally be designed as gravity systems flowing full at design discharge, but may be pressurised with the use of appropriate pits and joints.

Pipe friction losses and pipe sizes in relation to discharge shall be determined using the Colebrook-White formula with the acceptable roughness co-efficients nominated in AS 2200.

3.5 MAJOR SYSTEM CRITERIA

Surcharging

Surcharging of drainage systems which would provide for water depth above the top of kerb is not permitted except:

- Surcharging of drainage system for storm frequencies greater than 5% probability may be permitted across the road centreline where the road pavement is below the natural surface of the adjoining private property.
- Flow across footpaths will only be permitted in situations specifically approved by Council, where this will not cause flooding of private property.

Velocity/depth criteria

The velocity × depth product of flow across the footpath and within the road reserve shall be such that safety of children and vehicles is considered.

The maximum allowable depth of water is 0.2 metres and the maximum velocity × depth product of 0.4 m^2/s is permitted.

Where the safety of only vehicles can be affected, a maximum velocity × depth product of 0.6 m^2/s is permitted.

In open channels the above velocity × depth product criteria will be followed where possible or the design shall address the requirements for safety in relation to children by providing safe egress points from the channel or other appropriate methods.

Freeboard

Freeboard requirements for floor levels and levee bank levels from flood levels in roadways, stormwater surcharge paths and open channels are given below:

- In roadways:
  - A minimum freeboard of 0.3 m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks. A higher freeboard may be required in certain circumstances.
  - Where the road is in fill or overtopping of kerbs and flow through properties may occur a 100 mm freeboard shall be provided between the ponding level of water in the road and the high point in the footpath. Driveway construction in these instances needs to consider this requirement.
- In stormwater surcharge paths—A minimum freeboard of 0.3 m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks.
- In open channels—A minimum freeboard of 0.5 m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks.

Roadway capacities

Road capacity charts are provided in the Council's current Handbook of Drainage Design Criteria for some standard road designs.

For other road designs, flow capacities of roads should be calculated using Volume 1 of AR&R with a flow adjustment factor as given in Council's current Handbook of Drainage Design Criteria.

3.6 OPEN CHANNELS

Criteria

Design of open channels shall be in accordance with Volume 1 of AR&R. Open channels shall be designed to contain the major system flow less any flow that is contained in the minor system, with an appropriate allowance for blockage of the minor system.

Location

Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning.

Where Council permits the use of an open channel to convey flows from a works site to the receiving water body, such a channel shall comply with the requirements of this work section.

Channel roughness

Friction losses in open channels shall be determined using Mannings 'n' values given in Table 3.3. Mannings 'n' Roughness Co-efficients for open channels shall generally be derived from information in AR&R. Mannings 'n' values applicable to specific channel types are given in Table 3.3.

Safety of persons

Where the product of average Velocity and average flow Depth for the design flow rate is greater than 0.4 m^2/s, the design will be required to specifically provide for the safety of persons who may enter the channel in accordance with Volume 1 of AR&R.

Side slopes

Maximum side slopes on grassed lined open channels shall be 1 in 4, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum cross slopes of 1 in 20.

Low flows

Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within a pipe system or concrete lined channel section at the invert of the main channel.

Subsurface drainage shall be provided in grass lined channels to prevent waterlogging of the channel bed. The width of the concrete lined channel section shall be the width of the drain invert or at least sufficiently wide enough to accommodate the full width of a tractor.

Hydraulic jumps

Transition in channel slopes to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

Table 3.3 Specific channel type 'n' values

Channel type	**'n'**
Concrete pipes or box sections	0.011
Concrete (trowel finish)	0.014
Concrete (formed without finishing)	0.016
Sprayed concrete (gunite)	0.018
Bitumen seal	0.018
Bricks or pavers	0.015
Pitchers or dressed stone on mortar	0.016
Rubble masonry or random stone in mortar	0.028
Rock lining or rip-rap	0.028
Corrugated metal	0.027
Earth (clear)	0.022
Earth (with weeds and gravel)	0.028
Rock cut	0.038
Short grass	0.033
Long grass	0.043

3.7 MAJOR STRUCTURES

Criteria

All major structures in urban areas, including bridges and culverts, shall be designed for the 100 year ARI storm event without afflux.

Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding is minimal and does not inundate private property.

A minimum clearance of 0.3 m between the 100 year ARI flood level and the underside of any major structure superstructure is required to allow for passage of debris without blockage.

Design by certified persons

Certified structural design in accordance with *0160 Quality (Design)* shall be required on bridges and other major culvert structures and may be required on some specialised structures where the Superintendent deems necessary.

Culverts

Culverts (either pipe or box section) shall be designed in accordance with charts provided in Council's current Handbook of Drainage Design Criteria, with due regard being given to inlet and exit losses, inlet and outlet control and scour protection.

Retarding basins

Critical storm duration

For each ARI a range of storm events shall be run to determine the peak flood level and discharge from the retarding basin.

Storm patterns shall be those given in Volume 1 of AR&R. Sensitivity to storm pattern should be checked by reversing these storm patterns.

The critical storm duration with the retarding basin is likely to be longer than without the basin.

A graph showing the range of peak flood levels in the basin and peak discharges from the basin shall be provided for the storms examined.

Routing

Flood routing should be modelled by methods outlined in AR&R.

High level outlet

The high level outlet to any retarding basin shall have capacity to contain a minimum of the 100 year ARI flood event. Additional spillway capacity may be required due to the hazard category of the structure.

The hazard category should be determined by reference to ANCOLD.

The spillway design shall generally be in accordance with the requirements for Open Channel Design in this work section.

Salinity prevention

Wherever practical and certainly in areas known to be affected by high water tables and/or salinity of groundwater, retarding basins shall be designed to be water retentive so that surface drainage water does not leak to the subsurface, recharging groundwater.

Pipe systems shall contain the minor flow through the Retarding Basin wall.

Outlet pipes shall be rubber ring jointed with lifting holes securely sealed.

Pipe and culvert bedding shall be specified to minimise its permeability, and cut off walls and anti-seepage collars installed where appropriate.

Low flow provision

The low flow pipe intake shall be protected to prevent blockages.

Freeboard at dwellings

Minimum floor levels of dwelling shall have a freeboard of 0.5 m above the 100 year ARI flood level in the basin.

Public safety issues

Basin design is to consider the following aspects relating to public safety:

- Side slopes are to be a maximum of 1 in 6 to allow easy egress. Side slopes of greater than 1 in 4 may require handrails to assist in egress.
- Water depths shall be, where possible, less than 1.2 m in the 20 year ARI storm event. Where neither practical or economic greater depths may be acceptable. In that case the provision of safety refuge mounds should be considered.
- The depth indicators should be provided indicating maximum depth in the basin.
- Protection of the low flow intake pipe shall be undertaken to reduce hazards for people trapped in the basin.
- Signage of the spillway is necessary to indicate the additional hazard.
- Basins shall be designed so that no ponding of water occurs on to private property or roads.
- No planting of trees in basin walls is allowed.
- No basin spillway is to be located directly upstream of urban areas.
- Submission of design Drawings to the Dam Safety Committee is required where any of these guidelines are not met or Council specifically requires such submission.

4 STORMWATER DETENTION

4.1 CRITERIA

Installation of stormwater detention is required on work sites within the Council area where under capacity drainage systems exist.

Installation of Stormwater Detention is required on redevelopment sites within the Council area where under capacity drainage systems exist.

A redevelopment site is defined as a site which used to have or was originally zoned to have a lower density development than is proposed.

4.2 SALINITY PREVENTION

Location of basins for stormwater detention, stormwater treatment or sedimentation purposes shall avoid areas that are known to be permanent or seasonal groundwater discharge areas. This action reduces the likelihood of recharge into the groundwater.

The requirements for stormwater detention design are outlined in the Council's current Handbook for Drainage Criteria.

5 INTERALLOTMENT DRAINAGE

5.1 CRITERIA

Interallotment drainage shall be provided for every allotment which does not drain directly to its frontage street or a natural watercourse.

Interallotment drainage shall be contained within an easement not less than 1.0 m wide, and the easement shall be in favour of the upstream allotments.

The interallotment drain shall be designed to accept concentrated drainage from buildings and paved areas on each allotment for flow rates having a design ARI the same as the 'minor' street drainage system.

In lieu of more detailed analysis, the areas of impervious surface given in Table 5.1 are assumed to be contributing runoff to the interallotment drain.

Table 5.1 Runoff contribution to interallotment drains

Development type	**% of lot area**
Residential (2a)	40
Residential (2b)	70
Industrial	80
Commercial	90

5.2 PIPES

Pipes shall be designed to flow full at the design discharge without surcharging of inspection pits.

Pipes shall be constructed with rubber ring joins and be of either fibre reinforced concrete, reinforced concrete, PVC, Polypropylene or flexible which shall conform respectively to the requirements of AS 4139, AS/NZS4058, AS/NZS1254 and AS/NZS 5065.

The interallotment drainage pipes shall have a minimum longitudinal gradient of 0.5%.

5.3 PITS

Interallotment drainage pits shall be located in each lot and at all changes of direction. Pits shall be constructed of insitu concrete, with 100 mm thick walls and floor and have a minimum 600 × 600 internal dimensions. Precast concrete or plastic pits approved by Council are permitted.

Depressed grated inlets are to be provided.

5.4 SEWER MAINS RELATIONSHIP

Where interallotment drainage and sewer mains are laid adjacent to each other they are to be spaced 1.0 metres between pipe centrelines (where the pipe inverts are approximately equal).

Where there is a disparity in level between inverts the spacing is to be submitted for approval.

Where sewer mains are in close proximity to interallotment drainage lines they are to be shown on the interallotment drainage plan.

6 DETAILED DESIGN

6.1 CONDUITS

Materials

Conduits and materials shall be in accordance with the standards detailed in Council's current *Handbook for Drainage Design Criteria*.

Bedding and cover

Pipe bedding and cover requirements for reinforced and fibre reinforced concrete pipes shall be determined from the *Concrete Pipe Association* refer to www.concpipe.asn.au or AS/NZS 3725. For PVC and PP pipes, the requirements shall be to AS/NZS 2032.

Particular situations may be identified during the design of works for the use of buried flexible pipes in accordance with AS/NZS 2566.1 and submitted for approval by the Superintendent. Council.

Jointing

Conduit jointing shall be in accordance with Council's current Handbook for *Drainage Design Criteria.*

Location

Drainage lines in road reserves shall generally be located behind the kerb line and parallel to the kerb. Drainage lines in easements over private property shall generally be centrally located within easements.

Trench Stops

Trench Stops shall be designed on drainage lines in accordance with Council's current Handbook for *Drainage Design Criteria* .where the pipe gradient exceeds 5%. The design details shall address the size, and position in the trench as well as spacing along the line .

6.2 PITS

Pits shall be designed with benching to improve hydraulic efficiency and reduce water ponding. Typical pit designs and other pit design requirements are included in Council's current Handbook for Drainage Design.

Safety and safe access are important considerations in pit design. Step irons (where required) shall be detailed and grates shall be of 'bicycle safe' design.

A list of the Standards or Codes relevant to pit designs are included in Council's current *Handbook for Drainage Design.*

6.3 STORMWATER DISCHARGE

Salinity prevention

Stormwater discharge shall be located so as to avoid recharging groundwater and creating or worsening salinity degradation of adjacent land.

Stormwater discharge shall be located to avoid areas with high groundwater tables, groundwater discharge areas or salt affected land.

The Designer shall meet requirements of the appropriate land and water resources authority with regard to the salinity levels of discharge to natural watercourses.

Scour protection

Scour protection at culvert or pipe system outlets shall be constructed in accordance with guidelines set down in Council's current Handbook of Drainage Design Criteria unless outlet conditions dictate the use of more substantial energy dissipation arrangements.

Kerb and channel (gutter) termination

Kerb and channel (gutter) shall be extended to drainage pit or natural point of outlet. Where outlet velocity is greater than 2.5 m per second or where the kerb and gutter discharge causes scour, then protection shall be provided to prevent scour and dissipate the flow.

Easements, adjoining owners

Where required by the consent authority, at points of discharge of gutters or stormwater drainage lines or at any concentration of stormwater on to adjoining properties, either upstream or downstream, the Superintendent shall arrange for a Deed of Agreement with the adjoining owner(s) granting permission to the discharge of stormwater drainage and the creation of any necessary easements.

Other authorities' requirements

Where the drainage is to discharge to an area under the control of another statutory authority, e.g. State Rail Authority, the design requirements of that Statutory Authority shall be met.

Minimum easement width

The minimum drainage easement width shall be 3.0 m for Council drainage systems. The overall width of the easement in Council's favour will be such as to contain the full width of overland flow or open channel flow in the major system design event.

Discharge to recreation reserves

Piped stormwater drainage discharging to recreation reserves is to be taken to a natural water course and discharged in an approved outlet structure or alternatively taken to the nearest trunk stormwater line.

6.4 TRENCH SUBSOIL DRAINAGE

Subsoil drainage shall be provided in pipe trenches in cases where pipe trenches are backfilled with sand or other pervious material.

A 3 m length of subsoil drain shall be constructed in the bottom of the trench immediately upstream from each pit or headwall.

The subsoil drain shall consist of 100 mm diameter agricultural pipes, butt jointed with joints wrapped with hessian, or slotted PVC pipe.

The upstream end of the subsoil drain shall be sealed with cement mortar, and the downstream end shall discharge through the wall of the pit or headwall.

7 DOCUMENTATION

7.1 DRAWINGS AND SCALES

Catchment areas

Catchment Area Plans shall be drawn to scales of 1:500, 1:4000 or 1:25000, unless alternative scales are specifically approved by Council and shall show contours, direction of grading of kerb and gutter, general layout of the drainage system with pit locations, catchment limits and any other information necessary for the design of the drainage system.

Drainage system layout

The drainage system layout plan shall be drawn to a scale of 1:500 and shall show drainage pipeline location, drainage pit location and number and road centreline chainage, size of opening and any other information necessary for the design and construction of the drainage system.

The plan shall also show all drainage easements, reserves and natural water courses. The plan may, for some projects, be combined with the road layout plan.

Longitudinal section

The drainage system longitudinal section shall be drawn to a scale of 1:500 horizontally and 1:100 vertically and shall show pipe size, class and type, pipe support type in accordance with AS/NZS 3725 or AS/NZS 2032 as appropriate, pipeline and road chainages, pipeline grade, hydraulic grade line and any other information necessary for the design and construction of the drainage system.

Open channels

Open channel cross sections shall be drawn to a scale of 1:100 natural and shall show the direction in which the cross sections should be viewed. Reduced levels are to be to Australian Height Datum (AHD), unless otherwise approved by the Superintendent where AHD is not available.

Cross sections may alternatively be provided in compatible electronic format as a data input file for the design flow rates.

Details

Details including standard and non-standard pits and structures, pit benching, open channel designs and transitions shall be provided on the Drawings to scales appropriate to the type and complexity of the detail being shown.

Work-as-executed drawings

Work-as-executed drawings shall be submitted to the Superintendent upon completion of the drainage construction.

The detailed drawings may form the basis of this information, however, any changes must be noted on these drawings.

Where the works are for a subdivision, the work-as-executed drawings must be submitted before a subdivision certificate can be issued.

7.2 EASEMENTS AND OTHER DEEDS OF AGREEMENT

Any deed of agreement or easement necessary to be entered into as part of the drainage system, in accordance with this work section, will need to be completed prior to commencement or work.

Where the works are for a subdivision, evidence will need to be submitted prior to any approval of the engineering Drawings.

Where an agreement is reached with adjacent landowners to increase flood levels on their property or otherwise adversely affect their property, a letter signed by all the landowners outlining what they have agreed to and witnessed by an independent person shall be submitted prior to commencement of work.

Where the works are for a subdivision, the letter will need to be submitted prior to any approval of the engineering Drawings.

Easements will need to be created prior to the issue of the subdivision certificate.

7.3 SUMMARY SHEETS

Hydrology

A copy of a hydrological summary sheet providing the minimum information set out in Council's current Handbook of Drainage Design Criteria is required.

Hydraulics

A copy of a hydraulic summary sheet providing the minimum information set out in Council's current Handbook of Drainage Design Criteria is required.

Computer data files and output

Computer program output may be provided as long as summary sheets for hydrological and hydraulic calculations in accordance with this work section are provided with plans submitted for checking and with final drawings.

Copies of final computer data files, for both hydrological and hydraulic models shall be provided for Council's database of flooding and drainage information in formats previously agreed with Council.

Council's handbook for drainage design criteria

This work section has been designed to be used with Council's own 'Handbook of Drainage Design Criteria'. Where required, the handbook should include co-efficients, design requirements, design charts, material standards, and summary sheets for calculations that the Consultant shall use in design.

For ease of reviewing or preparing a handbook, the following list contains the requirements that are to be presented and the clauses in this work section where references are required.

Design IFD rainfalls for specific locations and individual zonings	**Design rainfall data**
Percentages impervious for specific locations and individual zonings	**Rational Method**
Run-off co-efficients for specific locations and individual zonings	
Sample summary sheet for hydrological calculations	**Alternative models and computer analysis**

Additional requirements for use of specified computer analysis programs	
Sample summary sheet for hydraulic calculations	**Hydraulic grade line**
Pit capacities	**Pit**
Pressure change co-efficient 'K_e' charts	**Hydraulic losses**
Allowable reductions in 'K_e' due to benching	
Pit pressure change co-efficients at bends	
Chart for pressure change co-efficient K_p	
Junction pressure change co-efficients K_l and K_u chart	
Sudden expansion and contraction losses	
Road capacity charts and flow adjustment factors to Tech Note 4 Chapter 14 of AR&R 1987	**Major system criteria**
Culvert Design Charts—inlet and exit losses, inlet and outlet control and scour protection	**Major structures criteria**
Requirements for stormwater detention design	**Criteria**
Conduit and material standards	
Conduit jointing details	**Conduits**
Typical pit designs, and other pit design requirements	**Pitts**
Lists of Standards or Codes relevant to pit design	
Guidelines for scour protection at outlets	**Stormwater discharge**

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0075 CONTROL OF EROSION AND STORMWATER MANAGEMENT

1 SCOPE AND GENERAL

1.1 SCOPE

Virtually all construction activity which requires the disturbance of the soil surface and the existing vegetation, naturally predisposes the construction site to erosion. This in turn leads to sediment loss in the resultant run-off water.

Since such soil disturbance is a necessary part of construction, it is essential therefore to develop measures which reduce the erosion hazard of any particular construction activity. Having done that, it is necessary to control run-off water, which carries the sediment, in such a way as to reduce the amount of that sediment leaving the site to an acceptable level.

After construction is complete and the site fully rehabilitated, permanent water quality control structures and features commence their role. These include trash racks, gross pollutant traps, wet retention basins and the creation of, or increase in size of wetlands.

1.2 OBJECTIVES

The objective of this work section is to:

- Limit/minimise the amount of site disturbance.
- Isolate the site by diverting clean upstream 'run-on' water around or through the site where possible.
- Control runoff and sediment movement as its point source rather than at one final point.
- Stage earthworks and progressively revegetate the site where possible to reduce the area contributing sediment. This in turn increases the efficiency and effectiveness of the entire sediment control system while decreasing the number and size of controls required.
- Provide an effective major stormwater system economical in terms of capital, operational and maintenance costs, incorporating water quality controls.
- Retain topsoil for effective revegetation works.
- Locate sediment control structures where they are most effective and efficient.

1.3 REFERENCED DOCUMENTS

The following documents referred in this work section are:

Work sections

0160 *Quality (Design)*
0074 *Stormwater drainage (Design)*
0250 *Open Space - landscaping*
1102 *Control of erosion and sedimentation*

1.4 BIBLIOGRAPHY

State legislation

New South Wales:
Protection of the Environment Operations Act, 1997
Dams Safety Act, 1978
Soil Conservation Act, 1938

Water Act, 1912

State and Territory Authority publications

Appropriate State Authorities as may or may not be included in the following listing:
New South Wales
- Department of Housing
- Managing Urban Stormwater, Soils and Construction, 3rd Ed. Aug. 1998.
- Roads and Traffic Authority
- Erosion and Sedimentation Design Considerations.
- Soil Conservation Service
- Erosion and Sediment Control—Model Policy and Code of Practice (Discussion Paper)
- NSW Department of Land and Water Conservation (DLWC)
- Urban Erosion and Sediment Control
- Western Australia
- Water and Rivers Commission
- Urban Erosion and Sediment Control: Field Guide 199
- Using Wetlands for Nutrient Stripping: Seminar Proceeding 1994
- Department of Environmental Protection
- A guideline for the prevention of dust and smoke pollution from land development sites in Western Australia

Other publications

Engineers Australia, Queensland Division (EAQ)
Soil Erosion and Sediment Control—Engineering Guidelines for Queensland Construction Sites, 1996.
Brisbane City Council (BCC)

Integrated Environment Management System Manual, 1997.

1.5 PLANNING AND CONCEPT DESIGN

Site characteristics

The Designer shall assess the physical characteristics and limitations of soils, landform and drainage of the proposed site and plan the works accordingly.

Approval

An erosion and sedimentation concept control plan for all projects shall be prepared and submitted to Council for approval.
The approved concept design shall be included in the Drawings for the project.

1.6 DETAILED DESIGN

Responsibility for design

The organisation responsible for the preparation of the detailed design of the Erosion and Sedimentation Control Plan will depend on whether the Works are to be constructed by Council or by Contract.

- Where Council's staff are utilised, the detailed design shall be prepared by Council, or its Consultant, in accordance with this work section and 1102 *Control of erosion and sedimentation*.
- For Works by Contract, the Contractor is responsible for preparing, and submitting for approval, the detailed Erosion and Sedimentation Control Plan in accordance with the requirements in 1102 *Control of erosion and sedimentation* and the Contract Drawings.

Approval

These detailed Erosion and Sedimentation Control Plans shall be referred to the Designer for a concurrence report in both cases and subsequent consideration for approval by Council.

No site works shall commence prior to approval of the detailed Erosion and Sedimentation Control Plan.

All works are to be carried out in accordance with the approved erosion and sedimentation control/water management plan. Its implementation must be supervised by personnel with appropriate qualifications and/or experience in soil conservation on construction sites.

Drawings

Detailed engineering designs for the Erosion and Sedimentation Control Plan shall include scaled drawings (no larger than 1:1000) and detailed specifications/diagrams which can be readily understood and applied on site.

All Drawings shall be in accordance with the minimum drafting requirements in 0160 *Quality (Design)*.

Items to be included, but not limited to, shall be:

- existing and final contours
- the location of all earthworks including roads, areas of cut and fill and re-grading
- location of access haulage tracks and borrow pits
- location and design criteria of erosion and sediment control structures
- location and description of existing vegetation
- proposed vegetated buffer strips and 'no access' areas
- location of critical areas (vegetated buffer strips, drainage lines and structures, water bodies, unstable slopes, flood plains and seasonally wet areas)
- type and location of diversion works to direct uncontaminated run-on around areas to be disturbed
- revegetation program
- procedures for maintenance of erosion and sediment control
- details for staging of works

Additional works

The erosion and sedimentation control/water management plan and its associated control measures shall be constantly monitored, reviewed and modified as required to correct any deficiencies. Council has the right to request changes if, in its opinion, the measures that have been put in place are inadequate.

Sample design

If required, example design details of water quality structures, sediment and erosion control devices may be obtained from Council and used as a guide when preparing an erosion and sedimentation control/water management plan.

2 EROSION CONTROL

2.1 BUFFER ZONES

General

Wetlands, stream and rivers adjacent to construction sites shall be protected by buffer zones.

Buffer zones are corridors of vegetation adjacent to waterways or disturbed areas. The vegetation filters suspended solids and reduces the nutrient levels in run-off.

Performance and width

Buffer zone performance increases as catchment area and slope gradient decreases. Thirty-metre-wide buffer zones generally provide adequate protection.

Table 2.1 Buffer zones

Slope **%**	**Buffer width** **m**
2	15
4	20
6	30
8	40
10	50
12	60
14	70

Contaminated water

Contaminated water in a concentrated form shall require treatment both at its sources point and final disposal. However buffer zones can reduce the need for other erosion and sediment control measures.

Fencing

A fence shall be used to exclude traffic from buffer zones to prevent damage to the vegetation, particularly during any construction phase.

2.2 'NO ACCESS' AREAS

Conserve vegetation

Existing vegetation on work sites shall be conserved as much as possible.

The landscape plan shall incorporate as much existing native vegetation as possible.

'No access' fences

Fenced areas shall be clearly signposted 'No Access Area'.

The 'no access' fence locations shall be shown on the detailed engineering design. These locations will be approximate only as machinery type, topography etc will determine actual on site location.

2.3 DIVERSION WORKS

Diversion types

Diversion works may be in the form of earth drains and banks, hay bales, sand bags or even pipelines and may be permanent or temporary.

Discharge point

Such techniques are used to divert the upstream run-on water around the site. Such flows shall discharge to a formal drainage point or open areas where level spreader banks should ensure a broad water spread.

Pipelines

Pipelines may also be used to convey such run-on through the site, and discharge the flow to a formal drainage point/dissipater if necessary. Such pipelines may also form part of the overall final drainage system.

Drain shape and pipe capacity

Diversion works are designed to carry peak flows at non-erosive velocities in bare soil, vegetated or lined drains/banks.

Design of the diversion system should suit the following:

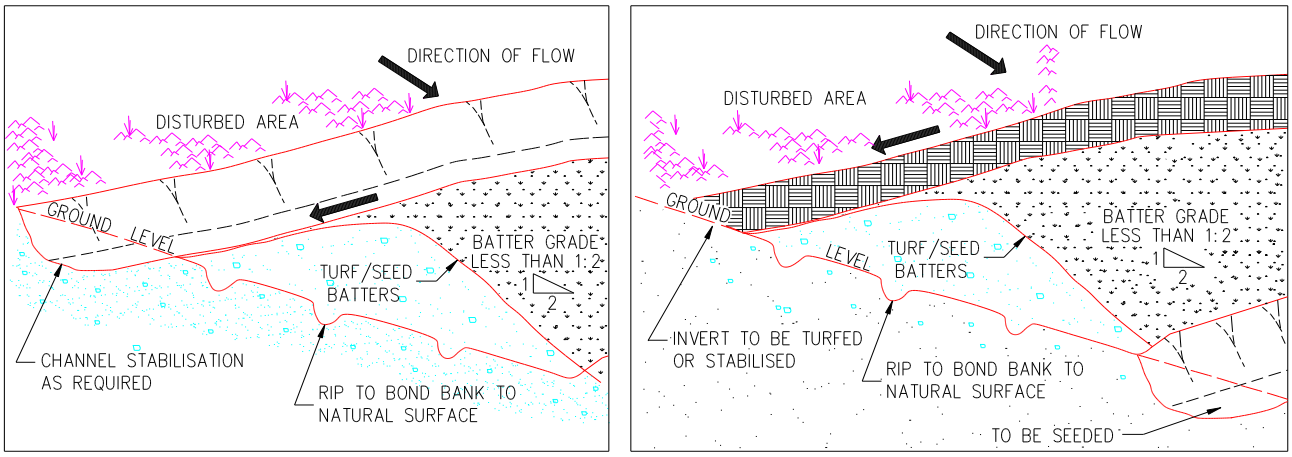
The drain should preferably be dish shaped with batter grades of less than 2:1

If a piped system is selected its design capacity shall be a minimum of the capacity nominated in 0074 *Stormwater drainage (Design)*.

Channel linings

Generally, the channel should be lined with turf. However, where velocities are designed in excess of 2 m per second, non erosive linings such as concrete, geotextiles, grouted rock etc or velocity reducers (check dams, etc.) are required.

Typical arrangements of diversion drains and banks are shown in Figure 2.1.



DIVERSION DRAIN DIVERSION BANK

Figure 2.1 Diversion drains/banks

2.4 DROP DOWN DRAINS

Dished and lined drains

These are temporary or permanent drains which divert concentrated run-off down slopes such as road batters without causing erosion.

They usually consist of a dished earth drain smoothly shaped, consolidated and lined with a variety of materials or they may be a flexible/rigid pipe or half pipe.

Piped drains

Drop down drains consisting of rigid, or flexible, pipes are very effective as a temporary measure during road construction used in association with an earth windrow (or bund wall) along the top edge of the batter.

Run-off flowing along the windrow is directed to the pipe by which water is conveyed down the batter. It is a simple matter to extend the pipe as the batter rises.

Capacity

Drop down drains shall have sufficient capacity for a minimum 1 in 5 year peak flow without eroding. Energy dissipaters may be required to reduce the flow velocity at the outlet of the drop down drain.

2.5 STOCKPILES

Location

The location of stockpiles shall be indicated on the approved engineering Drawings.

They shall be located:

- Clear of existing or proposed drainage lines.
- Clear of areas likely to be disturbed during construction.
- Clear of the drip zone of trees.
- Preferably on reasonably flat areas.

Erosion protection

Stockpiles shall be protected from erosion and sediment loss by:

- The installation of diversion works.
- The use of silt fences, hay bales etc. or other approved controls on the downstream side.
- Compaction.
-
- Topsoil stockpiles
- Site topsoil shall be isolated from subsoil material in separate stockpiles.

2.6 SEDIMENT BASINS, TRAPS AND DAMS

Retention structure

Sediment basins, traps and dams are either permanent or temporary sediment control devices that intercept sediment and run-off usually at the final discharge point of the site.

Construction

They are formed by excavation and/or by constructing embankments.

Types

There are two types of basins - wet and dry.

Location

Preferably sediment traps shall not be located directly upstream of residential areas.

Design criteria

Basin design shall meet the following:

- Volume/capacity of the trap shall be 250 m^3/ha of disturbed site including the building areas.
- An allowance of 50 m^3/ha is required if diversion controls are not used to direct clean upstream water from outside the site away from construction areas.
- The capacity shall be measured below the invert of the lowest incoming flow. Otherwise pipelines and associated works will be affected.
- A secondary or emergency stabilised spillway must be provided to prevent overtopping of the structure. This shall be directed to a safe overland flow path.
- The basin shall have a minimum of 0.5 metres freeboard above the level of the spillway.
- The basin shall be surrounded by a manproof fence with lockable gates.
- An all weather access must be provided to the basin for maintenance.
- The basin shall have an arbitrary length to width ratio of between 2:1 and 3:1. This encourages soil particle settlement. The entry and exit points should be located at the opposite ends of the basin.
- If this is not possible some form of approved baffles shall be installed to minimise short circuiting of the flow.
- Discharge of the basin shall be via a perforated riser encapsulated by a filter device for a dry basin. Wet basins shall be flocculated by dosing with gypsum and pumped.
- Internal basin batters shall be a maximum of 3:1 and external batters a maximum of 2:1.
- All disturbed areas including batters shall be topsoiled and seeded.
- In areas known to be affected by high groundwater tables and/or salinity of groundwater, basins shall be designed to be water retentive so that surface drainage water does not leak to the subsurface, recharging groundwater.

Permanent wet basins

Permanent wet basin designs slightly vary from the above. Refer to the **Stormwater Management Section** of this specification.

2.7 SEDIMENT TRAPS AND BARRIERS FOR MINOR CATCHMENTS

Retention/filtering structure

These are silt retention/filtering structures of a temporary nature used in situations where the catchment does not exceed 0.5 ha.

Types

Such sediment traps/barriers generally consist of:

- silt fences

- hay bales
- 'blue metal' groynes/sausages
- filter fabric located beneath stormwater grates
- gabions
- or a combination of the above.

Location

The choice of material and type of treatment will depend on the size of the catchment the location and the structure being treated such as:

- surface inlet pits
- kerb inlet pits
- catch drain disposal areas
- culvert inlets and outlets
- minor construction/earthwork sites
- check dams/velocity reducers etc.

2.8 LEVEL SPREADERS

Purpose and structure

Level spreaders are outlets or 'sills' having a level cross section. They convert erosive channelised flows into non-erosive sheet flow.

Location

Level spreaders can only be used to dissipate flows from small catchments. The area below the outlet should be stable and of even cross section so that the water will not re-concentrate into channels.

Design criteria

To reduce flow velocity before the spreader, the channel grade shall not exceed 1% for a minimum of 8 metres.

The outlet or 'sill' width depends on contributing catchment, slope and ground conditions. The minimum width should be four metres, and the maximum width 25 metres.

Final discharge should be over a level surface, which may require stabilising by turfing or seeding and fertilising or perhaps lining with a geotextile fabric or something similar.

2.9 SHAKEDOWN AREAS AND ACCESS STABILISATION

Construction site access

Access to construction sites shall be limited to a maximum of two locations.

Location approval

Such access locations shall require Council approval.

Types

Shakedown areas or access stabilisation shall comprise a bed of aggregate on filter cloth or a metal bar cattle grid located at any point where traffic enters or leaves a construction site.

Stabilised accesses reduce or eliminate tracking of sediments onto public rights of way or streets. Should such tracking occur the contaminants must be swept off the road way each day or before rain. Clean off draw bars etc after dumping and before starting journey.

Shaker grids (Cattle grids)

If a shaker grid is used, this should be so placed as to ensure the vehicles when crossing the grid have sufficient speed to 'shake the mud' or other contaminants such as gravel from the vehicle.

It must not be placed where the vehicle is slowing to enter a roadway.

Shaker grids shall be a minimum length of 7 metres.

Stabilised access

A stabilised access comprises a vehicular footpath suitably constructed to facilitate the collection of any site debris in order to prevent such material leaving the site.

Stabilised accesses are generally used on small sites.

The entrance shall be at least 15 metres long with a minimum width of 3 metres for a one way entrance and 6 metres minimum width for a two way entrance.

Flow control

Surface water flowing to the street entrance/exit must be piped under the access, or a berm constructed to direct surface flow away from the exit.

2.10 WIND EROSION AND DUST CONTROL

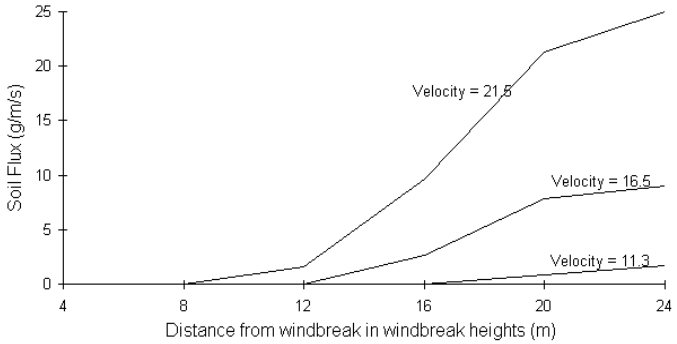
Erosion rate

Research has demonstrated average dust emission rates of over 2½ tonnes per hectare per month at urban construction sites. This erosion rate is unacceptable.

Treatments

Various measures are available to minimise such emissions, including:

- limiting the area of lands exposed to erosive forces through phasing works/progressive revegetation and/or provision of a protective ground cover and/or keeping the ground surface damp (not wet); and/or
- on building sites, installing a barrier fence on the windward side—effective to a distance of 15 times its height, assuming an acceptable soil flux of 5g/m/sec. See Figure 2.2.



Effect of distance from windbreak on soil loss, wind blowing at less than 90 to the windbreak.

Figure 2.2 Pollution control

2.11 REQUIREMENTS FOR BUILDING SITES—INTERNAL

Site clearing

The clearing of vegetation, preparation of building pads and similar construction works are to be undertaken in the last stages of the project when the majority of the site has been effectively revegetated.

When the project calls for the construction of a number of buildings, the sediment trap/s and other appropriate sediment controls shall remain operational.

Driveway control

Cross/catch drains shall be installed on long or steep unpaved driveways, disposing run-off to stable areas.

Site controls

Where a majority of the site is disturbed the following controls or measures shall be taken:

- Silt fences, located around the downstream sides of the site.
- Sediment traps/barriers to be provided to all on-site and adjacent stormwater inlets.
- Only one site access to be provided. This may require treatment to prevent soil being tracked from the site.
- All subsurface drainage for roofing must be in place prior to the installation of the roof and gutter so downpipes can be immediately connected.

2.12 REQUIREMENTS FOR BUILDING SITES—EXTERNAL

Control devices or works

Sediment control devices or stabilising works shall be provided outside construction sites where necessary or as directed by Council.

Likely accelerated erosion

Where increased stormwater run-off is likely to accelerate erosion of any downstream watercourse, the necessary remedial work shall be provided concurrently with other sediment and erosion requirements.

Downstream controls

Where sediment is likely to be transported from the site, all immediate downstream drainage inlets shall have appropriate controls installed.

Entry to private property

If such works require entry onto private property, written permission shall be obtained prior to the entry and commencement of such works.

Reinstatement

All disturbed areas on private property to be reinstated to original condition.

3 STORMWATER MANAGEMENT

3.1 MAIN COMPONENTS OF STORMWATER QUALITY ENHANCEMENT

Council works may require a change in land use and may be accompanied by a decline in stormwater quality. This applies to the long term as well as during the short term construction phase.

The main components required to enhance stormwater quality are as follows:

- Buffer zones and filter strips, being grassed, or similarly treated areas to facilitate the natural assimilation of water pollutants and reduce run-off. Refer to **Buffer Zones**.
- Wet retention ponds are permanent sediment ponds designed to allow particulate matter to settle out. They operate under both sedimentation and macrophyte regimes. Note that a large proportion of nutrients adhere to the sediments, and therefore settle out. Other nutrients are removed by macrophytic vegetation as part of the food chain.
- Trash Racks and Gross Pollutant Traps (GPT) designed to intercept litter and debris to maintain visual quality in downstream waterways, and to reduce the coarse sediment load on downstream water management structures.
- Wetland (nutrient) filter to enhance the removal of fine sediment and nutrients from stormwater run-off, and are largely dependent on biochemical removal mechanisms (i.e. nutrients taken up as part of the plant food chain).

3.2 EXCESS NUTRIENTS

Excess nutrients nitrogen (N) and Phosphorus (P) lead to eutrophication of waterways. This can cause uncontrolled growth of algae, water weeds etc, which can deplete oxygen levels, kill resident flora and fauna, and reduce recreational appeal.

However waterways do have a natural capacity to assimilate nutrients in small to moderate amounts as initial flows have.

It is essential to treat the ‘first flush’ of stormwater as these initial flows from urban areas have relatively high pollutant loads.

Such heavy pollution results from significant areas of impervious surfaces which do not assimilate pollutants such as dust, fertilisers, pesticides, detergents, etc to the same extent as occurs in more rural environments.

3.3 WET RETENTION BASINS AND PONDS

Purpose

Basins designed for water quality control should maximise the extent of settling. In general quiescent conditions and infiltration should be maximised.

Location and size

A wet retention basin can be located either on-line or off-line as shown in Figure 3.1. Its capacity however needs to be considerably greater if it is located on-line.

The wet retention basin usually has some form of energy dissipation at the inlet or a sufficient length-to-width ratio (greater than 2:1) to prevent short circuiting of flow across the pond, although its shape may vary considerably.

It should be located such that the basin does not locally raise the subsurface water table under circumstances that might lead to a salinity problem.

The pond may vary in size, but it usually has a minimum surface area of about 1% of the total catchment area.

At a depth of 2.5 metres, this provides a storage volume approximately equal to the maximum total run-off from a 1 in 1 year storm.

Basins may be installed as smaller multiple units (in series) or as large single units.

Basin efficiency

Other designs that will make the basin efficient in removing particles and provide for public safety, include the following:

- The minimum depth should be not less than 1.5 metres with an average depth of 2.5 metres. This discourages macrophyte growth in the deeper portions of the pond and also the breeding of mosquitos.
- The basins should have side slopes of approximately 1 in 8. This provides for safety and encourages microphyte growth around edges facilitating nutrient uptake.
- The maximum velocity through the pond based on a 1 in 1 year storm should not exceed 0.3 metres per second (at 2.5 metres depth, this is the maximum practical flow velocity at which optimum sediment removal can be achieved).
- A minimum freeboard of 0.3 metres should be provided between a restricted discharge outlet for the pond and a storm overflow weir. This discharge outlet should be designed so that the weir overtops on average three times per year.
- Inlet and outlet structures should be located at extreme ends of the basin, with short circuiting of flow further minimised by the use of baffles.

Construction and maintenance

Basins should be constructed prior to the commencement of any site clearing or construction works, and should be de-silted when the level of sediment reduces the average water depth to less than 1.5 metres.

Outlet Design

It may be desirable for the designer of an urban retention basin to incorporate an outlet device that enables dewatering of the basin. This simplifies de-silting, enabling earthmoving equipment to be used for de-silting operations.

Access track

An all weather access track shall be provided to the basin for maintenance works.

Trash racks

It is generally necessary to incorporate a gross solids trap and trash rack facility on major discharges into the retention basin. This prolongs the life of the basin and prevents the accumulation of litter.

Buffer zones

Basins should be surrounded by buffer zones, typically comprising grassed foreshores of not less than 20 metres between the nearest development and the basin.

This allows for some infiltration of drainage from sites, permits the drainage authority scope to develop aesthetic surrounds and reduces the likelihood of over the fence dumping of rubbish.

Settling velocity

The settling velocity of particles should service as the basis for design. This can only be found by conducting standard settling tests or from a knowledge of local soil characteristics.

The surface area of the required basin can then be determined from design settling velocities.

Dam Safety Requirements

Wet retention basins are regarded as impoundments and normal dam safety requirements shall be met.

The relevant State Authority responsible for dam safety shall be consulted to ascertain their requirements if the wet retention basin is:

- 10 metres or more in height and has a storage capacity of more than 10 megalitres; or
- 5 metres or more in height and has a storage capacity of 50 megalitres or more.

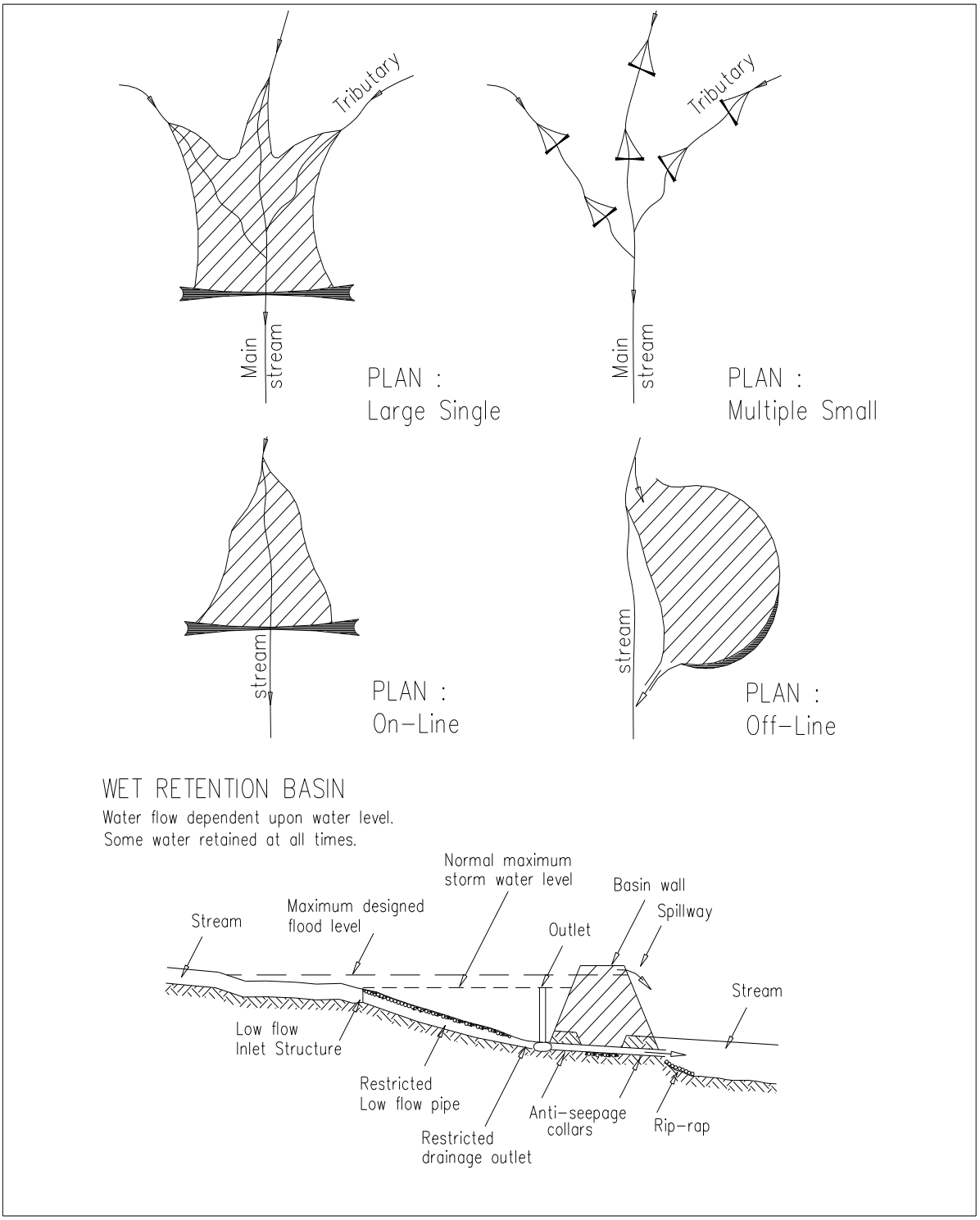


Figure 3.1 Configuration and design of wet retention basins

3.4 TRASH RACKS

Location, purpose and structure

Trash racks are usually permanent structures which intercept trash and other debris to protect the aesthetic and environmental quality of water.

Where appropriate, construct them upstream of all permanent retarding basins and/or wetlands which have a capacity greater than 5,000 cubic metres, and elsewhere as required by Council.

Design criteria

Generally, their design criteria should ensure:

- vertical bar screens with bar spacing of 65 mm clear;
- the length of the rack is consistent with the channel dimension and cause minimal damage when overtopped;
- they are as large as practicable while considering all other design criteria—a maximum height of 1.2 metres is suggested;
- a structure which remains stable in at least the 20 year ARI event, and is unlikely to cause flooding on adjacent lands as a result of the rack becoming completely blocked in the 100 year ARI event (analysis should include investigation of backwater effects and any consequent flooding);
- the structure drains by gravity to a dry condition; and
- adequate access for maintenance and which permits the use of mechanical equipment.

Associated structures

Where associated with outlet structures for small sediment basins or constructed wetlands, they can be relatively simple in design.

Gross pollutant trap

Trash racks may be incorporated in the design of gross pollutant traps.

Maintenance

Trash racks shall be checked periodically and all debris and silt removed.

3.5 GROSS POLLUTANT TRAPS

Location, purpose and structure

Gross pollutant traps (GPTs) are permanent structures used to trap coarse sediments, trash, litter, and other floating materials.

Usually, they are located upstream of constructed wetlands and receiving waters.

They consist of an energy dissipater at the upper end, concrete sediment trap and trash rack at the lower end. Sometimes a ‘mini’ wetland is incorporated at the downstream end.

GPTs can be defined as major or minor:

- major gross pollutant traps can be located on major floodways and waterways to intercept medium to high flows; and
- minor, enclosed gross pollutant traps can be located at heads of major floodways and/or where stormwater discharges into floodways or water bodies.

Application

Traps have restricted application and each should be justified on individual merits.

They have high construction costs and are generally unable to trap silt and clay sized particles other than in relatively small storm events (e.g. one year ARI, critical duration storm event).

Nevertheless, in some specialised situations their use might be justified, especially where a significant proportion of the bed load consists of particles coarser than 0.04 mm (sandy soils) and/or where their construction/maintenance cost can be justified when compared with more conventional sediment retention basins.

Sediment interception

Design traps to intercept at least 75% of sediment with a grain size of 0.04 mm or greater under average annual runoff conditions.

Further, ensure peak flow velocities are less than 0.3 metres per second in the 1 year ARI storm event, and taking into account any likely backwater effect from a blocked trash rack.

Capacity

The structure should have sufficient capacity and stability to discharge the inlet flow with the trash rack fully blocked without flooding adjacent properties.

Maintenance requirement

Ensure GPTs are capable of gravity drainage to a dry condition for periodic cleaning and maintenance if at all possible.

3.6 WETLANDS

Purpose and structure

Wetlands used for improvement of urban run-off quality can be either natural or artificial. They necessarily have to be shallow.

Growth of emergent aquatic plants (reeds, etc) should be encouraged by using side slopes of very low gradient (1 in 8 or less).

A large percentage (greater than 25%) of any permanent water should be less than 1 metre deep.

The remainder of any open water should have a depth of not greater than 2 metres which will allow submerged plant growth. Figure 3.2 shows a typical wetland arrangement.

Protection of natural wetlands

Where wetlands are natural, provision shall be made for the protection of the wetlands from clearing, construction of levees, draining and filing, but does not prevent wetlands being used for run-off control, provided safeguards and operation control ensures their continued viability.

The relevant State Environment Protection Authority should also be consulted.

Efficiency

Wetlands, like retention basins, operate more effectively when higher contact time between the pollutants and the biota of the wetland is provided.

Thus, like retention basins, wetlands will be more efficient when used in conjunction with upstream flow retardation basins that will maintain run-off closer to pre-development levels.

Care shall be taken to avoid situations that recharge the groundwater and elevate the water table so as to develop local salinity problems.

Water levels

A structure should be included to allow manipulation of water levels in the wetland. This will enable control of microphyte, insect populations and facilitate dredging.

Short circuit prevention

Where possible, small islands or shoals should be constructed in the upstream areas of the wetland to reduce water velocities, prevent short circuiting and promote aquatic plant growth.

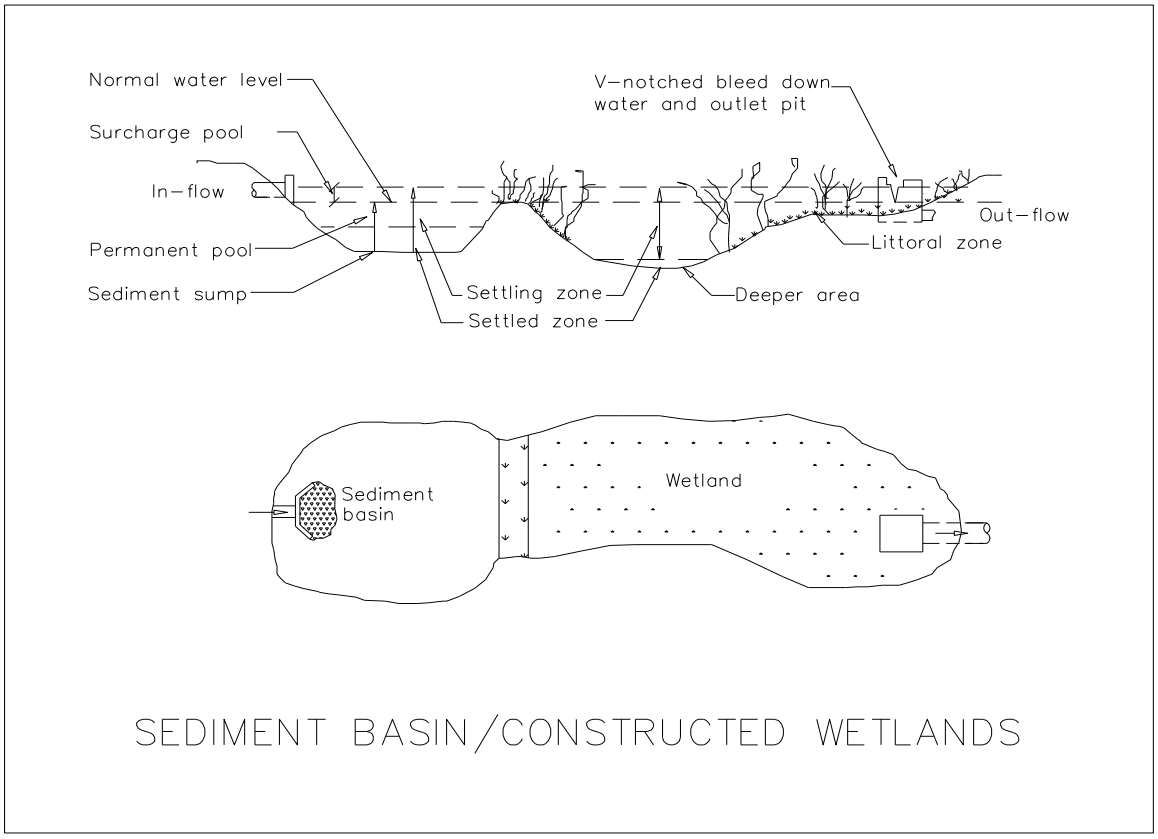


Figure 3.2 Sediment trap/constructed wetland

Protection from trash and large particles

The performance and life of wetlands, like wet retention basins, will suffer if they are not protected from trash and large particles. It is therefore recommended that trash racks/gross sediment/pollution traps be installed upstream of the wetland.

Buffer zones

Wetlands shall be surrounded by a buffer at least 20 metres wide in order to:

- Restrict access to maintenance vehicles by the installation of an all weather track with a lockable device.
- Acts as an infiltration area for surface run-off.
- Provide flood protection and secondary assimilation of pollutants.

Native vegetation

These areas are best planted with vegetation native to the area, but they can be used as grassed areas and an aesthetic feature.

The results of previous study indicates rates of removal of phosphorous and particles in wetlands are higher than for wet retention basins.

Surface area

In designing wetlands, it is recommended that, as an interim guide, the surface area of the wetlands be a minimum of 0.5% of the catchment which it serves.

If wetlands are used in conjunction with wet retention basins, this percentage can be proportionately lowered by allowing for the surface area of the installed wet retention basin.

Plant types

In open water zones, rooted emergent macrophytes appear to be more efficient than substrate microphytes (plants that are attached to the bottom of the water but which do not emerge).

This is because the emergent aquatic plants act as an oxygen pump, taking oxygen from the atmosphere into their roots and eventually into the water and so making it available for bacteria and attached algae which grow on the roots on the emergent plants.

In the crushed rock zones, emergent aquatic plants are the only types of macrophytes that will grow.

These plants will also act as oxygen pumps, and facilitate biological uptake of nutrients and the breakdown of organic matter by bacteria which grow on their roots.

A variety of plant species should be planted in artificial wetlands to achieve efficient colonisation and maximise pollutant removal. Establishment of plants should be through transplantation of seedlings during spring and early summer.

Aesthetic feature

Wetlands will serve other purposes than just improving a quality of urban run-off. They will serve to attract a large range of biota and bird habitat.

In areas where they have been installed, they have become an aesthetic feature. Indeed, this may present problems as surrounding communities may resist efforts by the controlling authority to de-silt the wetland.

Insect problems

To minimise mosquito problems, limit expanses of water with more than 50% shading and ensure no sections of water become isolated from the main body.

Wildlife refuge

Islands are highly beneficial as wildlife refuges, especially for birds. Their design should consider the effects on changes in water tables.

Native fish

Stock ponds with selected native fish to improve the water quality (not for sport), especially species which will control mosquito larvae and select zooplankton in preference to phytoplankton. Avoid use of fish which are bottom feeders.

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0076 SEWERAGE SYSTEMS - RETICULATION AND PUMP STATIONS (DESIGN)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this work section consists of the design of a sewerage system either as a stand-alone project or part of a development.

The work section contains procedures for the design of the following elements of the sewerage system:

- Gravity sewers including junctions and property connection sewers.
- Common effluent sewers both gravity and pressurised.
- Vacuum sewer system.
- Maintenance holes and other structures.
- Rising mains.
- Pump stations.

1.2 OBJECTIVE

The objective of the sewerage system is to transport sewage or effluent from domestic properties to the treatment plant in accordance with all current relevant legislation. Consumer requirements shall be met by providing a sewer main and allowing an appropriate point of connection for each individual property.

1.3 COMPLIANCE

The design of gravity sewer systems and pump station components shall comply with the Water Services Association of Australia's publication Sewerage Code of Australia unless specified otherwise herein and should be constructed in accordance with 1361 *Sewerage - reticulation and pump stations (Construction)*.

1.4 SUBSIDISED SCHEMES

Where the Specification forms part of a contract attracting Government Grant funds, the Principal shall identify

- Items which are not of the least cost option, that:
  - . Are intended to have a much longer design life than the normal asset service life detailed in the Asset Management Guidelines of the International Infrastructure Management Manual.
  - . Do not meet the project objectives and the requirements of the various Authorities for the least Net Present Value (NPV) but may become the preferred option for construction.
- Particular equipment which is procured without relevant competition through tendering.
- Duplication of equipment or unit processes in a system configuration.

1.5 SPECIFICATIONS TO BE USED BY THE DESIGNER

In designing a sewerage system it is assumed that the Designer shall possess, or have access to, the documents required to comply with this work section.

The Designer shall include the requirements of the 1361 *Sewerage - reticulation and pump stations (Construction)*.

The Designer shall use the latest edition of the Australian Standards, including amendments and supplements, unless specified otherwise.

References to the Sewerage Code of Australia are identified by part and section numbers and enclosed in brackets thus (WSAA Part, Section).

Sewerage Code of Australia drawings are to be used in preference to DPWS Standard Drawings (WSAA 02 Part 4).

1.6 REFERENCED DOCUMENTS

The following documents referred to in this work section shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Work section

1361 *Sewerage - reticulation and pump stations (Construction)*

Standards

AS 1102 series	Graphical symbols for electrotechnical documentation (Various)
AS 1214	Hot dipped galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 1281	Cement mortar lining of steel pipes and fittings
AS 1444	Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS 1579	Arc welded steel pipes and fittings for water and waste-water
AS 1646 series	Elastomeric seals for waterworks purposes (Series)
AS 1657	Fixed Platforms, walkways, stairways and ladders—Design, construction and installation
AS 1741	Vitrified clay pipes and fittings with flexible joints—Sewer quality
AS 2129	Flanges for pipes, valves and fittings
AS 2200	Design charts for water supply and sewerage
AS 2634	Chemical plant equipment made from glass-fibre reinforced plastics (GRP) based on thermosetting resins
AS 2837	Wrought alloy steels—Stainless steel bars and semi-finished products
AS 3571	Glass filament reinforced thermosetting plastics (GRP) pipes—Polyester based—Water supply, sewerage and drainage applications
AS/NZS 3735	Concrete structures retaining liquids
AS 3996	Access covers and grates
AS/NZS 4058	Precast concrete pipes (pressure and non pressure)
AS 4060	Loads on buried vitrified clay pipes
AS 4087	Metallic flanges for waterworks purposes
AS 4100	Steel structures
AS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 1260	PVC pipes and fittings for drain, waste and vent application
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 2280	Ductile iron pipes and fittings
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 3500	Plumbing and drainage
AS/NZS 3500.2	Sewerage
AS/NZS 3518	Acrylonitrile Butadienne Styrene (ABS) pipes and fittings for pressure applications
AS/NZS 3862	External fusion-bonded epoxy coating for steel pipes

AS/NZS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications
AS/NZS 4131	Polyethylene (PE) compounds for pressure pipes and fittings
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 4765(Int)	Modified PVC (PVC–M) pipes for pressure applications
AS/NZS 5065	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

Other publications

NSW Department of Commerce

MEW E101	Electrical Services Minimum Requirements
PWD-SD	Public Works Department Manual of Practice—Sewage Design
PWD-PSD	Public Works Department Manual of Practice—Sewage Pumping Station Design (May 1986)

Water Services Association of Australia (WSAA)

WSAA 02 Sewerage Code of Australia, 2nd Edition Ver. 2.3

1.7 BIBLIOGRAPHY

Standards

AS 1631	Cast grey and ductile iron non-pressure pipe and fittings
AS 3680	Polyethylene sleeving for ductile iron pipelines
SAA HB 48	Steel structures design handbook
BS EN 1091	Vacuum sewerage systems

Other publications

Institute of Public Works Engineering Australia (IPWEA)

Guide to Codes and Practices for Streets Opening - Streets Opening Conference 2007 (Sections 5 and 6 detailing locations and depths of other services and preferred location for water reticulation pipes)

NSW Department of Commerce

WS-SPEC	Technical Requirements (TRs) and Strategic products Specifications
PWD	Safety Guidelines for fixed ladders, stairways, platforms and walkways for use in sewage treatment Works, pumping stations and maintenance holes

Water Services Association of Australia (WSAA)

WSAA 04 Sewerage Pumping Station Code

Australian Building Codes Board

Building Code of Australia—PART E1, Fire Fighting Equipment

2 DESIGN CRITERIA

2.1 GENERAL

Standard

The design shall be in accordance with the Sewerage code of Australia, or PWD-SD and PWD-PSD unless specified otherwise herein (WSAA 02 Part 1).

Responsibility

Except where specified otherwise, the division of responsibilities between the Sewer Authority and the Designer shall be in accordance with the Sewerage code of Australia (WSAA 02 Part 1, Section 1.3).

Gravity system

The Designer shall confirm the design criteria with the Sewer Authority and shall design a gravity pipeline collection system with pump stations and rising mains, where necessary to comply with the requirements of this work section, to transport fresh sewage, or common effluent, for treatment.

Pressurised or vacuum system

Pressurised common effluent or vacuum systems shall only be considered after consultation with the Sewer Authority.

Discharges to gravity sewers

The Designer shall not provide for common effluent or vacuum discharges to gravity sewers or conventional wastewater treatment plants without the concurrence of the Sewer Authority.

2.2 DETERMINATION OF AREA TO BE SERVED

PWD-SD and upstream provision

The area to be served shall be determined in accordance with PWD-SD except that the Sewer Authority may require provision for an upstream sewer.

In the design brief the Sewer Authority will indicate the level and size of existing pipe as well as anticipated flows to be allowed for in the design (WSAA 02 Part 1, Section 2.3.2).

Alternatively, the Authority may require the designer to determine the future and ultimate upstream sewer loading and provide adequate allowance for such loadings to the satisfaction of the approving authority.

Depth

The depth of sewer shall be sufficient to allow a minimum of 90% of each lot to be serviced.

Provision of sewerage

All lots shall be able to be served by gravity sewers wherever possible.

2.3 DESIGN LOADING

Flows

The Designer shall obtain the concurrence of the Sewer Authority for the flow to be used for the design of sewers serving industrial areas and developments not specifically listed in the Sewerage Code of Australia or PWD-SD (WSAA 02 Part 1, Section 3).

Design codes

The design shall take account of AS 2200, AS/NZS 2566.1, AS/NZS 3500.2, AS/NZS 3735, the Sewerage Code of Australia and, where design elements are not covered elsewhere in these codes, PWD-SD and PWD-PSD.

2.4 SEWER ALIGNMENT (WSAA 02 PART 1, SECTION 4.3)

Consent of owner

Where it is necessary for sewers to be located outside the development, the Designer shall obtain written approval from the affected property owner.

Preparation of any application for approval from an affected property owner shall constitute a WITNESS POINT (WP).

The Principal shall advise whether the option to review and direct on the application is taken at the time of notification by the Designer.

Road reserve

Where sewers are proposed to be located within existing road reserves, the Designer shall check that the sewers do not conflict with other utility services and locate the sewers in accordance with established protocols (WSAA 02 Part 1, Section 4.4).

Easement

Sewers located on private property must be located in an easement of minimum width three (3) metres. Unless there are compelling reasons to the contrary the sewer shall be located in the centre of the easement.

A Registered Surveyor shall survey easements and pipelines (WSAA 02 Part 1, Section 4.5).

Trench width

Where control of the trench width is practical or effective, the design may be based on wide trench condition.

The Designer shall call up the need, in the Construction Specification, for the Contractor to supply special construction control with a method statement when there is economic justification to design to narrow trench condition.

2.5 MAINTENANCE HOLES (MHS) (WSAA 02 PART 1, SECTION 6.6)

Spacing

Maintenance holes shall generally be placed on gravity sewers as specified in PWD-SD Clause 6.1, except that the maximum spacing shall be 70 m (WSAA 02 Part 1, section 6.3).

Terminal maintenance hole

All upstream ends of sewers shall terminate in a maintenance hole if the upstream end is more than 30 m from the downstream maintenance hole.

Step irons

Step irons shall be provided to all maintenance holes where the depth from top of cover to the invert of the outlet pipe exceeds 1200 mm. Step Irons shall be of 24 mm diameter hot dip galvanised steel, cast aluminium or plastic encapsulated.

Venting

The Designer shall provide for the venting of maintenance holes which accept pumped discharges.

Connections to existing systems

Connections to existing maintenance holes or sewers of the existing sewerage system is to be based on the Sewer Authority's sewerage master plan.

Access covers

Access covers shall be manufactured in accordance with AS 3996.

2.6 MAINTENANCE SHAFTS (MSS) AND TERMINAL MAINTENANCE SHAFTS (TMSS)

As required by sewer authority

Maintenance shafts and terminal maintenance shafts shall be provided only as required by the Sewer Authority.

MH Layout

The provision of maintenance shafts and terminal maintenance shafts shall not affect the layout of maintenance holes or terminal maintenance holes unless directed by the Sewer Authority.

Maximum spacing

Where used, a terminal maintenance shaft shall be no further than 70 m from the nearest maintenance hole.

Conditions limiting use

The Designer shall take account of conditions limiting the use of maintenance shafts (WSAA 02 Part 1, Section 6.7).

2.7 PIPELINES (WSAA 02 PART 2

Type

Pipes and fittings for sewerage systems shall be of unplasticised PVC, modified PVC, ductile iron, vitrified clay, steel, polyethylene, polypropylene or glass reinforced plastic. The material specifications for each pipe type are provided in Section 3.

Witness Point

The choice of pipe type constitutes a WITNESS POINT (WP). The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

Fibre cement pipes and fittings

Fibre cement pipe and fittings shall not be used.

Concrete pipes

Concrete pipes shall not be used.

Buried pipes

Pipelines shall be buried. Above ground sewers may be designed in a gravity system only where other options are less practical (WSAA 02 Part 1, Section 8.7).

The action to provide for above ground sewers constitutes a WITNESS POINT.

The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

External protection

The Designer shall show on the Drawings the extent of external protection required to be undertaken by the Contractor.

External protection shall be shown to comply with 1361 *Sewerage - reticulation and pump stations (Construction)*.

Colour coding

Where sewer pipes or rising mains are to be located in close proximity to other services pipes or where there is the likelihood of the pipes not being recognised as sewerage pipes, the Designer shall provide for the pipes to be colour coded and shown on the Drawings accordingly.

Piers

Piers for any above ground sewer pipeline shall be in accordance with the Sewerage code of Australia Drawing SEW-1404.

Property connection

The pipeline alignment shall be such that no property connection sewer is to be more than 10 m in length.

Connection depth

The Designer shall ensure that connections to the pipeline shall be not more than 1500 mm in depth below the finished surface.

Special allowances

The Designer shall allow for adequate working area, waste removal and transport arrangements where scouring points or inspection pipe locations are nominated.

Thrust blocks

The Designer shall design thrust blocks to resist maximum pressure of the pipe, not the estimated surge pressure.

Surge control method

The Designer shall provide for surge control by specifying an appropriate rising main material and class selection.

2.8 JOINTS

Elastomeric seal or butt welded

Gravity sewers and rising mains shall generally be spigot and socket joints with elastomeric seals complying with AS 1646, or butt welded in the case of polyethylene pipe.

Flanges

Flanged joints connecting pipes, fittings, valves and pumps shall comply with AS 2129 (Flanges shall be Table C) or AS 4087, Class 16, as appropriate.

The concurrence of the Sewer Authority shall be obtained for the type of joint to be used (WSAA 02 Part 2, Section 10.3.2).

2.9 MINE SUBSIDENCE AREAS AND AREAS OF SLIPPAGE

Ground strain

The Designer shall accommodate the movement associated with the ground strain for the area, as advised by the Mine Subsidence Board for sewerage jointing systems in proclaimed Mine Subsidence Areas, or in a known or expected area of subsidence or slippage.

The design ground strain for the development shall be detailed on the Drawings.

Pipe jointing system

The pipe jointing system selected shall be capable of accepting ground movements, without impairing the water tightness of the joint, for the ground strain as advised by the Mine Subsidence Board. For areas with high ground strains a pipe jointing system using shorter effective length pipes and/or deep socket fittings shall be used.

This action constitutes a WITNESS POINT.

The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

Areas applicable

Where the Mines Subsidence Board does not cover an area of known, or suspected, subsidence or slippage, the above requirements shall still apply.

3 MATERIALS

3.1 PVC GRAVITY PIPE

Standard

PVC pipe shall be specified to be manufactured in accordance with AS/NZS 1260, designed in accordance with AS/NZS 2566.1 and with elastomeric seal spigot and socket joints (WSAA 02 Part 2, Table 10.1). The pipe shall be not less than Class SN 6.

Ductile iron pipe compatibility

Where PVC pipe is used in conjunction with DI fittings, the Designer shall ensure the jointing system is appropriate.

Fittings

Fittings for use with PVC pipe shall be elastomeric seal jointed.

3.2 PVC PRESSURE PIPE

Standard

PVC pressure pipe shall be specified to be manufactured in accordance with AS/NZS 1477, AS 4441 or AS/NZS 4765, designed in accordance with AS/NZS 2566.1, and with elastomeric seal spigot and socket joints (WSAA 02 Part 2, Table 10.3). The pipe class shall be selected based on pumping design and site conditions.

Ductile iron pipe compatibility

Where PVC pipe is used in conjunction with DI fittings, the Designer shall ensure the jointing system is appropriate.

Fittings

Fittings for use with PVC pressure pipe shall be elastomeric seal jointed.

3.3 DUCTILE IRON PIPE AND FITTINGS

Standard

Ductile iron pipes and fittings shall be specified to be manufactured and cement mortar lined in accordance with AS/NZS 2280, with minimum Class PN 20 for elastomeric seal joints. Where pipes are flanged, AS/NZS 2280 Flange Class pipe shall be specified (WSAA 02 Part 2, Table 10.1).

Corrosion protection

The Designer shall specify cement mortar lining in accordance with AS/NZS 2280, or fusion-bonded medium density polyethylene to AS/NZS 4158.

External protection shall be epoxy coating to AS 3862 where not otherwise specified as sleeved or wrapped, taking into account the type of corrosion protection required.

Joints

Generally, pipe and fitting joints shall be specified to be spigot and socket type using an elastomeric seal made of natural rubber, or ethylene propylene rubber with compounds complying with AS 1646.

Flanges

Flanges shall be specified to be manufactured in accordance with AS 2129 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129 and galvanised in accordance with AS 1214 or stainless steel in accordance with AS 2837 as for pumps specified in 1361 *Sewerage - reticulation and pump stations (Construction)*.

3.4 VITRIFIED CLAY (VC) PIPES AND FITTINGS

Standard

Vitrified Clay pipes and fittings shall be specified to be manufactured in accordance with AS 1741 and designed in accordance with AS 4060 (WSAA 02 Part 2, Table 10.2).

Joints

Pipe and fitting shall be spigot and socket type using an elastomeric seal joints. Natural rubber shall not be used.

3.5 STEEL PIPE AND FITTINGS

Standard

Steel pipes and fittings shall be specified to be manufactured in accordance with AS 1579 and designed to AS/NZS 2566.1.

Joints

The Designer shall specify the jointing system where long-term corrosion resistance, ease of construction or special circumstances dictate the need. The pipe jointing shall be either:

- Elastomeric seal jointed with seals complying with AS 1646, or
- Butt welded, welded spigot and socket, or welding using a welding collar, and with the application of a polyethylene heat shrunk sleeve over the weld, or wrapped, or
- Flanged to comply with AS 4087 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129 and galvanised in accordance with AS 1214, or stainless steel in accordance with AS 1444 as for pumps specified in 1361 *Sewerage - reticulation and pump stations (Construction)*.

3.6 POLYETHYLENE PIPE AND FITTINGS

Polyethylene pressure pipe and fittings shall be manufactured to comply with AS/NZS 4129 and AS/NZS 4130 and designed to AS/NZS 2566.1 (WSAA 02 Part 2, Table 10.2).

3.7 GLASS REINFORCED PLASTIC (GRP) PIPE AND FITTINGS

Glass reinforced thermosetting plastics (GRP) pipes and collars shall be manufactured to comply with AS 3571 and designed to AS/NZS 2566.1 (WSAA 02 Part 2, Table 10.2).

Fittings shall comply with AS 2634. Ductile iron fittings complying with AS/NZS 2280 with appropriate elastomeric seals to AS 1646 may also be used.

3.8 POLYPROPYLENE PIPE AND FITTINGS

Standard

Polypropylene pipes and fittings shall be specified to be manufactured to AS 5065 and designed to AS/NZS 2566.1 (WSAA 02 Part 2, Table 10.2).

4 PUMP STATIONS

4.1 GENERAL

Location

The Designer shall take into account access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves or on private property.

This action constitutes a **WITNESS POINT**.

The Principal shall advise at the time of notification by the Designer whether the option to confer on the locations is required.

Type

Where not provided as a vacuum sewerage system, the Designer shall provide for all pump stations to be of the single wet well submersible pump style with self contained freestanding switchboards suitable for external use.

Conditions

The Designer shall provide for the construction of the pump well after taking into consideration the ground and site conditions.

Preformed components

Preformed components or systems, complying with the Drawings, if any, may be used in lieu of in-situ construction provided:

- Preformed concrete cylindrical wall units are to be manufactured to AS/NZS 4058. The Designer shall take into account the cover requirements for reinforcing steel and cement types.
- Joints shall be internal flush
- The Designer shall ensure selected components make a watertight system and have a satisfactory surface finish.

Protection against flooding

Where the pump station site is exposed to possible flooding, the Designer shall provide for the top of pump well to be one (1) metre above the 1 in 100 year flood level or to such other level as provided by Council's planning instruments, whichever is the higher.

Protection against flotation

The Designer shall provide for the design of pump wells against flotation both during the construction/installation stage and whilst operating under flood conditions designed as above.

Package units

Package pump station units may be designed, with the prior concurrence of the Sewer Authority, where the area being serviced is small and/or their inclusion contributes to an overall lesser depth of excavation in the system.

Surfaces

The Designer shall provide for internal surfaces of wet wells to be prepared and coated with an epoxy paint system approved by the Superintendent. All bolted connections within wet wells shall be stainless steel complying with AS 2837 Grade 316.

Surcharges and overflows

The Designer shall size pipes and pump station capacity to avoid surcharges under design flow conditions. The Designer shall provide for overflows in strict accordance with the conditions of the licence, if any, permitting sewage overflow.

Alarms and signals

The Designer shall provide for alarms and signals systems with the concurrence of the Sewer Authority.

4.2 PUMPS

Special requirements

The Designer shall specify special requirements, if any, for materials to be used in the pump station, taking into consideration the nature and composition of the sewage to be pumped. Each pump shall be fitted with a flushing valve installed in accordance with the manufacturer's recommendations.

Size

The Designer shall provide for pump stations to be fitted with suitably sized pumps, consistent with other pumps in service, in conventional duty pump/standby pump arrangement.

Impeller clearance

Each pump shall be capable of passing solids of not less than 75 mm diameter unless grinding equipment is incorporated

Removal

Each pump shall be capable of being removed with the aid of fixed guide rails.

Inter-changeable

Pump sets are to be interchangeable within each pump station.

Structural steelwork

The Designer shall design structural steelwork in accordance with AS 4100 or HB 48.

4.3 ELECTRICAL

Design responsibility

Notwithstanding other clauses mentioned herein, the Designer shall be responsible for the design of the equipment as suitable for the purpose.

Equipment design shall comply with the requirements of the relevant standard specification.

SCA and electrical

The Designer shall provide for Switchgear Control Assembly (SCA), SCA housing and electrical requirements as detailed in 1361 *Sewerage - reticulation and pump stations (Construction)*.

Inter-changeability

Where more than one (1) item of equipment is designed to form a particular function, all such items of equipment shall be identical and completely interchangeable (eg. pilot lights, pushbuttons, relays, etc.).

Switchboard

The switchboard shall be installed visibly and physically accessible above areas at risk of flooding.

Ambient conditions

Ambient conditions shall be within the normally accepted limits of 0°C to 45°C.

Connection to local supply

The switchboard shall be connected to the local electricity supply system.

Nominal system parameters:

- 415 volt, 3-phase, 4-wire, 50 Hz, solidly earthed neutral system.
- Prospective Fault Current: as specified by the local supply Authority.

Standards

The works shall be designed in accordance with and subject to the provisions of MEW E101, except where modified by this work section.

Automatic operation

The pump station shall be designed for fully automatic operation in the unmanned condition.

4.4 WATER SUPPLY

Cleaning

The Designer shall provide for automatic well washers and flush valves to be installed at each pump station and controlled so that they operate when the duty pump is operating.

Contamination protection

The Designer shall provide at all pump stations for an adequate water supply for cleaning purposes.

This supply shall be protected from contamination due to backflow by the installation of a registered break tank or reduced pressure zone device in accordance with AS 3500.2.

4.5 LADDERS

Standard

Ladders shall comply with AS 1657 and applicable Occupational Health and Safety legislation (WSAA 02 Part 1, Section 6.6.8).

Ladder landings

If required, the Designer shall set intermediate landings in wells to achieve the minimum head room clearance.

Wherever possible, the landing shall be located adjacent to fittings and machinery requiring maintenance.

Ladder cages

Ladder cages shall not be used on ladders in pump station wet wells.

4.6 TELEMETRY

Schedule

The Designer shall provide for telemetry requirements in accordance with the schedule supplied by the Sewer Authority.

Compatibility

The telemetry system is to be compatible with the existing system, if any, in use.

4.7 OTHER APPURTENANCES

Venting

The Designer shall provide for venting of each pump station, and in built up areas, after consultation with the local Council.

Lifting equipment

The Designer shall provide for machinery lifting equipment including pump chains.

Gauges

The Designer shall provide pressure tapping and gauges for all valves, including isolation and non-return valves and as detailed in 1361 *Sewerage - reticulation and pump stations (Construction)*.

Covers

The Designer shall take account of the possibility of site flooding ingress and overflow, and occupational health and safety requirements in providing for access and inspection covers.

5 DOCUMENTATION

5.1 SEWERAGE SYSTEM

Approval

The Principal shall submit, to the Sewer Authority for approval, four (4) copies of the proposed sewerage system design, including calculations prior to commencement of construction (WSAA 02 Part 1, Section 9).

This action constitutes a WITNESS POINT.

The Principal shall advise at the time of notification by the Designer whether the option to direct the submission to the Sewer Authority is taken..

Drawings

The Drawings shall show to scale:

- Plan showing:
  - . Lot boundaries and lot numbers.
  - . Location and chainage of all maintenance holes, junctions and dead ends.
  - . Maintenance hole types.
  - . Location and size of all gravity and rising mains and pump stations.
  - . Location of vents.
  - . Sewer main number and maintenance hole number.
  - . Existing sewer mains, junctions and maintenance holes.
  - . For level lots, spot levels at the lot extremities to show that at least 90% of the area of the lot can be connected to the sewer by gravity.
  - . Hatching shall show the area of any lot not serviced.
  - . Site contours.
  - . Existing and proposed features and services.
  - . North point and scale bar.
  - . Easement location.
  - . Arrangement of other utilities.
- Longitudinal section showing:
  - . Reduced levels for natural surface and design surfaces at all changes in grade.
  - . Maintenance hole locations and type.
  - . Maintenance holes numbered in accordance with the Sewer Authority’s Asset Register.
  - . Invert levels for maintenance holes inlet and outlet.
  - . Size, type, class and grade of pipe.
  - . Location, invert level and size of all drainage lines, water mains, and other utility services crossing the main.
  - . Notation regarding all joining lines.
  - . Property ownership.
  - . Note upstream ET’s at each maintenance hole.
  - . Note ‘In road’ trench conditions.
- Pump stations—General arrangement of pump stations with site plan; concrete outlines; number, make, model and details of pumps; inlet and outlet pipework details and levels; pump cut in; cut out and alarm levels; switchboard location; pump station access details; design starts per hour.
- Pipe protection—Details of corrosion protection required for pipes and fittings.
- Trenchless installation—Areas designated for trenchless pipe installation.

Drawing scale, size and format

Detail plans shall be drawn to a scale of 1:500 and longitudinal sections to a horizontal scale of 1:1000 and a vertical scale of 1:100.

Drawings shall be 'A3' size and/or 'A1' after consultation with the Sewer Authority.

Drawings shall be provided also in electronic form after consultation with the Sewer Authority.

5.2 PUMP STATION

Approval

The Principal shall submit, to the Sewer Authority for approval, prior to commencement of the manufacture of any pumps and control equipment, four (4) copies of the following:

- Switch and Control Gear Assemblies—Proposed fully dimensioned manufacturing details, general arrangement (showing internal/external details) and foundation/gland plate details.
- Common Control—Complete circuit diagram and description of operation.
- Schedule of Equipment—Completed as to the equipment to be provided.
- Other Engineering drawings as required to fully describe the proposed equipment.

The submission of the documents constitutes a WITNESS POINT.

The Principal Shall advise at the time of notification by the Designer whether the option to direct the submission to the Sewer Authority is taken.

Confined space risks

The Designer shall take into consideration the technical requirements to minimise all risks associated with entry into confined space.

Drawing Size and format

Drawings shall be on 'A3' size. All symbols used shall conform to AS 1102 and all wires and terminals shall be numbered.

Drawings shall also be provided in electronic form after consultation with the Sewer Authority.

Asset register

The Designer shall provide asset schedules and Drawings in a form consistent with the existing or proposed Asset Register after consultation with the Sewer Authority. (WSAA 02 Part 1, Section 9.3.2).

6 ANNEXURE A

6.1 INSTRUCTION FOR SPECIFICATION PREPARATION

Incorporation of Local Requirements for Sewerage System Design

This work section recognises that each Council may need to vary the Specifications to meet local requirements. The items below may be taken into account in varying this design specification and 1361 *Sewerage - reticulation and pump stations (Construction)*.

The Water Directorate, a close partner of the Institute of Public Works Engineering Australia (IPWEA), may provide additional information regarding the following:

- A complete list of Australian Standards relevant to Sewerage System compiled as a result of a survey of Standards in use.

- A schedule of training organisations available to provide accreditation to Contractors and Superintendents.
- A schedule of products in use compiled as a result of a survey of users.
- Advice on handling different requirements between the Council and any subsidising Authority. Differences identified include:
  . Provision of more expensive materials, fittings and pumps.
  . Automation (e.g. Sewerage pump station well washers and flushing valves **Pumps**).
  . Depth of gravity sewers versus increased number of pump stations.
  . Dimensional variations, including:
    * Sewer maintenance hole spacing **Maintenance Holes**.
    * Length of sewer dead ends **Maintenance Holes**.
    * Length of sewer service connections **Pipelines**.
    * Cover requirements to 1361 *Sewerage - reticulation and pump stations (Construction)*.
    * Depth to sewer connections **Determination of area to be served** and **Pipelines**.

The grading requirements called up for sand bedding may need to be checked where Council wishes to facilitate local acquisition. See 1361 *Sewerage - reticulation and pump stations (Construction)*, **Pipe bedding** and Table 3.4).

Valve opening direction varies within and between Water Authorities. The requirements of the specifications may need to be checked against existing installations. See 1361 *Sewerage - reticulation and pump stations (Construction)* **Valves**.

The requirement for the location of property services varies between Councils. The requirements of the specifications may need to be checked against existing installations. See 1361 *Sewerage - reticulation and pump stations (Construction)* **Junction and property connection sewers**.

The number and timing for receipt of documents called up varies between Councils. The requirements of the work section may need to be checked against existing requirements.

Councils require varying lead times for notices to be given. The requirements of the work section may need to be checked against existing requirements.

Council may wish to consider the option for installation of curved pipes (e.g. in cul-de-sacs).

Council may wish to include provision for inverted syphons and associated venting.

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0160 QUALITY (DESIGN)

1 SCOPE AND GENERAL

1.1 SCOPE

This work section sets out the process for quality assurance of Designs required by Council for engineering works. The requirements are applicable to all design work whether undertaken by Designers within Council, a Consultant or a Sub-consultant.

The work section refers to Engineering Design processes. Requirements which refer to the Concept Design of developments are generally covered in Council's Subdivision Code. The requirements of the Subdivision Code are a prerequisite to the quality requirements for Engineering Design provided in this Specification.

The work section refers also to engineering design processes for developments that do not involve subdivision

1.2 OBJECTIVE

This work section's objective is to set standards and document requirements for the execution and recording of design processes in order that the infrastructure associated with any Council works is designed to be fit for service and of a standard reasonably maintainable by Council as a community asset.

It is also an objective that these qualities be readily demonstrable by clear records of key design processes and that data relevant to the upkeep of the assets is available to Council's management.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this work section are:

Work sections

0041 *Geometric road layout*
0042 *Pavements*
0043 *Subsurface drainage (Design)*
0061 *Bridges and other structures*
0044 *Footpaths and cycleways*
0021 *Site regrading*
0074 *Stormwater drainage (Design)*
0075 *Control of erosion and stormwater management*
1102 *Control of erosion and sedimentation*

Standards

AS 1170	Structural design actions
AS 1684	Residential timber-framed construction
AS 1742	Manual of uniform traffic control devices
AS 1742.2	Manual of uniform traffic control devices—Traffic control devices for general use
AS 3600	Concrete structures
AS 4100	Steel structures
AS 5100	Bridge design

Other publications

Engineers Australia
Australian Rainfall and Runoff (AR&R)
WSAA

WSA 02	Sewerage Code of Australia WSA 02- As amended.
WSA 03	Water Reticulation Code of Australia WSA 03-As amended.
WSA 04	Pump Station Code of Australia as amended
WSA 07	Pressure Sewerage Code of Australia as amended

1.4 BIBLIOGRAPHY

Workgroups

00 *Planning and Design* workgroup
11 *Construction – Roadways* workgroup

Standards

AS/NZS ISO 9000	Quality management systems—Fundamentals and vocabulary
AS/NZS ISO 9001	Quality management systems—Requirements
AS/NZS ISO 10013	Guidelines for quality management system documentation
AS/NZS ISO 19011	Guidelines for quality and/or environments management systems auditing
SAA HB 90.3	The Construction Industry—Guide to ISO 9001:2000

Council's Codes and Policies

Section 90 (EP&A ACT)
Local Government Act (1993)
Local Government Act (1919) Subdivisions Pt XII
Technical Publications used as Engineering Standards (AR&R)
NSW Department of Public Works and Services guidelines for water reticulation and sewerage systems

1.5 CERTIFICATION

Certification report

The Designer shall present all engineering drawings to Council for acceptance. Each set of drawings shall be accompanied by a Certification Report signed by the Designer. The Certification Report shall comprise the certificate and check lists set out in Annexure A.

Certification of preliminary drawings

Certification Reports shall be submitted with preliminary drawings and shall be resubmitted with updates when final drawings are submitted.

A certification report is not required when submitting Concept Plans.

Design non-conformance

The Certification Report shall indicate on check lists any aspects of design which do not meet requirements or tolerances set out in This work section and other applicable Council design and construction specifications.

1.6 DRAFTING REQUIREMENTS

General

Design drawings shall be definitive and clearly set out so as to present the design concepts in such a way that the project can be understood, specified for construction and satisfactorily built.

Standard sheet and plan numbers

All design drawings shall be prepared on a Council approved standard sheet and shall be clearly numbered with separate sheets numbered as part of a set. All drawing sheets shall have an allocated space in the bottom right hand corner for an assigned number provided by Council.

Logical order

The information shown on the drawings shall be logically collected on discrete sheets.

- Drawings should not be overcrowded with information and should not rely on colour printing or colour wash to impart information. Drawings should be on A1 or A2 size sheets and be suitable for black and white copying and photo reduction to A3 paper size without loss of clarity.
- Annexure B provides guidelines for grouping information in design drawings.

1.7 DESIGNER'S QUALIFICATIONS

Civil works

An engineer, deemed to be suitably experienced in the relevant field by Council and eligible for Chartered Professional Membership of the Institution of Engineers, Australia or, a Registered Surveyor, deemed to be suitably experienced by Council, shall be accepted as qualified to prepare plans for roadworks, drainage works, water supply, sewerage works (excluding pumping stations), canal works (excluding flood control structures and bridges).

Structures

An engineer qualified as above shall be accepted as qualified to prepare plans for bridges, retaining walls, miscellaneous structures, buildings, pumping stations and flood control structures.

1.8 RECORDS

General

The Designer shall retain appropriate design records in a format such that they can be understood readily with no prior knowledge of the particular design.

In the case of a Consultant or Sub-consultant preparing the design, copies of records shall be made available to Council on request and without charge.

Design file

A design file shall be maintained which contains records of calculations, approvals and decisions, geotechnical data and other design data that could be relevant in reviewing aspects of the design or planning future maintenance responsibilities.

Calculation record retention

Calculations that can readily be re-done need not be kept once the construction maintenance period of the project has expired.

Hydrologic and hydraulic design

Particular requirements apply to hydrological and hydraulic design data (refer to 0074 *Stormwater drainage (Design))*.

1.9 AUDIT

General

Council shall have the right of audit of all processes and documents related to the project design. The Designer shall provide Council all reasonable assistance in inspecting records of designs submitted to Council for acceptance.

Notice of access

In order to provide for such audit, access to the premises of the Designer will be provided to Council on a 24 hour notice basis.

2 ANNEXURE A—CERTIFICATION REPORT

Snowy Valleys Council

2.1 DESIGN CERTIFICATE

Project Title: _____

Council Drawing No: _____

Name of Designer: _____

I certify that the subject drawings represent a design for which the attached design check lists provide a valid record.

I certify that this Design has been carried out in accordance with current standards of good industry practice and in accordance with Council's Design Specifications and specific instructions received with the exception of departures cited in the attached design check lists for Council's advice.

I certify that this Design will not significantly impact on the environmental factors of the area as interpreted under Part V of the Environmental Planning and Assessment Act.

I certify that all structural elements of the Design have been designed by an Engineer deemed to be suitably experienced in the relevant field by Council and eligible for Chartered Professional Membership of the Institution of Engineers, Australia.

Contact Phone: _____ _____ _____

Design Engineer/Surveyor Date

Contact Postal Address:

_____ _____

Qualifications

_____

_____

_____

2.2 DESIGN CHECK LIST 1

BASE PLOT OF EXISTING FEATURES

Reference: Council's Survey Brief and Policies on Environment, Heritage, etc.

Drawings: General Layout, Drainage and Intersection Layout Plans.

		Check completed by (initials)	Date	Not applicable (tick)
1.1	Initial plot verified by site inspection for existing drainage.	…….	...../...../.....	☐
1.2	Initial plot verified by site inspection for existing property descriptions, boundaries and accesses.	…….	...../...../.....	☐
1.3	Initial plot of contours verified as representative of site terrain.	…….	...../...../.....	☐
1.4	Trees and significant environmental features affected by the works are clearly indicated and annotated.	…….	...../...../.....	☐
1.5	Features significant to heritage considerations within the works boundaries are clearly indicated and annotated.	…….	...../...../.....	☐
1.6	Existing public and private property likely to be affected by these Designs are clearly indicated and annotated.	…….	...../...../.....	☐
1.7	Survey and bench-marks clearly indicated and annotated.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.3 DESIGN CHECK LIST 2

HORIZONTAL ROAD ALIGNMENT

Reference: Design Specifications 0041 *Geometric road layout*, 0061 *Bridges and other structures*, 0044 Footpaths and cycleways

Drawings: General layouts, typical road cross sections, plan and longitudinal sections, intersection layouts

		Check completed by (initials)	**Date**	**Not applicable (tick)**
2.1	Alignment compatible with design speed.	…….	...../...../.....	☐
2.2	Alignment is adequate in relation to clearance of roadside hazards.	…….	...../...../.....	☐
2.3	Driver and pedestrian sight distance is adequate.	…….	...../...../.....	☐
2.4	Conflict with existing services is minimised.	…….	...../...../.....	☐
2.5	Road widths and lanes meet Councils requirements and design traffic requirements.	…….	...../...../.....	☐
2.6	Alignment of bridges suits road alignment.	…….	...../...../.....	☐
2.7	Pedestrian, bicycle and parking requirements are met.	…….	...../...../.....	☐
2.8	Provision for large vehicles such as buses, garbage trucks and emergency vehicles is adequate.	…….	...../...../.....	☐
2.9	Intersection layouts meet turning requirements of design traffic including emergency vehicles.	…….	...../...../.....	☐
2.10	Pavement width tapers and merges are adequate.	…….	...../...../.....	☐
2.11	Pedestrians and prams are catered for.	…….	...../...../.....	☐
2.12	Conflict with existing public utility services has been identified and resolved.	…….	...../...../.....	☐
2.13	Horizontal road alignment setout data is clearly defined and tabulated.	…….	...../...../.....	☐
2.14	Horizontal road alignment has been provided in accordance with any conditions of development consent.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.4 DESIGN CHECK LIST 3

VERTICAL ROAD ALIGNMENT

Reference: Design Specifications 0041 *Geometric road layout*, 0061 *Bridges and other structures*, 0044 *Footpaths and cycleways*

Drawings: Plan and longitudinal sections, road cross sections.

		Check completed by (initials)	**Date**	**Not applicable (tick)**
3.1	Grades meet maximum and minimum requirements.	…….	...../...../.....	☐
3.2	Vertical clearances to bridges and services meet standards.	…….	...../...../.....	☐
3.3	Vertical sight distance is adequate for drivers and pedestrians.	…….	...../...../.....	☐
3.4	Cover to drainage structures or services is adequate.	…….	...../...../.....	☐
3.5	Vertical alignment is adequate for disposal of surface drainage from properties and from road.	…….	...../...../.....	☐
3.6	Grades are satisfactory for 1:100 year flood levels.	…….	...../...../.....	☐
3.7	Vertical alignment is compatible with property access.	…….	...../...../.....	☐
3.8	The gradient on an intersecting road is not significantly greater than the cross slope of the through pavement and no greater than 3% at give way and stop signs.	…….	...../...../.....	☐
3.9	Sight distance is acceptable for all accesses to roundabouts.	…….	...../...../.....	☐
3.10	Alignment coordination with horizontal alignment is in accordance with the AUSTROADS design guides as referenced in the AUS-SPEC specifications.	…….	...../...../.....	☐
3.11	Conflict with existing public utility services has been identified and resolved.	…….	...../...../.....	☐
3.12	Vertical road alignment setout data is clearly defined on the longitudinal sections.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.5 DESIGN CHECK LIST 4

ROAD CROSS SECTIONS

Reference: Design Specifications 0041 *Geometric road layout*, 0061 *Bridges and other structures*, 0044 *Footpaths and cycleways*

Drawings: Typical Road Cross Sections, Road Cross Sections and Longitudinal Sections.

		Check completed by (initials)	Date	Not applicable (tick)
4.1	Typical cross sections have complete dimensions.	…….	...../...../.....	☐
4.2	Typical cross sections have kerb & gutter, road safety barrier and surface drainage indicated.	…….	...../...../.....	☐
4.3	Batter slopes are indicated and batter treatment is indicated where appropriate.	…….	...../...../.....	☐
4.4	Pavement description and surface treatment is indicated.	…….	...../...../.....	☐
4.5	Property boundaries, service allocations and location of known existing underground services and footpath treatments are indicated.	…….	...../...../.....	☐
4.6	Sufficient cross sections are shown to define all variations and width transitions.	…….	...../...../.....	☐
4.7	Cross sections are of sufficient width to fully assess impact of road level on adjoining property.	…….	...../...../.....	☐
4.8	Stability of embankment slopes, batters and retaining walls has been verified as satisfactory.	…….	...../...../.....	☐
4.9	Cross section reference level conforms with vertical road alignment.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.6 DESIGN CHECK LIST 5

ROAD AND INTERALLOTMENT DRAINAGE

Reference: Design Specifications 0021 *Site regarding*, 0074 *Stormwater drainage (Design),* 0043 *Subsurface drainage (Design)*

Drawings: Drainage Plan and Schedule of Drainage Elements, Drainage Profiles and Drainage Structure Details

		Check completed by (initials)	**Date**	**Not applicable (tick)**
5.1	Drawings indicate existing surface drainage.	…….	...../...../.....	☐
5.2	Hydrological data is the most current available.	…….	...../...../.....	☐
5.3	Hydrologic and hydraulic design calculations are complete and fully recorded and available for audit.	…….	...../...../.....	☐
5.4	Underground drainage and structures do not conflict with services.	…….	...../...../.....	☐
5.5	The designed drainage lines are compatible with existing incoming lines and outgoing lines.	…….	...../...../.....	☐
5.6	The length of line, type of pipe, size, class and bedding requirements are indicated for each drainage line on the schedule of drainage elements.	…….	...../...../.....	☐
5.7	Height of fill over drainage lines is within allowable limits.	…….	...../...../.....	☐
5.8	Drainage is provided for local depressions, e.g., median areas or areas adjacent to fills.	…….	...../...../.....	☐
5.9	The effect of headwater and back-up water on private property has been assessed.	…….	...../...../.....	☐
5.10	Subsurface drainage has been provided when required and clearly located by line and level, with details provided.	…….	...../...../.....	☐
5.11	The need for batter drains has been considered for fills and cuttings.	…….	...../...../.....	☐
5.12	The height and energy level of downstream drainage has been considered.	…….	...../...../.....	☐
5.13	Drainage structures and flowpaths are located so as to ensure safe vehicular and pedestrian transit.	…….	...../...../.....	☐
5.14	Drainage structure number, setout, type and pipe details indicated on the drainage plans and schedule of drainage elements.	…….	...../...../.....	☐
5.15	Emergency flowpaths are located so as to minimise impact on private property.	…….	...../...../.....	☐

ROAD AND INTERALLOTMENT DRAINAGE

Reference: Design Specifications 0021 *Site regarding*, 0074 *Stormwater drainage (Design),* 0043 *Subsurface drainage (Design)*

Drawings: Drainage Plan and Schedule of Drainage Elements, Drainage Profiles and Drainage Structure Details

		Check completed by (initials)	Date	Not applicable (tick)
5.16	Road drainage has been provided in accordance with Council's Handbook for Drainage Design Criteria.	…….	...../...../.....	☐
5.17	Inter allotment drains have been designed in accordance with Council's Specification and/or Australian Rainfall and Runoff (AR&R).	…….	...../...../.....	☐
5.18	Appropriate land stabilisation and velocity controls have been implemented to pipe systems, open channels and embankments.	…….	...../...../.....	☐
5.19	For allotments affected by flood controls, the floor height controls are to be compatible with road and drainage levels.	…….	...../...../.....	☐
5.20	Stormwater drains are designed to be connected to an approved point of discharge, such point of discharge already existing and operational.	…….	...../...../.....	☐
5.21	Gross pollutant traps have been designed to meet the requirements of "Water Sensitive Design" principles and this Design Manual.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.7 DESIGN CHECK LIST 6

SIGNS AND MARKINGS

Reference: Council's Signposting and Pavement Marking Policies
Drawings: Pavement marking and signposting

		Check completed by (initials)	Date	Not applicable (tick)
6.1	Sign types, sizes, locations and support structure details are shown on the drawings in accordance with AS 1742 (All parts).	…….	...../...../.....	☐
6.2	Pavement linemarking and pavement marking type and setout is indicated on the drawings to meet the requirements of AS 1742.2.	…….	...../...../.....	☐
6.3	Signs and linemarking have been designed in accordance with Council's Policies.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.8 DESIGN CHECK LIST 7

PAVEMENT DESIGN

Reference: Design Specification 0042 *Pavement*
Drawings: Typical road cross sections, road cross sections

		Check completed by (initials)	**Date**	**Not applicable (tick)**
7.1	The pavement design and surface treatment is shown clearly on the typical road cross sections and any variations are indicated on appropriate cross sections.	…….	...../...../.....	☐
7.2	The pavement design complies with Council's Pavement Design Specification.	…….	...../...../.....	☐
7.3	Geotechnical data is assessed as adequate and is held on the design file.	…….	...../...../.....	☐
7.4	Geotechnical data is assessed as adequate and is held on the design file.	…….	...../...../.....	☐
7.5	All geotechnical data has been sourced and tested by a NATA or Council approved accredited laboratory.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.9 DESIGN CHECK LIST 8

BRIDGE/MAJOR CULVERT DESIGN

Reference: Design Specification 0061 *Bridges and other structures*
Drawings: Structure details

		Check completed by (initials)	**Date**	**Not applicable (tick)**
8.1	The design has been performed by an Engineer deemed to be suitably experienced in the relevant field by Council and eligible for Chartered Professional Membership of the Institution of Engineers, Australia.	…….	...../...../.....	☐
8.2	Geotechnical data is assessed as adequate and is held on the design file.	…….	...../...../.....	☐
8.3	The type and functional dimensions of the bridges meet AS 5100, AS 4100, AS 3600, AS 1684, AS 1170,.	…….	...../...../.....	☐
8.4	The type and class of all materials are indicated on the drawings.	…….	...../...../.....	☐
8.5	Records of all significant design calculations are available for audit.	…….	...../...../.....	☐
8.6	The design complies with any conditions of development consent.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.10 DESIGN CHECK LIST 9

EROSION/AND SEDIMENTATION CONTROL PLANS

Reference: Design Specifications 1102 *Control of erosion and sedimentation,* 0075 *Control of erosion and stormwater management*

Drawings: Erosion and Sedimentation Control Concept Plans

		Check completed by (initials)	**Date**	**Not applicable (tick)**
9.1	Both short term and long term erosion control concept plans have been prepared using the guidelines within Council's Design Specification 0075 *Control of erosion and stormwater management during construction* and 1102 *Control of erosion and sedimentation*.	…….	...../...../.....	☐
9.2	Erosion and sedimentation control has been designed in accordance with any conditions of development consent.	…….	...../...../.....	☐

DEPARTURES FROM COUNCIL OR RTA REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

2.11 DESIGN CHECK LIST 10 WATER SUPPLY

Reference: Design work section 0071 *Water supply – reticulation and pump stations (Design)*

		Check Completed By *(initials)*	Date	Not Applicable *(tick)*
10.1	**Design has been completed in accordance with the Water Supply Code of Australia and the stated requirements of Snowy Valleys Council Council**		/ /	☐
10.2	Design has been completed by a competent designer experienced in water supply design		/ /	☐
10.3	The designer has consulted the following stakeholders:		/ /	☐
(i)	All property owners affected by the proposed work.		/ /	☐
(ii)	Groups representing indigenous and heritage interests		/ /	☐
(iii)	Fire authorities		/ /	☐
(iv)	All other utility agencies		/ /	☐
(v)	Road and/or rail owners		/ /	☐
(vi)	Developers of adjacent or proposed works likely to be relevant to the water supply design.		/ /	☐
10.4	The Designer has assessed the system capacity and operating characteristics at connecting points to the existing water supply system.		/ /	☐
10.5	The Designer has performed a network analysis to assess the adequacy of the existing system to service the new development and to determine impacts of the new system proposed upon the existing system, taking into account any separate developments on adjacent or nearby land.		/ /	☐

		Check Completed By *(initials)*	**Date**	**Not Applicable** *(tick)*
10.6	The Designer has shown that maximum and minimum service pressures can be maintained at the most hydraulically disadvantaged properties connected in each zone within the system.	_____	___/___/___	☐
10.7	The potential for future water quality problems or water stagnation has been minimised.	_____	___/___/___	☐
10.8	Valve spacing and positioning permits isolation of individual zones.	_____	___/___/___	☐
10.9	Minimum fire fighting demands have been addressed	_____	___/___/___	☐
10.10	Clearances from all other utility services meet the minimum clearances given in Table 4.1 of the Water Supply Code of Australia.	_____	___/___/___	☐
10.11	Design drawings or specifications detail anchorage points	_____	___/___/___	☐
10.12	Provision has been made for air, scour and other control and isolation valves in accordance with Snowy Valleys Council Council requirements.	_____	___/___/___	☐
10.13	Design drawings contain details specified in Clause 7.2.4 of the Water Supply Code of Australia.	_____	___/___/___	☐

DEPARTURES FROM COUNCIL OR STATE NORMAL REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

_____

_____

_____

_____

_____

_____

2.12 DESIGN CHECK LIST 11 SEWERAGE SYSTEM

		Check Completed By *(initials)*	Date	Not Applicable *(tick)*
11.1	**Design has been completed in accordance with the Sewerage Code of Australia and the stated requirements of Snowy Valleys Council Council**	_____	/ /	☐
11.2	Design has been completed by a competent designer experienced in sewerage reticulation design	_____	/ /	☐
11.3	The designer has consulted the following stakeholders:	_____	/ /	☐
(i)	All property owners affected by the proposed work.	_____	/ /	☐
(ii)	Groups representing indigenous and heritage interests	_____	/ /	☐
(iii)	Fire authorities	_____	/ /	☐
(iv)	All other utility agencies	_____	/ /	☐
(v)	Road and/or rail owners	_____	/ /	☐
(vi)	Developers of adjacent or proposed works likely to be relevant to the sewerage reticulation design.	_____	/ /	☐
11.4	The Designer has prepared a Servicing Strategy for the area to be developed in accordance with Table 1.2 of the Sewerage Code of Australia, and the Strategy has been approved by Snowy Valleys Council Council.	_____	/ /	☐
11.5	The Designer has performed a network analysis to assess the adequacy of the existing system to service the new development and to determine clearances between sewers and other underground services have been established on the design plans and as a minimum meet the clearances prescribed in Table 4.2 of the Sewerage Code of Australia.	_____	/ /	☐

		Check Completed By *(initials)*	**Date**	**Not Applicable** *(tick)*
11.6	The Designer has shown that the pipe sizing and longitudinal grading comply with the requirements of Clause 4.5 of the Sewerage Code of Australia.	_____	/ /	☐
11.7	Clearances between sewers and other underground services have been established on the design plans and as a minimum meet the clearances prescribed in Table 4.2 of the Sewage Code of Australia.	_____	/ /	☐
11.8	Design drawings contain details specified in the Sewerage Code of Australia.	_____	/ /	☐

DEPARTURES FROM COUNCIL OR STATE REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

3 ANNEXURE B—EXAMPLE COMPILATION OF DRAWINGS

An example of the sequence of drawing sheets acceptable to Council in the compilation of a full set of Roadworks Drawings is set out as follows.

Sheet No	Topic
1.	Development consent number (if applicable), project title, locality sketch and index of sheets.
2.	General layout plan with contour details and a clear indication of the extent of work.
3.	Typical road cross sections showing road widths, pavement (design) configuration, batter slopes, kerb and gutter types.
4.	Plan and longitudinal section of each road showing setout data, road safety barrier locations, guide posts and services.
5.	Drainage Plan and schedule of drainage elements (pipe lines and structures).
6.	Drainage profiles.
7.	Drainage structure details.
8.	Road cross sections.
9.	Intersection layout details.
10.	Pavement marking and signposting.
11.	Erosion and sedimentation control concept plans (short term and long term treatment).
12.	Structure details—bridges, retaining walls, etc.

1. Any one set of Roadworks Plans may require more than 1 sheet for each of the topics listed and may also require supplementary sheets for site specific details.

2. Scales are required to be nominated on all drawings and north points shown on all plan views.