



DESIGN MANUAL

FOR THE

SUBDIVISION OF LAND

REVISION G
Reviewed
August 2017

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INTRODUCTION

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1 COUNCIL AIMS

The City of Greater Dandenong has the following aims when managing the subdivision of land:

- To prepare innovative and responsive strategic plans to build a safe, liveable and sustainable city for present and future generations.
- To manage the planning and implementation of infrastructure asset development in a cost effective, affordable manner.
- To advocate on behalf of the community on infrastructure development by government bodies and private developers.
- To provide a functional, attractive and safe environment for residents that is consistent with recognized standards and which addresses all the relevant stakeholders' needs.
- To minimise adverse effects on the natural environment.
- To provide for the needs of future users of the land in respect to building requirements, vehicular and accessible pedestrian access, provision of services and an amenity consistent with the zoning of the land.
- To assist developers by providing for the economic utilisation of the land resource of the area.
- To achieve a balance between the subdivision of residential land and the amenity of existing residents.
- To provide for an equitable and efficient distribution of public amenities and services.
- To minimise Council's future infrastructure maintenance renewal expenditure.
- To facilitate and ensure mandatory compliance by developers with all relevant Federal, State and Local Laws

Council Aims

This Design Manual 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. The City of Greater Dandenong's Design Specifications and Construction Specifications provide necessary additional information.

Additional Information

2 COUNCIL AUTHORITY

Council is mandated under Federal and State law as the Municipal Planning Authority and is responsible for implementation and oversight of the requirements and limitations of those laws which relate to land development and subdivision within the City of Greater Dandenong municipal boundaries.

The City of Greater Dandenong has planning and development policies which set out Council's necessary provisions for development and subdivision. Compliance with the provisions of Council's Planning Scheme does not necessarily imply that Council is required to consent to, or approve, an application.

Greater Dandenong Planning Scheme

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3 DEVELOPMENT AND SUBDIVISION PROCESSES

It is important to understand that a Planning and Subdivision Approval is required before land can be "subdivided" and sold. In due course a Building Application is required before buildings are commenced.

Development and Application Consent

The Planning and Subdivision Application is a requirement of the Planning and Environment Act (1987) and the Subdivision Act 1988 to allow consent to be provided to the concept of the development in relation to Council's controls and requirements eg. land use, community facilities, traffic generation, environmental considerations etc.

After a Planning Permit is approved the more detailed requirements of the subdivision under the Subdivision Act are addressed in a Subdivision Application.

Subdivision Approval

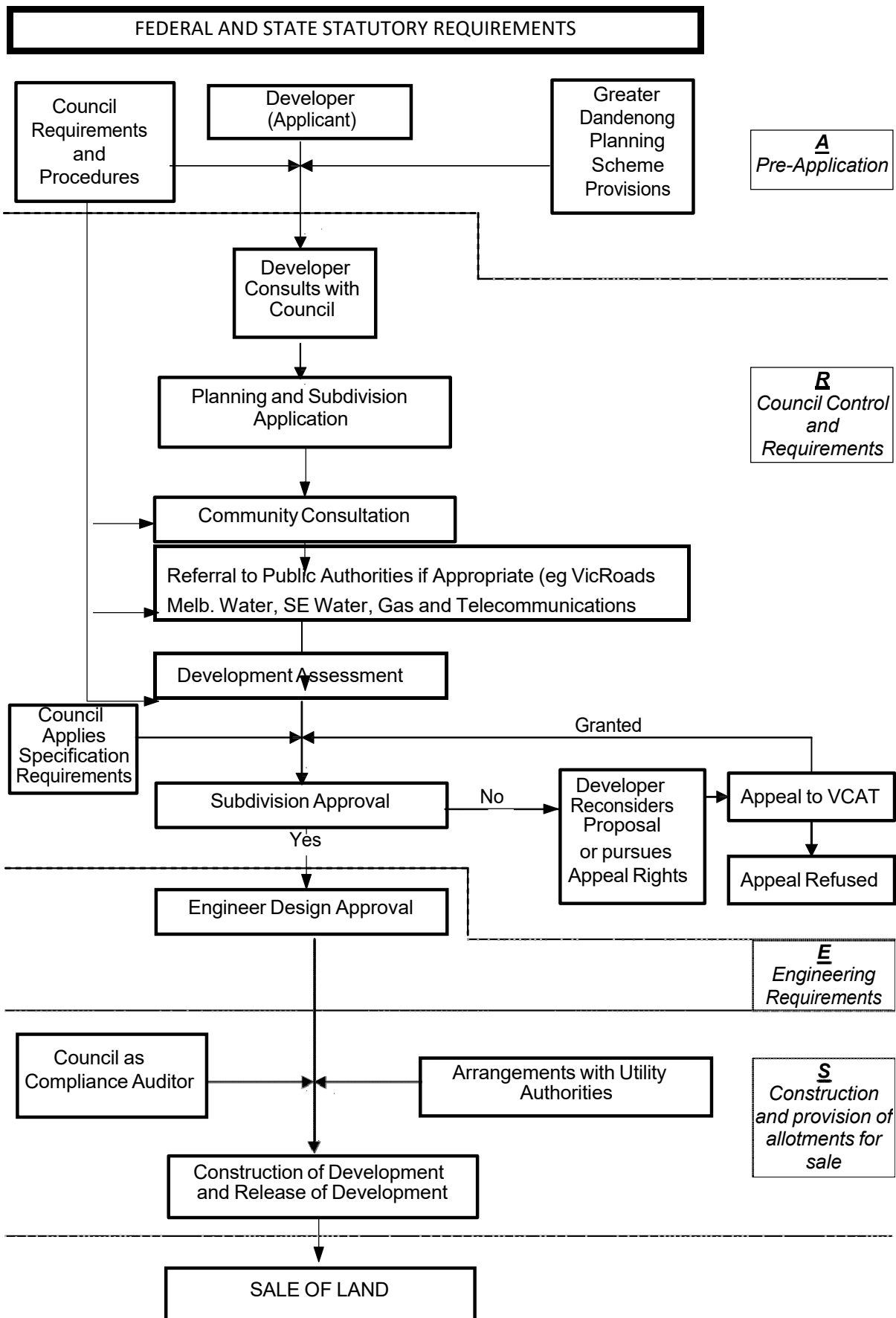
It should be noted that the Planning Application and the Subdivision Application can be made and processed at the same time. However, a Subdivision Plan is not able to be Certified (a requirement prior to lodging with the Land Titles Office) until a Planning Permit has been granted, and where required, the Subdivision Plan modified to comply with any conditions of a Planning Permit.

4 COUNCIL WORKS/MAJOR DEVELOPMENTS

Council may also undertake works in conjunction with major developments under any specific, lawful terms and conditions as it may agree with a private developer. Detailed requirements will be considered in conjunction with the Development and Subdivision Processes set out above

Work by Others

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FLOW DIAGRAM – OVERALL DEVELOPMENT PROCESS

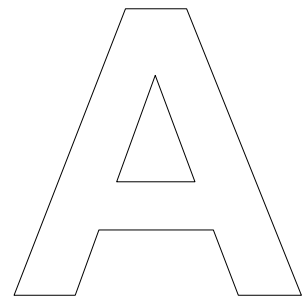
SECTION A

APPLICATION PROCESS

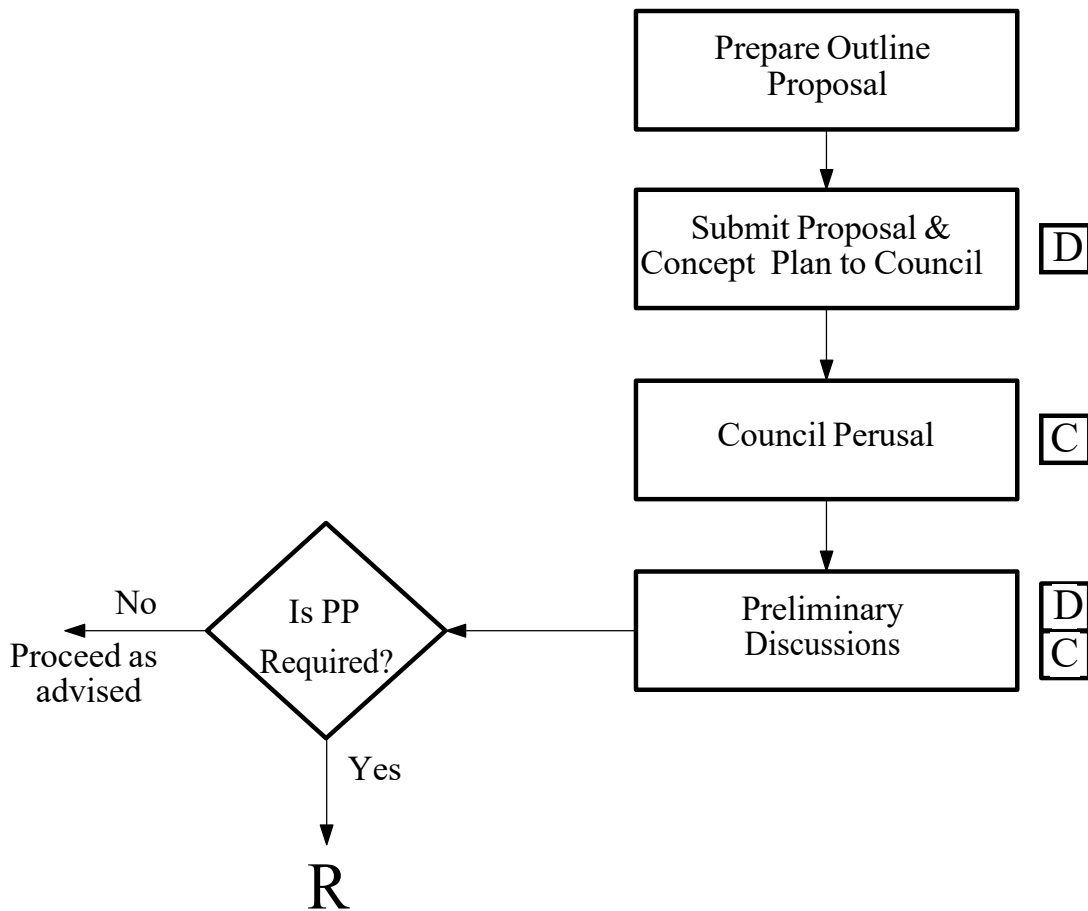
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- A5 Time Requirement to Complete Subdivision Works.
- A6 Transfer of Title to Council



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NOTE: **D** denotes Developer responsibility
C denotes Council responsibility
R denotes proceed to a flow diagram for consideration of Council Requirements

PP denotes Planning Permit

FLOW DIAGRAM A – PRE-APPLICATION PROCESS

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A1 FORMULATING A DEVELOPMENT AND SUBDIVISION APPLICATION

A person or company making application to develop and/or subdivide an area of land within the City of Greater Dandenong municipal boundaries will be required to lodge a Planning and Subdivision Application. Council has a standard application for a Planning Permit Form, while the form for the Subdivision (certification application) is provided by the licensed Land Surveyor carrying out the subdivision requirements. In all cases the applications must be accompanied with supporting information which will be detailed later. Copies of Council's current Application for a Planning Permit Form can be obtained from the municipal service centres.

Application Form

Before formally applying to Council to develop and/or subdivide, a considerable amount of information about the site needs to be sought. The Developer should be aware of the nature of title of the land, easements, 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.

Developer's Information

It is recommended that a preliminary consultation with Council will enable the Developer to determine what Council codes are applicable, what zone provisions apply and which legislative requirements are applicable and most importantly whether professional assistance is recommended.

Early Consultation

It is advantageous to prepare a concept plan at this early stage indicating the location, aspect and size of the various elements of the development. The more information shown on the concept plan, the more likely the consultations with Council and others will benefit both the Developer and the Council.

Concept plan

The purpose of consultation about concept plan proposals (which may be accompanied by explanatory reports or background material) is to:

Purpose of Consultation

- assess whether any modifications to the proposal are necessary prior to its being formally submitted;
- identify Council's requirements in regard to the particular Planning and Subdivision Application;
- identify the Developer's accountability for DDA compliance within the proposal;
- identify any problems which may necessitate the Developer reviewing his approach;
- indicate Council's potential requirements (eg financial contributions for services and amenities).

While consultation with Council at this early stage and the preparation of concept plans is not mandatory, it is obviously in the Developer's interest if it will reduce costs in preparing plans, increase the likelihood of Planning Permit issue and reduce the time the Council needs to consider the formal application.

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A2 MAKING APPLICATION FOR DEVELOPMENT AND SUBDIVISION

A Planning and Subdivision Application is only required if the planning instrument(s) applying to the land so require. Minor subdivisions such as boundary adjustments which meet standards do not require Planning Permits. All the necessary information should have been compiled in consultation with Council whilst formulating the application and developing the concept plan.

**Planning and
Subdivision
Application
Boundary
Adjustments**

The written approval of the owner is not required if the application is not by the owner. However, the Planning Application is required to indicate the name of the owner (if not the applicant) and be signed by the owner or a declaration that the owner has been notified of the application completed. The City of Greater Dandenong's scale of fees for Planning and Subdivision Applications can be obtained from the Planning Department enquiry desk.

**Owner's
Approval**

Planning and Subdivision Applications are to be accompanied by fifteen (15) copies of subdivision plans drawn on one of the following paper size sheets, A1, A2, A3 or A4

**Number of
Plan Copies**

The concept plan shall show the following:

**Plan Detail
Required**

- a. Reduction ratio (preferably 1:500)
- b. The location, boundary dimensions, site area and north point of the land
- c. The existing vegetation and trees on the land (attention is drawn to Council's Tree Preservation Order).
- d. The location and uses of existing buildings on the land and adjoining properties.
- e. Contours based on existing levels of the site (preferably one metre interval drawn to Australian Height Datum).
- f. Any natural features of the site, including rock formations or cliffs, watercourses, flood levels, wetlands, forest areas and slip areas.
- g. Any existing drains, easements or rights-of-way affecting the site.
- h. Title description of land.
- i. Details of existing and proposed subdivision pattern (including the number of lots and location of roads).
- j. Any Heritage items (buildings and sites), or relics defined by the Heritage Act or considered of local significance.
- k. Details of how DDA compliance will be integral to the design of the project.
- l. Other details relevant to consideration of the application.

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

**Additional
Information**

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A3 SITE AND CONTEXT DESCRIPTION AND DESIGN RESPONSE

The following requirements are set out at Clause 56.01 of the Greater Dandenong Planning Scheme.

56.01 SITE AND CONTEXT DESCRIPTION AND DESIGN RESPONSE

An application must be accompanied by:

- A site and context description.
- A design response

56.01-1 Site and context description

The site and context description may use a site plan, photographs or other techniques and must accurately describe:

- In relation to the site:
 - Site shape, dimensions and size
 - Orientation and contours
 - Trees and other significant vegetation
 - The siting and use of existing buildings on the site
 - Street frontage features such as poles, street trees and kerb crossovers
 - Access Points
 - Drainage and infrastructure connections.
- In relation to the surrounding area:
 - The pattern of subdivision of the surrounding area.
 - Existing land uses.
 - The siting and use of existing buildings on the adjacent properties.
 - The location and type of significant vegetation.
 - Street and footpath widths, material and detailing.
 - Location, distance and characteristics of any nearby public open space.
 - Direction and distances to local shops, schools, community and recreational facilities.
 - Directions and distances to public transport routes and stops.
 - Direction and distances to existing neighbourhood, town and regional activity centres and major employment areas and their catchments.
 - Existing transport routes, including freeways, arterial and sub-arterial roads and major roads connecting neighbourhoods.
 - Local street network.
 - Traffic volumes and movements on adjacent roads.
 - Pedestrian paths, shared and bicycle only paths.
 - Any places of natural or cultural significance.

If in the opinion of the responsible authority a requirement of the site and context description is not relevant to the evaluation of an application, the responsible authority may waive or reduce the requirement.

Satisfactory site and context description

The responsible authority must inform the applicant in writing:

- Before notice of an application is given, or
- If notice of an application is not required to be given, before deciding the application, that the site and context description meets the requirements of Clause 56.01-1 and is satisfactory or does not meet the requirements of Clause 56.01-1 and is not satisfactory.

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If the responsible authority decides that the site and context description is not satisfactory, it may require more information from the applicant under Section 54 of the Act.

The responsible authority must not require notice of an application to be given or decide an application until it is satisfied that the site and context description meets the requirements of Clause 56.01-1 and is satisfactory.

This does not apply if the responsible authority refuses an application under Section 52(1 A) of the Act.

56.01-2 Design response

The design response must explain how the proposed design:

- Derives from and responds to the site and context description.
- Meets the objectives of Clause 56.
- Responds to any site and context features for the area identified in a local planning policy or a Neighbourhood Character Overlay.

The design response must include a correctly proportioned plan showing the subdivision in context with the adjacent area. If in the opinion of the responsible authority this requirement is not relevant to the evaluation of an application, it may waive or reduce the requirement.

If the subdivision will create a new community node or precinct, the plan should also show and explain:

- Proposed neighbourhood areas and centres.
- Proposed commercial centres.
- Proposed schools and community facilities.
- Pedestrian catchments of proposed commercial and community facilities.
- Proposed land uses.
- Proposed street layout and network including street types.
- Mixture and distribution of lot sizes.
- Proposed public open space.
- Natural features to be retained.
- Proposed design and sustainable management objectives for the capture and reuse water networks.
- Asset protection and where necessary site protection works to prevent damage to WSUD features and landscaping both during construction and for the early development phase when major infill building works are underway.
- Proposed public transport routes.
- Proposed path network including , pedestrian and shared paths, demonstrating compliance with DDA requirements.
- If proposed, any Bicycle only paths.
- Proposed staging of the subdivision
- Compliance with Federal and State DDA legislation.

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A4 COUNCIL'S CONSIDERATION OF APPLICATIONS FOR DEVELOPMENT AND SUBDIVISION

Council will deal with each application on its merits.

Council's Design Manual deals with minimum design standards. These standards should not be interpreted as relieving the designer of the responsibility to properly assess all conditions and to use sound planning and engineering practices in the development of designs. Council is prepared to consider alternative approaches to subdivision design where the Developer satisfies Council that its objectives have been achieved.

Design Standards

Regulations normally require Council to determine planning applications within 60 days of receipt of the application. Upon determination of any application, a written notification will be sent to the applicant stating that consent/approval has been granted subject to detailed conditions, or that consent/approval has been refused (with reasons).

Determination within 60 days

Where an Applicant is dissatisfied with the determination of an application, the applicant may lodge an appeal with the Victorian Civil and Administrative Tribunal, (VCAT). Such an appeal is required to be lodged with the Tribunal within specified timelines. Advice on these is normally provided on the reverse of Council's notification of its decision or by contacting VCAT.

Appeal to Tribunal

A5 TIME REQUIREMENTS FOR SUBDIVISION WORKS

A subdivision proposal given development consent requires road and drainage works to be commenced within two years of development approval, (an extension of time may be applied for and granted by Council), and the infrastructure construction works to be fully completed within five years of the certification of the plan of subdivision under Section 6 of the Subdivision Act 1988.

2 Year Limit on Roads and Drainage

In some cases a development may be of sufficient magnitude that it requires staging. Where staged development is proposed, the Developer 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.

Staged Development

When the development consent and subdivision approval have been granted, the Developer will require the services of a Registered Surveyor to prepare the final survey plan. This plan is submitted to Council under the Subdivision Act 1988 with the appropriate fees.

Final Survey Plan, Fees

In some instances, both the Planning Application and the Subdivision Application may be processed at the same time.

In order to affect registration and the issue of new titles for the proposed subdivision lots, the documents released should then be lodged promptly with the Land Registry.

Issue of New Titles

A6 TRANSFER OF TITLES TO COUNCIL

Under the Subdivision Act 1988, reserves and roads are automatically created in the name of the relevant authority (CGD).

Title Handover Council Land

At completion of the subdivision and following release of titles from the Land Titles Office the Developer shall submit the appropriate Council Officer within five (5) working days all titles in the name of the City of Greater Dandenong. Failure to comply with this requirement will result in the maintenance bond being held for security until such time as all titles have been delivered to Council.

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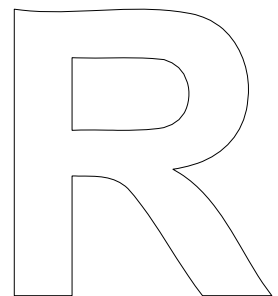
SECTION R

COUNCIL REQUIREMENTS

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Flow Diagram R - Council Requirements

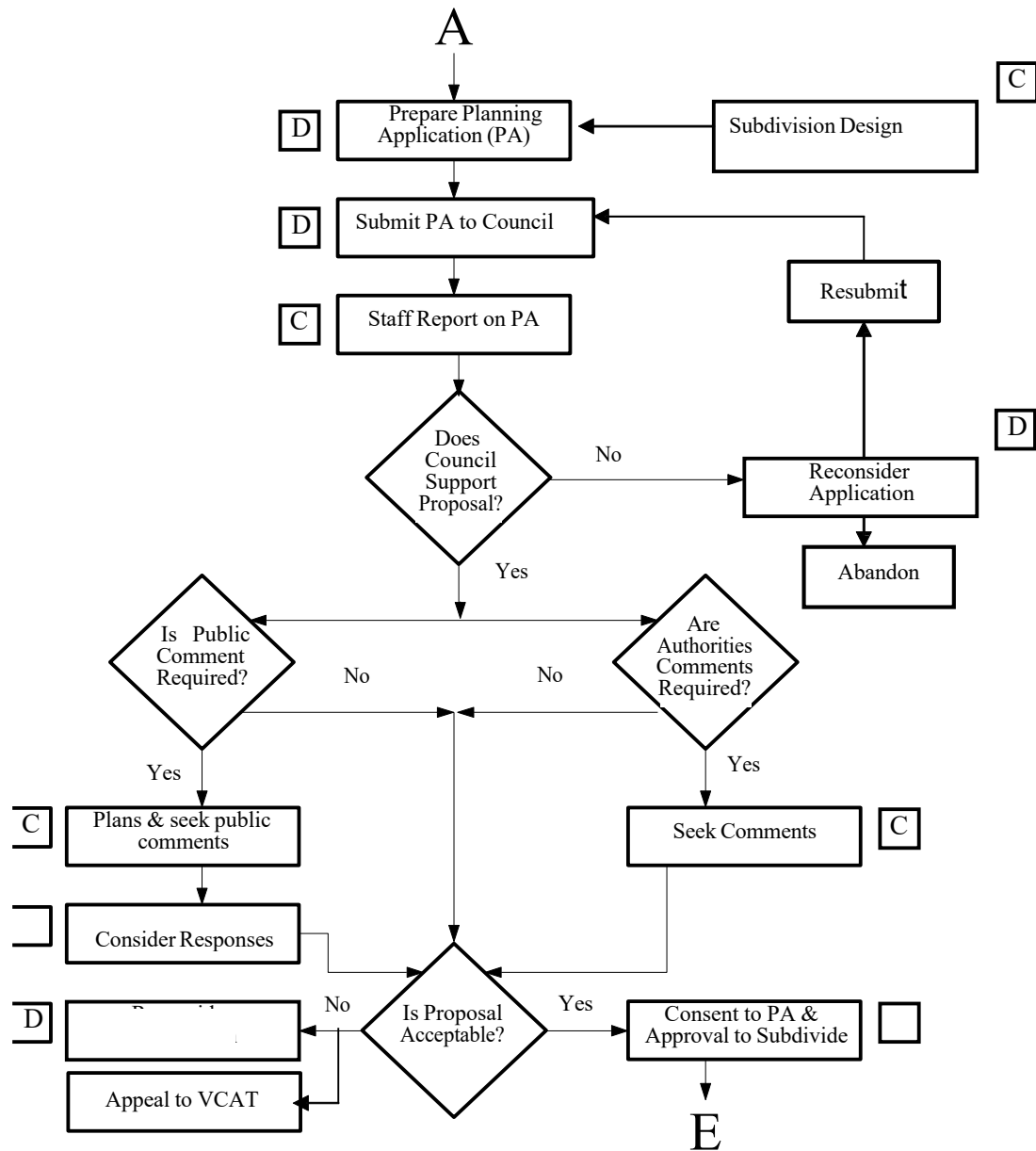
- R1 Environmental Considerations
- R2 Subdivision Design - Urban Residential Areas
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- R5 Subdivision Design- Industrial/Commercial Areas
- R6 Subdivision Design- Natural Hazard Areas
- R7 Provision for Open Space and Other Contributions



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NOTE: E denotes proceed to a flow diagram 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).
- DDA compliance - Is a statement of compliance required?
- Easements.

FLOW DIAGRAM R - COUNCIL CONTROL AND REQUIREMENTS

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R1 ENVIRONMENTAL CONSIDERATIONS

Statement of Environmental Effects

Information

At Council's discretion a Statement of Environmental Effects may be required for a development application. This statement normally addresses such matters as:

- suitability of the land
- access
- traffic generation
- risk of flooding
- flora and fauna
- local amenity

Tree Preservation

The proposed plan of subdivision shall identify vegetation that is significant to the overall landscape of the area. Trees to be removed shall also be identified on the plan of subdivision.

Trees are not to be lopped, damaged or removed without the prior consent of Council. Council's Delegated Officer is to be contacted prior to any clearing or underscrubbing being carried out.

Delegated Council Officer

Any significant tree/s identified by Council shall be protected at all times during excavation and/or construction. Council may require the applicant to lodge a bond at the time of engineering plan 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 Certificate of Compliance.

Lodging of Bond

Heritage Items

Any sites of Aboriginal carvings or relics or sites significant to heritage for other reasons shall be identified in the application. Aboriginal Affairs, Victoria should be contacted for details and verification.

Aboriginal and other Relics

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. Heritage Victoria should be contacted for details and verification. Adequate area is to be retained around any heritage item to protect its setting. Where a heritage overlay is in place the requirements of the overlay must be complied with.

Heritage Overlay

R2 SUBDIVISION DESIGN - Urban Residential Areas

Urban residential land is defined as land within areas zoned Residential, Comprehensive Development Zone or Mixed Use Zone. Applicants will be required to provide fully serviced subdivisions including the provision of sealed roads and durable, surfaced foot and/or bicycle path systems with all necessary drainage, and kerb and channel to adequately and safely provide for vehicular and pedestrian access to each allotment. The applicant will be required to meet the full cost of kerb and channelling across all road frontages of any subdivision in urban areas except where direct vehicular access is restricted. Roads adjoining a reserve are to be provided with kerb and channel.

Full Service

Kerb & Channel

There are statutory requirements and Council requirements pertinent to lot sizes, lot widths, building line set backs etc, and the supply of services to allotments. The City of Greater Dandenong Planning Scheme sets out these requirements for each zone type. Council has requirements for access to subdivisions with the objectives of:-

Lot Size

- providing for flow of through traffic with least disruption;

Road Traffic

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- 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 DDA compliant, pedestrian and shared cycle paths.

Pedestrians and Cyclists

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

Applicants will be required to extend and meet the full cost of water and sewerage reticulations within subdivisions plus the cost of connecting to existing services.

Water and Sewerage

Electricity services are to be extended to the subdivision and in accordance with the requirements of energy supplier and at no cost to energy supplier. Underground power will be required except where it can be shown that it is not appropriate. Underground telephone cables, where underground electricity is used, are to be provided by the applicant.

Electricity

Applicants will be required to provide for Telephone facilities within the design.

Telephone

Urban stormwater runoff and any systems proposed for its control, capture and reuse will need to be assessed in terms of satisfactory operational performance to meet discharge and detention and water quality management objectives both within and external to the development and also information must be provided on the cyclic maintenance and refurbishment requirements to ensure sustainable ongoing performance.

Stormwater Runoff**R3 SUBDIVISION DESIGN - Rural Residential Areas**

Rural residential land is defined as rural homesite and hobby farm land. Kerb and channelling and underground stormwater drainage are required for zoned land where there is a particular requirement whilst other subdivisions are required to provide approved lined table drains where scour velocities are exceeded and/or the soils are susceptible to erosion from stormwater.

Kerb & Channel

There are statutory requirements and Council requirements pertinent to lot sizes, lot widths, building line set backs etc and the supply of services to allotments. The City of Greater Dandenong Planning Scheme sets out these requirements for each zone type. The designer of a subdivision is required to comply with the requirements of Council's Planning Scheme and this Design Manual.

Lot Size

Effluent disposal will normally be by way of appropriate on-site disposal. However where the development is in near proximity to an existing sewerage area or where in the opinion of the Delegated Council Officer, the land is unsuitable for site disposal of effluent, sewerage reticulation connected to an outfall system will be required. A geotechnical report to support sewerage treatment proposals is to accompany an application for this type of development.

Sewerage

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.

Natural Features

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

Sensitive Environments

A covenant may be required on larger lots being subdivided prohibiting the ringbarking, cutting down, topping, lopping, removal, endangering or wilful destruction of any tree without the consent of Council. Where it can be demonstrated that such actions would not result in a loss of any native vegetation, significant stands of trees and/or soil erosion could not be accelerated due to tree removal, a covenant is not required.

Covenant on Land Clearing

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R4 SUBDIVISION DESIGN - Rural Development Areas

Rural land is defined as that land other than urban and rural residential. Rural land generally comprises larger holdings zoned rural. Applicants will be required to provide an all-weather road system to provide a functional and safe vehicular access to each allotment.

All Weather Roads

The designer of a subdivision is required to provide for the requirements of Council's Design Manual, and the Planning Scheme.

Sealing of the road system may be required on all new roads and existing roads which will be an extension of existing sealed roads. Council will not approve the subdivision of lands proposing non-dedicated road access (eg private road systems) however consideration will be given to the creation of a right-of-way to serve allotments not having dedicated road access and such right-of-way is to link directly to an existing or proposed dedicated road.

Sealing of Roads

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

- (a) The status of the road.
- (b) Existing road surface condition.
- (c) Cost of upgrading.
- (d) Flooding frequency and hazards of creek or river crossings.
- (e) Potential population catchment.

The extension of electricity mains to the subdivision is required, however, subdivisions in areas remote from electricity mains may be relieved of this requirement, only if special circumstances prevail and details of such circumstances are submitted to Council by the Applicant, together with the written agreement from the energy supplier.

Electricity

R5 SUBDIVISION DESIGN - Industrial/Commercial Areas

The Planning Scheme 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 subdivision is in an allowable zoning and is in conformity with Council's planning principles for the area.

Planning Scheme

The designer should cater for a range of lot sizes for the needs of large as well as small developers. Any lot should be large enough for parking and landscaping as well as the specific industrial or commercial use. Both commercial and industrial subdivisions will need to comply with the Planning Scheme for the area. Accessible pedestrian paths must be provided to service all allotments, clearly delineated and protected from any risks arising from adjacent vehicle parking or vehicle movements through the area.

Lot Sizes

Engineering road design and pavement design will need to cater for heavy and commercial vehicle traffic conditions as specified by Council.

Pavement for Heavy Traffic

Applicants will be required to extend and meet the full cost of water and sewerage reticulations within subdivisions plus the cost of connecting to existing supplies. Electricity services are to be extended to the subdivision and in accordance with the requirements of energy supplier at full cost to the Developer. Underground power and telephone services will be required and are to be provided by the applicant 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 energy

Water and Sewerage

Electricity

Telephone

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supplier. Evidence of conformity with energy supplier and telephone service requirements must be submitted prior to release of the final plan of survey.

R6 SUBDIVISION DESIGN - Natural Hazard Areas

Subdivisions of land susceptible to tidal influence may require Environmental Impact Statements in accordance with the Department of Infrastructure (Planning and Land Use) requirements.

***Flooding
Coastal
Erosion***

The subdivision of flood prone land is to comply with the requirements of Council's Flood Prone Land Policies.

Policies

Council will only support 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 to be treated on its merits.

Embankments

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

R7 PROVISION OF OPEN SPACE AND OTHER CONTRIBUTIONS

In residential subdivisions (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.

***Public Reserve
and
Contributions***

Applicants will also be required to contribute towards arterial roadworks where upgrading requirements can be attributed to the development.

Council's authority to impose conditions of contribution is derived from the Subdivisions Act 1988. Accordingly Council's contribution requirements will be in accordance with Section 18 of the Act and Section 52.01 of the City of Greater Dandenong Planning Scheme.

Section 18

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

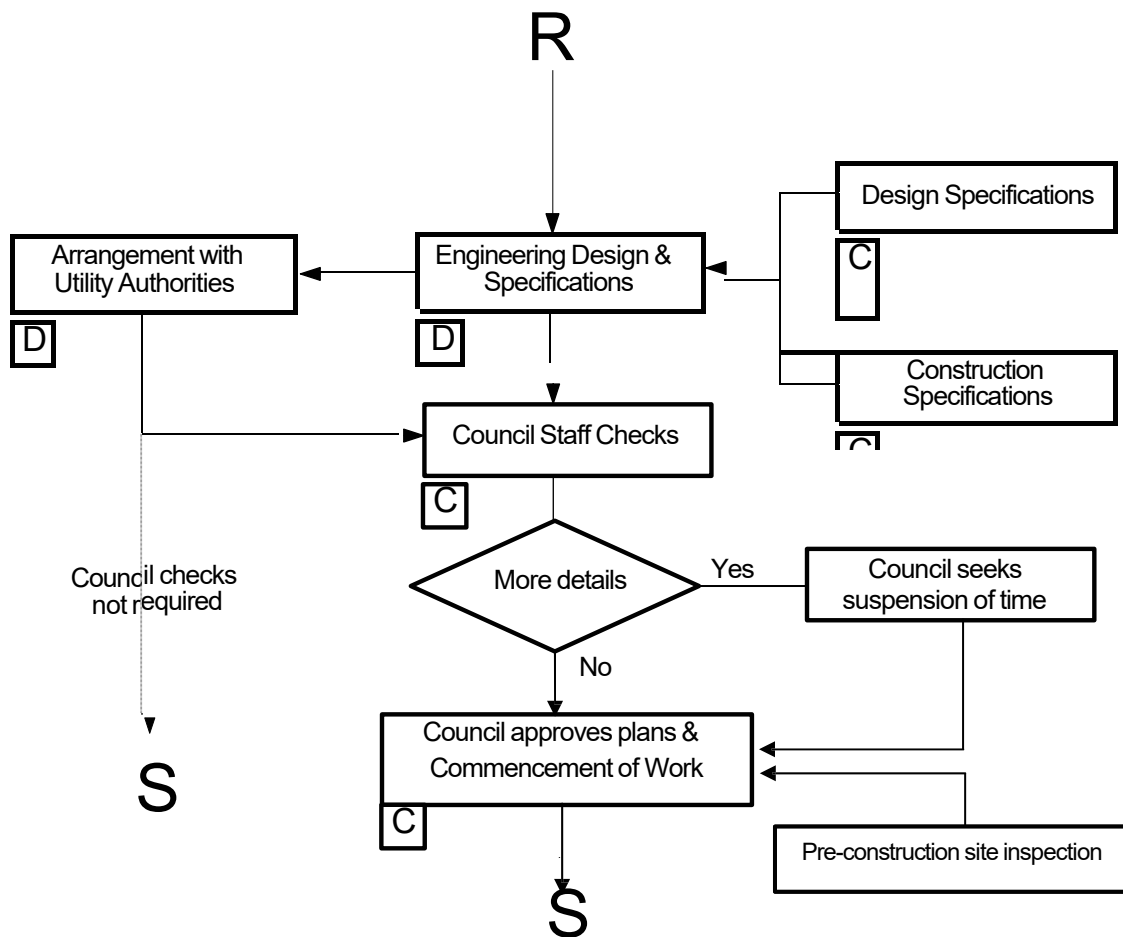
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SECTION E

ENGINEERING REQUIREMENTS

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- Flow Diagram E - Engineering Requirements
- E1 Engineering Design Drawings and Specifications
- E2 Commencement of Work
- E3 Inspection and Testing
- E4 Insurances
- E5 As Constructed Drawings & Schedule of Quantities
- E6 Quality Assurance Principles
- E7 Asset Management
- E8 Road Safety Audit
- E9 Road Maintenance



NOTE: S denotes proceed to flow diagram for the Provision for Sale of Allotments (S)

FLOW DIAGRAM E - ENGINEERING REQUIREMENTS

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E1 ENGINEERING DESIGN DRAWINGS & SPECIFICATIONS

All design drawings for earthworks (site regrading), roadworks, drainage works and foreshore works are to be certified by a Civil Engineer. All drawings for bridgeworks, retaining walls, other major structures and pumping stations are to be certified by a Civil Engineer.

Qualification of Designers

Standard Drawings, Design Specifications and Construction Specifications have been prepared by Council. Specifications other than those supplied by Council are required to be prepared by a Civil Engineer and will need to be submitted to Council for approval with each set of engineering designs to comply.

Council's Specifications

In summary a set of design drawings shall consist of:

- a) Earthworks (site regrading)
- b) Roadworks
- c) Road Pavement
- d) Road Furnishings
- e) DDA compliant footpaths to Council specifications
- f) Stormwater Drainage and Discharge water quality management
- g) Foreshore Works (e.g. lakes, wetlands)
- h) Services Plan
- i) Water Sensitive Urban Design & Landscaping Works
- j) Erosion Control Works
- k) Public Lighting Design

NOTE: Australian Height Datum (A.H.D.) shall be used for all *levels* & all plan views shall be aligned to **Geocentric Datum of Australia (G.D.A.)**. All drainage design drawings shall to be to **D-Spec** requirements.

E2 COMMENCEMENT OF WORKS

Approval to the subdivision will stipulate whether the 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 Section DQS of this Design Manual and the quality requirements of Aus-Spec #1. Acceptance of the submitted Quality Plan will be required prior to commencement of works.

Quality Assurance

Where a Quality Assurance contract is not a requirement and a Quality Plan is not therefore provided, it will be necessary as a minimum requirement that the Principal's Superintendent or Superintendent's Representative under the Contract be nominated and approved as suitably qualified and experienced. Council shall also nominate its representative.

Nominated Representative

E3 INSPECTIONS AND TESTING

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

Cost of Quality Testing

Similarly joint inspections at key stages of construction will be required to be carried out by representatives of both Council and the Developer. Key stages include:

Inspections

- Site regrading and clearing
- Installation of erosion control measures
- Preservation measures installed for trees, vegetation or heritage sites as determined
- Drainage line installation prior to backfilling
- Subgrade preparation
- Establishment of line and level for kerb and channel placement

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Road Pavement construction
 Road Pavement surfacing
 Practical Completion
 Final Completion

Council will insist on uninterrupted access at all times for the Council representative so as to enable audit inspections or testing. Records of all test results required by Council will be made available to Council promptly when requested and tests will be undertaken strictly to prescribed test procedures by testing organisations approved by Council prior to work commencement.

**Records of
Testing and
Inspections**

E4 INSURANCES

The Supervising Consultant shall take out professional indemnity insurance indemnifying himself and Council. The Supervising Consultant will also provide Council with evidence that all contractors have obtained appropriate third party and public risk insurance satisfactory to Council's requirements.

**Third Party
Insurance
Public Risk**

E5 QUALITY ASSURANCE PRINCIPLES

The principles of Quality Assurance procedures will be applied by Council to all subdivision works. In major or otherwise significant subdivisions the provisions of Australian Standard AS/NZS ISO 9000 series 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 9000 series (2000) will be determined prior to the preparation of design plans. In all cases Council will require the Developer to organise and pay for inspection and testing services such that he can validly certify the quality of all works and materials progressively during construction.

Quality Plan

Unless specifically exempted by Council in writing, Contractors used by Developers for subdivisional works within the City of Greater Dandenong shall be accredited under the Civil Contractors Federation (CCF) National Prequalification Program or an equivalent.

**CCF
Accreditation**

E6 ASSET MANAGEMENT

A Life Cycle Management Plan should be provided for any non-standard assets proposed to be included in the development.

E7 AS-CONSTRUCTED - DRAWINGS & SCHEDULE OF QUANTITIES

Following completion of the work, one full set of as constructed drawings & schedule of quantities in an approved electronic format is to be submitted and retained by Council for record purposes. All as constructed drawings & schedule of quantities shall bear the Consulting Engineer's or Consulting Surveyor's certification stating that all information shown on the plans is accurate.

Certification

E8 ROAD SAFETY AUDIT

The Developer is required to engage an approved Road Safety Auditor for the purposes of conducting a Road Safety Audit at the following subdivisional milestones as determined by the Responsible Authority. The RS Auditor must also have competency in DDA compliance requirements assessment and this aspect should be included in the audit process.

Audits

- Concept design stage
- Final design
- On completion of the works

E9 ROAD MAINTENANCE

Maintenance of the completed works shall be undertaken by the Developer for the period set out in the Subdivision Act 1988.

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SECTION S

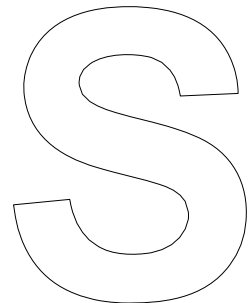
ALLOTMENTS FOR SALE

CONTENTS

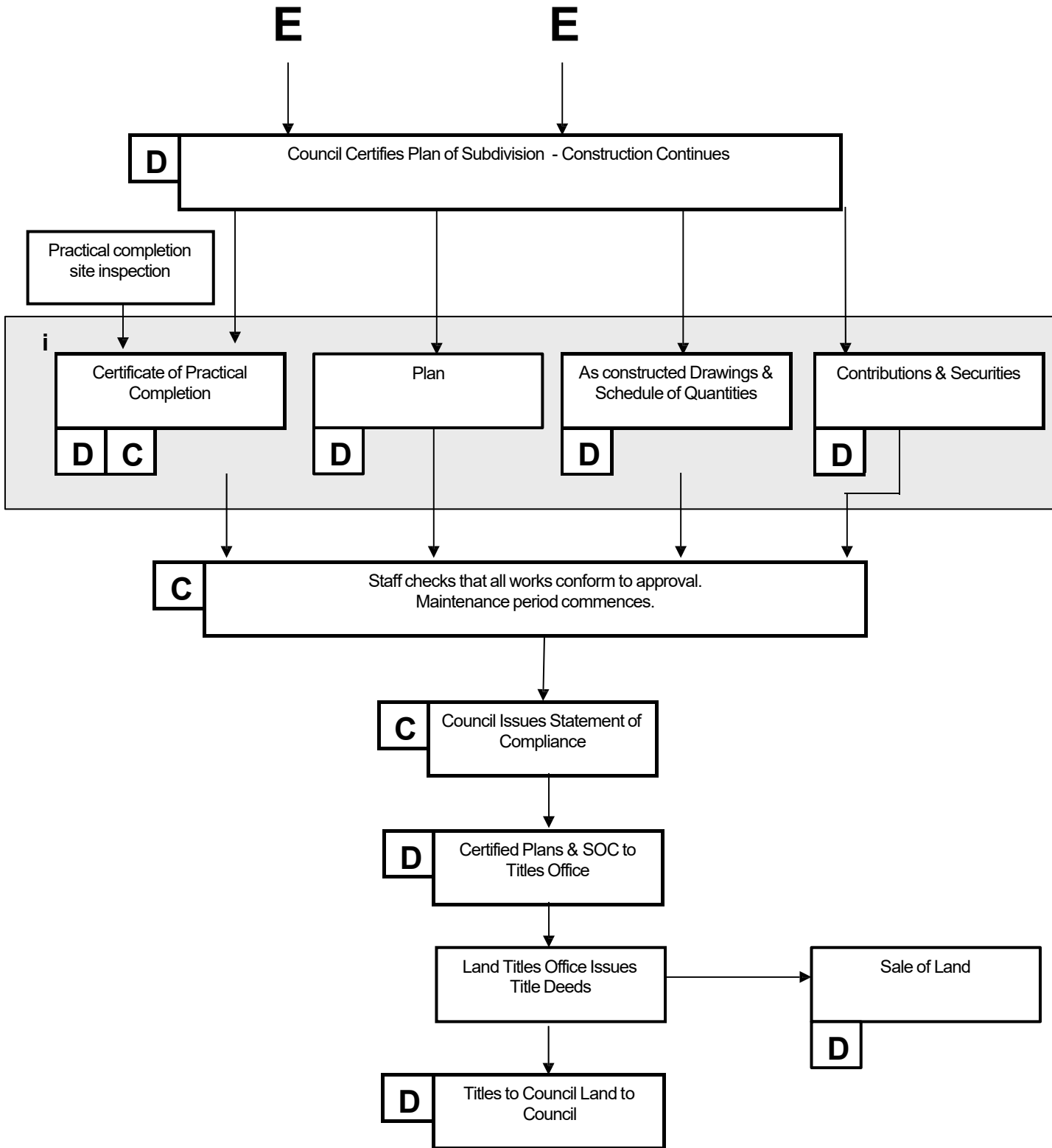
Flow Diagram S - Provision of Allotments for Sale

S1 Completion of Works and Certification.

S2 Early Release of Allotment by Application of Engineering Bonds



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NOTE:
 #W.A.C. denotes Works-as-Constructed and describes plans and drawings showing as built details.
 #SOC denotes Statement of Compliance.
 i – Critical elements that must all be complied with prior to progression to the next stage

FLOW DIAGRAM S – PROVISION OF ALLOTMENTS FOR SALE

S1 COMPLETION OF WORKS AND CERTIFICATION

On practical completion of construction works the Supervising Consultant is to advise the Delegated Council Officer to that effect in writing and certify that the whole of the works have been carried out in accordance with the approved plans and specification. If the whole of the works are considered satisfactory the Delegated Officer will agree to a date (the date of practical completion) on which the whole of the works are considered to have entered into the maintenance period. The maintenance period shall be no less than three months.

Maintenance Period

At this stage the Developer's Surveyor completes the final property survey. The appropriate form under the Subdivisions Act 1988 (Form 23), stating that the final survey including corner levels on all new allotments has been completed, must be lodged with Council's Planning Department within one (1) month of the date of practical completion.

Final Survey

The standard maintenance period will commence for all components at the date of practical completion and not beforehand, and shall extend for a period not less than three (3) months.

Maintenance Period

In some circumstances, council may at the planning approval stage, impose extended maintenance warranty requirements for specific asset types for periods up to 10 years.

The amount of the maintenance bond lodged with Council shall equate to 5% of the value of the actual work completed and this shall be held for a period 3 months from Practical Completion.

S2 EARLY RELEASE OF ALLOTMENTS BY APPLICATION OF ENGINEERING BONDS

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:

Guarantee Bonds

- Applications for Bonding of the works shall be made in writing to the delegated Council officer setting out clearly the grounds for Bonding, the value of outstanding works, estimated date for completion of the works and the form of bond proposed to be lodged with Council.
- The amount of the Bond and the term of the Bond will be negotiated between the Developer and the Delegated Council Officer.
- Bonding will generally only be agreed to for uncompleted works that do not impact on the safe operation of the development. Works that are considered necessary for the safe functioning of the development will not be subject to Bonding and include drainage infrastructure, pavements, primer seals, regulatory signs and associated pavement markings.
- Council will consider all requests to Bond incomplete works but generally will only Bond the following types of works;
 - Ⓞ Final asphalt wearing course subject to a sealed course being in place over the completed pavement
 - Ⓞ Small sections of kerb and channel and footpath which may be held up due to service authority works
 - Ⓞ Street trees
 - Ⓞ Landscaping

Ⓞ Water
Sensitivity
Urban
Design

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Features which may be damaged by early building development work on the new allotments.

Form of Bond

- Bonding shall only be in the form of an unrestricted bank guarantee in favour of Council or cash.

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- The value of the Bond will be based on the value of the outstanding works plus 50% as assessed by the Delegated Council Officer unless a reduced amount can be accepted without prejudicing the Council's position to satisfactorily complete the outstanding works. **Bond Value**
- In assessing a submission for Bonding, the Delegated Council Officer will consider the Council's duty of care requirements for both existing and new residents and/or tenants of the area.
- Bonding of works will only be agreed to for a maximum period of one (1) year unless extenuating circumstances can justify a longer period. **Bonding of Works**

S3 CIVIL WORKS PERMIT

1. Prior to undertaking any opening within a road under the control of Council the Contractor shall obtain a Civil Works Permit, pay all fees and comply with the following conditions:

- a) Current public liability insurance policy with a cover of not less than \$5 million per claim, and that all responsibility for liability and/or claims for damages which arise as the result of the work are to be borne by the person or company to whom this is issued. Insurance must remain current for the duration of the works otherwise this permit will become invalid (Note: Council may request to sight your Insurance Policy at any time during the works).
- b) This permit is non refundable and must be available on site at all times whether the permit holder or any other person is carrying out the works
- c) This permit is valid for 12 months (in accordance with the above dates) or when the prescribed works have concluded, whichever comes first.
- d) Give 24 hours notice for an inspection appointment.
- e) Any works in addition to those prescribed in this permit must not be conducted without prior approval by Council's appointed officer.
- f) Ensure that adequate and effective safety precautions (including traffic management to VicRoads Code of Practice if required) are adhered to at all times. Barriers and signs must be installed at the work site for the entire duration of the works in accordance with the Standards Association of Australia. **Permit Conditions**
- g) Restriction of the free passage of traffic, including pedestrians, should be minimised, in both time and work area.
- h) Works which will affect access to, or the safe navigation of a public carriageway must be completed within one day, between the hours of 8am and 5pm Mon – Fri or 9am and 5pm any other day. Any variation to this requirement must be ratified by Council's appointed officer before starting works.
- i) Any further work by Council to a road opening that fails or does not meet Council's specifications will be at the cost of the permit holder. This includes the cost of any additional inspections required.
- j) On the completion of works the area around the work site must be restored to a safe, clean and tidy condition and all surplus material must be removed. Any damage to the road surface will be repaired by the Council at the permit holder's expense unless prior arrangements have been made. If applicable deposit refunds will not be processed until a site inspection has taken place to satisfy compliance with the permit conditions.

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- k) Council may at any time assume control of the work site, should the permit holder fail to comply in a timely manner with the requirements of this permit or the directives of Council's Delegated Officer. Any costs associated with the permit holder failure to comply will be passed on.

- l) Council reserves the right to charge an additional fee should the scope of works change from that stated on the permit.

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

DQS

QUALITY ASSURANCE REQUIREMENTS FOR DESIGN

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**QUALITY ASSURANCE REQUIREMENTS
FOR DESIGN**

DQS.01 SCOPE

1. This Design Specification sets out the process for quality assurance of Designs required by Council for development consents. The requirements are applicable to all design work whether undertaken by the Developer, the Developer's Project Manager, Consultant or a Sub-consultant.

Quality Assurance

2. The Specification refers to Engineering Design processes. Requirements which refer to the Concept Design of developments are generally covered in this Design Manual. The requirements of the Design Manual are a prerequisite to the quality requirements for Engineering Design provided in this Specification (DQS).

Prerequisite

3. The Specification refers also to engineering design processes for developments that do not involve subdivision.

4. Notwithstanding the above Council reserves the right to undertake such checks as it deems necessary.

Council Design Check

DQS.02 OBJECTIVES

1. This Specification aims to set standards and document requirements for the execution and recording of design processes in order that the infrastructure associated with any development is designed to be fit for service and of a standard reasonably maintainable when it is accepted by Council as a community asset.

Maintenance

2. 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.

Records

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DQS.03 REFERENCE AND SOURCE DOCUMENTS

(a) Statutory Compliance

All Specifications for Design and Construction must comply with;
 Disability Discrimination Act (1992)
 Planning and Environmental Act (1987)
 Subdivision Act (1988)
 Local Government Act (1989)
 Council's Codes and Policies

(b) Australian Standards

AS/NZS 1428.1 – 2009 Design for Access and Mobility, General requirements for New Building Work
 AS/NZS 1428.9 – 2002 Design for Access and Mobility, Tactile Pavement Indicators
 AS/NZS 3905.2 Guide to quality system Standards AS/NZS 9001, AS/NZS 9002 and AS/NZS 9003 for construction.
 AS/NZS 3913 Quality manuals - Guide to preparation.
 AS/NZS ISO 8402 Quality management and quality assurance - Vocabulary.
 AS/NZS ISO 9001 Quality systems - Model for quality assurance in design, development, production, installation and servicing.
 AS/NZS ISO 9004.1 Quality management and quality system elements - Guidelines.

(c) Other

Technical Publications used as Engineering Standards
 Interim Policies and Guidelines

DQS.04 CERTIFICATION

- 1. The Developer shall present all engineering drawings to Council's Delegated Engineer for acceptance. Each set of drawings shall be accompanied by a Certification Report which will be signed by the Developer's Engineer or Surveyor. The Certification Report will comprise the certificate and check lists set out in Annexure DQS-A. **Certification Report**
- 2. Certification Reports shall be required with preliminary drawings and shall require resubmission with updates when final drawings are submitted. Certification is not required with concept plans. **Certification of Preliminary Drawings**
- 3. The Certification Report shall indicate on check lists any aspects of design which do not meet requirements or tolerances set out in Council's Design and Construction Specifications and Design Manual. **Design Non Conformance**

DQS.05 MINIMUM DRAFTING REQUIREMENTS

- 1. 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. **Criteria**
- 2. All design drawings should be clearly numbered by the designer 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. **Sheet Numbers**
- 3. The information shown on the drawings shall be logically collected on discrete sheets to avoid illogical and onerous effort in cross referencing between sheets in order to find information. 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 size sheets and be suitable for black and white copying and

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photo reduction to A3 paper size without loss of clarity.

**Logical
Drawing
Sheets**

4. Annexure DQS-B provides guidelines for grouping information in design drawings.

DQS.06 DESIGNER'S QUALIFICATIONS

1. A Civil Engineer deemed to be suitably qualified and experienced by Council shall be eligible to be a Corporate Member of the Institution of Engineers, Australia and shall be accepted as qualified to supervise the preparation of plans for roadworks, drainage works, canal works (excluding flood control structures and bridges).

Civil Engineer

2. A Civil Engineer qualified as detailed above shall be accepted as qualified to prepare plans for bridges, retaining walls, miscellaneous structures, buildings, pumping stations and flood control structures.

**Structural
Design by
Engineer**

3. The Civil Engineer and all subordinate designers shall be employed by an incorporated Consulting Engineering firm having third party accreditation under the relevant ISO standard for Quality Assurance

**Consultant's
Quality
Assurance**

DQS.07 RECORDS

1. The Designer shall retain appropriate design records in a format such that they can be understood readily by design staff with no prior knowledge of the particular design.

2. Calculations which can readily be re-done need not be kept once the construction maintenance period of the project has expired.

**Calculation
Record
Retention**

3. A design file shall be maintained by the Developer or the Developer's Consultant

Design File to

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containing records of calculations, approvals and decisions, geotechnical data and other design data which could be relevant in reviewing aspects of the design or planning future maintenance responsibilities. **be kept**

4. Particular requirements apply to hydrological and hydraulic design data. (Refer to Council's Stormwater Drainage Design Specification). **Hydrologic Hydraulic Design**

5. As Constructed Documentation - Council requires that "As Constructed" information for all Road, Drainage and Open Space assets created by the development shall be provided in digital format in accordance with R-Spec, D-Spec and O-Spec protocols . (Consultant/Developer Specification for the delivery of Data to Local Government - Further details of these requirements may be found at the following website - www.gissa.com.au)
Plan files shall be provided in PDF and AutoCAD format on CD.

6. Copies of records will be made available to Council on request and without charge.

DQS.08 AUDIT

1. Council shall have the right of audit of all processes and documents related to the project design. The Developer and the Developer's Consultant shall provide Council's Officers all reasonable assistance in inspecting records of designs submitted to Council for acceptance. **Provide Assistance**

2. In order to provide for such audit, access to the premises of the Developer or the Developer's Consultant will be provided to Council on a minimum 24 hour notice basis. **Notice of Access**

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ANNEXURE DQS-A

CITY OF GREATER DANDENONG DESIGN CERTIFICATION REPORT

Project Title: _____

PA No: _____

Consultant's Drawing No: _____

Name of Consultant: _____

Name and Address of Developer: _____

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 the City of Greater Dandenong Design Manual 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 the Planning and Environment Act.

I certify that this design has been checked by an Access and Mobility Consultant accredited by ACAA, for compliance with the Disability Discrimination Act 1992.

I certify that this Design is in strict compliance with the development consent conditions and where a variance to the consent is found, written confirmation has been received from Council approving of the variance prior to the lodgement of Design Drawings (this includes designs for staged construction).

I certify that all structural elements of the Design have been designed by a competent qualified practicing Civil or Structural Engineer.

I certify that this design has been subject to an independent Road Safety Audit at the concept and final design stages and that all requirements of the independent audit have been incorporated into this design.

Contact Phone: _____

_____ Design Engineer

_____ Date

Contact Postal Address: _____

_____ Qualifications

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Design Check List 1 BASE PLOT OF EXISTING FEATURES

		Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
1.1	Initial Plot verified by site inspection for existing drainage.	_____	/ /	<input type="checkbox"/>
1.2	Initial Plot verified by site inspection for existing property descriptions, boundaries and accesses.	_____	/ /	<input type="checkbox"/>
1.3	Initial Plot of contours verified as representative of site terrain.	_____	/ /	<input type="checkbox"/>
1.4	Trees and significant environmental features affected by development are clearly indicated and annotated.	_____	/ /	<input type="checkbox"/>
1.5	Features significant to heritage considerations within the development boundaries are clearly indicated and annotated.	_____	/ /	<input type="checkbox"/>
1.6	Existing public and private property likely to be affected by these Designs are clearly indicated and annotated.	_____	/ /	<input type="checkbox"/>
1.7	Survey and bench-marks clearly indicated and annotated.	_____	/ /	<input type="checkbox"/>

DEPARTURES FROM COUNCIL OR STATE ROAD AUTHORITY NORMAL REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

Design Check List 2 HORIZONTAL ROAD ALIGNMENT

		Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
2.1	Alignment compatible with design speed.	_____	/ /	<input type="checkbox"/>
2.2	Alignment is adequate in relation to clearance of roadside hazards.	_____	/ /	<input type="checkbox"/>
2.3	Driver and Pedestrian sight distance is adequate.	_____	/ /	<input type="checkbox"/>
2.4	Conflict with existing services is minimised.	_____	/ /	<input type="checkbox"/>
2.5	Road widths and lanes meet Councils requirements and design traffic requirements.	_____	/ /	<input type="checkbox"/>
2.6	Alignment of bridges suits road alignment.	_____	/ /	<input type="checkbox"/>
2.7	Pedestrian, bicycle and parking physical and DDA compliance requirements are met.	_____	/ /	<input type="checkbox"/>
2.8	Provision for large vehicles such as buses, garbage trucks and emergency vehicles is adequate.	_____	/ /	<input type="checkbox"/>
2.9	Intersection Layouts meet turning requirements of design traffic including emergency vehicles.	_____	/ /	<input type="checkbox"/>
2.10	Pavement width tapers and merges are adequate.	_____	/ /	<input type="checkbox"/>
2.11	The Accessibility requirements of the pedestrian environment are catered for.	_____	/ /	<input type="checkbox"/>
2.12	Conflict with existing Public Utility services has been identified and resolved.	_____	/ /	<input type="checkbox"/>
2.13	Horizontal road alignment has been provided in accordance with any Conditions of Development Consent.	_____	/ /	<input type="checkbox"/>
2.14	Horizontal road alignment setout data is clearly defined and tabulated.	_____	/ /	<input type="checkbox"/>

Design Check List 3 VERTICAL ROAD ALIGNMENT

		Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
3.1	Grades meet maximum and minimum requirements.	_____	/ /	<input type="checkbox"/>
3.2	Vertical clearances to bridges and services meet standards.	_____	/ /	<input type="checkbox"/>
3.3	Vertical sight distance is adequate for drivers and pedestrians.	_____	/ /	<input type="checkbox"/>
3.4	Cover to drainage structures or services is adequate.	_____	/ /	<input type="checkbox"/>
3.5	Vertical alignment is adequate for disposal of surface drainage from properties and from road.	_____	/ /	<input type="checkbox"/>
3.6	Grades are satisfactory for 1:100 year flood levels.	_____	/ /	<input type="checkbox"/>
3.7	Vertical alignment is compatible with property access.	_____	/ /	<input type="checkbox"/>
3.8	The maximum gradient of any section of footpath does not exceed 2.5%	_____	/ /	<input type="checkbox"/>
3.9	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.	_____	/ /	<input type="checkbox"/>
3.10	Sight distance is acceptable for all accesses to roundabouts.	_____	/ /	<input type="checkbox"/>
3.11	Alignment coordination with horizontal alignment is in accordance with the AUSTRoads design guides as referenced in the AUS-SPEC specifications.	_____	/ /	<input type="checkbox"/>
3.12	Conflict with existing Public Utility services has been identified and resolved.	_____	/ /	<input type="checkbox"/>
3.13	Vertical road alignment setout data is clearly defined on the longitudinal sections.	_____	/ /	<input type="checkbox"/>

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Design Check List 4 ROAD CROSS SECTIONS

	Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
4.1 Typical Cross Sections have complete dimensions.	_____	____ / ____ / ____	<input type="checkbox"/>
4.2 Typical Cross Sections have kerb & channel, road safety barrier and surface drainage indicated.	_____	____ / ____ / ____	<input type="checkbox"/>
4.3 Batter slopes are indicated and batter treatment is indicated where appropriate.	_____	____ / ____ / ____	<input type="checkbox"/>
4.4 Property boundaries, service allocations and location of known existing underground services and pathway treatments are indicated.	_____	____ / ____ / ____	<input type="checkbox"/>
4.5 Sufficient Cross Sections are shown to define all variations and width transitions.	_____	____ / ____ / ____	<input type="checkbox"/>
4.6 Cross sections are of sufficient width to fully assess impact of road level on adjoining property.	_____	____ / ____ / ____	<input type="checkbox"/>
4.7 Stability of embankment slopes, batters and retaining walls has been verified as satisfactory.	_____	____ / ____ / ____	<input type="checkbox"/>
4.8 Cross section reference level conforms with vertical road alignment.	_____	____ / ____ / ____	<input type="checkbox"/>
4.9 Location of all service authority facilities in compliance with the Coordination of Street Works Code of Practice 1995.	_____	____ / ____ / ____	<input type="checkbox"/>
4.10 Approved landscape plans detailing verge widths, tree planting details submitted and approved.	_____	____ / ____ / ____	<input type="checkbox"/>

DEPARTURES FROM COUNCIL OR STATE ROAD AUTHORITY NORMAL REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

Design Check List 5 ROAD AND INTERALLOTMENT DRAINAGE

		Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
5.1	Design prepared in accordance with the principles set out in the Urban Stormwater – Best Practice Environmental Management Guidelines – CSIRO 1999 – May 2006 Revision.	_____	/ /	<input type="checkbox"/>
5.2	Drawings indicate existing surface drainage.	_____	/ /	<input type="checkbox"/>
5.3	Hydrological data is the most current available.	_____	/ /	<input type="checkbox"/>
5.4	Hydrologic and Hydraulic design calculations are complete and fully recorded and available for audit.	_____	/ /	<input type="checkbox"/>
5.5	Underground drainage and structures do not conflict with services.	_____	/ /	<input type="checkbox"/>
5.6	The designed drainage lines are compatible with existing incoming lines and outgoing lines.	_____	/ /	<input type="checkbox"/>
5.7	The length of line, type of pipe, size, class and bedding requirements are indicated for each drainage line on the schedule of drainage elements.	_____	/ /	<input type="checkbox"/>
5.8	Height of fill over drainage lines is within allowable limits.	_____	/ /	<input type="checkbox"/>
5.9	Drainage is provided for local depressions eg median areas or areas adjacent to fills.	_____	/ /	<input type="checkbox"/>
5.10	The effect of headwater and back-up water on private property has been assessed for storm events up to and including the 1 in 100 year event.	_____	/ /	<input type="checkbox"/>
5.11	Subsurface drainage has been provided when required and clearly located by line and level, with details provided.	_____	/ /	<input type="checkbox"/>
5.12	The need for batter drains has been considered for fills and cuttings.	_____	/ /	<input type="checkbox"/>
5.13	The height and energy level of downstream drainage has been considered.	_____	/ /	<input type="checkbox"/>
5.14	Drainage structures and flowpaths are located so as to ensure safe vehicular and pedestrian transit.	_____	/ /	<input type="checkbox"/>

	Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
5.15 Drainage structure number, setout, type and pipe details indicated on the drainage plans and schedule of drainage elements.	_____	____ / ____ / ____	<input type="checkbox"/>
5.16 Emergency flowpaths are located so as to minimise impact on private property.	_____	____ / ____ / ____	<input type="checkbox"/>
5.17 Road drainage has been provided in accordance with any Conditions of Development Consent.	_____	____ / ____ / ____	<input type="checkbox"/>
5.18 Interallotment drains have been designed in accordance with Council's Specification and/or Australian Rainfall and Runoff (Edition 1987).	_____	____ / ____ / ____	<input type="checkbox"/>
5.19 Appropriate land stabilisation and velocity controls have been implemented to pipe systems, open channels and embankments.	_____	____ / ____ / ____	<input type="checkbox"/>
5.20 For allotments affected by flood controls, the floor height controls are to be compatible with road and drainage levels.	_____	____ / ____ / ____	<input type="checkbox"/>
5.21 Stormwater drains are designed to be connected to an approved point of discharge, such point of discharge already existing and operational.	_____	____ / ____ / ____	<input type="checkbox"/>
5.22 Gross pollutant traps and other stormwater management features have been designed to meet the requirements of "Water Sensitive Design" principles and this Design Manual.	_____	____ / ____ / ____	<input type="checkbox"/>
5.23 Asset Management Operational Manuals have been developed and supplied to council at handover on Practical Completion. These documents comprehensively describe the minimum operational inspection and management requirements for continued use and cyclic refurbishment.	_____	____ / ____ / ____	<input type="checkbox"/>

DEPARTURES FROM COUNCIL OR STATE ROAD AUTHORITY NORMAL REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

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Design Check List 7 PAVEMENT DESIGN

	Check Completed By <i>(initials)</i>	Date	Not Applicable <i>(tick)</i>
7.1 The carriageway pavement design and surface treatment is shown clearly on the drawings and any variations are indicated on appropriate cross sections.	_____	_ / _ / _____	<input type="checkbox"/>
7.2 The carriageway pavement design complies with Council's Pavement Design Specification.	_____	_ / _ / _____	<input type="checkbox"/>
7.3 Carriageway Pavement Design is in accordance with any Conditions of Development Consent.	_____	_ / _ / _____	<input type="checkbox"/>
7.4 Pedestrian pavements, kerb ramps, road crossings, handrails and other street furniture comply with DDA and Council specifications.	_____	_ / _ / _____	<input type="checkbox"/>
7.5 Geotechnical data is assessed as adequate and is held on the design file.	_____	_ / _ / _____	<input type="checkbox"/>
7.6 All geotechnical data has been sourced and tested by a NATA accredited laboratory.	_____	_ / _ / _____	<input type="checkbox"/>

DEPARTURES FROM COUNCIL OR STATE ROAD AUTHORITY NORMAL REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

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Design Check List 9 EROSION AND SEDIMENTATION CONTROL PLANS

		Check Completed By (initials)	Date	Not Applicable (tick)
9.1	Both short term and long term erosion control plans have been prepared using the guidelines within Council's Design Specification D7 and Construction Specification C211.	_____	_ / _ / _____	<input type="checkbox"/>
9.2	Erosion and Sedimentation Control has been designed in accordance with any Conditions of Development Consent.	_____	_ / _ / _____	<input type="checkbox"/>

DEPARTURES FROM COUNCIL OR STATE ROAD AUTHORITY NORMAL REQUIREMENTS OR SPECIAL FEATURES TO BE NOTED:

ANNEXURE DQS-B

EXAMPLE COMPILATION OF SUBDIVISION DESIGN DRAWINGS

An example of the sequence of **Subdivision Design Drawings** acceptable to Council is as follows:

A) CIVIL WORKS**FACE SHEET**

- PROJECT DESCRIPTION (LARGE LETTERING 20MM MIN @ A1)
- LOCALITY PLAN (1:10,000 @ A1)
- OVERALL SITE PLAN (1:2,500 @ A1)
- SHEET INDEX
- NOTES
- LEGEND

DETAIL DESIGN PLAN(S) (1:500 @ A1)**ROAD CENTRELINE LONG SECTION(S) (1:500H, 1:50V @ A1)****ROAD CROSS SECTIONS (1:100H, 1:50V @ A1)****TYPICAL ROAD CROSS SECTION(S) (1:100H & V @ A1), SERVICE OFFSET TABLE(S) & PAVEMENT DETAIL(S)****INTERSECTION/COURT BOWL DETAIL PLAN(S) (1:200 @ A1)****KERB RETURN LONG SECTIONS (1:200H, 1:20V @ A1)****DRAINAGE CATCHMENT PLAN (1:1,000 @ A1)****DRAINAGE LONG SECTIONS (1:500H; 1:50V @ A1) & PIT SCHEDULE****NON STANDARD DRAINAGE STRUCTURE DETAILS****EROSION AND SEDIMENTATION CONTROL PLANS (SHORT TERM & LONG TERM TREATMENT).****STRUCTURE DETAILS – BRIDGES, MAJOR CULVERTS, RETAINING WALLS, ETC.****TRAFFIC MANAGEMENT, SIGNING & LINEMARKING PLAN (1:500 @ A1)**

- PLAN TO SHOW DESIGN VEHICLE SWEEP PATHS

B) URBAN & LANDSCAPE DESIGN:**URBAN & LANDSCAPE DESIGN DRAWING(S) (1:500 @ A1) TO INCLUDE -**

- A SURVEY (INCLUDING BOTANICAL NAMES) OF ALL EXISTING VEGETATION TO BE RETAINED AND/OR REMOVED
- BUILDINGS AND TREES (INCLUDING BOTANICAL NAMES) ON NEIGHBOURING PROPERTIES WITHIN THREE METRES OF THE BOUNDARY.
- DETAILS OF SURFACE FINISHES OF PATHWAYS AND DRIVEWAYS.
- A PLANTING SCHEDULE OF ALL PROPOSED TREES, SHRUBS AND GROUND COVERS, INCLUDING BOTANICAL NAMES, COMMON NAMES, POT SIZES, SIZES AT MATURITY, AND QUANTITIES OF EACH PLANT. ALL SPECIES SELECTED MUST BE TO THE SATISFACTION OF THE RESPONSIBLE AUTHORITY.
- LANDSCAPING AND PLANTING WITHIN ALL OPEN AREAS OF THE SITE.
- (SPECIFY NUMBER) CANOPY TREES (MINIMUM TWO METRES TALL WHEN PLANTED) IN THE FOLLOWING AREAS: (SPECIFY LOCATION).
- DETAILS OF THE IN-GROUND IRRIGATION SYSTEM.
- DETAILS & LOCATION OF ANY FENCING REQUIRED FOR PUBLIC OPEN SPACE AREAS.
- DETAILS & LOCATION OF ANY STRUCTURES & TREATMENTS SUCH AS GATEWAY STRUCTURES, SIGNAGE, BOLLARDS ETC.
- **SPECIFY OTHER REQUIREMENTS.**

C) LIGHTING DESIGN**LIGHTING DESIGN DRAWINGS IN ACCORDANCE WITH AS/NZS 1158 TO INCLUDE -**

- LAYOUT PLAN (1:500 @ A1)
- LIGHTING SCHEDULE/SPECIFICATION & INCLUDING COMPLIANCE DOCUMENTATION – REFER TO ATTACHMENT B AUS-SPEC 1197 STREET AND PUBLIC LIGHTING
- POLE SCHEDULE SPECIFICATION
- FOOTING DESIGN

- NOTES:**
- (i) **Bar Scales** are required on all drawings.
 - (ii) **North Points** shown on all plan views.
 - (iii) Three (3) A1 sized sets of SUBDIVISION DESIGN DRAWINGS, plus an electronic copy in DXF or AutoCad DWG format must be submitted to the Responsible Authority for approval purposes.

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CITY OF GREATER DANDENONG SUPERVISION CERTIFICATION REPORT

Project Title: _____

PA No: _____

Name of Consultant: _____

Name and Address of Developer: _____

Name and Address of Contractor: _____

I certify that the works for this project have been carried out in accordance with the design, plans and specifications and in accordance with the quality assured requirements as approved by the City of Greater Dandenong. The works have now reached the stage of Practical Completion and are fit for use with the exception of departures cited in the attached.

I certify that these works did not significantly impact on the environmental factors of the area as interpreted under the Planning and Environment Act.

I certify that all supervision of the works have been undertaken by a competent qualified practicing Civil Engineer.

I certify that the final works have been subject to an independent road safety audit and that all requirements of that audit have been complied with.

Contact Phone: _____
Supervising Engineer _____ Date _____

Contact Postal Address: _____
Qualifications _____

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D1

GEOMETRIC ROAD DESIGN (Urban and Rural)

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**DESIGN MANUAL D1
GEOMETRIC ROAD DESIGN (Urban and Rural)**

GENERAL

D1.01 SCOPE

1. This section sets out the specifications developed specifically for the design of subdivision roadworks using principles of street design and pedestrian accessibility to and within all public precincts to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.

***Subdivision
Roadworks***

2. A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road. The concept of designing to regulatory street speeds is contrary to the current principles of subdivision road design.

***Acceptable
Vehicle Speed***

3. All relevant design principles must 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.

***Integrated
Design
Principles***

4. The words "street" and "road" are interchangeable throughout all parts of this Specification.

5. For the purpose of this Specification the definition of terms used to define the components of the road reserve shall be in accordance with AS 1348.1 and as set out below.

***Road Reserve
Component
Definitions***

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 (verge).

Pathway - A public way reserved for the movement of pedestrians and of manually propelled vehicles.

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.

D1.02 AIMS

1. The provision of a road system within a subdivision is to be designed so as to achieve the following aims:

- Provide DDA compliant footpaths and pathways which enable convenient and safe access for pedestrians, vehicles and cyclists.
- Provide safe, logical and hierarchical transport linkages with existing street system.
- Provide DDA compliant points of access for pedestrians to the public transport system and appropriately designed access and facilities for buses, emergency and service vehicles.

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- Provide for a quality product that minimises maintenance costs.
- Provide a convenient way for public utilities.
- Provide an opportunity for street landscaping.
- Provide convenient parking for visitors.
- Have appropriate regard for the climate, geology and topography of the area.

D1.03 REFERENCE AND SOURCE DOCUMENTS

1. Council Specifications

Dandenong Planning Scheme
All Specifications for Design and Construction.

2. Australian Standards

- AS 1348.1 - Road and traffic engineering – Glossary of terms, Road design and construction.
- AS/NZS 1428.1 and 4.1 - Design for Access and Mobility
- AS 2890.6 - Accessible Parking facilities: Off-street car parking.
- AS/NZS 3845 - Road safety barrier systems.

3. VIC State Authorities

VicRoads - Road Design Guidelines.
VicRoads Traffic Engineering Manual Volume 1 and 2

4. Other

- AUSTRROADS
- Part 1: Introduction to Road Design
- Part 2: Design Considerations
- Part 3: Geometric Design
- Part 4: Intersections and Crossings - General
- Part 4A: Unsignalised and Signalised Intersections
- Part 4B: Roundabouts
- Part 4C: Interchanges
- Part 5: Drainage – General and Hydrology Considerations
- Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface
- Part 5B: Drainage – Open Channels, Culverts and Floodways
- Part 6: Roadside Design, Safety and Barriers
- Part 6A: Pedestrian and Cyclist Paths
- Part 6B: Roadside Environment
- Part 7: Geotechnical Investigation and Design
- Part 8: Process and Documentation

The Institute of Municipal Engineering Australia, Qld Division - 1993: Design Guidelines for Subdivisional Streetworks.

ARRB Special Report No. 33, L E Comerford: A Review of Subdivision Road Design Criteria.

Stapleton, C 1984: Streets Where We Live - A Manual for the Design of Safer Residential Estates.

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Stapleton, C 1988, Dept of Transport South Australia: Planning & Road Design for New Residential Subdivisions.

Brindle, R 1988, ARRB: Planning & Design of the Local Trunk Collector.

Colman, J 1978, ARRB: Streets for Living.

Pak-Poy Kneebone - 1989: Research Study into Road Characteristics for Residential Development.

Cement and Concrete Association of Australia:2004 Guide to Residential Streets and Paths

D1.04 CONSULTATION

1. Designers must consult with the Council and other relevant authorities prior to or during the preparation of design. Designers should in addition to requirements of this Specification ascertain specific requirements of these authorities as they relate to the designs in hand.
2. Public consultation on designs shall be provided where such action is required by Council’s current policy.
3. The Designer shall obtain service plans from all relevant public utility authorities and organisations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views.

Council, Other Authorities

Public Consultation

Public Utilities

D1.05 PLANNING CONCEPTS

1. 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 related physical design standards. Routes should differ in alignment and design standard according to the volume of traffic they are intended to carry, the desirable traffic speed, and other factors.
2. The road pattern and width will be determined by Council based on the strategic importance and road hierarchy on their merits.
3. Pedestrian and bicycle facilities must be considered in the planning context to ensure that a logical system of pathways and footpaths offer a functional and convenient service and that these are compliant with the DDA requirements.
4. The road network for residential developments should have clear legibility.
5. The road network should reinforce legibility by providing sufficient differentiation between the road hierarchy and functions.
6. Distinct landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance the legibility.
7. 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.
8. 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.
9. There will be special constraints and costs associated with the design of roads through or adjacent to land known to be salt affected. Early planning shall consider avoiding detrimental interference with land known to be salt affected. Adjustments in

Road Hierarchy

Road Widths

Pedestrian Facilities

Legibility

Differentiation

Landmark Features

Introduced Features

Intersection Turning Movements

horizontal and vertical line shall be considered to avoid recharge of

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subsurface water within or adjacent to the road reserve. Consultation with the relevant land and water resource authority shall be mandatory under the above circumstances.

Salinity Prevention, Early Planning, Mandatory Consultation

10. 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.

Landscaping, Salinity Prevention

D1.06 DRAWING REQUIREMENTS

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(a) Reduction Ratios

1. All plans for urban design are to be reduced to 1:500. Rural designs may be reduced to 1:1000.

Longitudinal Sections	1:500 H 1:100 V
Cross Sections	1:100 Natural

(b) Drawing Sheets

1. Separate sheets should be provided for

- a. Cover sheets
- b. Plan views
- c. Longitudinal sections
- d. Cross sections
- e. Structural details
- f. Standard drawings

(c) Drawing Presentation

1. Drawings are to be presented on A1 sheets unless otherwise authorised. They are to be clear and legible and prepared in consistent lettering and style. Council has the authority to refuse drawings that do not meet these drafting requirements. Drawings copied from other works will not be accepted. All drawings shall be clearly referenced with notations and tables as appropriate. The Designer should always be mindful that apart from being a permanent record and legal document, drawings should be easily read and understood by the Contractor, and others involved in the construction of the Works. Terminology should be kept in 'plain English' where possible.

Clear and Legible, Permanent Record, Legal Document

2. The scope and sequence of drawing sheets shall comply with the example provided in Annexure DQS-B of the Specification for QUALITY ASSURANCE REQUIREMENTS FOR DESIGN.

Compliance

(d) Certification

1. Drawings shall bear the signature of the design consultant and shall where required by the Council be certified as complying with the appropriate design specifications (D1 to D10). The certificate shall be in the format detailed in Annexure DQS-A of the Specification for QUALITY ASSURANCE REQUIREMENTS FOR DESIGN.

Design Consultant

URBAN DESIGN CRITERIA

D1.07 ROAD HIERARCHY

1. 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 on Figure D1.1.

Functionality

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FUNCTIONAL CLASSIFICATIONS

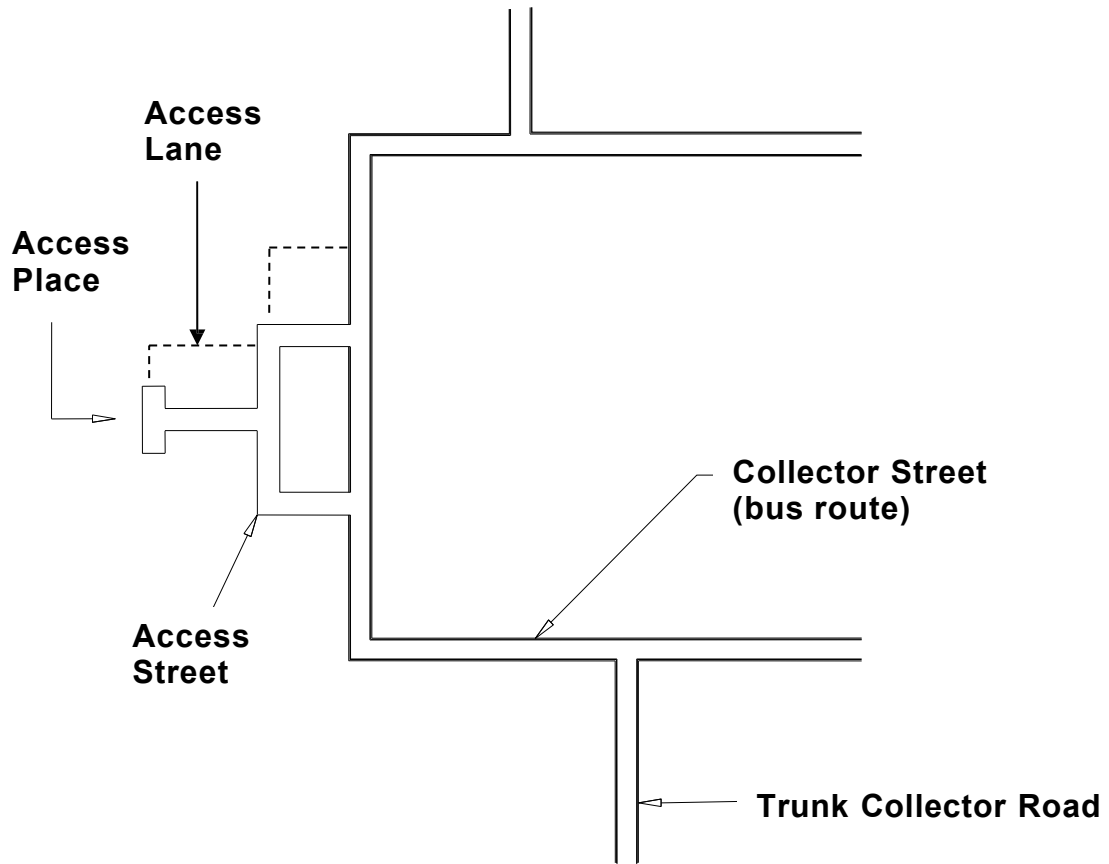


Figure D1.1
Typical Road Hierarchy

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2. Four distinct levels of roads are:

- Access Lane – non vehicular only
- Access Place
- Access Street
- Collector Street
- Trunk Collector Road.

3. The lowest order road (Access Place) having as its primary function, residential space - amenity features which facilitate pedestrian and cycle movements, and where vehicular traffic is subservient in terms of speed and volume, to those elements of space, amenity, pedestrians and cyclists. The features of a typical access street are shown in Figure D1.2.

Access Place

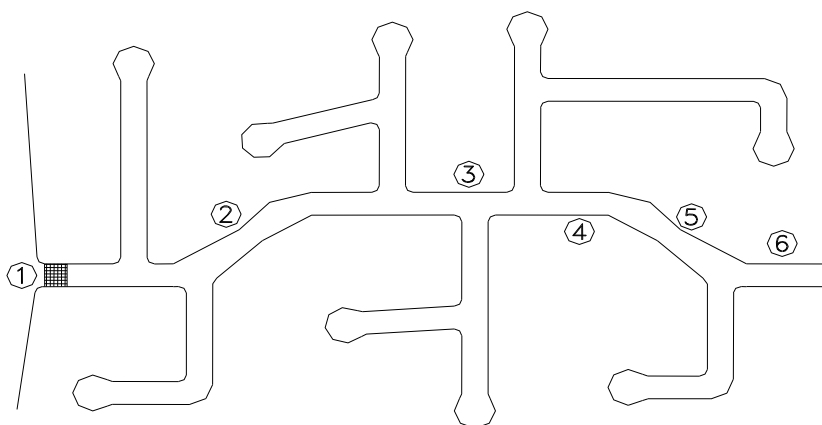


**Figure D1.2
Access Place**

4. The next level road (access street) as a local residential street 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 Place. A typical Access Street is illustrated in Figure D1.3.

Access Street

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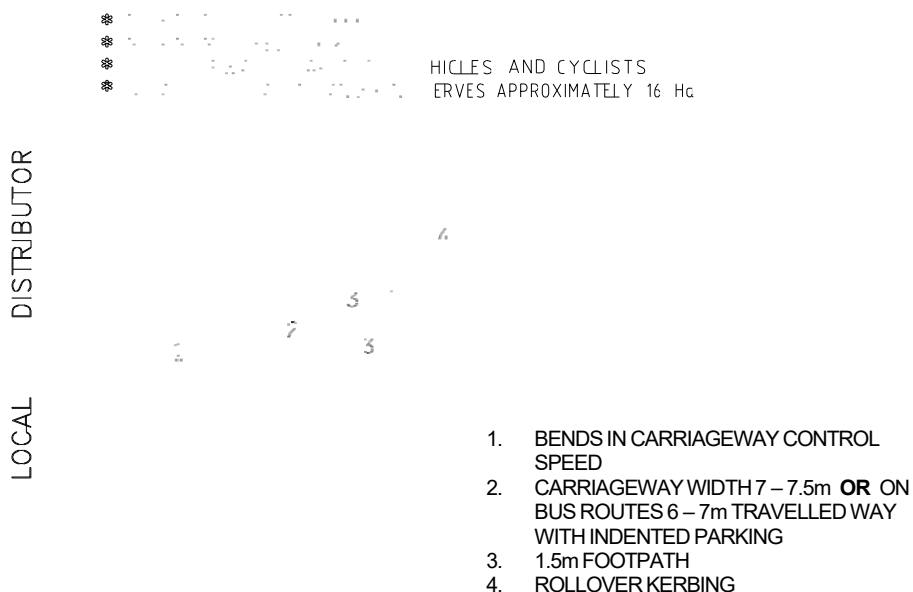


- 5. BRICK-PAVED ENTRY THRESHOLD SIGNIFIES ENTRY TO LOWER SPEED ENVIRONMENT
- 6. BENDS IN CARRIAGEWAY CONTROL SPEED
- 7. SHORT SECTIONS OF STRAIGHT CARRIAGEWAY CONTROL SPEED
- 8. CARRIAGEWAY WIDTH 7m
- 9. 1.5m FOOTPATH
- 10. ROLLOVER OR FLUSH KERBING

**Figure D1.3
Access Street**

5. The second highest order road (collector street) 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 in Figure D1.4.

Collector Street

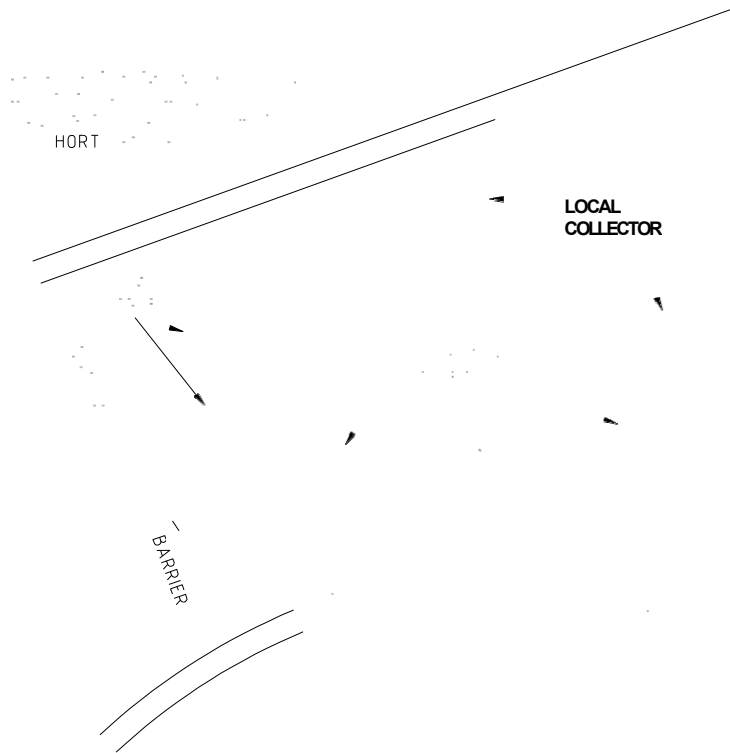


**Figure D1.4
Collector Street**

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6. The highest order road (trunk collector road) within a residential development 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 local Trunk Collector should serve only the development and should not attract through traffic. Figure D1.5 shows the layout of a trunk collector road.

Local Trunk Collector Road



**Figure D1.5
Trunk Collector Road**

D1.08 ROAD NETWORK

1. The design features of each type of road convey to the driver its primary functions and encourage appropriate driver behaviour (refer Figure D1.2 to D1.5).
2. Traffic volumes and speeds on any road should be compatible with the residential functions of that road.
3. The maximum length of an access street should ensure its status as a residential place is retained, where the traffic, in terms of speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. This length will also ensure that residential convenience is not unduly impaired as a result of speed restraints.
4. The length of local collector within a development should be minimised.
5. The time required for drivers to travel on all streets within the development should be minimised.

Compatibility

Access Place

Local Collector

Travel Time

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6. Where access streets form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining access streets or open space systems so as to ensure such pedestrian and bicycle network are functionally efficient. **Pedestrian or Bicycle Network**
7. The road network should ensure that no road links with another road which 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, however, no access street or local street should have access to an access-controlled arterial road. **Road Links**
8. Connections between internal roads should be T-junctions or controlled by roundabouts. **Internal Road Connections**
9. The road layout should conform to the requirements of the external road network and satisfy the transport provisions of an outline development plan. **Transport Provisions**
10. The external road network should be designed and located to provide routes which are more convenient for potential through traffic within the network. Major roads should be provided at intervals of no more than 1.5 km and should be complete and of adequate capacity to accommodate through network movements. The internal road system should not provide through routes that are more convenient than the external road network. **External Road Network**

D1.09 DESIGN SPEED

1. Among the principal parameters used in road design are “stopping distance”, “sight distance”, “curve radii”, “lane width” and “superelevation”. As these parameters are related directly to the speed of traffic on the road, one of the first requirements in design is to establish the appropriate speed or speeds to use for design. To overcome these problems, designers are now required to obtain realistic estimates of eighty five percentile vehicle operating speeds on each element of the road and then to ensure that the design speed of every element is either equal to, or greater than the eighty five percentile operating speed on that element. **VicRoads Guidelines**
2. 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 standard roads, operating speeds will tend to be in excess of arbitrary speed standards. Attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement. **Low Speeds**
Hazardous Features
3. The need for road safety barriers shall be assessed and designed in accordance with AS/NZS 3845. **Road Safety Barriers**

D1.10 LONGITUDINAL GRADIENT

1. A general minimum gradient of 0.5 per cent should be adopted for flat terrain. **Flat Terrain**
2. Longitudinal grade of the minor street on the approach to an intersection should not exceed 4 per cent, 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. **Intersections**
3. Turning circles in cul-de-sacs on steep grades should have grades less than 5 per cent. **Cul-de-Sacs**

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D1.11 HORIZONTAL CURVES AND TANGENT LENGTHS

1. The horizontal alignment of a road is normally in a series of tangents (straights) and curves which may be 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 as described in Clause D1.09. 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 which progressively tighten produce an uncomfortable sense of disorientation and alarm. Sudden reverse curves which drivers cannot anticipate also have a potential to cause similar conditions.

Speed/Radius Relation

2. Where speed restriction is provided by curves in the street alignment the relationship between the radius of the curve and the desired vehicle speed is given in VicRoads Road Design Guidelines.

Speed Restriction

3. Sight distance on curves is determined by formula, values of which are tabulated in VicRoads Road Design Guidelines.

D1.12 VERTICAL CURVES

1. Vertical curves will be simple parabolas and should be used on all changes of grade exceeding 1 per cent. The desirable minimum design speed is 60 km/h. The length of the crest vertical curve for stopping sight distance should conform with VicRoads Road Design Guidelines. These standards are based on 1.5 seconds reaction time which provides a reasonable safety margin for urban conditions, where drivers' reaction time is usually considered to be lower than in rural conditions.

Criteria

2. For adequate riding comfort, lengths of sag vertical curves should conform with the VicRoads Road Design Guidelines. 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 length for sag vertical curves are shown in Table D1.3.

Riding Comfort

Table D1.3 Minimum Length of Sag Vertical Curves

	Access Place and Access Street (m)	Collector (m)	Trunk Collector (m)
Minimum vertical curve	25	35	50
Absolute minimum vertical curve (to be applied at road junctions only)	6	12	20

3. 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.

Side Road Junctions

4. Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) has been suggested. This is to avoid water ponding in excessively flat sections of kerb and channel. A minimum grade of 0.5 per cent should be maintained in the kerb and channel. This may require some warping of road cross sections at sag points.

Sag Curves

5. The three dimensional coordination of the horizontal and vertical alignment of a road should be aimed at improved traffic safety and aesthetics. Economic considerations

Horizontal and Vertical

often require a compromise with aesthetic considerations. The following principles should be applied:

**Alignment
Coordination**

- 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 gradeline between sag curves may adversely affect the road's symmetry and appearance.

D1.13 SUPERELEVATION

1. 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 access roads which are designed for speeds of 40 km/h or less and with curves of 60m 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.

**Low Design
Speed,
Crowned
Pavement**

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

**High Design
Speed**

3. 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.

Criteria

4. Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are shown in Table D1.4.

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Table D1.4 Minimum Radius of Curvature

	Design Speed km/h	60	70	80
Minimum Superelevation (%)	5	145	195	255
	4	150	205	265
	3	160	215	280
	2	170	230	300
	1	180	245	315
Maximum Crossfall (%)	0	190	260	340
	1	260	355	460
	2	285	390	505
	3	315	430	560

(Source: NAASRA (Now AUSTRROADS), Guide policy for the geometric design of major urban roads.)

5. 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 2m 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 per cent, a crossfall of 63mm in a 450mm wide gutter may be adopted.

***Transitions,
Offset Crowns***

D1.14 ROAD RESERVE CHARACTERISTICS

1. The cross section of the road reserve must provide for all functions that the road is expected to fulfill, 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 D1.5 details characteristics of the road reserve.

***Cross Section
Provisions***

Table D.1.5 Characteristics of Roads in Residential Subdivision Road Networks

Road Type	No. of Dwellings Served	Maximum Traffic Volume (vpd) ⁽¹⁾	Maximum Speed ⁽²⁾ (km/h)	Carriageway Width (m) ⁽³⁾		Parking Provisions Within Road Reserve	Kerbing ⁽⁴⁾	Footpath Requirement	Bicycle-path Requirement	Verge Width (each side)
				Minimum	Maximum					
Access Lane	Fewer than 50	50	15	One Lane: 3.0 Two Lane: 5.5		Nil	Nil	No	No	Nil
Access Place	Small and fewer than 30	300	15	Two Lane: 6.5		Indented	Rollover kerb – Approved profile	1.5m wide one side for courts with more than 5 Lots	No	4.0m
Access Street	Fewer than 200 and preferably fewer than 100	1000 2000	30 40	Two Lane: 7.0		Carriageway	Rollover kerb – Approved profile	1.5m wide footpath both sides	No	4.5m
Collector Street		3,000	50 20 at designated pedestrian or bicycle crossings ²	Two Lane: 7.5		Carriageway	Rollover kerb – Approved profile	1.5m wide footpath both sides	Where provision for cyclists required, footpaths to be joint use and 2.0m wide both sides	4.5m
Trunk Collector		6000	60 ³	Duplicated Carriageway Two Lanes each Carriageway (5.5m)		Carriageway	Rollover kerb – Approved profile	2.0m wide footpath, and/or 2.0m bicycle path both sides	2.0m bicycle path both sides only in the verge	6.0m (minimum 6.0m central median)

NOTES TO TABLE D1.5:

1. 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 Clauses D1.09 and D1.11 on designing for specific operating speeds.
 3. Widening required at bends to allow for wider vehicle paths (using AUSTRROADS Turning Templates).
 4. Where kerbing is not required a flush pavement edge treatment can be used. Maximum carriageway widths required if kerbing used.
 5. Minimum width required to provide for pedestrians, services, drainage, landscape and preservation of existing trees. Add additional width on one side for future widening of carriageway to 5.0m if required. For two lane carriageway design, no provision for widening required.
 6. 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.
 7. 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 Specification.
 8. On bus routes, 7.0m travelled way with 2.0m wide indented parking and bus bays defined by kerbed protuberances. Where bicycle way can be anticipated, a bicycle lane is required along the kerb. Provide adequate road reserve width for widening of carriageway for future bus route if required.
 9. Speed on trunk collector road not to exceed legal limit.
- * Many elements are inter-related. Therefore variations from any particular recommended characteristic may require changes to others.

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2. The carriageway width must 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 Clause D1.20 for bus routes.) **Operational Aspects**
3. The safety of pedestrians and cyclists where it is intended they use the carriageway must also be assured by providing sufficient width. **Pedestrians, Cyclists**
4. 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. **Access to Allotments**
5. 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. **Discourage Speeding**
6. 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. **Verge Width**
7. 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. **Sight Distance across Verge**
8. Stopping sight distances and junction or intersection sight distances, provided by the verge should be based on the intended speeds for each road type.

D1.15 CROSSFALL

1. Desirably, roads should be crowned in the centre. Typical pavement crossfalls on straight roads are:

<i>Pavement Type</i>	<i>Crossfall</i>
Bituminous seal coat	3 per cent
Bituminous concrete pavement	2.5 per cent
Cement concrete pavement	2 per cent

(Source: NAASRA (Now AUSTRROADS), Guide policy for geometric design of major urban roads.)

2. There are many factors affecting levels in urban areas which 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 per cent, although up to 6 per cent may be used where unavoidable. The rate of change of crossfall should not exceed: 6 per cent per 30m for through traffic; 8 per cent per 30m for free flowing turning movements; or 12 per cent per 30m for turning movements for which all vehicles are required to stop. **Offset Crown Lines**
Rate of Change
3. The crossfall on a collector or trunk collector 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. A rate of change of grade of two per cent in the kerb line of the side street relative to the centre line grading is a reasonable level. **Precedence**

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D1.16 VERGES AND PROPERTY ACCESS

1. A suitable design for the verge will depend on utility services, the width of footpath, access to adjoining properties, likely pedestrian usage and the planting or preservation of trees. Low level footpaths are undesirable but may be used if normal crossfalls are impracticable. Crossfalls in footpath paving should not exceed 2.5 per cent, in accordance with AUSTRROADS Guide to Traffic Engineering Practice, PART 13, Pedestrians. Longitudinal grade usually parallels that of the road and this may be steeper than 5 per cent. **Criteria**

2. Differences in level across the road between road reserve boundaries may be accommodated by: **Options**

- Cutting at the boundary on the high side and providing the verge at normal level and crossfall.
- A uniform crossfall across the carriageway.

3. The above measures can be used singularly or combined. The verge formation should extend with a 0.5m berm beyond the road reserve boundary.

4. The Designer shall design a vehicular driveway centreline profile for the property access and check this design using critical car templates to ensure that vehicles can use the driveway satisfactorily. **Driveway Profile**

D1.17 INTERSECTIONS

1. 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 trunk collector roads. **Traffic Volumes**

2. Pedestrian usage at intersections must be accommodated and must comply with DDA requirements **Pedestrian Use**

3. Intersection design for the junction of subdivision roads with existing state rural, or urban roads and national highways should generally be in accordance with the publication AUSTRROADS Guide to Traffic Engineering Practice, PART 5, Intersections at Grade. **State Roads National Highways**

4. Intersections with state roads, or national highways are to be designed, approved and constructed in accordance with the requirements of VicRoads. **Approval of State Road Authority**

5. Where major intersections are required to serve a development complete reconstruction of the existing road pavements will be necessary where the speed environment and irregularity of the existing road pavement may endanger the safety of traffic in the locality. **Existing Road Pavement**

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6. Intersections should be generally located in such a way that: **Criteria**
- The streets intersect preferably at right-angles and not less than 70°.
 - 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 left-right staggered pattern should have a minimum centreline spacing of 50m to provide for a possible right-turn auxiliary lane on the major street.
 - A right-left manoeuvre between the staggered streets is preferable, avoiding the possibility of queuing in the major street.
7. Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections. **Sight Distance**
8. Where required, appropriate provision should be made for vehicles to park safely. **Parking**
9. The drainage function of the carriageway and/or road reserve must be satisfied by the road reserve cross-section profile. **Draining**
10. All vehicle turning movements are accommodated utilising AUSTRROADS Design Vehicles and Turning Templates, as follows: **Turning Movements**
- For intersection turning movements involving trunk collector roads, the "design semi-trailer" with turning path radius 15.0m.
 - For intersection turning movements involving local streets or collector streets, but not trunk collector roads, the "design single unit" bus with turning path radius 13m.
 - For intersection turning movements on access streets but not involving trunk collector roads, collector streets or local streets, the garbage collection vehicle used by the local authority.
 - For turning movements at the head of cul-de-sac access streets sufficient area is provided for the "design single unit" truck to make a three-point turn or, where the length of the cul-de-sac is less than 60m, for the "design car" to make a three-point turn. Where driveway entrances are to be used for turning movements, the required area is to be designed and constructed to withstand the relevant loads.
11. Turning radii at intersections or driveways on trunk collector road accommodate the intended movements without allowing desired speeds to be exceeded. **Turning Radii**
12. On bus routes 3-centred curves with radii 7.0m, 10.0m, 7.0m are used at junctions and intersections. **Bus Routes**

D1.18 ROUNDABOUTS

1. Roundabouts are to be approved by the Council and VicRoads. **Approval**
2. Roundabouts should generally be designed in accordance with the requirements of the publication

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AUSTROADS Guide to Traffic Engineering Practice - PART 6 Roundabouts. Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following:

Criteria

- entry width to provide adequate capacity
- adequate circulation width, compatible with the entry widths and design vehicles eg. buses, trucks, cars.

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- central islands of diameter sufficient only to give drivers guidance on the manoeuvres expected
- deflection of the traffic to the left on entry to promote gyratory movement
- adequate deflection of crossing movements to ensure low traffic speeds
- a simple, clear and conspicuous layout
- design to ensure that the speed of all vehicles approaching the intersection will be less than 50 km/h.
- Pedestrian crossing facilities associated with roundabouts must be sited clear of circulating vehicle paths and must meet DDA compliance requirements.

D1.19 TRAFFIC CALMING

1. Traffic calming devices are to be approved by the Council. **Approval**
2. Calming devices such as thresholds, slowpoints, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of the publication AUSTROADS Guide to Traffic Management Part 8, Local Area Traffic Management (LATM). Devices designs should generally comply with the following: **Criteria**

(a) Streetscape

- reduce the linearity of the street by segmentation
- avoid continuous long straight lines (eg. kerb lines)
- enhance existing landscape character
- maximise continuity between existing and new landscape areas.

(b) 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 100-150m.

(c) Design Vehicles

- emergency vehicles must be able to reach all residences and properties
- no obstructions by roads at the access to all emergency vehicle depots
- 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 LATM principles, building construction traffic must be provided for.

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- Industrial estates must be able to accommodate the movement of B-Double and Higher Mass Limit Vehicles.

(d) 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 300m), using appropriate devices, streetscapes, or street alignment to create short sight lines

(e) 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.

(f) Critical Dimensions

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

- pavement narrowings
 - single lane 3.50m between kerbs
 - 3.75m between obstructions
 - two lane 5.50m minimum between kerbs
- bicycle lanes (including adjacent to pavement narrowings) - 1.2m absolute minimum (1.0m in special circumstances in accordance with AUSTRROADS Guide to Traffic Engineering Practice – PART 14, Bicycles)
- plateau or platform areas
 - 75mm to 150mm height maximum, with 1 in 15 ramp slope
- width of clear sight path through slowing devices
 - 1.0m maximum

(i.e. the width of the portion of carriageway which does not have its line of

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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.

D1.20 BUS SERVICES

The following requirements are set out at Clause 56.03/6 in the Greater Dandenong Planning Scheme.

(a) Public Transport Objectives

To provide for bus routes that are accessible from all dwellings and activity centres and efficient to operate.

To provide a movement network in the vicinity of fixed rail that is focused towards passenger stops.

To establish a movement network that provides convenient linkages to activity centres and local facilities either within or adjoining the development.

(b) Standard C13

The street and road network should provide for access to public transport within a reasonable safe and convenient walking distance of all dwellings.

Proposed bus routes should connect efficiently with existing or likely future bus routes, to provide for ease of movement of buses between developments, and to link major activity centres internal and external to the development.

Bus Routes

Buses should be able to safely access the development and move safely between developments without complicated turning manoeuvres.

The alignment and geometry of streets that form bus routes should provide for the efficient and unimpeded movement of buses.

Streets suitable for bus routes through the development should be no more than 30 percent longer than the bus routes available on the adjacent traffic route network.

Street networks near railway stations and major light rail routes should be focussed towards stops to provide high levels of accessibility and surveillance.

At least 90 percent of dwellings should be within 400 metres safe walking distance from an existing or proposed bus, tram or light rail route and should not be more than 500 metres from the nearest stop, or within 800 metres of a railway station.

(c) Council Policy – Provision of Bus Stops

I. Background

The Department of Infrastructure is responsible for the number, location and signage of bus stops throughout the municipality.

Council is responsible for paving, shelter, lighting, seating, rubbish bins, setbacks, line marking and all stops must achieve DDA compliance requirements.

The facilities provided at any one stop will depend on:

1. The location of the stop

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2. The patronage level
3. The age of the patrons
4. The availability of funds.

The bus stops selected for the installation of shelters is determined in conjunction with public requests and the bus company serving the particular bus route.

Sites are inspected to ensure that the installation of a shelter is feasible, appropriate, would not hinder future works in the area, would not hinder access to the adjacent property and would not adversely impact on the surrounding area.

II. Standard

One style of bus shelter adopted throughout the municipality.

One factor that must be taken into consideration is that of safety for the travelling public. This is achieved by ensuring bus shelters provide maximum visibility. Maximum visibility to be achieved by the installation of glass (or plastic) on all the panels of the shelter.

Bus Stops Standard

Existing non compliant shelters are to be updated to current adopted style.

III. Funding

The initial funding source for the installation of facilities at bus shelters is via Council's city Improvement Program.

A subsidy of \$1,000 per shelter is available through the Department of Infrastructure.

The installation of additional shelters can be funded through advertising. This would be subject to a suitable agreement being entered into covering such issues as the style and content advertising material being to Council's satisfaction, issue of Planning Permits, advertising being restricted to the main road bus routes.

IV. Advertising

Advertising to be confined to the panel on the departure side of the shelter. The panel is to be internally illuminated. The internal illumination is to also serve to light the bus shelter thus improving the safety of the shelter.

As not all bus stops or shelters are suitable for the placement of advertising, shelters with advertising shall be limited to the main roads.

Advertising on Bus Shelters

In line with Council's objective to develop a high profile for the municipality it is essential that the standard and quality of shelters and the advertising material meet this objective.

Style and content of the advertising material to be to Council's satisfaction.

V. Taxi Ranks

Taxi Ranks, where appropriate are to be included on the list for the installation of shelters.

Taxi Ranks

IV. Maintenance

In line with Council's objective to develop a high profile for the municipality it is essential that the standard of maintenance of the shelters meet this objective.

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D1.21 STREET LIGHTING & ELECTRIC POWER SUPPLY

PUBLIC LIGHTING OF ROADS/ROAD RESERVES/FOOTPATHS/CAR PARKS shall be in accordance with the provisions of the following standards:

Standards Australia AS/NZS

1158.0 : 2005 Road Lighting Introduction

1158.1.1 :2005 Road Lighting Part 1 lighting performance and Installation Design requirements - Vehicular traffic (Category V),

1158.1.3 :2005 Road Lighting Part 1.3 – Guide to design , installation, operation and maintenance (Category V)

1158.3.1 :2005 Pedestrian Area (Category P) lighting-Performance and installation design requirements.

1798: preferred Dimensions for Lighting Columns and Bracket Arms and generally in accordance with the recommendations contained within AustRoads “Guide to Traffic Engineering Practice-Roadway Lighting” guidelines.

4282 :1997 Control of the Obtrusive effects of Outdoor Lighting

- *DESIGN BRIEF* for Category V or P lighting shall be submitted to Council for written approval prior to the design of the public lighting being undertaken.
- *Appendix 2 - Public Lighting Administrative Policy – The appendix provides the detailed explanation of the application of the standards for the various types of lighting installations.*
- *DOCUMENTATION OF COMPLIANCE* with Mandatory Requirements shall be supplied with the design drawings and specifications by the designer to Council for acceptance and written approval. No public lighting works are to be undertaken until Council’s written acceptance of the public lighting design.
- All *ELECTRICAL POWER SUPPLY* cables & conduits are to be installed underground, at the offsets shown on Council’s standard drawings.
- *PUBLIC LIGHTING ASSETS AND INSTALLATIONS* must be to the responsible public lighting authority’s approved standards and specifications or as otherwise approved by Council in writing. The installation of non-standard public lighting shall be subject to Council’s written approval and Council reserves the right to determine the preferred type, design and category of non standard installations.
- *PUBLIC LIGHTING DESIGN DRAWINGS* are to part of the compilation of drawings that form the complete subdivision design (see p.49 of this manual for details). The lighting design drawings must show, inter alia – luminaire / pole schedule, footing details, as installed pole spacing.

D1.22 PEDESTRIANS AND CYCLISTS

Requirements of Clause 56.04 of the Greater Dandenong Planning Scheme are -

(a) Pedestrian and Cyclists Objectives

To provide a safe, convenient and legible network of on-street and off-street paths for pedestrians and cyclists to points of attraction within and beyond the development.

To design & develop new residential communities to promote walking and cycling to daily activities.

(b) Standard C14

Subdivisions should provide a network of pedestrian and bicycle paths in accordance with any relevant approved state, regional or local walking trail or bicycle plan and constructed in accordance with the Austroads Guide to Road Design – Part 6A, (Pedestrians and Cyclists).

The residential street network should be designed to:

- Provide a network of low traffic volume & low traffic speed routes for cyclists.
- Promote the use of streets for on-road cycling to daily activities.
- Connect abutting cul-de-sac heads with pedestrian and bicycle paths.

Footpaths and bicycle paths should be provided on streets in accordance with the requirements specified in Table C7.

Footpaths and pathways should be designed and located in compliance with DDA requirements, and have regard for pedestrian amenity, sun and shade, postal deliveries and other likely use patterns.

Footpaths should be provided on both sides of an access street. It may be acceptable for footpaths to be provided on one side of a street if:

- There is no development fronting that side of the street or topography or vegetation precludes provision.
- Vehicle volumes and speeds are low and the use of the street pavement is considered safe and comfortable for some pedestrian use.
- Adequate arrangements are made for postal delivery.

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- Pedestrian use will not be deterred by the lack of a footpath.

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Footpaths or shared paths must:

- Comply with DDA requirements
- Be constructed with a durable, non-skid surface.
- Be constructed in accordance with an approved construction standard.
- Be of sufficient width and strength to cater for projected user types and volumes.
- Facilitate ease of use by the disabled, aged and very young.

Maximum longitudinal gradient of bicycle paths should generally be no greater than any adjacent street pavement and provide for safe sight distances at crossings.

Alignment of paths should:

- Allow safe and convenient use by pedestrians and cyclists.
- Be varied to protect trees and other significant features.
- Focus on vistas and landmarks to add visual interest where possible.

RURAL DESIGN CRITERIA

D1.23 GENERAL

1. In addition to the foregoing sections this section specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farms types of developments.

2. Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in AUSTRROADS Guide to the Geometric Design of Rural Roads.

Design Speed

3. Where appropriate superelevation, widening and centreline shift and their associated transitions are to comply with the VicRoads Road Design Guidelines or AUSTRROADS Guide.

4. Where the table drain is likely to scour a dish drain, or similar structure is to be constructed along the invert. Also for grades of less than 0.8%, the inverts of the drain are to be lined with approved material to prevent siltation.

Table Drain

5. All rural subdivisions should be designed to restrict access to major roads.

6. Rural residential subdivisions may be required to provide kerb and channel on both sides of roads and piped drainage.

Kerb and Channel

7. Vehicle access should be limited to one point on to local, collector, trunk collector road networks.

Access

D1.24 SIGHT DISTANCES

1. Stopping and minimum sight distances. Stopping sight distance should be provided at all points on the road. The stopping distance is measured from an eye height of 1.15m to an object height of 0.20m, using a reaction time of 1.5 seconds. A minimum sight distance measured from a height of 1.15m to a height of 1.15m is preferable for speeds of 60 km/h and over. Tables are provided in the VicRoads Road Design Guidelines.

Stopping Distance

Sight Distance

2. Stopping distance is the sum of the braking distance and the distance the vehicle travels during a reaction time of 1.5 seconds, and may be calculated using the following formula:

Braking Distance

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$$d = 0.42V + \frac{V^2}{254f}$$

Where d = stopping distance (m)
 V = speed of vehicle (km/h)
 f = coefficient of longitudinal friction

(Source: AUSTROADS Guide to the Geometric Design of Rural Roads,)

3. Recommended sight distances (based on the VicRoads Road Design Guidelines and adjusted to include lower speeds and minimum sight distances using the above formula) are shown in Table D1.7.

Table D1.7 Stopping Sight Distance

Travel Speed km/h	Coefficient of * longitudinal friction	Stopping sight distance (m)	Minimum sight distances (m)
40	0.52	33	**
50	0.50	46	**
60	0.47	60	180
70	0.45	80	220
80	0.43	100	260

* bituminous or concrete surfaces

** not applicable at lower speeds

4. These figures may apply on crest vertical curves only where there are straight alignments. Adjustments should be calculated for steep grades.

D1.25 HORIZONTAL AND VERTICAL ALIGNMENT

1. Horizontal and vertical curves are to be designed generally to the requirements of AUSTROADS - Guide to Geometric Design of Rural Roads. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform with the terrain to achieve desirable aesthetic quality and being in harmony with the landform.

Criteria

D1.26 INTERSECTIONS

1. Intersections should generally be designed in accordance with the publication AUSTROADS Guide to Traffic Engineering Practice - Part 5, Intersections at Grade. Generally intersections with existing main and local roads will conform to the layouts shown in Figure D1.6 below. The type of intersection required will depend on existing and planned connecting roads. Where required pedestrian access must be DDA compliant

Criteria

2. Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location shall be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

Sight Distance

ASD relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.

ESD relates to the driver entering the intersection from a minor road and ability to

observe the roadway layout and assess traffic gaps.

SISD relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration so as to provide adequate stopping distance in potential collision situations.

Tabulated speed/sight distance requirements together with detailed explanations for each of the sight distance criteria are given in Part 5 of the AUSTRROADS Guide, Intersections at Grade. Repositioning of an intersection may be required to obtain conformance with the sight distance criteria.

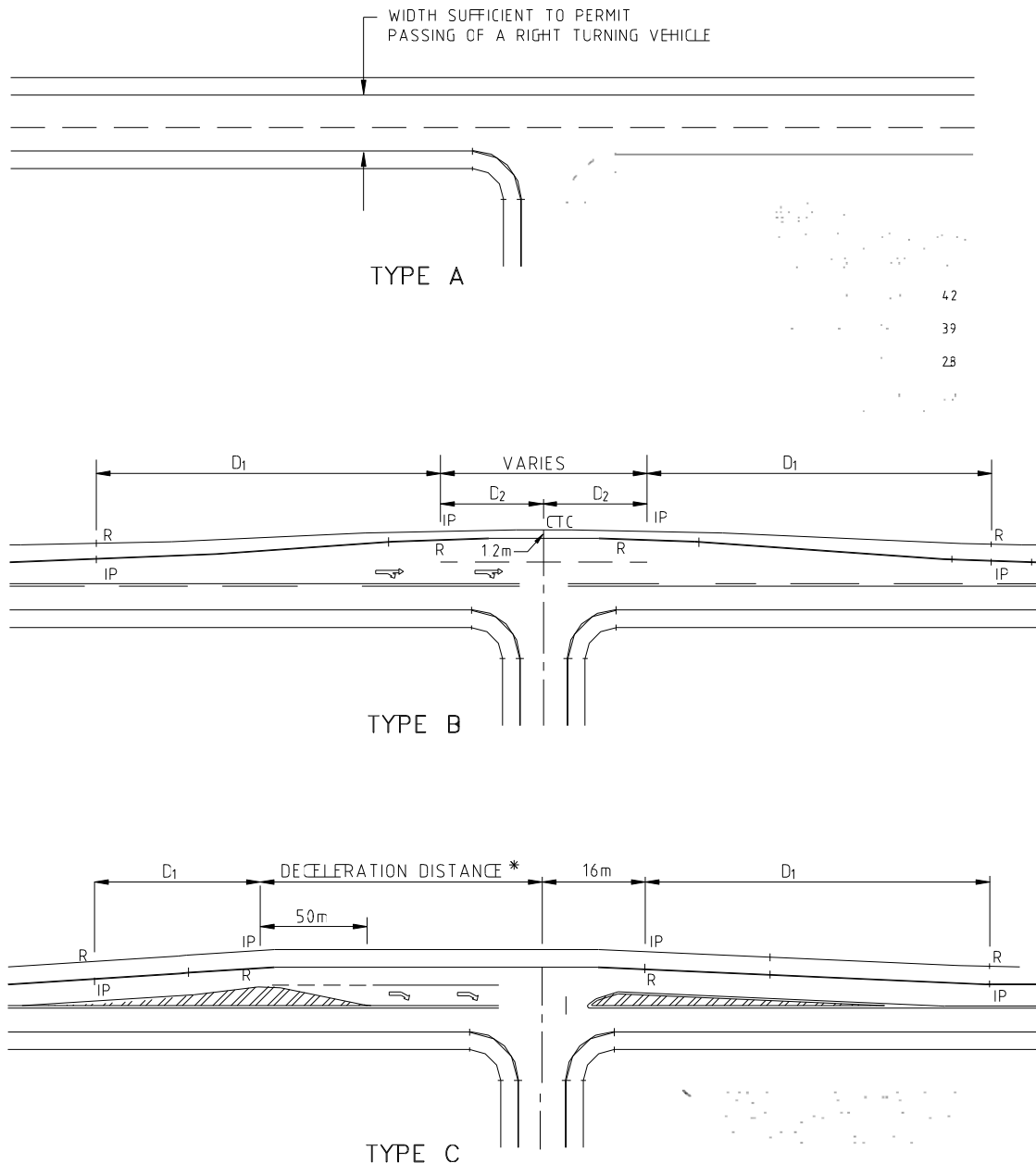


Figure D1.6 Typical Rural Intersection Treatments

Source: AUSTRROADS Guide to Traffic Engineering Practice PART 5, Intersections at Grade.

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3. Staggered-T arrangements proposed for rural cross-intersections should preferably be of the "right to left" type. This arrangement eliminates traffic queuing in the major road, the need for additional pavement for right turn lanes and greater stagger length associated with "left to right" T-intersections. Figures and discussion on staggered-T treatments are given in Part 5 of the AUSTRROADS Guide, Intersections at Grade.

Staggered-T Intersections

D1.27 PLAN TRANSITIONS

1. A plan transition is the length over which widening and shift is developed from the "tangent-spiral" point to the "spiral-curve" point; ie, the length between the tangent and the curve. In urban road design it is often impracticable to use plan transitions as kerb lines are fixed in plan and any shift requires carriageway widening. Widening on horizontal curves compensates for differential tracking of front and rear wheels of vehicles; overhang of vehicles; and transition paths. Where proposed roads are curved, the adequacy of carriageway width should be considered.

Widening and shift on Curves

2. Abrupt changes in crossfall, can cause discomfort in travel and create a visible kink in the kerb line. A rate of change of kerb line of no more than 0.5 per cent relative to the centreline should ensure against this. The wider the pavement the longer the transition. Superelevation transitions should be used at all changes in crossfall, not just for curves. Drainage problems can arise with superelevation transitions which may require extra side entry pits and steeper channel crossfalls. Where crossfalls change at intersections, profiles of the kerb line should be drawn. Calculated points can be adjusted to present a smooth curve.

Crossfall Changes

D1.28 CARRIAGEWAYS

Refer to Table D1.5 for general design parameters

D1.29 SUPERELEVATION

1. Use of maximum superelevation will be considered where the radius of the curve in approaching the minimum speed environment. Reference should be made to AUSTRROADS Guide to Geometric Design of Rural Roads for superelevation calculation. At low and intermediate ranges of design speed (i.e. below 80 km/h) it is desirable to superelevate all curves at least to a value equal the normal crossfall of straights.

Design Speed

D1.30 SCOUR PROTECTION / FILTRATION

1. Scour protection of roadside drainage and table drains is required. The level of protection will depend on the nature of the soils, road gradients and volume of stormwater runoff. Protection works may involve concrete lined channels, turfing, rock beaching, grass seeding, wetland plantings, individually or any combination of these. Geotechnical investigations should be carried out of determine the level and extent of any protection works prior to proceeding to final design stage.

Roadside Drainage and Table Drains

SPECIAL REQUIREMENTS

D1.31 STREET TREES

1. Street trees shall be planted and maintained by the Developer in accordance with an approved Street Tree Planting Schedule

2. Species to be planted shall be selected from the "Approved Species List" available from Council and shall comply with Council's Verge Width Policy with regards to species type. Inappropriate species for the verge width available will not be permitted.

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**CITY OF GREATER
DANDENONG**

**SUBDIVISION DESIGN
SPECIFICATION**

D2

PAVEMENT DESIGN

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PAVEMENT DESIGN

GENERAL

D2.01 SCOPE

1. The work to be executed under this Specification consists of the design of the road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface. ***Design Criteria***

2. The Specification contains procedures for the design of the following forms of surfaced road pavement construction: ***Surfaced Pavement Types***
 - (a) flexible pavements consisting of unbound granular materials;
 - (b) flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;
 - (c) rigid pavements (ie. cement concrete pavements);
 - (d) concrete or clay segmental pavements.

3. Consideration to the design of unsealed (gravel) pavements will only be given for minor rural subdivisions/developments in isolated rural areas where the access to the subdivision is via an existing unsealed road. ***Unsealed Pavements***

D2.02 OBJECTIVES

1. 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. ***Pavement Performance***

D2.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

D1	-	Geometric Road Design
D4	-	Subsurface Drainage Design
C242	-	Flexible Pavements
C244	-	Sprayed Bituminous Surfacing
C245	-	Asphalt
C247	-	Mass Concrete Subbase
C248	-	Plain or Reinforced Concrete Base
C254	-	Segmental Paving
C255	-	Bituminous Microsurfacing

(b) VIC State Authorities

Bituminous Sprayed Surfacing Manual - Technical Bulletin No 54 - April 2004

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(c) Other

- AUSTROADS - Guide to Pavement Technology
- AUSTROADS - Guide to Control of Moisture in Roads.
- ARRB-SR41 - Australian Road Research Board, Special Report No. 41 - A Structural Design Guide for Flexible Residential Street Pavements, 1989.
- Cement and Concrete Association of Australia.
 CACA - T51 - Concrete Pavement Design for Residential Streets, Second Edition 2004
- 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 Segmental Pavements, A Design and Construction Guide for Sites Subjected to Vehicular and Pedestrian Traffic, 1989.

PAVEMENT DESIGN CRITERIA**D2.04 DESIGN VARIABLES**

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

- (a) Design Traffic
- (b) Subgrade Evaluation
- (c) Environment
- (d) Pavement and Surfacing Materials
- (e) Construction and Maintenance Considerations

D2.05 DESIGN TRAFFIC

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

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

**Minimum
Pavement
Design Life**

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2. 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 new subdivisions, the design traffic shall take account of both the construction traffic associated with the subdivision development and the in-service traffic for the subdivision and any future developments linked to that subdivision. 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.

**Equivalent
Standard
Axles**

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

Traffic Data

4. In general, reference should be made to ARRB-SR41 for the calculation of design traffic volumes up to 10^6 ESAs and AUSTRROADS Pavement Design for design traffic volumes approaching or exceeding 10^6 ESAs. Refer also to Tables 2.7a and 2.7b.

**Design Traffic
Volumes**

D2.06 SUBGRADE EVALUATION

1. Except where a mechanistic design approach is employed using AUSTRROADS Pavement Design, 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).

**California
Bearing Ratio**

2. The following factors must be considered in determining the design strength/stiffness of the subgrade:

**Design
Considerations**

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

3. The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must 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 Specification for 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.

**Design CBR
Considerations**

4. 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 ARRB SR41) to give an estimated equilibrium in-situ CBR. The Design CBR for each subgrade area is computed by using the appropriate formulae as follows:

**Calculation of
Design CBR**

Design CBR = Least of estimated CBRs, for less than five results

Design CBR = 10th percentile of all estimated CBRs, for five or more results

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$$= C - 1.3S$$

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

5. 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. **Field Confirmation**

6. 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. **Summary of Results**

D2.07 ENVIRONMENT

1. 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 AUSTRROADS Pavement Design, ARRB-SR41, and to NAASRA (Now AUSTRROADS) - Guide to Control of Moisture in Roads. **Moisture and Temperature**

2. The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials: **Moisture Considerations**

- (a) Rainfall/evaporation pattern
- (b) Permeability of wearing surface
- (c) Depth of water table and salinity problems
- (d) Relative permeability of pavement layers
- (e) Whether shoulders are sealed or not
- (f) Pavement type (boxed or full width)

3. 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 (ie. CBR or modulus) at the highest moisture content likely to occur during the design life, ie 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. **Evaluate Design CBR**

4. 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. **Temperature Change**

5. 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.

D2.08 PAVEMENT AND SURFACING MATERIALS

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

- (a) Unbound granular materials, including modified granular materials

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- (b) Bound (cemented) granular materials
- (c) Asphalt
- (d) Cement Concrete

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

**Surfacing
Classification**

- (a) Sprayed bituminous seals (flush seals)
- (b) Asphalt and bituminous microsurfacing (cold overlay)
- (c) Cement Concrete
- (d) Concrete Segmental Pavers
- (e) Clay Segmental Pavers

3. Unbound granular materials, including modified granular materials, shall satisfy the requirements of the Construction Specification for FLEXIBLE PAVEMENTS.

4. Bound (cemented) granular materials shall satisfy the requirements of the Construction Specification for FLEXIBLE PAVEMENTS.

5. Asphaltic concrete shall satisfy the requirements of the Construction Specification for ASPHALT.

6. Cement concrete shall satisfy the requirements of the Construction Specifications for MASS CONCRETE SUBBASE, PLAIN OR REINFORCED CONCRETE BASE, or FIBRE REINFORCED CONCRETE, as appropriate.

7. Sprayed bituminous seals shall satisfy the requirements of the Construction Specification for SPRAYED BITUMINOUS SURFACING.

8. Concrete and clay segmental pavers shall satisfy the requirements of the Construction Specification for SEGMENTAL PAVING.

9. Bituminous microsurfacing (cold overlay) shall satisfy the requirements of the Construction Specification for BITUMINOUS MICROSURFACING.

D2.09 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

1. 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:

- (a) Extent and type of drainage
- (b) Use of boxed or full width construction
- (c) Use of stabilisation
- (d) Aesthetic, environmental and safety requirements
- (e) Social considerations
- (f) Construction under traffic
- (g) Use of staged construction
- (h) Ongoing and long-term maintenance costs

These factors are further discussed in AUSTRROADS Pavement Design.

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PAVEMENT THICKNESS DESIGN

D2.10 PAVEMENT STRUCTURE - GENERAL

1. The pavement thickness, including the thickness of surfacings, shall not be less than 250mm for roads in which kerb and channelling is to be constructed, 200mm for unkerbed roads and 150mm for carparks. **Minimum Pavement Thickness**
2. Notwithstanding subgrade testing and subsequent pavement thickness design, the thickness of subbase and base layers shall not be less than those set out in Tables 2.7a and 2.7b.
3. The subbase layer shall extend a minimum of 150mm behind the rear face of any kerbing and/or channelling. **Subbase Extent**
4. The base and surfacing shall extend to the face of any kerbing and/or channelling. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or channelling, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing and/or channelling. **Base Extent**
5. For unkerbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder. **Unkerbed Roads**
6. The pavement designer shall make specific allowance for traffic load concentrations within carpark areas (eg entrances/exits), traffic lights and at major intersections. **Carparks**
7. 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. **Drainage**

D2.11 UNBOUND GRANULAR FLEXIBLE PAVEMENTS (BITUMINOUS SURFACED)

1. 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 ARRB-SR41, using Figure 7 (95% confidence limit curves).
2. For design traffic above 10^6 ESAs, the design shall be in accordance with AUSTROADS Pavement Design.

D2.12 FLEXIBLE PAVEMENTS CONTAINING BOUND LAYERS (BITUMINOUS SURFACED)

1. 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.
2. 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 ARRB-SR41, using Figure 7 (95% confidence limit curves).
3. **RECYCLED CONCRETE MATERIALS** - Where it is proposed to make use of recycled materials in flexible pavements, the requirements of Vicroads Standard Section 820 shall be met for the manufacture of recycled concrete and plant mixed wet mix crushed concrete products. Where it is proposed to incorporate a cement treated bound layer in a pavement subbase using nominal 20mm sized recycled concrete material, the product shall conform to the requirements of Vicroads standard section 821.
4. **RECLAIMED ASPHALT PAVEMENT (RAP)** Reclaimed, comingled asphalt and pavement material may be permitted to be used in new asphalt production provided it has

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been crushed and screened and is free of contaminants. Vicroads standard specification 407 must be complied with and the maximum allowable amount of RAP to be included will be determined by the mix design which is required to meet loading and service conditions of the pavement. Accredited comparative performance test results may be submitted to justify the use of a higher percentage of RAP, where these tests show that the higher percentage of RAP provides better performance outcomes than the corresponding mix using virgin components.

5. **CRUSHED GLASS FINES** Glass fines manufactured from container glass cullet, free from contamination and graded to a 5mm product may be used in non-wearing course asphalt layers as detailed in the product mix design where these meet the requirements of Vicroads standard section 702.

6. **REGISTRATION OF MIX** Crushed granular mixes incorporating recycled materials must comply with Vicroads Code of Practice RC 500 series relevant to the proposed application. These materials may be classified as general or conditional according to their level of compliance with the code of practice.

7. **MIX GUIDANCE MATRIX** Vicroads Technical Note 107 (September 2011) provides comprehensive advice on how materials are to be used as alternatives to conventional products.

D2.13 RIGID PAVEMENTS

1. Rigid (concrete) pavements, with design traffic up to 10^6 ESAs shall be designed in accordance with either CACA -T51 or AUSTRROADS Pavement Design.

2. Rigid (concrete) pavements for design traffic above 10^6 ESAs, the design shall be

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in accordance with AUSTRROADS Pavement Design.

D2.14 CONCRETE SEGMENTAL PAVEMENTS

1. Concrete segmental pavements with design traffic up to 10^6 estimated commercial vehicles exceeding 3T gross shall be designed in accordance with CMAA-T45.
2. For design traffic above 10^6 estimated commercial vehicles exceeding 3T gross the design shall be in accordance with AUSTRROADS Pavement Design, with the calculation of design traffic in terms of ESAs.

D2.15 CLAY SEGMENTAL PAVEMENTS

1. Clay segmental pavements with design traffic up to 10^6 ESAs shall be designed in accordance with Design Manual 1 - Clay Segmental Pavements.
2. For design traffic above 10^6 ESAs and up to 10^7 ESAs the design shall involve consideration of both Design Manual 1 - Clay Segmental Pavements and AUSTRROADS Pavement Design, with the thicker and more conservative design of each of the two methods adopted.
3. For design traffic above 10^7 ESAs, the pavement shall be designed in accordance with AUSTRROADS Pavement Design.

SURFACING DESIGN

D2.16 CHOICE OF SURFACE TYPE

1. Except where the pavement is designed for concrete or segmental block surfacing, the wearing surface shall be a bituminous wearing surface as follows:-

***Bitumen
Wearing
Surface***

- (a) Urban Residential streets - Access Place and Access Street:
 - prime and/or primer seal, plus asphalt.
- (b) Urban Residential streets - Collector and Trunk Collector
 - prime and/or primer seal, plus asphalt.
- (c) Commercial and Industrial streets:
 - prime and/or primer seal, plus asphalt
- (d) Rural Residential streets:
 - prime and/or primer seal, plus asphalt.

2. At intersection approaches and cul-de-sac turning circles on rural roads with flush seals, either bituminous microsurfacing or asphalt surfacing shall be provided within the vehicle braking and turning zones.

***Braking and
Turning Zones***

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

Approval

D2.17 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)

1. The design of sprayed bituminous (flush) seals, including primer seals, shall be in

Seal Design

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accordance with the VicRoads Bituminous Surfacing Manual.

2. 7mm primer seals shall be indicated on the Drawings below all flush seals, bituminous microsurfacing, and asphalt surfacings. Where a 7mm primer seal is impractical, a 10mm primer seal shall be indicated in lieu. **Primer Seal**

3. 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: **Two-Coat Flush Seals**

1st coat	14mm
2nd coat	7mm

4. Single coat flush seals shall be allowable if bituminous microsurfacing (or asphaltic concrete) is to be applied as the finished surface. The preferred seal type is either 14mm or 10mm. **Single Coat Flush Seal**

D2.18 ASPHALT

1. 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 the ARRB Gap-graded mix in accordance with ARRB-SR41 and the Construction Specification for ASPHALT. **Light to Medium Traffic**

2. In urban residential collector and trunk collector 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 Construction Specification for ASPHALT. **Medium to Heavy Traffic**

3. Asphalt surfacings shall be designed in accordance with Table 2.7(a) and 2.7(b). **Minimum Thickness**

4. Unless otherwise specified the following method of construction using asphalt shall be followed:

- i. Unless otherwise directed by the Delegated Engineer, upon completion of the road pavement and preparation of pavement surface, a prime shall be applied at the correct application. **Primer-sealing**

DOCUMENTATION

D2.19 DESIGN CRITERIA AND CALCULATIONS

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

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

SPECIAL REQUIREMENTS

D2.20 NATA ACCREDITED TESTING

1. All testing required by the quality requirements of the specification shall be undertaken by a NATA accredited laboratory. **NATA**

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Table 2.7a – MINIMUM PAVEMENT COMPOSITION REQUIREMENTS FOR RESIDENTIAL ROADS AND STREETS (6)

		ACCESS PLACE (4)		ACCESS STREET (4)		COLLECTOR ROAD (4)		TRUNK COLLECTOR (5)	
Wearing Course	Minimum Thickness	30mm		30mm		40mm		40mm	
	Material type	VicRoads Asphalt Type L Size 10 mix		VicRoads Asphalt Type N Size 10 mix		VicRoads Asphalt Type N Size 10 mix		VicRoads Asphalt Type H Size 10 mix	
Prime	Material type	Prime or Primer Seal		Prime or Primer Seal		Prime or Primer Seal		Prime or Primer Seal	
Base Course	Minimum thickness	170mm		170mm		160mm		160mm	
	Material type	VicRoads Class 2 Crushed Rock		VicRoads Class 2 Crushed Rock		VicRoads Class 2 Crushed Rock		VicRoads Class 2 Crushed Rock	
Upper Subbase Course	Minimum thickness	50mm		100mm		150mm		200mm	
	Material type	VicRoads Class 3 Crushed Rock or CGD11		VicRoads Class 3 Crushed Rock or CGD11		VicRoads Class 3 Crushed Rock		VicRoads Class 3 Crushed Rock	
Lower Subbase Course	Minimum thickness	100mm (1)	150mm (2)	100mm (1)	150mm (2)	100mm (1)	150mm (2)	100mm (1)	150mm (2)
	Material type	VicRoads Class 4 Crushed Rock or CGD12	Stabilised Soil (3)	VicRoads Class 4 Crushed Rock or CGD12	Stabilised Soil (3)	VicRoads Class 4 Crushed Rock or CGD12	Stabilised Soil (3)	VicRoads Class 4 Crushed Rock or CGD12	Stabilised Soil (3)
Select Filling (if required)	Minimum thickness	As required for construction purposes.							
	Material type	CGD12 or Type A filling (in accordance with VicRoads Standard Specification 204)							

- Notes:
- (1) If required. Actual thickness subject to design. Minimum thickness 100mm.
 - (2) Actual in-situ stabilisation depth is 200mm. Only 150mm taken into account in thickness design (see Section 2.1.1.2 (d))
 - (3) May be lime stabilised soil or lime/cement stabilised soil complying with the requirements of City of Greater Dandenong Standard Specifications CC04 and CC04A, respectively.
 - (4) To be designed in accordance with ARRB-SR41, A Structural Design Guide for Flexible Residential Street Pavements 1989 &/or ARRB-R21, A Guide to the Design of New Pavements for Light Traffic 1998.
 - (5) To be designed in accordance with AUSTRROADS – Pavement Design, A Guide to the Structural Design of Road Pavements, 2004.
 - (6) Also refer to City of Greater Dandenong standard drawings SD 100 & SD 101.

Table 2.7b – MINIMUM PAVEMENT COMPOSITION REQUIREMENTS FOR RESIDENTIAL ROADS AND STREETS (6)

		INDUSTRIAL ROAD (5)		RURAL ROAD/NON URBAN ZONE (6)	
Wearing Course	Minimum thickness	80mm (see SD 101)		-	
	Material type	VicRoads Asphalt Type H Size 20 mix		Two Coat Prime & Seal Size 7/14 aggregate	
Prime	Material type	Prime or Primer Seal		Prime or Primer Seal	
Base Course	Minimum thickness	120mm		100mm	
	Material type	VicRoads Class 2 Crushed Rock		VicRoads Class 2 Crushed Rock	
Upper Subbase Course	Minimum thickness	250mm		200mm	
	Material type	VicRoads Class 3 Crushed Rock or CGD11		VicRoads Class 3 Crushed Rock or CGD11	
Lower Subbase Course	Minimum thickness	100mm (1)	150mm (2)	100mm (1)	150mm (2)
	Material type	VicRoads Class 4 Crushed Rock or CGD12	Stabilised Soil (3)	VicRoads Class 4 Crushed Rock or CGD12	Stabilised Soil (3)
Select Filling (if required)	Minimum thickness	As required for construction purposes.			
	Material type	CGD12 or Type A filling (in accordance with VicRoads Standard Specification 204)			

- Notes:
- (1) If required. Actual thickness subject to design. Minimum thickness 100mm.
 - (2) Actual in-situ stabilisation depth is 200mm. Only 150mm taken into account in thickness design (see Section 2.1.1.2 (d))
 - (3) May be lime stabilised soil or lime/cement stabilised soil complying with the requirements of City of Greater Dandenong Standard Specifications CC04 and CC04A, respectively.
 - (4) To be designed in accordance with ARRB-SR41, A Structural Design Guide for Flexible Residential Street Pavements 1989 &/or ARRB-R21, A Guide to the Design of New Pavements for Light Traffic 1998.
 - (5) To be designed in accordance with AUSTRROADS – Pavement Design, A Guide to the Structural Design of Road Pavements, 2004.
 - (6) Also refer to City of Greater Dandenong standard drawings SD 100C & SD 101D.

CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D3

STRUCTURES BRIDGE DESIGN

Note: This section has been deleted from the Design Manual

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D4

SUBSURFACE DRAINAGE DESIGN

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DESIGN SPECIFICATION DM4 SUBSURFACE DRAINAGE DESIGN

GENERAL

D4.01 SCOPE

1. The work to be executed under this Specification consists of the design of the subsurface drainage system for the road pavement and/or subgrade.
2. This Specification contains procedures for the design of subsurface drainage, including:
 - (a) Subsoil and Foundation Drains
 - (b) Sub-Pavement Drains
 - (c) Drainage Mats, including Type A and Type B Mats.

D4.02 OBJECTIVES

1. 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. **Control Moisture Content**
2. 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. **Salinity Prevention**

D4.03 TERMINOLOGY

1. Subsoil drains are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings and fill areas. **Subsoil Drains**
2. Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation. **Foundation Drains**
3. 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. **Sub-pavement Drains**
4. 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 A Drainage Mats**
5. 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. **Type B Drainage Mats**

D4.04 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specification

AUS-SPEC #1 Document:

- | | | |
|-----|---|-------------------------------|
| 230 | - | Subsurface Drainage - General |
| 231 | - | Subsoil and Foundation Drains |
| 232 | - | Pavement Drains |
| 233 | - | Drainage Mats |

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(b) Australian Standards

- AS2439.1 - Perforated drainage pipe and associated fittings.
- AS/NZS 1477 - Unplasticised PVC (UPVC) pipes and fittings for pressure applications.

(c) Other

- AUSTROADS - Guide to the Control of Moisture in Roads, 1983
- ARRB-SR35 - Australian Road Research Board, Special Report No. 35 - Subsurface Drainage of Road Structures, Gerke R.J., 1987.
- ARRB-SR41 - Australian Road Research Board, Special Report No. 41 - A Structural Design Guide for Flexible Residential Street Pavements, Mulholland P.J., 1989.

SUBSOIL AND SUB-PAVEMENT DRAINS**D4.05 WARRANTS FOR USE**

1. Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings and fill areas. **Subsoil Drains**
2. Sub-pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade. **Sub-pavement Drains**
3. 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: **Geotechnical Survey**
 - (a) Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level. **Locations**
 - (b) Locations of known hillside seepage, high water table, isolated springs or, salt affected areas..
 - (c) Irrigated, flood-prone or other poorly drained areas.
 - (d) Highly moisture susceptible subgrades, ie. commonly displaying high plasticity or low soaked CBRs.
 - (e) Use of moisture susceptible pavement materials.
 - (f) Existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture.
 - (g) 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.

4. 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 **During Construction**

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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.

D4.06 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross sections of subsoil and sub-pavement drains are detailed in Councils standard drawings. As indicated in these drawings, subsoil drain trenches are excavated to below subgrade level, while sub-pavement drains extend into or adjacent to the pavement layers to facilitate drainage of the pavement layers in addition to the subgrade. **Typical Cross Sections**
2. In kerbed roads, the location for the line of the trench is directly behind the kerblines. Pavement layers must extend to at least the line of the rear of the trench. **Kerbed Roads**
3. 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 the standard drawings. **Unkerbed Roads**
4. The minimum desirable longitudinal design grade shall be 1.0%. For non corrugated pipes, an absolute minimum grade of 0.5% is acceptable. **Grade**
5. Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 600mm in earth and 450mm in rock, and below the invert level of any service crossings. **Trench Dimensions**
6. 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. **Outlets, Salinity Prevention**
7. Cleanouts are to 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. **Cleanouts**
8. 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. **Salinity Prevention**

FOUNDATION DRAINS

D4.07 WARRANTS FOR USE

1. 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. **Foundation Drains**
2. 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. **Geotechnical Survey During Construction**
3. Where the road formation traverses known swampy, flood-prone, salt affected **Need for**

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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.

Additional Drains

D4.08 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross-sections of foundation drains are shown below in Figure DM4.3.

Typical Cross Section

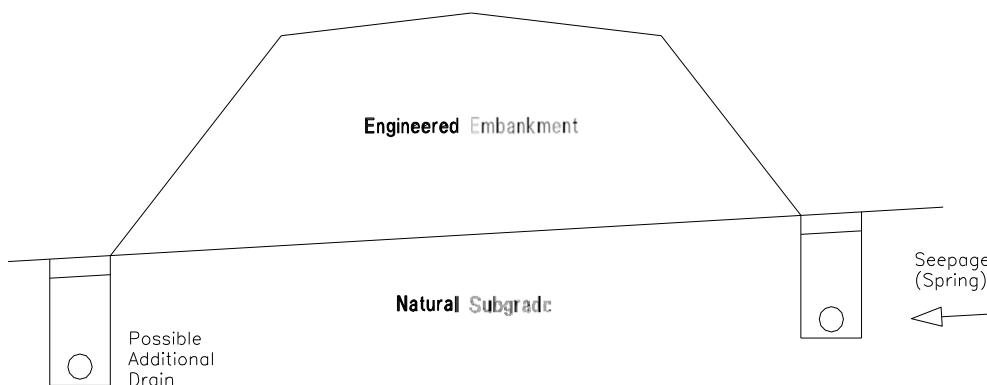


Figure DM4.3 - Foundation Drains

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

Grade

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

Trench Dimensions

4. Outlets shall be spaced at maximum intervals of 150 metres.

Outlets

5. 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.

Cleanouts

DRAINAGE MATS (BLANKETS)

D4.09 WARRANTS FOR USE

1. 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 A Mats

2. 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.

Type B Mats

3. The need to design for the provision of drainage mats should be apparent from the

Geotechnical

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result of the geotechnical survey along the proposed road formation alignment.

Survey

MATERIALS

D4.10 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

1. Pipes designated for subsoil, foundation and sub-pavement drains shall be 100mm dia. slotted pipe.
2. Corrugated plastic pipe shall conform with the requirements of AS2439.1. 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 AS2439.1.
3. Slotted rigid UPVC pipe shall be of a type and class approved by Council.
4. All pipe shall be slotted, and fitted with a suitable geotextile filter tube, except for cleanouts and outlets through fill batters which shall be unslotted pipe.

Slotted UPVC

D4.11 INTRA PAVEMENT DRAIN PIPE

1. Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses neither less than 150mm nor more than 200mm shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.
2. Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses exceeding 200mm shall be slotted pipe of a type and class approved by Council.
3. Pipes for use in Type B drainage mats shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

D4.12 FILTER MATERIAL

1. The types of filter material covered by this Specification shall include:
 - (a) Type A filter material for use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats.
 - (b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains.
 - (c) Type C filter material comprising crushed rock for use in Type A drainage mats.
 - (d) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.
2. Material requirements and gradings for each type of filter material are included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.
3. 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 Special Report 35.

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D4.13 GEOTEXTILE

1. To provide separation (ie. 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 the Construction Specification, SUBSURFACE DRAINAGE GENERAL.
2. Geotextile shall also be designated for both Type A and Type B Drainage Mats.

DOCUMENTATION**D4.14 DRAWINGS AND CALCULATIONS**

1. 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/channel or edge of pavement. The location of outlets and cleanouts shall also be indicated on the Drawings.
2. 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 Specification shall be submitted to Council's Delegated Officer for approval with the Drawings.

SPECIAL REQUIREMENTS

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D5

STORMWATER DRAINAGE DESIGN

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DESIGN MANUAL D5 STORMWATER DRAINAGE DESIGN

GENERAL

D5.01 SCOPE

1. The work to be executed under this Specification consists of the design of stormwater drainage systems for urban and rural areas.

D5.02 OBJECTIVES

1. The objectives of stormwater drainage design are as follows:

- (a) To prevent flood damage to the built and natural environment and prevent both short term and long term inundation of dwellings.
- (b) To minimize the risks to the public of exposure to high velocity flows or dangerously deep water bodies during or as a consequence of rainfall events.
- (c) To contain nuisance flows to a level that is acceptable to the community.
- (d) To ensure the street system operates adequately during and after major storm events.
- (e) To provide a stormwater system that minimises erosion and utilises open space in a manner that does not detract from its principal function.
- (f) To protect the environmental values and physical characteristics of receiving watercourses.

***Design
Objectives
Major Works***

***Design
Objectives
Minor Works***

The objectives of minor drainage design are as follows:

- (a) To prevent stormwater damage to property.
- (b) To provide a stormwater system that can be maintained economically.
- (c) To minimise the occurrence of traffic accidents during minor storm events.
- (d) To minimise increases in stormwater run-off and protect the environmental values and physical characteristics of receiving watercourses from degradation by urban run-off.

***Design
Principles***

2. In pursuit of these objectives, the following principles shall apply:

***New
Developments***

- (a) New Developments are to provide a stormwater drainage system in accordance with the "major/minor" system concept set out in Chapter 14 of Australian Rainfall & Runoff, 2003 (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.
- (b) Redevelopment - Where the proposed development replaces an existing development, the on-site drainage system is to be designed in such a way that the estimated peak flow rate from the redeveloped site for the design storm event does not exceed that which would be expected from the existing development subjected to the same design event.

***Re-
Development***

3. All stormwater design shall be undertaken in accordance with the principles for Water Sensitive Design. The City of Greater Dandenong has adopted a best practice environmental management approach in regard to the operation and maintenance of the stormwater management systems and proposes to improve stormwater quality by:

***Water
Sensitive
Design***

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- Assessing and planning operational activities which have potential to affect stormwater quality or quantity
- Development of stormwater management plans
- Planning for new developments and assessing development applications
- Planning and designing new drainage infrastructure
- By identifying opportunities to upgrade existing infrastructure to improve environmental performance

4. All stormwater systems donated to Council through the subdivisional and development process achieve their design lives due to the application of quality design and construction practices.

D5.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

- C220 - Stormwater Drainage - General
 - C221 - Pipe Drainage
 - C222 - Precast Box Culverts
 - C223 - Drainage Structures
 - C224 - Open Drains including Kerb & Channel
- City of Greater Dandenong Subdivision Checklist
Dandenong Planning Scheme Clause 56.09
City of Greater Dandenong Sustainable Stormwater Strategy City of Greater Dandenong Handbook of Drainage Design Guidelines
City of Greater Dandenong Water Sensitive Urban Design Guidelines and Specifications

(b) Australian Standards

- AS 1254 - Unplasticised PVC (uPVC) pipes and fittings for stormwater or surface water applications.
- AS 2032 - Code of practice for installation of uPVC pipe systems.
- AS/NZS 2566.1 - Buried flexible pipelines, structural design
- AS 3725 - Loads on buried concrete pipes.
- AS 4058 - Precast concrete pipes.
- AS 4139 - Fibre reinforced concrete pipes and fittings.

(c) VIC State Authorities

- VicRoads - Road Design Guidelines.

(d) Other

- CSIRO - Urban Stormwater – Best Practice Environmental Management and Guidelines 1999
- AUSTROADS - Bridge Design Code.
- Inst. of Eng. - Australian Rainfall and Runoff (AR&R) - A guide to flood estimation 2003.
- Concrete Pipe Association of Australia
 - Concrete Pipe Guide, charts for the selection of concrete pipes to suit varying conditions.
- Henderson, FM. Open Channel Flow, 1966.

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John Argue - Australian Road Research Board Special Report 34

- Stormwater drainage design in small urban catchments: a handbook for Australian practice.

Kingston City Council and Melbourne Water:2003 – Keeping our Stormwater Clean – A Guide for Building Sites

HYDROLOGY

D5.04 DESIGN RAINFALL DATA

1. Design Intensity-Frequency-Duration (IFD) Rainfall - IFD relationships shall be derived in accordance with Volume 1 Chapter 2, of AR&R, for the particular catchment under consideration.

I-F-D Relationships

2. The nine basic parameters read from Maps 1-9 in Volume 2 of AR&R shall be shown in the calculations submitted to Council, except where the Bureau of Meteorology provides a polynomial relationship for the catchment.

3. Where design IFD rainfalls are provided for specific locations these are provided in Council's current Handbook of Drainage Design Guidelines.

4. Design Average Recurrence Interval (ARI) Annual Exceedence Probability (AEP) - For design under the "major/minor" concept, the design ARIs or AEPs to be used are given below.

Average Recurrence Intervals

Storm Frequency and Coefficient of Run-off			
Development	Coefficient of	Storm Frequency	AEP
Residential lots			
Gross densities < 20 lots/ha	0.60	1 in 5 years	.181
Gross densities > 20 lots/ha	0.60	1 in 10 years	.095
Multi-Unit site	0.75	1 in 10 years	.095
Industrial	0.90	1 in 20 years	.049
Garden Industrial	0.75	1 in 20 years	.049
Commercial	0.90	1 in 100 years	.01
Roads	0.80	As per relevant area	
Pervious areas	0.20	As per relevant area	

Table D5.0

5. In addition, where a development is designed in such a way that the major system flows involve surcharge, then the underground system (both pipes and inlets) shall be designed to permit flows into and contain flows having an ARI of 1 in 100 years or AEP of .01 from the upstream catchment which would otherwise flow across the property. A surcharge path shall be defined for systems even where 1 in 100 year ARI or AEP of .01 flows can be maintained within the system. Surcharge paths shall only be provided across public land and will not be permitted over private property.

Easements in Private Property

D5.05 CATCHMENT AREA

1. The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or built paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.

Catchment Definition

2. 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.

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3. Catchment area land use shall be based on current available zoning information or proposed future zonings, where applicable.

D5.06 RATIONAL METHOD

1. Rational Method calculations to determine peak flows shall be carried out in accordance with Volume 1, Chapter 14, of AR&R and the requirements of this Specification.

2. All calculations shall be carried out by a qualified person experienced in hydrologic and hydraulic design.

**Qualified
Person**

3. Coefficients of Run-off shall be calculated based on Volume 1, Chapter 14.5 of AR&R and the Council's Handbook of Drainage Design Guidelines. Full details of coefficients utilised shall be provided

**Runoff
Coefficients**

4. Details of percentage impervious and Coefficients of Run-off for specific locations and for individual zonings are given in Council's current Handbook of Drainage Design Guidelines. These can be used in lieu of more detailed calculations.

5. 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.

**Times of
Concentration**

6. 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.

**Different Flow
Characteristics**

7. The time of concentration in an urban area shall be 7 minutes minimum and 20 minutes maximum unless sufficient evidence is provided to justify a greater time.

8. 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.

**Flow Paths to
Pits**

9. Surface roughness coefficients "n" shall generally be derived from information in Volume 1, Chapter 14 of AR&R and the City of Greater Dandenong Drainage Design Guidelines.

**Overland Flow
Retardance**

D5.07 COMPUTER MODELS

1. Where computer analysis programs are used, copies of the final data files shall be provided on submission of the design to Council and with the final drawings after approval by Council.

**Files to
Council**

2. Any computer analysis for stormwater design shall be compatible with the current City of Greater Dandenong requirements and produce a report in a format approved by Council.

Compatibility

HYDRAULICS

D5.08 HYDRAULIC GRADE LINE

1. Hydraulic calculations shall generally be carried out in accordance with AR&R and shall be undertaken by a qualified person experienced in hydrologic and hydraulic design. The calculations 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

**Qualified
Person**

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output.

Calculations

2. 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.

3. Downstream water surface level requirements are given below:-

Downstream Control

- (a) Known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event.
- (b) Where the downstream starting point is a pit and the hydraulic grade line is unknown, the obvert level of the pipe at the downstream pit is to be adopted.
- (c) 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.
- (d) 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.
- (e) 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.

D5.09 MINOR SYSTEM CRITERIA

1. The acceptable channel flow widths in the 20% probability event is 2.5 metres maximum. Wider flow widths may be approved on roads with flat grades.

Channel Flow Widths

2. Minimum conduit sizes shall be as follows:

Conduit Sizes

- Pipes 225mm diameter.
- Pipes under roads 300mm diameter
- Box Culverts 600mm wide x 300mm high. (To be used in special circumstances only)

3. Minimum and maximum velocity of flow in stormwater pipelines shall be 1.0m/sec and 3m/sec respectively.

Velocity Limits

4. The maximum rate of discharge at the entry point to a Melbourne Water drainage system shall be 0.3m/sec.

D5.10 PITS

1. Side Entry Pits shall be spaced so that the channel flow width is limited in accordance with this Specification 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.

Spacing

2. Other pits shall be provided:

- To enable access for maintenance.
- At changes in direction, grade, level or class of pipe.
- At junctions.

3. The maximum recommended spacing of pits, other than site entry pits, are given in Table D5.1 below:

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	Pipe Size (mm)	Spacing (m)
Generally	less than 1200	45 to 90
	1200 or larger	150
In tidal influence	all	100

Table D5.1 Pit Spacing

4. Kerb inlet lengths to side entry pits are to be a preferred maximum of 3.0m, with an absolute maximum of 5.0m where the grade is 10% or more, and an absolute maximum of 4.0m where the grade is less than 10%. Throat width and slope of throat shall comply with Council's standard drawings. In adopting these standards the Designer shall take into account the risk to both Council and the public as well as public safety.

Inlet Capacity

Throat Width

5. Information on pit capacities is available in the following sources:-

- Council's current Handbook of Drainage Design Guidelines.
- VicRoads Road Design Guidelines, with due allowance to inlet bypass due to grade, for grade inlet pits, and recognised orifice or weir formulae for sag inlet pits.
- Pit relationships given in Volume 1, Chapter 14 of AR&R.

6. None of these pit charts include any blockage factors. The percentage of theoretical capacity allowed in relation to type of pit is given in Table D5.2 below:-

Allowance for Inlet Blockage

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
Continuous Grade	Side entry	80%
Continuous Grade	Grated	50%
Continuous Grade	Combination	90%

Table D5.2 Allowable Pit Capacities

7. A "Pit Schedule" shall be submitted detailing the pit number, pit size, inlet pipe (S) diameter, outlet pipe diameter, invert levels of all pipes and finished surface levels.

Pit Schedule

D5.11 HYDRAULIC LOSSES

1. The pressure change co-efficient "Ke" shall be determined from the appropriate charts given in council's current Handbook of Drainage Design Guidelines.

Pit Losses

2. Allowable reduction in "Ke" due to benching is given in Council's current Handbook of Drainage Design Guidelines.

3. Computer program default pressure change coefficient "Ke" shall not be acceptable unless they are consistent with those from the charts in Council's current Handbook of Drainage Design Guidelines. The chart used and relevant coefficients for determining "Ke" value from that chart shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

4. Bends may be permissible in certain circumstances and discussions with Council regarding their use is required prior to detailed design. Appropriate values of pit pressure change coefficient at bends are given in Council's current Handbook of Drainage Design Guidelines.

Bend Losses

5. Where possible design should try to avoid clashes between services. However, where unavoidable clashes occur with existing sewer mains then the pressure change coefficient Kp shall be determined from the chart given in Council's current Handbook of Drainage Design Guidelines.

Service Entry Losses

6. Requirements for private pipes entering Council's system are given below:-

- (a) 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.
- (b) If a junction has to be added which is larger than 225mm then a junction pit shall be built at this location in accordance with this Specification.
- (c) 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.
- (d) Collars shall be fitted in accordance with the requirements set out on the standard drawing.

Junction Pits***Breaking In***

7. Construction of a junction without a 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 coefficients Ku, for the upstream pipe and Kl, for the lateral pipe, shall be determined from the chart given in Council's current Handbook of Drainage Design Guidelines.

Pipe Junction Losses

8. 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 Guidelines.

***Contraction/
Expansion Losses***

9. 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. Pipe friction losses and pipe sizes in relation to discharge shall be determined using the appropriate references including the Council Drainage Design Handbook and acceptable roughness coefficients being 0.6mm for concrete pipes and 0.06mm for FRC pipes.

Pipe Friction Losses

10. Property drains shall be 100mm PVC sewer class from residential properties and 225mm diameter minimum for industrial property drains. When residential drains are connected to kerb and channel they are to be located 5m from the side property boundary. The connection shall be via a rectangular kerb entry adaptor and shall be a welded solvent joint. The location of the drain shall be marked on the face of the kerb with an "H". Industrial property drains shall only be connected to the underground drain and for large allotments the diameter shall be determined by calculation.

Property Drains

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D5.12 MAJOR SYSTEM CRITERIA

1. Surcharging of drainage systems which would provide for water depth above the top of kerb will not be permitted except: **Surcharging**

- (a) 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.
- (b) Flow across footpaths will only be permitted in situations specifically approved by Council, where this will not cause flooding of private property.
- (c) Surface water flow may be permitted where water depth and velocity even under the most severe rainfall event conditions can be kept within safe standards and the public not endangered. In this situation the maximum depth of flow is .35m and maximum flow velocity 1.5m/s

2. The velocity x 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 x depth product of $0.4\text{m}^2/\text{s}$ is permitted. Where the safety of only vehicles can be affected, a maximum velocity x depth product of $0.6\text{m}^2/\text{s}$ is permitted. In open channels the above velocity x 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. **Velocity/Depth Criteria**

3. Freeboard requirements are set to ensure that valuable buildings and their contents and people in them are safely above the 100 year flood level. Lower freeboard requirements are established for outbuildings on the basis that their contents and uses are not as important **Freeboard**

In determining the importance of assets and hence the appropriate freeboard, the following matters should be considered:
 Whether essential or valuable assets or equipment is to be kept or installed on the lowest level of the building;
 The nature of the use of any basements where provided;
 The nature value and use of any outbuildings; and
 The treatment of small extensions and garages where an existing building is less than the required freeboard height above the 1:100 year flood level.

Freeboard for floor levels and levee bank levels from flood levels in roadways stormwater surcharge paths and open channels are given below:

In Roadways:-

- (a) A minimum freeboard of 0.3m 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.
- (b) Where the road is in fill or overtopping of kerbs and flow through properties may occur a 100mm 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:-

- (c) A minimum freeboard of 0.3 shall be provided

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between the 100 year flood level and floor levels on structures and entrances to underground car parks.

In Open Channels:-

- (d) A minimum freeboard of 0.3m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks. The design plans shall clearly show all flood levels, amount of freeboard and other relevant information.

In Flood Plains

- (e) A minimum freeboard of 0.6m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks. These requirements are considered necessary to address the following floodplain characteristics, Flood surges, wave and wind effects or backwater curve problems due to tidal effects;
Larger than predicted flood flows and higher flood levels due to inaccurate rainfall intensity and flood flow estimations;
Requirement to address essential services provision or other sensitive activities which demand no diminution of site access and occupation safety.

The design plans shall clearly show all flood levels, amount of freeboard and other relevant information.

Outbuildings which are not to be occupied and will only be used for storage of low value items may have floor levels set at half the freeboard height requirements of the above cases.

4. Road capacity charts are provided in the Council's current Handbook of Drainage Design Guidelines for some standard road designs. For other road designs, flow capacities of roads should be calculated using Technical Note 4 in Volume 1, Chapter 14 of AR&R with a flow adjustment factor as given in Council's current Handbook of Drainage Design Guidelines.

**Roadway
Capacities**

5. The drainage system shall be designed to ensure the flows downstream of the site are restricted to predevelopment levels unless increased flows are approved by Melbourne Water. The built environment downstream of the proposed development shall

**Downstream
Flows**

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not be degraded by major drainage flows or floodwaters.

6. The drainage system should be designed to ensure that the land form of water courses is stabilised and that erosion is minimised. **No Erosion**

7. Floodways must be restricted to areas where no damage to property can occur and must discharge all gap flows. Roadways may be used as floodways provided the flow depth and velocities do not create hazards for motorists.

D5.13 a. OPEN CHANNELS

1. 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 development site to the receiving water body, such a channel shall comply with the requirements of this Specification. **Safety**

2. Design of open channels shall be in accordance with Volume 1, Chapter 14, of AR&R. Open channels will 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.

3. Friction losses in open channels shall be determined using Mannings "n" values given below:- **Channel Roughness**

Mannings "n" Roughness Coefficients for open channels shall generally be derived from information in Chapter 14 of AR&R. Mannings "n" values applicable to specific channel types are given below:-

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

4. Where the product of average Velocity and average flow Depth for the design flow rate is greater than $0.4\text{m}^2/\text{s}$, the design will be required to specifically provide for the safety of persons who may enter the channel in accordance with Volume 1, Chapter 14, of AR&R.

5. 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. **Side Slopes**

6. 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. **Low Flows**

7. Transition in channel slopes to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

**Hydraulic
Jumps**

5.13 b. SWALE DRAINS

1. Swale drains will be permitted where they form part of a Water Sensitive Urban Design Treatment Train and shall be designed to be suitably connected to other drainage assets with adequate access provisions for maintenance and cleaning. Where Council permits the use of a swale to convey and treat flows from a development site, such a swale shall comply with the requirements of this Specification.
2. Design of swale shall be in accordance with Chapter 8 of *WSUD Engineering Procedures: Stormwater*. Swale will be designed to convey minor flood rates, with an overflow for greater flows.
3. The overflow system will be designed to allow major flows to be safely conveyed and not increase any flood risk compared to conventional stormwater systems with an appropriate allowance for blockage (i.e 50%).
4. Flow velocities within the swale should not:
 - Exceed $0.5\text{m}\cdot\text{s}^{-1}$ for minor storm flow rates;
 - Exceed $1.0\text{m}\cdot\text{s}^{-1}$ for major storm flow rates;
5. Friction losses in open channels shall be determined using Mannings “n” values given below:-

Mannings “n” Roughness Co-efficients for swale shall generally be derived from information in Chapter 14 of AR&R. Mannings “n” values applicable to specific vegetation types are given below:

 - Short Grass 0.033
 - Long Grass 0.043
6. Where the average flow Depth for the design flow rate is greater than 0.35m or where the product of average Velocity and average flow Depth for the design flow rate is greater than $0.35\text{m}^2\cdot\text{s}^{-1}$, the design will be required to specifically provide for the safety of persons who may enter the swale.
7. Maximum side slopes of swale shall be 1 in 3, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum longitudinal slopes of 1 in 100 and maximum longitudinal slope of 1 in 25.
8. Subsurface drainage shall be provided in swale to prevent waterlogging of the channel bed where the longitudinal slope is less than 1 in 80.
9. A minimum 100mm set down must be provided between the top of the ground surface (before turf/vegetation is placed) and the road surface (or any adjacent impervious surface) to allow for sedimentation accumulation.
10. A minimum 50mm set down below the road surface must be provided following construction.

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D5.14 MAJOR STRUCTURES

1. 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. **Afflux**
2. A minimum clearance of 0.3m 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. **Freeboard**
3. Certified structural design shall be required on bridges and other major culvert structures and may be required on some specialised structures. **Structural Design**

D5.15 a. RETARDING BASINS – COUNCIL CONTROLLED

1. 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, Chapter 11 of AR&R. Sensitivity to storm pattern should be checked by reversing these storm patterns. **Critical Storm Duration**
2. 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.
3. Flood Routing should be modelled by methods outlined in AR&R. **Routing**
4. 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. **High Level Outlet**
5. The spillway design shall generally be in accordance with the requirements for Open Channel Design in this Specification.
6. 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. **Salinity Prevention**
7. 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**
8. The low flow pipe intake shall be protected to prevent blockages.
9. Freeboard - Minimum floor levels of dwelling shall be 300mm above the 100 year ARI flood level in the basin. **Freeboard at Dwellings**
10. Public Safety Issues - Basin design is to consider the following aspects relating to public safety. **Safety Issues**
 - 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. Where handrails or grab rails are required then they must be designed in accordance with AS 1428.4

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- Water depths shall be, where possible, less than 1.2m 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.
- Planting of trees in basin walls is allowed subject to Council approval.

5.15 b. SEDIMENTATION BASIN – COUNCIL CONTROLLED

1. Sedimentation basins will be permitted where they form part of a Water Sensitive Urban Design Treatment Train and shall be designed to be suitably connected to other drainage assets with adequate all-weather access provisions for maintenance and cleaning. Where Council permits the use of a sedimentation basin to treat flows from a development site, such a sedimentation basin shall comply with the requirements of this Specification.
2. Design of sedimentation basin shall be in accordance with Chapter 4 of *WSUD Engineering Procedures: Stormwater* and Melbourne Water's *Constructed Wetland Guidelines*. Sedimentation basin will be designed to contain design flows (generally 1 in 1 year), with an overflow system for greater flows.
3. The overflow system (generally a weir) will be designed to allow major flows to be safely conveyed and not increase any flood risk compared to conventional stormwater systems with an appropriate allowance for blockage (i.e 50%). Sedimentation basin shall not be designed to have a high flow bypass to ensure that some level of treatment is achieved even during high flow condition.
4. The restricted discharge outlet shall be placed at least 300mm below the invert level of the overflow system.
5. Flow velocities within the sedimentation basin should not:
 - Exceed $0.3\text{m}\cdot\text{s}^{-1}$ for design flow rates;
 - Exceed $0.5\text{m}\cdot\text{s}^{-1}$ for minor storm flow rates.
6. Maximum batter slopes of sedimentation basin shall be 1 in 3, with a preference given to 1 in 6 side slopes.
7. A buffer zone of 20m minimum shall surround a sedimentation basin from the nearest development.
8. Surrounding soil conditions (e.g. contamination, poor infiltration capacity) may pre-requisite the use of an impervious liner.

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9. The depth of the sedimentation basin shall be a minimum of 1.5m and sufficient storage shall be provided for accumulated sediment not to exceed two-third of the sediment sump for a period of less than 5years.
10. Mechanisms to isolate and drain the sedimentation basin to allow maintenance operations shall be designed.
11. The outlet structure(s) of the sedimentation basin shall be designed and located so that they are easily identifiable and maintained. Outlets shall be accessible from the bank of the basin, with inlets to the orifices submerged to minimise clogging. Any submerged outlet pipes will be clearly marked.
12. The base of the sediment sump shall be designed as a hard structure (e.g. concrete slab) to facilitate maintenance operations.
13. Adequate area shall be allocated for dewatering and short term storage of removed sediments.
14. Sedimentation basins are regarded as impoundments and normal dam safety requirements should be met. Sedimentation basin shall be constructed in accordance with the requirements of Melbourne Water and the Department of Sustainability and Environment.
15. Depth indicators shall be provided indicating maximum depth in the sedimentation basin.
16. Appropriate safety measures shall be provided to minimise risk associated with the sedimentation basin.

D5.16 STORMWATER DETENTION

1. Installation of Stormwater Detention is required on redevelopment sites within the City 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.
2. 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.
3. The requirements for Stormwater Detention Design are outlined in the Council's current Handbook for Drainage Design Guidelines.

**Re-
development**

**Salinity
Prevention**

D5.17 BIO-RETENTION SYSTEMS

(Raingardens, Tree-pits etc.)

1. Bio-retention systems will be permitted where they form part of a Water Sensitive Urban Design Treatment Train and shall be designed to be suitably connected to other drainage assets with adequate access provisions for maintenance and cleaning. Where Council permits the use of a bio-retention system to treat flows from a development site, such a bio-retention system shall comply with the requirements of this Specification.

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2. Design of bio-retention shall be in accordance with Chapter 6 of *WSUD Engineering Procedures: Stormwater*. Bio-retention will be designed to contain design flows (generally 1 in 3months), with an overflow system for greater flows.
3. The overflow system will be designed to allow minor flows to be safely conveyed and not increase any flood risk compared to conventional stormwater systems with an appropriate allowance for blockage (i.e 50%). The invert level of the overflow pits shall be placed at least 100mm below the invert level of the inlet (e.g. street gutter).
4. Flow velocities within the bio-retention system should not:
 - Exceed $0.5\text{m}\cdot\text{s}^{-1}$ for minor storm flow rates;
 - Exceed $1.0\text{m}\cdot\text{s}^{-1}$ for major storm flow rates;
5. The filter media of the bio-retention system shall have a minimum depth of 400mm and a maximum depth of 1000mm.
6. The filter media shall:
 - Provide a hydraulic conductivity between 100mm/hr and 200mm/hr;
 - Have a saturated hydraulic conductivity 10 times greater than that of the surrounding soils when in close proximity to structures (e.g. roads);
 - Have an organic content between 5% and 10%, measured in accordance with AS1289 4.1.1 - 1997
 - Preferably have a pH ranging between 6.0 to 7.5.
7. The drainage layer surrounding the perforated underdrainage pipes shall be a minimum of 150mm thick and preferably 200mm thick. It can be either coarse sand (1mm) or fine gravel (2-5mm). Should fine gravel be used, a transition layer of sand or a geotextile fabric will be required to prevent any filtration media being washed into the perforated pipes.
8. Native vegetation shall be used, in accordance with the guidelines.
9. The perforated underdrainage pipe(s) shall be sized so that the filtration media are freely drained.
10. Surrounding soil conditions (e.g. contamination, poor infiltration capacity) may pre-requisite the use of an impervious liner.

5.18 CONSTRUCTED WETLAND

1. Constructed wetlands will be permitted where they form part of a Water Sensitive Urban Design Treatment Train and shall be designed to be suitably connected to other drainage assets with adequate access provisions for maintenance and cleaning. Where Council permits the use of a constructed wetland to treat flows from a development site, such a constructed wetland shall comply with the requirements of this Specification.
2. Design of constructed wetland shall be in accordance with Chapter 9 of *WSUD Engineering Procedures: Stormwater* and *Melbourne Water's Constructed Wetland*

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Guidelines. Constructed wetland will be designed to contain design flows (generally 1 in 1 year), with a bypass system for greater flows.

3. The bypass system will be designed to allow minor flows to be safely conveyed and not increase any flood risk compared to conventional stormwater systems with an appropriate allowance for blockage (i.e 50%). If the constructed wetland forms part of the major drainage system, the bypass system will be designed to allow major flows to be safely conveyed and not increase any flood risk compared to conventional stormwater systems.
4. Batter slopes in the extended detention zone shall be a minimum of 1 in 6 side slopes.
5. Batter slopes in the macrophyte zone below normal water level shall be 1 in 8 side slopes.
6. Maximum batter slopes of inlet and outlet ponds below normal water level shall be 1 in 3, with a preference given to 1 in 6 side slopes.
7. The extended detention depth shall be a maximum of 500mm above normal water level.
8. Flow velocities within the macrophyte zone of the constructed wetland should not exceed $0.05\text{m}\cdot\text{s}^{-1}$ for design flow rates.
9. The detention time in the macrophyte zone of the constructed wetland shall be ideally 72hrs, with a minimum detention time of 48hrs.
10. A minimum of 150mm of topsoil with a minimum 5% organic content, measured in accordance with AS1289 4.1.1, will be provided throughout the macrophyte zone and adjacent fringing ephemeral areas to assist the establishment of the aquatic macrophyte vegetation.
11. A minimum of 80% coverage of emergent macrophyte vegetation will be provided within the macrophyte zone (below the normal water level).
12. Constructed wetland shall be designed so as to reduce mosquito breeding capacity and favour their predation.
13. A buffer zone of 20m minimum shall surround the constructed wetland from the nearest development.
14. Surrounding soil conditions (e.g. contamination, poor infiltration capacity) may pre-requisite the use of an impervious liner.
15. The outlet structure(s) of the constructed wetland shall be designed and located so that they are easily identifiable and maintained. Outlets shall be accessible from the bank of the wetland, with inlets to the orifices submerged to minimise clogging. Any submerged outlet pipes will be clearly marked.

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16. Appropriate safety measures shall be provided to minimise risk associated with the constructed wetland.
17. Depth indicators shall be provided indicating maximum depth in the constructed wetland.

INTERALLOTMENT DRAINAGE

D5.19 INTERALLOTMENT DRAINAGE

1. Interallotment Drainage shall be provided for every allotment which does not drain directly to its frontage street, a constructed easement drain or a natural watercourse. All allotments shall be designed to drain either to the street frontage or a suitable easement drain.

DETAILED DESIGN

D5.20 CONDUITS

1. Conduits and materials shall be in accordance with the standards detailed in Council's current Handbook for Drainage Design Guidelines. **Materials**
2. Pipe bedding and cover requirements for reinforced and fibre reinforced concrete pipes shall be determined from the Concrete Pipe Association "Concrete Pipe Guide" or AS 3725. For uPVC pipes, the requirements shall be to AS 2032. **Bedding and Cover**
3. The design and selection of the pipe material and class must consider the **Construction**

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- appropriate construction loadings that will be applicable to the development site. **Loading**
4. Conduit jointing shall be in accordance with Council's current Handbook for Drainage Design Guidelines. **Jointing**
5. Drainage lines in road reserves shall generally be located behind the kerb line and parallel to the kerb. Drainage lines in easements shall generally be centrally located within easements. **Location**
6. Bulkheads shall be designed on drainage lines where the pipe gradient exceeds 5 per cent. The design details shall address the size, and position in the trench as well as spacing along the line. **Bulkheads**

**ADVICE TO THE DEVELOPER'S DESIGNER
BURIED FLEXIBLE DRAINAGE PIPES**

Particular situations may be identified during the design of a development for the use of buried flexible pipes instead of the pipes specified in Council's Handbook or the AUS-SPEC Specification C221 for PIPE DRAINAGE.

In such cases, the Developer's Designer will be required to select the flexible pipe type appropriate for the particular application and prepare the relevant technical specification clauses for supply and construction with reference to AS/NZS 2566.1, Buried flexible pipelines Part 1: Structural design. The proposed additional clauses would then be submitted by the Developer, as a variation to the development consent, for approval by Council. If use is approved, then the supply and construction specification clauses shall be inserted in the Special Requirements section of the AUS-SPEC Specification C221 for PIPE DRAINAGE.

D5.19 PIT DESIGN

1. 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 and Council's standard drawings. Safety and safe access are important considerations in pit design. Step irons shall be detailed where required and grates shall be of "bicycle safe" design.

D5.20 STORMWATER DISCHARGE

1. 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. **Salinity Prevention**
2. 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 Guidelines unless outlet conditions dictate the use of more substantial energy dissipation arrangements. **Scour Protection**
3. Kerb and channel shall be extended to drainage pit or natural point of outlet. Where outlet velocity is greater than 2.5m per second or where the kerb and channel discharge causes scour, then protection shall be provided to prevent scour and dissipate the flow. **Kerb & Channel Termination**
4. At points of discharge of channels or stormwater drainage lines or at any concentration of stormwater from one or on to adjoining properties, either upstream or downstream, Council will require the Developer to enter into a Deed of Agreement with the adjoining owner(s) granting permission to the discharge of stormwater drainage and **Outfall/ Easements Adjoining Owners**

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the creation of any necessary easements with the cost of the easement being met by the Developer.

5. Where the drainage is to discharge to an area under the control of another statutory authority eg, Melbourne Water, the design requirements of that Statutory Authority are also to be met by the Developer.

**Other
Authorities'
Requirements**

6. The minimum drainage easement width shall be 3.0m for drainage systems to be taken over by Council. 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.

**Council
Easement**

7. Subject to the consent of Council, 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.

**Recreation
Reserves**

DOCUMENTATION

D5.21 DRAWINGS

1. 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 channel, general layout of the drainage system with pit locations, catchment limits and any other information necessary for the design of the drainage system.

**Catchment
Areas**

2. 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.

**Drainage
System Layout**

3. The plan shall also show all drainage easements, reserves and natural water courses. The plan may be combined with the road layout plan.

4. The Drainage System Longitudinal Section shall be drawn to a scale of 1:500 horizontally and 1:50 vertically and shall show pipe size, class and type, pipe support type in accordance with AS 3725 or AS 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.

**Longitudinal
Section**

5. 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 Council where AHD is not available. Cross sections may alternatively be provided on floppy disk in HEC2 format as a data input file for the design flow rates.

**Open
Channels**

6. 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.

Details

7. Work-as-Constructed Drawings shall be submitted to the Council 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.

**Work-as-
Constructed
Drawings**

8. All drawings submitted to the Council shall comply with the requirements of Appendix DQS-B.

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D5.22 EASEMENTS AND AGREEMENTS

1. Evidence of any Deed of Agreement necessary to be entered into as part of the drainage system 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.
2. 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 any approval of the Engineering Drawings.

D5.23 SUMMARY SHEETS

1. A copy of a Hydrological Summary Sheet providing the minimum information set out in Council's current Handbook of Drainage Design Guidelines is required. *Hydrology*
2. A copy of a Hydraulic Summary Sheet providing the minimum information set out in Council's current Handbook of Drainage Design Guidelines is required. *Hydraulics*

D5.24 COMPUTER PROGRAM FILES AND PROGRAM OUTPUT

1. Computer program output may be provided as long as summary sheets for Hydrological and Hydraulic calculations in accordance with this Specification are provided with plans submitted for checking and with final Drawings.
2. Copies of final computer data files, for both hydrological and hydraulic models shall be provided for Council's data base of flooding and drainage information in formats previously agreed with Council. *Hydraulic Models*

SPECIAL REQUIREMENTS

D5.25 GROSS POLLUTANT TRAPS

1. It is Council policy to reduce the volume of water borne pollutants such as industrial, commercial and domestic litter, vegetation and coarse sediments from entering water courses and streams, and eventually Port Phillip Bay via the underground drainage system by a program of installation of litter traps at strategic locations.
2. Where Council determines that an area is likely to have a "litter concentration" a gross pollutant trap shall be designed and installed by the Developer.
3. Any unit installed shall be capable of capturing all material larger than 20mm from all flows up to a storm with an average recurrence interval of three months (i.e. 0.9 cubic metres). The unit shall be capable of providing for the bypassing of stormwater flows in excess of the treatment capacity of the unit. The bypass shall protect the operational integrity of the drainage system during floods and be designed such that scour and/or re-suspension of pollutants previously collected does not occur during periods of high flow or bypass flow conditions. The unit shall be designed so that there is no capacity loss of existing drainage system. *GPT Design Requirements*
4. The unit shall be designed so that all collector pollutants are able to be removed by mechanical means.
5. Refer also to Clause D7.21 for additional general information.

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D5.26 CCTV INSPECTION and ACCEPTANCE CRITERIA

1. At the end of the maintenance period, a CCTV inspection of all drainage pipes and ancillary works shall be carried out and reported to the satisfaction of Council's Delegated Officer. The CCTV inspection shall be carried out in accordance with Water Services Association of Australia – Conduit Inspection Reporting Code WSA 05-2006 or as updated..

**CCTV
Inspection**

2. All drainage pipes and other ancillary drainage installations with evidence of significant cracking, or other defects, shall be replaced and / or reinstated to Council's satisfaction, before the subdivision will be released (Statement of Compliance issued). Acceptance criteria for drainage pipes and other ancillary works shall be in accordance with Tables F1, F2 and F3 of the Conduit Inspection Reporting Code WSA 05-2006.

3. Pipe inspection software used to record the inspection data shall be compatible with WINCAN V8 or latest. The CCTV pipeline condition information shall be provided to Council in both electronic and hard copy format. The electronic copy shall include the WINCAN Project Files or compatible equivalent and a PDF file of printed report.

D5.27 STORMWATER PUMPS

1. Where connection to the Responsible Authority's drainage infrastructure cannot be achieved by gravity alone, Council may consider alternative drainage systems. Written approval for the design and installation of internal drainage systems up to the Council designated legal point of discharge must be obtained from the relevant building surveyor.

**Pump
Approval**

2. The following sample calculation is for the City of Greater Dandenong area –

CONTRIBUTING AREA (A) = 1,000 SQ.M.
 ANNUAL RETURN INTENSITY(A.R.I.) = 10 YEARS
 AEP .095
 STORM PERIOD (T) = 120 MIN.
 RAINFALL INTENSITY (I) = 18 MM / HR.
 RUNOFF CO-EFFICIENT (C) = 0.9
 PEAK DISCHARGE AS PER RATIONAL METHOD = $Q = C * I = 0.9 * 18 \sim 16$ LITRES / HOUR / SQ.M.
 THEREFOR VOLUME FOR 1 HOUR STORM = $V = Q * T * A = (16 / 1,000) * 2 * 1,000$
 = 40 CU.M.

ALTERNATIVE PUMP CAPACITY – WET WELL VOLUME COMBINATION EXAMPLE

SITE AREA 1,000 SQ.M.

COMBINED EFFECTIVE STORAGE VOLUME 25 CU.M.

PUMP CAPACITY (L/S)	VOLUME PUMPED IN 30 MIN.	REQUIRED WET WELL VOLUME (CU.M.)
(L/S)	(CU.M.)	(CU.M.)
8	14.4	25.6

CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D6

SITE REGRADING

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DESIGN MANUAL D6 - SITE REGRADING

GENERAL

D6.01 SCOPE

1. This Design Specification sets out requirements for the site regrading involved in land development and subdivision. Conceptual requirements are presented as necessary considerations when preparing designs for site regrading.

2. The scope of this Specification 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.

***Familiarity
with other
Specifications
Required***

D6.02 OBJECTIVES

1. This Specification 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 development
- equality of building conditions for residential development
- a minimal impact on adjoining properties and developments.

Environmentally Sound

Safe for Construction

Impact on Adjoining Properties

D6.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

Construction Specifications

- C211 - Control of Erosion and Sedimentation
- C212 - Clearing and Grubbing
- C213 - Earthworks
- C273 - Landscaping

Design Specifications

- D1 - Geometric Road Design
- D5 - Stormwater Drainage Design
- D7 - Erosion Control and Stormwater Management

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(b) Australian Standards

- AS 3798 - Guidelines on earthworks for commercial and residential developments
- AS 2870.1 - Residential slabs and footings - Construction.

(c) Other Authorities

Guidelines for Development in flood prone areas published by Melbourne Water version 1.0 (or as amended)

D6.04 SITE REGRADING CONCEPT

1. 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:

- (a) Alleviate flooding of low-lying ground
- (b) Fill gullies or create emergency flowpaths after underground stormwater piping has been installed
- (c) Allow improved runoff from flat ground
- (d) Regrade excessively steep slopes that would preclude economical construction of dwelling foundations
- (e) 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

2. 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.

Drainage

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

Natural Environment

4. 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).

Overland Flow

5. 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 development and minimising haulage of imported fill or spoil to and from the development site. Bulk haulage should always be considered an adverse effect on adjacent development, and infrastructure.

Minimal Road Haulage**D6.05 SPECIAL TREATMENT OF PARTICULAR AREAS**

1. 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.

Flooding

2. 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 development and advise the Developer 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

Inundation Areas

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recommendations.

3. Site constraints either natural or otherwise may be required to be identified as a burden on developed property. 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 covenant placed on title to the land advising prospective purchasers of any restrictions affecting the land. **Restrictions on Land Use**
4. 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. **Piped Gullies or Depressions**
5. The location of such 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. **Dams and Water Courses**
6. 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 envelopes shall be filled to ensure all dwellings are protected from the 1 in 100 year flood. **Flat Ground**
7. Building areas containing natural ground slopes of an excessively steep nature, ie greater than 15% shall be brought to the attention of a Geotechnical Engineer for investigation of compatibility with dwelling types proposed. Specific requirements shall be noted on the Drawings. **Steep Slopes**
8. 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. **Salinity Prevention**

D6.06 GENERAL STANDARD OF LOT PREPARATION

1. Special requirements will apply where necessary but generally lots are to 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 development. Prior consultation with Council's Delegated Council Officer is necessary. Such requirements shall be shown on the Drawings. **Clearing**
2. All timber and other materials cleared from lots shall be removed from the site. All roots, loose timber, etc which may contribute to drain blockage shall be removed. Such requirements shall be shown on the Drawings. **Disposal**
3. Selected trees shall be preserved by approved means to prevent destruction. The Delegated Council Officer shall be consulted for advice and all specific requirements noted on the Drawings. **Preservation of Trees**

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D6.07 STANDARD OF FILL FOR LOTS

1. The following notations are to be incorporated in the Drawings. "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". **Drawing Notations**
2. All work shall be in accordance with AS 3798 – Level 1 Testing. Fill is to be placed in layers not exceeding 150mm 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. **Fill Quality**
3. 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 Council and will be subject to specific requirements determined by prevailing conditions. **Restricted Fill**
4. It is essential that prior advice be given of intended use of such materials. It should be noted that failure to obtain Council's approval may lead to an order for removal of any material considered by Council or other relevant authorities as unsuitable or in any way unfit for filling. **Prior Approval**
5. All public areas, nature strips and Council reserves where filling has been placed are to be dressed with clean arable topsoil, fertilised and planted with warm season grasses. This work shall be carried out in accordance with the Construction Specification for LANDSCAPING **Top Dressing**

D6.08 TEMPORARY DIVERSION DRAINS

1. 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. **Silt/Erosion Control**

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

Control measures will include, but not be limited to:

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

The requirements identified in the Design Specification for EROSION CONTROL AND STORMWATER MANAGEMENT should be addressed for any additional requirements.

D6.09 CONCURRENCE WITH THE ENVIRONMENT PROTECTION AUTHORITY (EPA)

1. The Designer is recommended to refer to the 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/Developer to make enquiries with EPA and subsequently obtain Council approval to proposed measures. **Specific Considerations**

D6.10 WORK AS CONSTRUCTED DRAWINGS

1. The Designer shall annotate on the site regrading plan, the site specific detail to be **Site Specific**

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shown on the Work-as-Constructed 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.

Details**D6.11 CARTAGE OF SOIL**

1. The Designer shall refer to Council for acceptable haul roads with applicable load limits. This detail shall be required to be shown on the site regrading plan. The payment of a Bond may be required by the Developer/Contractor where Council has some concern about the ability of a haul road to sustain the loads without undue damage or maintenance requirements.

***Possible
Bond
Requirement***

2. Unless specific application is made to Council and approval obtained, the plans will be annotated as follows:

Topsoil

"All topsoil shall be retained on the development site and utilised effectively to encourage appropriate revegetation."

3. No movement of weeds or dumping of fill either from or to the site will be permitted unless all approved environmental requirements have been met.

D6.12 EFFECT ON ADJOINING PROPERTIES

1. Where it is proposed to divert or direct piped stormwater into adjoining properties, drainage easement rights are to be created over the adjoining lots in accordance with the Specification for STORMWATER DRAINAGE DESIGN.

***Stormwater
Easement***

2. 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.

***Construction
Agreement*****SPECIAL REQUIREMENTS**

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D7

EROSION CONTROL AND STORMWATER MANAGEMENT

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EROSION CONTROL AND STORMWATER MANAGEMENT

GENERAL

D7.01 SCOPE

1. 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. **Erosion**
2. Since such soil disturbance is a necessary part of development, 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. **Reduce Sedimentation**
3. 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. **Water Quality**

D7.02 AIMS

1. Limit/minimise the amount of site disturbance. **Site Disturbance**
2. Isolate the site by diverting clean upstream "run-on" water around or through the development where possible. **Diversion Works**
3. Control runoff and sediment movement as its point source rather than at one final point. **Point Source**
4. 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. **Progressive Revegetation**
5. Provide an effective major stormwater system economical in terms of capital, operational and maintenance costs, incorporating water quality controls. **Major Stormwater**
6. Retain topsoil for effective revegetation works. **Topsoil**
7. Locate sediment control structures where they are most effective and efficient. **Sediment Structures**

D7.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

- DQS - Quality Assurance Requirements for Design
- D5 - Stormwater Drainage Design
- C211 - Control of Erosion and Sedimentation
- C273 - Landscaping

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(b) Victorian State Legislation

Environment Protection Act, 1970
Water Act, 1989
Planning and Environment Act 1987
Catchment and Land Protection Act 1994
Environmental Effects Act 1978
Litter Act 1987
Soil Conservation and Land Utilisation Act 1958

(c) Other

Technical Publications used as Engineering Standards
City of Greater Dandenong Water Sensitive Urban Design
Guidelines and Specifications
Environmental Guidelines for major Construction Sites, Best Practice
Environmental Management Series, EPA, PUB.480, December 1995
Construction Techniques for Sediment Pollution Control, EPA, PUB.275,
May 1991
State Environmental Protection Policy (The Air Environment), 1981
Urban Stormwater Best Practice Environmental Guidelines – CSIRO 1999
Kingston City Council and Melbourne Water:2003 – Keeping our Stormwater
Clean – A Guide for Building Sites

D7.04 PLANNING AND CONCEPT DESIGN

1. Assess the physical characteristics and limitations of soils, landform and drainage of the site and plan the subdivision accordingly.
2. A concept design shall be submitted with the development application to Council for all developments. This will assist in assessing the impact of the development on the site.

**Site
Characteristics**

**Concept Design
Submission**

D7.05 DETAILED DESIGN

1. After development consent is given an erosion and sediment control/water management plan shall be submitted to Council as part of the detailed engineering design. This plan shall give all details for erosion, sediment and pollution controls and shall be site specific and not a generalisation of erosion control philosophy. It may also form part of the contract specifications for a contractor to comply with during construction.
2. Detailed engineering designs shall include scaled drawings (no larger than 1:1000) and detailed specifications/diagrams which can be readily understood and applied on site by supervisory staff. All Drawings shall be in accordance with the minimum drafting requirements in the Specification for QUALITY ASSURANCE REQUIREMENTS FOR DESIGN.

Site Specific

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

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- 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

3. No site works shall commence prior to approval of the detailed engineering design. 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.

Approval

4. The erosion and sedimentation control/water management plan and its associated control measures shall be constantly monitored, reviewed and modified as required, by the Developer, 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.

Additional Works

5. If required, examples of proposed subdivisions detailing locations 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.

Example Design

EROSION CONTROL

D7.06 BUFFER ZONES

1. 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. Wetlands, stream and rivers adjacent to construction sites shall be protected by buffer zones.

Filters

2. Buffer zone performance increases as catchment area and slope gradient decreases. Thirty-metre-wide buffer zones generally provide adequate protection.

Performance

Slope %	Buffer Width in Metres
2	15
4	20
6	30
8	40
10	50
12	60
14	70

3. Buffer zones can reduce the need for other erosion and sediment control measures. However, contaminated water in a concentrated form will require treatment both at its sources point and final disposal.

Contaminated Water

4. A fence shall be used to exclude traffic from buffer zones to prevent damage to the vegetation, particularly during any construction phase. **Fencing**

D7.07 "NO ACCESS" AREAS

1. It is Council Policy to conserve as much existing vegetation in new developments as possible. **Conserve Vegetation**

2. The landscape plan shall incorporate as much existing native vegetation as possible.

3. 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. **No Access**

4. Fenced areas shall be clearly signposted "No Access Area".

D7.08 DIVERSION WORKS

1. Diversion works may be in the form of earth drains and banks, haybales, sand bags or even pipelines and may be permanent or temporary. **Diversion Types**

2. 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. **Discharge Point**

3. Pipelines may also be used to convey such run-on through the development site, and discharge the flow to a formal drainage point/dissapator if necessary. Such pipelines may also form part of the overall final drainage system. **Pipelines**

4. Design of the diversion system should suit the following:-

(a) The drain should preferably be dish shaped with batter grades of less than 2:1 **Drain Shape**

(b) If a piped system is selected its design capacity shall be a minimum of the capacity nominated in the Specification for STORMWATER DRAINAGE DESIGN. **Pipe Capacity**

5. Diversion works are designed to carry peak flows at non-erosive velocities in bare soil, vegetated or lined drains/banks. **Peak Flows**

6. Generally, the channel should be lined with turf. However, where velocities are designed in excess of 2m per second, non erosive linings such as concrete, geotextiles, grouted rock etc or velocity reducers (check dams etc) are required. **Non-Erosive Linings**

7. Typical arrangements of diversion drains and banks are shown in Figure D7-1.

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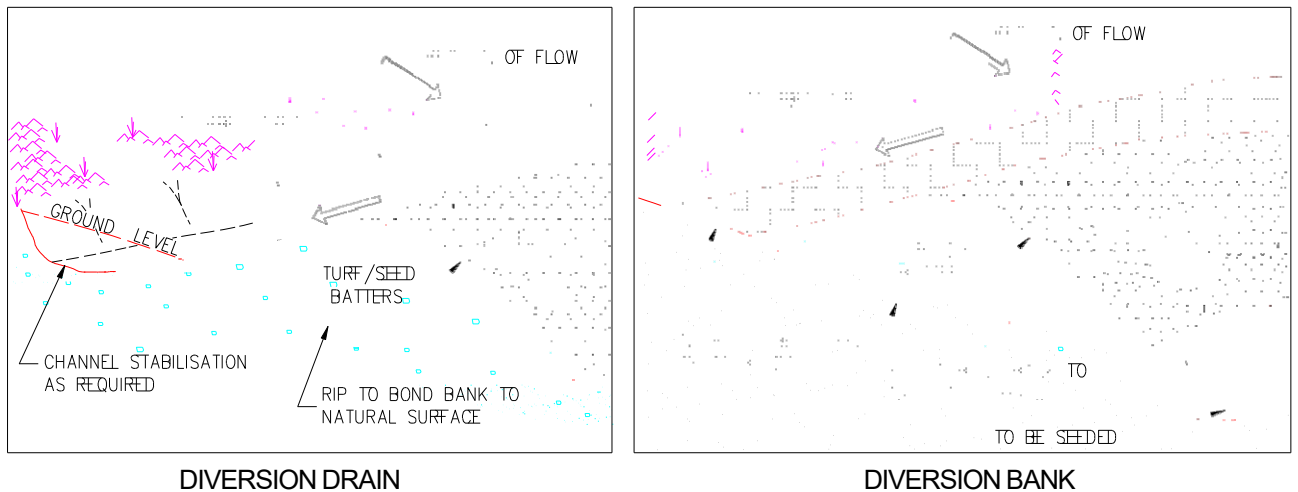


Figure D7-1 - Diversion Drains/Banks

D7.09 DROP DOWN DRAINS

1. 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.

Lined Drains

2. 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.

Piped Drains

3. Drop down drains shall have sufficient capacity for a minimum 1 in 5 year peak flow without eroding. Energy dissipators may be required to reduce the flow velocity at the outlet of the drop down drain.

Capacity

D7.10 STOCKPILES

1. Location of stockpiles shall be indicated on the approved engineering Drawings.

2. Stockpile sites shall be located:

Location

- (a) Clear of existing or proposed drainage lines.
- (b) Clear of areas likely to be disturbed during construction.
- (c) Clear of the drip zone of trees.
- (d) Preferably on reasonably flat areas.

3. Stockpiles must be protected from erosion and sediment loss by:

Erosion Protection

- (a) The installation of diversion works.
- (b) The use of silt fences, haybales etc or other approved controls on the downstream side.
- (c) Compaction.

4. Site topsoil shall be isolated from subsoil material in separate stockpiles.

Separate Stockpiles

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D7.11 SEDIMENT BASINS/TRAPS/DAMS

- | | | |
|----|---|-----------------------------|
| 1. | Sediment traps are either permanent or temporary sediment control devices that intercept sediment and run-off usually at the final discharge point of the site. | Sediment Control |
| 2. | They are formed by excavation and/or by constructing embankments. | Construction |
| 3. | There are two types, wet and dry basins. | Types |
| 4. | Preferably sediment traps shall not be located directly upstream of residential areas. | Location |
| 5. | Basin design must meet the following: | Design Criteria |
| | (a) Volume/capacity of the trap shall be 250m ³ /ha of disturbed site including the building areas. | |
| | (b) An allowance of 50m ³ /ha is required if diversion controls are not used to direct clean upstream water from outside the site away from construction areas. | |
| | (c) The capacity shall be measured below the invert of the lowest incoming flow. Otherwise pipelines and associated works will be affected. | |
| | (d) 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. | |
| | (e) The basin shall have a minimum of 0.5 metres freeboard above the level of the spillway. | |
| | (f) The basin shall be surrounded by a manproof fence with lockable gates. | |
| | (g) An all weather access must be provided to the basin for maintenance. | |
| | (h) The basin shall have an arbitrary length to width ratio of between 2 and 3:1. This encourages soil particle settlement. The entry and exit points should be located at the opposite ends of the basin. | |
| | (i) If this is not possible some form of approved baffles shall be installed to minimise short circuiting of the flow. | |
| | (j) 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. | |
| | (k) Internal basin batters shall be a maximum of 6:1 and external batters a maximum of 6:1 excluding areas covered by water. | |
| | (l) All disturbed areas including batters shall be topsoiled and seeded. | |
| | (m) 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. | |
| 6. | Permanent wet basin designs slightly vary from the above. Refer to the Stormwater Management Section of this Specification. | Permanent Wet Basins |

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D7.12 SEDIMENT TRAPS/ BARRIERS FOR MINOR CATCHMENTS

1. These are silt retention/filtering structures of a temporary nature used in situations where the catchment does not exceed 0.5ha.

Filtering Structures

2. Such sediment traps/barriers generally consist of:

Barrier Types

- (a) silt fences
- (b) hay bales
- (c) "blue metal" groyne/sausages
- (d) filter fabric located beneath stormwater grates
- (e) gabions
- (f) or a combination of the above.

3. 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:

Location of Structure

- (a) surface inlet pits
- (b) kerb inlet pits
- (c) catch drain disposal areas
- (d) culvert inlets and outlets
- (e) minor construction/earthwork sites
- (f) check dams/velocity reducers etc.

D7.13 LEVEL SPREADERS

1. Level spreaders are outlets or "sills" having a level cross section. They convert erosive channelised flows into non-erosive sheet flow.

Convert Flows

2. 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.

Location

3. To reduce flow velocity before the spreader, the channel grade shall not exceed 1 per cent for a minimum of 8 metres. The outlet or "sill" width depends on contributing catchment, slope and ground conditions. The minimum width should be 4 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.

Design Criteria

D7.14 THE LOCATION OF SHAKEDOWN AREAS AND ACCESS STABILISATION

1. Access to construction sites shall be limited to a maximum of two locations.

Number of Accesses

2. Such access locations shall require Council approval.

Location Approval

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3. 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 roadway each day or before rain. Clean off draw bars etc after dumping and before starting journey.

Types

4. 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. Cattle grids shall be a minimum length of 7 metres.

Cattle Grid

5. A stabilised access comprises a vehicular pathway 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 for a two way entrance.

Stabilised Access

6. 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.

Flow Control

D7.15 WIND EROSION/DUST CONTROL

1. Research has demonstrated average dust emission rates of over 2½ tonnes per hectare per month at urban construction sites. This erosion rate is unacceptable.

Erosion Rate

2. Various measures are available to minimise such emissions, including:-

Treatments

- (a) 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
- (b) 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 5 grams per metre per second. See Figure D7-2.

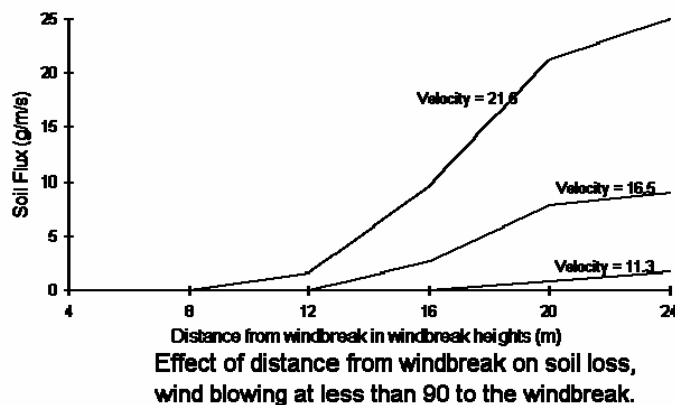


Figure D7-2 - Pollution Control

D7.16 REQUIREMENTS FOR BUILDING SITES

- | | |
|--|----------------------------|
| 1. The clearing of vegetation and preparation of building pads is to be undertaken in the last stages of the development when the majority of the site has been effectively revegetated. | Site Clearing |
| 2. When the development calls for the construction of a number of buildings, the sediment trap/s and other appropriate sediment controls shall remain operational. | Development Control |
| 3. Cross/catch drains shall be installed on long or steep unpaved driveways, disposing run-off to stable areas. | Driveway Control |
| 4. Where a majority of the lot is disturbed the following controls or measures shall be undertaken: | Lot Control |
| (a) Silt fences, located around the downstream sides of the lot. | |
| (b) Sediment traps/barriers to be provided to all on-site and adjacent stormwater inlets. | |
| (c) Only one site access to be provided. This may require treatment to prevent soil being tracked from the site. | |
| (d) All subsurface drainage for roofing must be in place prior to the installation of the roof and gutter so downpipes can be immediately connected. | |

D7.17 EXTERNAL SITE REQUIREMENTS

- | | |
|---|----------------------------|
| 1. Sediment control devices or stabilising works shall be provided outside construction sites where necessary or as directed by the Superintendent. | Necessary Controls |
| 2. 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. | Accelerate Erosion |
| 3. Where sediment is likely to be transported from the site, all immediate downstream drainage inlets shall have appropriate controls installed. | Downstream Controls |
| 4. If such works require entry onto private property, written permission shall be obtained prior to the entry and commencement of such works. | Written Permission |
| 5. All disturbed areas on private property to be reinstated to original condition and to the satisfaction of the owner. | Reinstated |

STORMWATER MANAGEMENT

D7.18 GENERAL

- | | |
|--|------------------------|
| 1. Most developments mean a change in land use and is usually 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:- | Main Components |
| (a) Buffer Zones and Filter Strips, being grassed, or similarly treated areas to facilitate the natural assimilation of water pollutants and reduce run-off. | |
| (b) 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 | |

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downstream water management structures.

- (c) 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.
- (d) Wetland (Nutrient) Filter to enhance the removal of fine sediment and nutrients from stormwater run-off, and are largely dependent on biochemical removal mechanisms (ie, nutrients taken up as part of the plant food chain).

2. Excess nutrients (N,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.

**Excess
Nutrients**

3. 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.

First Flush

D7.19 WET RETARDING BASINS/PONDS

1. Basins designed for water quality control should maximise the extent of settling. In general quiescent conditions and infiltration should be maximised.

**Maximise
Infiltration**

2. A wet retarding basin can be located either on-line or off-line as shown in Figure D7-3. Its capacity however needs to be considerably greater if it is located on-line. The wet retarding 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 per cent 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.

**Location and
Size**

3. Other design guides that will make the basin efficient in removing particles and provide for public safety, include the following.

**Basin
Efficiency**

- (a) 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.
- (b) The basins should have side slopes of approximately 1 in 6. This provides for safety and encourages microphyte growth around edges facilitating nutrient uptake.
- (c) 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).
- (d) 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.
- (e) 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.

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4. 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. **Construction and Maintenance**
5. (a) 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. **Outlet Design**
- (b) An all weather access track shall be provided to the basin for maintenance works. **Access Track**
6. 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. **Trash Racks**
7. 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 developments, permits the drainage authority scope to develop aesthetic surrounds and reduces the likelihood of over the fence dumping of rubbish. **Buffer Zones**
8. The settling velocity of particles should service as the basis for design. This, of course, 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 (Randall et al 1982). **Particle Settling**
9. Wet retarding basins are regarded as impoundments and normal dam safety requirements should be met. Wet retarding basins shall be constructed in accordance with the requirements of the local Catchment Management Authority and the Department of Natural Resources and Environment. **Basin Classification**

D7.20 TRASH RACKS

1. 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. **Environmental Quality**
2. Generally, their design criteria should ensure:- **Design Criteria**
- (a) vertical bar screens with bar spacing of 65mm clear;
 - (b) the length of the rack is consistent with the channel dimension and cause minimal damage when overtopped;
 - (c) they are as large as practicable while considering all other design criteria - a maximum height of 1.2 metres is suggested;
 - (d) 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);
 - (e) the structure drains by gravity to a dry condition; and
 - (f) adequate access for maintenance and which permits the use of mechanical equipment.

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- | | |
|--|-------------------------------------|
| 3. Where associated with outlet structures for small sediment basins or constructed wetlands, they can be relatively simple in design. | <i>Associated Structures</i> |
| 4. Trash racks may be incorporated in the design of gross pollutant traps. | <i>Gross Pollutant Trap</i> |
| 5. Trash racks shall be checked periodically and all debris and silt removed. | <i>Maintenance</i> |

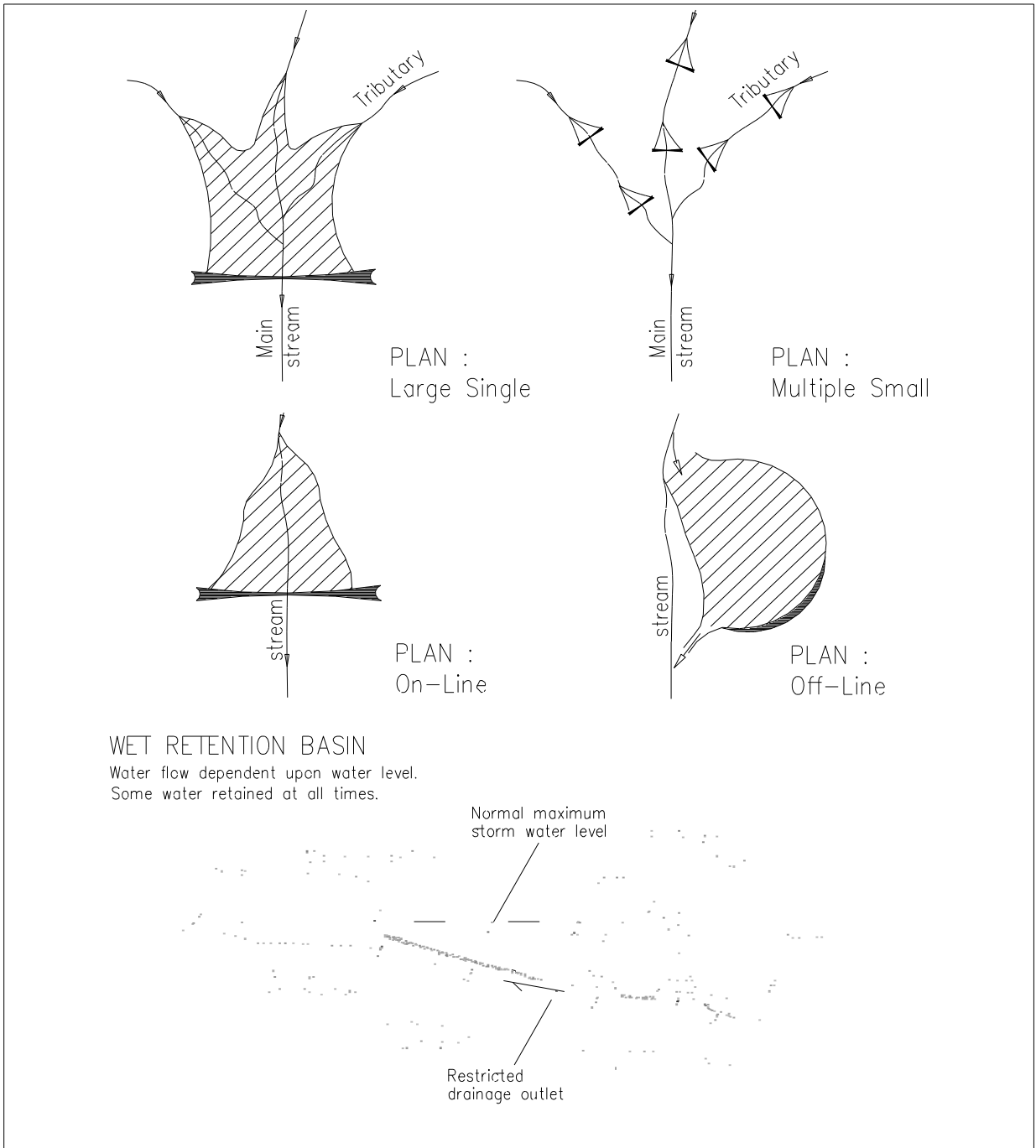


Figure D7-3 - Configuration and Design of Wet Retarding Basins

D7.21 GROSS POLLUTANT TRAPS

- | | |
|---|--------------------------------|
| <p>1. 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.</p> | Description |
| <p>2. These 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 (eg, 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 0.04mm (sandy soils) and/or where their construction/maintenance cost can be justified when compared with more conventional sediment retention basins.</p> | Applications |
| <p>3. GPTs can be defined as major or minor:</p> <p>(a) major gross pollutant traps can be located on major floodways and waterways to intercept medium to high flows; and</p> <p>(b) minor, enclosed gross pollutant traps can be located at heads of major floodways and/or where stormwater discharges into floodways or water bodies.</p> | Definition |
| <p>4. Design traps to intercept at least 75 per cent of sediment with a grain size of 0.04mm 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.</p> | Sediment Interception |
| <p>5. The structure should have sufficient capacity and stability to discharge the inlet flow with the trash rack fully blocked without flooding adjacent properties.</p> | Capacity |
| <p>6. Ensure GPTs are capable of gravity drainage to a dry condition for periodic cleaning and maintenance if at all possible.</p> | Maintenance Requirement |

D7.22 WETLANDS

- | | |
|---|--------------------------|
| <p>1. 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 sideslopes of very low gradient (1 in 8 or less). A large percentage (greater than 25 per cent) 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 D7.4 shows a typical wetland arrangement.</p> | Depth and Batters |
| <p>2. Where wetlands are natural, provision should be made for the protection of the wetland from clearing, construction of levees, draining and filling, but does not prevent the wetland being used for run-off control, provided safeguards and operation control ensures their continued viability. The design shall cater for maintenance access.</p> | Protection |
| <p>3. Wetlands, like retarding basins, operate more effectively when higher contact time between the pollutants and the biota of the wetland is provided. Thus, like retarding 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.</p> | Efficiency |
| <p>4. 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.</p> | Water Levels |

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5. 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. **Short Circuiting**
6. The performance and life of wetlands, like wet retarding 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. **Wetland Protection**
7. Wetlands need to be surrounded by a buffer at least 20 metres wide in order to:- **Buffer Zones**
- (a) Restrict access to maintenance vehicles by the installation of an all weather track with a lockable device.
 - (b) Acts as an infiltration area for surface run-off.
 - (c) Provide flood protection and secondary assimilation of pollutants.
8. These areas are best planted with vegetation native to the area, but they can be used as grassed areas and an aesthetic feature. **Native Vegetation**
9. Work in the ACT indicates rates of removal of phosphorous and particles in wetlands are higher than for wet retarding basins. **Results**
10. In designing wetlands, it is recommended that, as an interim guide, the surface area of the wetlands be a minimum of 0.5 per cent of the catchment which it serves. If wetlands are used in conjunction with wet retarding basins, this percentage can be proportionately lowered by allowing for the surface area of the installed wet retarding basin. **Surface Area**
11. 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. **Microphyte Types**
12. 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. **Revegetation**
13. 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. **Aesthetic Feature**
14. To minimise mosquito problems, limit expanses of water with more than 50 per cent shading and ensure no sections of water become isolated from the main body. **Insect Problems**
15. Islands are highly beneficial as wildlife refuges, especially for birds. Their design should consider the effects on changes in water tables. **Wildlife Refuge**
16. 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. **Native Fish**

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Figure D7-4 - Sediment Trap/Constructed Wetland

SPECIAL REQUIREMENTS

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D8

WATERFRONT DEVELOPMENT

Note: This section has been deleted from the Design Manual

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CITY OF GREATER DANDENONG

SUBDIVISION DESIGN SPECIFICATION

D9

CYCLEWAY AND PATHWAY DESIGN

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**DESIGN SPECIFICATION D9
CYCLEWAY AND PATHWAY DESIGN**

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DESIGN MANUAL D9 CYCLEWAY AND PATHWAY DESIGN

GENERAL

D9.01 SCOPE

1. This Specification sets out requirements to be used in the design of various types of cycleways and pathways.

2. All relevant design principles contained in the AUSTRROADS Guide referenced below must be integrated in the design of cycleways and associated infrastructure. This Specification serves as a companion document to the AUSTRROADS Guide extended to incorporate basic requirements for pathways.

AUSTRROADS

D9.02 OBJECTIVES

1. This Specification aims to set standards and document requirements related to the provision of cycleways and pathways which encourage pedestrian activities and cycling for transportation and recreational purposes. Cycleways and pathways are to be safe and convenient and shall maintain a satisfactory level of service for all users including users with disabilities and limited mobility.

Safety

Level of Service

D9.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

- D1 - Geometric Road Design
- City of Greater Dandenong – Bicycle Strategy
- City of Greater Dandenong – Standard Drawings

(b) Australian Standards

- AS 1742 - Manual of Uniform Traffic Control Devices.
- AS 2156.1 - Walking tracks, Classification and signage
- AS 2156.2 - Walking tracks, Infrastructure design
- AS 2890.3 - Bicycle parking facilities
- SAA HB69.14 - Guide to traffic engineering practice – Bicycles
- AS/NZS 1428.1 -2009 – Design for Access and Mobility – General Requirements
- AS/NZS 1428.4:2002 Design for Access and Mobility Part 4 – Tactile Indicators

(c) Other

AUSTRROADS - Austroads Guide to Road Design – Part 6A,(Pedestrians and Cyclists).

Ministry of Transport, Victoria - State Bicycle Committee
- Planning and Design of Bicycle Facilities,

Cement and Concrete Association of Australia:2004 Guide to Residential Streets and Paths

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D9.04 CONSULTATION

1. The Designer must consult with Council, the Developer's Landscape Architects/Designers and relevant authorities prior to and during the preparation of cycleway and pathway design.

**Landscape
Designers
Public
Authorities**

D9.05 PLANNING CONCEPTS

1. Council will provide specific requirements for cycleways and pathways in Council's Footpath Strategy as well as in a regional or local strategic bicycle plan. The Designer will need to enquire about such documents and comply with requirements defined.

**Footpath
Strategy and
Bicycle Plan**

2. The Designer should be familiar with cycleway geometric design requirements in terms of:

**Geometric
Design**

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

**AUSTROADS
Guide**

These requirements are discussed in the AUSTRROADS Guide.

3. The Designer shall incorporate all the requirements for disabled access as appropriate for pathway design in accordance DDA requirements and with any Council Policy or Development Control Plan on Access and Mobility and AS/NZS 1428.1 and 1428.4.

**4. Disabled
Access**

D9.06 CYCLEWAY AND PATHWAY TYPES

1. Cycleways can be provided on road and off road. The AUSTRROADS Guide provides detailed descriptions, warrants, widths, pavement marking etc for the majority of these cycleways.

**On Road Off
Road**

2. Common alternative cycleway types include:

On Road

Shared Parking/Bicycle Lanes
Wide Kerbside Lanes
Shared Traffic Lanes
Exclusive Bicycle Lane
Sealed Shoulder

Off Road

Shared Use Bicycle/Pedestrian Pathway
Separated Pathway – Pedestrian and cyclist use is
separated physically
Exclusive Cycleway

The AUSTRROADS Guide provides advice on the suitability of pavement conditions, drainage pit grates etc for on road cycleways.

**AUSTROADS
Guide**

3. Common pathway types include:

Exclusive Pedestrian Pathways
Shared Use Bicycle/Pedestrian Pathways

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By definition pedestrian pathways are "off road" in that pedestrian facilities routinely designed adjacent to roadways are termed footpaths and are designed to meet criteria outlined in Council's Footpath Strategy and typically related to road cross section detailing.

Footpaths

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

Land Reserves

D9.07 PROVISIONS FOR CYCLEWAYS AND PATHWAYS AT STRUCTURES

1. Designers shall consider the best way to provide for the uninterrupted movement of cyclists and pedestrians at interfaces with proposed and existing structures.. Structures include bridges and underpasses over rivers, roads or railways. The reference and source documents provides information on:

**Bridges
Underpasses**

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

D9.08 SIGNAGE AND PAVEMENT MARKING

1. The Designer shall provide adequate signposting design for cycleways and pathways.

2. Signs and pavement marking will provide for the safe and convenient use of the facility. The signs and pavement marking will comply with AS 1742.9 Bicycle facilities.

Compliance

D9.09 START/END OF JOURNEY FACILITIES

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

2. Such facilities could include:

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

Facilities

3. Bicycle parking installation design should meet appropriate criteria discussed in the AUSTRROADS Guide and be fabricated to meet AS 2890.3. Tactile surface markers must be provided in accordance with AS/NZS1428.4.1

Parking

D9.10 MINIMUM DESIGN STANDARDS

1. Minimum design standards shall be in accordance with the guidelines provided in this Specification and referenced documents.

D9.11 DOCUMENTATION

1. The following listing outlines Council's minimum requirements for presentation of cycleway and/or pathway designs.

- All plans for cycleways/pathways 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.

Plans

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- Longitudinal Sections will be required for all off-road cycleways where grades exceed 4%. **Long Sections**
 - Longitudinal Sections will have reduction ratios of 1:500 horizontal and 1:100 vertical.
 - 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. **Cross Sections**
 - A typical cross section will be detailed to indicate pavement materials and layer depths.
2. All Drawings shall be in accordance with the minimum drafting requirements in the Specification for QUALITY ASSURANCE REQUIREMENTS FOR DESIGN.

SPECIAL REQUIREMENTS

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ATTACHMENT 'A' – DRAINAGE DESIGN GUIDELINES

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**CITY OF GREATER DANDENONG
HANDBOOK FOR DRAINAGE DESIGN GUIDELINES**

1. Plan (Scale)

Locality Plan	1 : 5000 or 1 : 10000
Alignment Plan	1 : 500
Longitudinal Sections	1 : 500 Horizontal 1 : 50 Vertical
Cross Sections	1 : 100 Horizontal 1 : 50 Vertical
Structural Detail	
Pit Schedule	

2. General

- a) **Australian Height Datum (A.H.D.)** shall be used for all *levels* & all plan views shall be to **Geocentric Datum of Australia (G.D.A.)**. All drainage design drawings shall to be to **D-Spec** requirements.
- b) The layout shall provide drainage for each allotment. Pipe diameters shall be shown on the alignment plan.
- c) No drainage lines are to be backfilled until inspected and passed by Council's Supervisor.
- d) Overland flow paths are to be provided.
- e) The longitudinal sections shall show all side entry, junction, easement and property connection pits, pit numbering, pipe capacity, (m³/sec) and velocity (m/sec) of the drainage flowing full and the actual flow in the pipe
- f) Where drains are in excess of 1.5m deep before works commence notice of such proposal is to be sent to the Secretary for Minerals and Energy in accordance with clause 202 of the Mines (Trenches) Regulations 1979.
- g) The design shall provide for all external catchments.

3. Design Parameters

Pipe Roughness Values	Mannings 'n'	Colbrook-White 'k'
Concrete Pipes	0.013	0.6
UPVC & FRC Pipes	0.009	0.06
Other types of pipe	In accordance with manufacturers recommendations for aged pipe conditions	
Rainfall Intensities	Determined using the coefficients in Attachment A	

Storm Frequency and Coefficient of Run-off	Development	Coefficient of Run-off	Storm Frequency
	Residential lots Gross densities < 20 lots/ha Gross densities > 20 lots/ha	0.60 0.60	1 in 5 years 1 in 10 years
	Multi-Unit site	0.75	1 in 10 years
	Industrial	0.90	1 in 20 years
	Garden Industrial	0.75	1 in 20 years
	Commercial	0.90	1 in 100 years
	Roads	0.80	As per relevant area
	Previous areas	0.20	As per relevant area
Pipe Design Velocities	Minimum velocity – 1.0 m/sec when pipes are running full Maximum velocity – 3.0 m/sec when pipes are running full.		
Initial time of concentration	7 minutes. For larger industrial and commercial sites longer times will require justification.		
Pipe Roughness	Manning's n = 0.013 Colbrook-White k = 0.6 for concrete pipes		
Pipe Materials	Steel Reinforced Concrete Class 2 minimum. Rubber ring jointed for all pipe diameters. Fibre Reinforced Concrete Class 2 minimum. PVC will be considered as individual submissions are made. (Minimum standard is sewer class pipe to AS 1260) Aluminium spiral will be considered as individual submissions are made.		
Pipe Cover	In accordance with AS 3725 "Loads on Buried Precast Concrete Pipes. Design Load to be E7 wheel load in service conditions.		
Minimum Cover	Easement drains – 500 mm Road pavements and nature strips – 700 mm. May be reduced by using appropriate class of pipe.		
Pit Covers	All pit covers are to comply with OHS and are to be light weight fibreglass composite pit lids covers and frames.		

Pit Sizes	<p>All pits with pipes larger than 600 mm diameter shall have the width dimension equal to the pipe diameter plus 150 mm minimum.</p> <p>All pits deeper than 1 metre shall be fitted with step irons.</p> <p>All pits with internal dimensions greater than 900 mm x 600 mm shall be reduced at the top to provide for Council's standard frame and cover, which suits a pit of 900 mm x 600 mm internal dimensions.</p>
Side Entry Pits	<p>< 1 m deep – 900 mm x 600 mm</p> <p>> 1 m deep – 900 mm x 750 mm</p>
Junction Pits Easement	<p>< 1 m deep – 900 mm x 600 mm</p> <p>> 1 m deep – 900 mm x 750 mm</p>
Junction Pits	900 mm x 600 mm
Pit Spacing	Pits to be provided at grade changes and pipe diameter changes
Side entry Pits	90 metres. Provide SE pit at kerb return to prevent water flowing around return
Junction Pits Easement	90 metres
Junction Pits	45 metres
Property Drains	For drains larger than 900 mm a separate drain shall be provided for property drain connections.
Residential	100 mm PVC sewer class. When connected to kerb and channel to be located 5 m from the side property boundary. The connection shall be via a rectangular kerb entry adaptor and shall be a welded solvent joint. The location of the drain shall be marked on the face of the kerb with an "H".
Industrial	225 mm diameter minimum, connected to underground drain. For large allotments size to be calculated.
Drain Location	
Road Reserve	On high side of road.
Easement Drains	Minimum 1.0 m from boundary. Increase for large pipes.
Curved alignments	Permitted for pipes > 750 mm dia – radius and deflection to be in accordance with manufacturers specifications.
Pit schedule	Schedule shall show – pit number, pit size, inlet pipe(s) diameter, outlet pipe diameter, invert levels of all pipes, finished surface levels.

Frequency / Intensity Coefficients

Frequency	Coefficients						
5 years	3.1293	-0.6054	-0.0133	0.00776	-0.001225	-0.0001459	0.0000198
10 years	3.2768	-0.6162	-0.0130	0.00716	-0.001019	-0.0000301	-0.000060
20 years	3.4463	-0.6254	-0.0130	0.00677	-0.000855	0.0000469	-0.0000220
50 years	3.6459	-0.6262	-0.0131	0.00596	-0.000570	0.0001824	-0.0000531
100 years	3.7837	-0.6435	-0.0130	0.00542	-0.000415	0.0002791	-0.0000733

ATTACHMENT 'B' – STREET AND PUBLIC LIGHTING GUIDELINES

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1197 STREET AND PUBLIC LIGHTING
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GENERAL**RESPONSIBILITIES****General**

Requirement: Provide street lighting and electrical systems, as documented.

Design and Construct contracts

Requirement: Complete the requirements documented in **PRE-CONSTRUCTION PLANNING** and conform to **MATERIALS, EXECUTION** and the **ANNEXURES**.

Construct only contracts

Requirement: Conform to the requirements documented in **MATERIALS, EXECUTION** and the non-design requirements of the **ANNEXURES**.

CROSS REFERENCES**General**

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

0136 General requirements (Construction).

0152 Schedule of rates (Construction).

0161 Quality management (Construction).

0319 Auxiliary concrete works.

1101 Traffic management.

1102 Control of erosion and sedimentation (Construction).

1151 Road openings and restoration.

1391 Service conduits.

[complete/delete]

STANDARDS**General**

Lighting for roads and public spaces: To the AS/NZS 1158 series.

Design for intersections and crossing: Austroads AGRD04.

Design for roadside environment: Austroads AGRD06B.

Luminaires: To SA/SNZ TS 1158.6 and AS/NZS 60598.2.3.

Electrical installations: AS/NZS 3000.

Minimum energy performance standards (MEPS)

General: To AS/NZS 4782.2, AS/NZS 4783.2 and AS 4934.2.

Self-ballasted lamps: To AS/NZS 4847.2.

INTERPRETATION**Abbreviations**

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

CCT: Correlated colour temperature.

CIE: International Commission on Illumination.

CRI: Colour rendering index.

HID: High intensity discharge.

IES: Illuminating Engineering Society.

LED: Light-emitting diode.

PE: Photoelectric.

Definitions

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

Control system: A lighting control system comprising a combination of some or all of the following:

Automatic sensing and control components.

Computer interface for programming.

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Contract No.
Dimming systems.
Manual overrides.
Motion detection sensors (occupancy sensors).
Timers.

Electricity distributor: Any person or organisation that provides electricity from an electricity distribution system to one or more electrical installations. Includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.

Proprietary luminaires: Luminaires available as a catalogue item.

Common text

SUBMISSIONS

Authority approval

Design: Submit evidence of electricity distributor approval of the design.

Design documentation

Design and Construct contracts: Submit design documents to **PRE-CONSTRUCTION PLANNING**.

Products and materials

Proprietary equipment: Submit manufacturers' information for luminaires, fittings and accessories.

Records

Evidence of compliance: Submit documentation confirming all works conforms to this worksection and the electricity distributor's requirements.

Audit: Submit results of verification testing and evidence of satisfactory inspection by the electricity distributor on completion of commissioning and testing.

Variations

Columns directly buried in the ground: If the soil is unsuitable for installing columns in the ground, submit details of alternative pole mounting method.

Warranties

Manufacturer's warranty: Submit the manufacturer's published product warranties.

Common text

INSPECTIONS

Notice

General: Give notice so that inspection may be made of the following:

Footings for base mounted columns: Formwork and anchor bolt assembly location.

Power cables: Completed installation of cabling including trenching if required.

Audit: Commissioning and verification testing.

PRE-CONSTRUCTION PLANNING

LIGHTING DESIGN CRITERIA

General

Requirement: Design the street lighting installations to the following:

Vehicular traffic category V: To AS/NZS 1158.1.1 and AS/NZS 1158.1.2.

Pedestrian areas Category P: To AS/NZS 1158.3.1.

Pathways and cycleways: To AS/NZS 1158.3.1.

Pedestrian crossings: To AS/NZS 1158.4.

Tunnels and underpasses: To AS/NZS 1158.5.

Lighting design strategy: Make sure the documented installations meets the following principles:

Safety and comfort: Provides a safe and comfortable visual environment for pedestrians/cyclists/drivers at night.

Aesthetic quality: Enhances the pedestrian spaces and parks and provides good colour rendition to give people and surrounds a natural appearance.

Sustainability: Maximises efficiency and minimises greenhouse gas emissions.

Minimise street clutter: Coordinated with other lighting elements.

Safety and amenity

Requirement: Design the street lighting installations to maintain and enhance the security of the Work area and at least meet the following:

Provide a sense of safety by allowing pedestrians to see and be seen.

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Minimise glare: Prevent glare, blind spots, light spill and light pollution.

CCTV: If required, make sure the lighting level provided is sufficient so that clear, high resolution digital images can be captured.

Vandalism: With luminaire selection and mounting height that does not provide opportunities for vandalism.

Direction signage and maps: Adequately illuminate to facilitate clear, safe wayfinding and orientation.

Encourage active transport at night.

Sustainability

Requirement: Design the street lighting installations to meet the following:

Minimise energy consumption: Through the establishment of appropriate lighting levels and luminaire and equipment selection.

Asset management and maintenance:

Material and design of luminaires and support, including brackets, to withstand the environmental conditions of the site.

Fixings: Concealed and tamperproof.

Park lighting

Requirement: Design park lighting installations as appropriate for the size, location, circulation patterns/access and use of the park. Conform to the following:

Main pathway: Extend park lighting off the main pathway.

Glare: Minimise glare sources.

Additional lighting applications: Integrate tree and furniture lighting to improve the perception of safety and increase park activity.

Lighting level: Provide sufficient lighting level to the main park pathways and park perimeter to assist navigation and wayfinding.

Visibility: Maximise the visibility the pedestrian has of the whole park.

DESIGN DOCUMENTATION

General

Design information: Prepare documentation, including the following:

Lighting design report: Include details of non-conforming design elements, whole of life cost analysis, and how construction of the project will be managed so that the design is successfully implemented.

Lighting design drawings: Include details of the following:

Existing and proposed electrical load of the lighting circuits.

Cable offsets: Existing cable locations and offsets that are maintained by the electricity distributor.

Distribution pole attachment details.

Lighting details: Lighting classification and subcategory, mounting height, tilt, maximum spacing and any non-conforming portions.

Lighting schedule: With details of lamps, luminaires, brackets, columns, mounting heights, and other equipment.

Details of the design method used: Include the values of the light technical parameters obtained, for each road element, compared to the limiting values in the AS/NZS 1158 series.

Computer analysis information: To the AS/NZS 1158 series.

Luminaire intensity distribution tables: IES or CIE format, as appropriate, and the origin of this photometric data.

Computer program used: The name and source of the program and a statement with details of conformance to the requirements of AS/NZS 1158.2.

Details of the road surface reflection characteristics: Assumed in luminance-based design calculations.

Maintenance: Justification for the maintenance factor used in the calculations and associated schedule of maintenance, e.g. for luminaire cleaning and or lamp replacement intervals.

Cross-section drawings: Showing proposed column type, setbacks, outreach arm, luminaire offset and luminaire.

Designer qualifications

Requirement: Use only persons appropriately experienced and qualified to undertake the lighting and electrical design work.

Authority requirements

Requirement: Liaise with and conform to the requirements of the electricity distributor.

Approvals: Obtain documented approval of the design from the electricity distributor.

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GENERAL

Standards

Materials: To the electricity distributor standards.

PROPRIETARY LUMINAIRES

General

Requirement: Provide proprietary luminaires complete with lamps, luminaire control equipment, lighting control equipment, and accessories, as documented.

Lamp manufacturer: Provide lamps of the same type from the same brand and country of manufacture.

Self-ballasted lamps: To AS/NZS 60968 and AS/NZS 60969.

Luminaire body

Form and construction of the luminaire: To SA/SNZ TS 1158.6 Section 2.

FLUORESCENT LAMPS

Standards

General: To SA/SNZ TS 1158.6.

Fluorescent lamps: To AS/NZS 4782.1 and AS/NZS 4782.2.

Compact fluorescent lamps: To AS/NZS 4847.1 and AS/NZS 4847.2.

General

CCT: 4000 K or as documented.

Linear lamp type: T8 (26 mm diameter) or T5 (16 mm diameter), linear lamps, triphosphor, TL84, as documented.

Compact fluorescent lamps types: Four-pin, non-integrated type.

FLUORESCENT LAMP BALLASTS

Linear lamp types

Requirement: Electronic fluorescent lamp ballasts for fluorescent lamp lighting systems selected for compatibility with the lamp and control method.

Electronic fluorescent lamp ballasts: Conform to the following:

To AS/NZS 60929 and AS/NZS 61347.2.3.

Current total harmonic distortion: < 15%.

Soft start.

Number of ballasts: Provide separate ballasts for each lamp or integral dual ballasts as an alternative for dual lamp fittings.

Ballast performance measurement – fluorescent lamps: To AS/NZS 4783.1.

Reactive fluorescent lamp ballasts: Conform to the following:

To AS/NZS 60921 and AS/NZS 61347.2.8.

Connections: Quick-connect terminals or wiring, suitable for the operating temperature close to the ballast.

Number of ballasts: Provide separate ballasts for each lamp.

Ballast type: Low loss ballasts.

Starters: Multi-pulse soft start voltage pulse type as follows:

Starters (electronic type) other than glow starters: To AS/NZS 61347.2.1.

Glow type Starters: To AS 4111 and AS/NZS 60155.

CFL lamp types

Requirement: Electronic fluorescent lamp ballasts for CFL lighting systems selected for compatibility with the lamp and control method.

Electronic fluorescent lamp ballasts: To AS/NZS 61347.2.3 and AS/NZS 60929.

Current total harmonic distortion: < 15%.

Number of ballasts: Provide separate ballasts for each lamp or integral dual ballasts as an alternative for dual lamp fittings.

Ballast performance measurement – fluorescent lamps: To AS/NZS 4783.1.

Reactive fluorescent lamp ballasts: Conform to the following:

To AS/NZS 60921 and AS/NZS 61347.2.8.

Connections: Quick-connect terminals and wiring, suitable for the operating temperature close to the ballast.

Ballast type: Low loss ballasts.

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Starters: Multi-pulse soft start voltage pulse type as follows:

Starters (electronic type) other than glow starters: To AS/NZS 61347.2.1.

Glow type Starters: To AS 4111 and AS/NZS 60155.

Fluorescent lamp power factor correction

Power factor correction on all luminaires: To minimum power factor of 0.9 lagging.

Power factor correction capacitors

Requirement: To SA/SNZ TS 1158.6 Section 4, AS/NZS 61048 and AS/NZS 61049.

Surge protection devices (SPD)

Requirement: Provide surge protection, as documented, metal oxide varistors fitted and installed as recommended by the electronic control gear manufacturer.

Minimum MOV value: 320 joules.

DISCHARGE LAMPS (HID)

Standards

High pressure mercury vapour: To IEC 60188.

High pressure sodium vapour: To IEC 60662.

Low pressure sodium vapour: To IEC 60192.

Metal halide lamps: To IEC 61167.

Lamp controlgear for HID lamps: To AS/NZS CISPR 15, AS/NZS 60923, AS/NZS 61347.1 and the AS/NZS 61347.2 series.

Discharge lamp ballasts

Requirement: Ballasts for lighting systems selected for compatibility with the lamp and control method.

High-pressure mercury vapour, low-pressure sodium vapour, high-pressure sodium vapour and metal halide type: To AS/NZS 60923 and the AS/NZS 61347 series.

Metal halide type:

≤ 150 W: Reactors or electronic controlgear.

> 150 W outdoor: To the lamp manufacturer's recommendation.

Igniters: If required, provide igniters which cut out when lamp ignites and after pre-determined time period if lamp fails to ignite.

Instant restrike igniters: If required, provide instant restrike igniters for instant restart of suitable HID lamps to the manufacturer's requirements.

HID power factor correction

Power factor correction on all luminaires: To minimum power factor of 0.9 lagging.

Capacitors

Standard: To AS/NZS 61048 and AS/NZS 61049.

Integral fuses

Requirement: Integral fuses for reactive high intensity discharge (HID) lamp ballasts.

LIGHT-EMITTING DIODES (LEDS) LUMINAIRES

General

Requirement: Provide light emitting diode (LED) luminaires, as documented, including integral LEDs, reflectors, lenses, heatsinks and drivers.

Light-emitting diode luminaires

Performance: LED luminous efficacy of the LED luminaire at normal operating temperature in its normal position and enclosure of > 60 lumens per watt.

Life of the LED in the complete luminaire: L70 to IES LM-80-2008 or as documented.

Colour: CRI > 80.

CCT: 3000K or as documented.

Light-emitting diode lamp replacement modules

Reflector lamps replacement modules luminous efficacy: At operating temperature in normal position and enclosure more than 40 lumens per watt where the quoted beam angle is the angle between the points of 50% of maximum luminous intensity.

Linear fluorescent lamps replacement modules luminous efficacy: > 80 lumens per watt.

CONTROL GEAR ENCLOSURE

General

Standards: To SA/SNZ TS 1158.6 Section 3.

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Requirement: Provide controlgear support enclosure within the body of the luminaire, except where remotely mounted controlgear is documented or required by the manufacturer.

Enclosures and controlgear mounting assemblies: Heat dissipation facilities to dissipate heat from the luminaire.

Controlgear enclosure: Form a barrier against direct contact with live parts of the controlgear and the area of the luminaire containing the lamp and lamp support holders.

Fixing: Screw fixed.

LIGHTING CONTROL

General

Automatic control systems: By use of photo-electric (PE) cells controlling groups of street lighting fittings.

PE cells: To the electricity distributor's requirements.

Manual controls

Requirement: Provide manual control of luminaires into groups, zones and to individual devices, as documented.

Control wiring: To the control system manufacturers' recommendation, with distinctive sheath colour.

Controllers and contactors: Rated for the characteristics of the controlled load and to AS/NZS IEC 60947.4.3.

WIRING SYSTEMS

Selection

Cable selection: To AS/NZS 3008.1.1.

Wiring and cable reticulation systems: Provide systems appropriate to the installation conditions and the function of the load. Include the following:

Underground services.

Above-ground services.

Type: Re-wireable system.

Circuit arrangements: For long street lighting circuits, distribute the lighting load over three phases to the local network distributor requirements.

Neutral conductors: The same size as the corresponding active conductors. Rate the neutral conductor size for the maximum harmonic currents.

Cable support system: To AS/NZS 3000.

POWER CABLES

Underground cable systems

Polymeric insulated cables: To AS/NZS 5000.1.

Cable

Requirement: Select multi-stranded copper cables.

Default insulation: V-75.

Default sheathing: 4V-75.

Minimum size of power sub-circuits: 2.5 mm².

Voltage drop: Select final sub-circuit cables within the voltage drop parameters dictated by the route length and load.

Fault loop impedance: Final sub-circuit cables to satisfy the requirements for automatic disconnection under short circuit and earth fault/touch voltage conditions.

Colours

Fixed wiring cables: Coloured conductor insulation or at least 150 mm of close fitting coloured sleeving at the termination points of each conductor.

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

A phase: Red.

B phase: White.

C phase: Blue.

Sheath: White.

Above-ground cable systems

Aerial cables: To AS 1746.

Requirements: To the electricity distributor's requirements.

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STREET LIGHTING SUPPORT COLUMNS**General**

Columns: For fabricated columns higher than 2400 mm, designed to support street lighting accessories, conform to the following:

Public lighting poles: AS 1798.

Concrete structures: AS 3600.

Steel structures: To AS 4100.

Structural design of columns: To AS/NZS 4676.

Hot-dipped galvanized (zinc) coatings on ferrous articles: To AS/NZS 4680.

Design

Requirement: Tapped hot-dipped galvanized steel, aluminium or concrete columns, designed, manufactured and tested by a specialist manufacturer.

Mounting: Conform to the following:

Steel and aluminium columns: Base plate mounting, suitable for mounting on rag bolt assemblies.

Concrete columns: Direct mounting in the ground.

Footings and rag bolt assemblies: Designed by a professional engineer and independently certified.

Site specifics: Consider the design wind category and the soil conditions.

Dimensions: To AS 1798.

Rag bolt assemblies: Galvanized threaded steel of cross-sectional area designed to support each column taking into account the wind loads expected to act on the column and the luminaires mounted on the column. Set the rag bolt assemblies in the concrete footings. Cut holding bolts within 3 threads above top of base plate top lock nuts.

Base sealing: Seal space under pole base plate with grout.

Maintenance access: Provide pole stirrups secured to either side of the column for access to accessories. Locate the first stirrup greater than or equal to 3 m above ground level.

Electrical connections: For hollow metal or concrete poles, provide a recess fitted with a flush mounted lockable or screw fixed cover at the base of the column for access to cable connections and equipment.

Cable support: For connections higher than 3 m, provide a catenary wire cable support system unless cable and anchor methods at the ends of the cable suspension are designed for unsupported cable suspension.

At column base: Provide the following:

Adequate drainage.

Street lighting controlgear panel.

POWER POLES**Hardwood poles**

Requirement: Conform to the requirements of AS/NZS 3000, the local network distributor's standards and the local Service and Installation Rules.

Selection: Dressed, natural, round poles with all sapwood removed.

Capping: Galvanized steel, domed cap extending 25 mm down the sides. Fix with galvanized steel nails.

Termite and fungus treatment: To 600 mm above ground level.

Hardwood cross arms

Material: 75 x 75 x 1500 mm minimum hardwood.

Fixing: Securely fix to pole with M20 galvanized bolts, nuts and washers.

Bracing: Two 5 x 40 x 690 mm galvanized steel fixed at 45° to the pole below the cross arm with M12 x 75 mm galvanized coach screws in the pole and M12 galvanized bolts, nuts and washers in the cross arms.

Steel poles

General: Hot-dipped galvanized round steel poles conforming to the requirements of AS/NZS 3000, the local network distributor's standards and the local Service and Installation Rules.

Capping: Galvanized steel, domed cap extending 25 mm down the sides. Fix with galvanized steel screws.

Drainage: Provide adequate drainage at the column base.

Bases: Provide columns with mounting bases for fixing to reinforced concrete footings via rag bolt assemblies.

CUSTOM DESIGNED POLES/COLUMNS**General**

Columns: Designed, manufactured and tested by a specialist manufacturer.

Standards: To the electricity distributor's standards and to the local Service and Installation Rules.

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Construction

Requirement: Hot-dip galvanized steel columns and fittings after fabrication. Powder coat or anodise aluminium columns and fittings after fabrication.

Drainage: Provide adequate drainage at the column base.

Bases and footings for custom designed columns

Bases: Provide mounting bases for rag bolt assembly fixing to reinforced concrete footings.

Bases to custom designed columns: As documented.

Footings and rag bolt assemblies: Designed by a professional engineer and independently certified.

Site specifics: Design for the site wind category and the soil conditions.

Dimensions: To AS 1798.

Rag bolt assembly: Cut holding bolts within 3 threads above top of base plate top lock nuts.

Base fixing: Galvanized holding down nut with galvanized lock nut above.

Design of footing and rag bolt assemblies: Undertake design by a professional engineer and provide independent certification.

Base sealing: Seal space under pole base plate with grout.

Finish: Paint to the documented colour.

Cable support at point of supply

Underground cable facilities: Provide access and cable support for conduit and cable systems connecting the street lighting fixtures to the underground cable duct system.

Accessory mountings: Adjustable mountings to suit accessories. Include provision for rigidly clamping each item in position, once adjusted correctly.

Maintenance access: Provide pole stirrups, as documented, secured to either side of the column for access to accessories. Locate the first stirrup minimum 3 m above the ground level.

Electrical connections for hollow metal or concrete poles: If a continuous conduit system is not utilised, provide a recess fitted with a lockable or screw fixed flush mounted cover at the base of the column for access to cable connections and equipment.

Cable support: If cable and anchor methods at the ends of the cable suspension are not designed for unsupported cable suspension, provide a catenary wire cable support system for connections higher than 3 m.

Service connection: Pole mounted equipment including weatherproof box and service fuses at the service connection point as required by the electricity distributor.

Street lighting controlgear panel: Provide controlgear panel at base of column.

SOLAR STREET LIGHTING**General**

Requirement: Proprietary solar street lighting assemblies complete with solar panels, lamps, luminaires lighting control equipment, batteries and accessories, as documented.

Solar panels: Monocrystalline, high efficiency type, sized to meet the lamp size and battery storage requirements.

Panel efficiency: $\geq 21\%$

Storage battery: Maintenance free, deep cycle gel type, sized to meet the run time and lamp wattage requirements.

Lamp type: High performance LED, sized to meet the lighting level requirement.

Lamp control: Local PE cell mounted within the unit.

FOOTINGS**Concrete**

Concrete, reinforcement and formwork: To the *0319 Auxiliary concrete works* worksection and the requirements of the street lighting column manufacturer.

Compressive strength of concrete: 25 MPa.

Anchor bolts

Welding: To AS/NZS 1554.1 Category GP.

Anchor bolt assemblies: Hot-dip galvanize after fabrication to AS/NZS 4680 with minimum 100 μm thickness and a bright finished appearance free from all galvanizing defects.

Treatment before galvanizing: To AS 1627.1 and AS 1627.4 (class 2.5 Blast).

Galvanized bolts, nuts and washers: To AS/NZS 1214.

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ESTABLISHMENT

Protection of services and utilities

Existing services: Locate and protect existing services and utilities before starting excavation work.

Damage: Rectify any damage to existing services and utilities.

LUMINAIRES

Installation

Mounting: Mount luminaires on proprietary supports.

Completion

Replacement of lamps: At the date of completion, verify the operation of all luminaires. Replace lamps which have been in service for more than 50% of the lamp life as published by the lamp manufacturer.

LIGHTING SUPPORTS

General

Free standing luminaires: Provide columns and mounting for free standing road lighting luminaires, as documented..

Luminaires on network power poles: Mount luminaires with proprietary hardware on network power poles conforming to the electricity distributor's standards.

Column installation

Installation of columns: As documented.

Columns set in the ground: Set columns in the ground to AS 1798 and to the manufacturers' requirements.

Soil suitability: If the soil is unsuitable, use alternative pole types and mount in concrete or on rag bolt assemblies set in concrete footings.

Footings for base mounted columns

Location: Construct concrete footings at the locations for street lighting columns, as documented.

Excavation: Excavate footings neatly from solid material. Compact to 90% maximum dry density.

Dimensions: Construct footings to the dimensions and embedment details, as documented.

Anchor bolt assembly: Locate accurately and firmly support the anchor bolt assembly.

Concrete supply and placement: To the *0319 Auxiliary concrete works* worksection.

Electrical conduits: Make sure all conduits have large radius bends through the footing. No

Elbow bends: Not permitted.

Placing: Do not place concrete until the formwork and anchor bolt assembly location have been approved.

Columns directly buried in the ground

Requirement: To AS 1798 and the manufacturers' recommendations.

Soil suitability: If the soil is unsuitable, use alternative pole and support method, such as mounting in concrete or on rag bolt assemblies set in concrete footings.

Hardwood poles

Requirement: Set poles directly in the ground.

Planting depth: 1600 mm minimum or as required by AS/NZS 3000, the electricity distributor's standards and the Service and Installation Rules.

Verification: Verify soil suitability to support poles.

POWER SUPPLY

Connection

Local network system: Provide power supply and connection to each luminaire from the electricity distributor's low voltage system to conform to the electricity distributor's standards.

Earthing: Provide earthing to meet the requirements of the electricity distributor.

Cable installation

Classifications: To AS/NZS 3013 and as documented.

Handling cables: Report damage to cable insulation, serving or sheathing.

Stress: Do not use installation methods that exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints: Locate in accessible positions in lighting column bases, junction boxes and/or in pits.

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TESTING**Audit**

Requirement: Audit the installation for conformance to the documents.

ANNEXURES**ANNEXURE – SUMMARY OF HOLD AND WITNESS POINTS**

Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
SUBMISSIONS, Design Documentation Design and Construct contracts	H	For Design and Construct contracts, design documentation.	2 weeks before commencement	Commencement
SUBMISSIONS, Authority approval Design	H	Evidence of electricity distributor design approval.	5 days before commencement	Commencement
SUBMISSIONS, Products and materials Proprietary equipment	H	Manufacturer's information for luminaires, fittings and accessories.	5 days before commencement	Material ordering
INSPECTIONS, Notice Footings for base mounted columns	H	Formwork and anchor bolt assembly location.	1 day before installation	Column installation
SUBMISSIONS, Variations Columns directly buried in the ground	H	Alternative pole mounting method if soil is unsuitable.	3 days before installation	Column installation
INSPECTIONS, Notice Power cables	W	Completed cable installation	1 day before inspection	-
INSPECTIONS, Notice Audit	W	Commissioning and verification testing.	1 day before inspection	-
*H = Hold Point W = Witness Point				

ANNEXURE – PAY ITEMS**Pay items – lump sum**

Pay items	Unit of measurement	Schedule rate inclusions
1197.1 Installation of street lighting	Lump sum.	All costs associated with all materials, plant, equipment and labour for the installation of all overhead cabling, outreaches, luminaries, lamps on new poles and the replacement of existing for connection to the existing power supply, commissioning and testing, and the removal and disposal of redundant items.

Pay items	Unit of measurement	Schedule rate inclusions
Traffic management	Lump sum.	To the 1101 Traffic management worksection.

Pay items – associated activities

Pay items	Unit of measurement	Schedule rate inclusions
1197.4 Excavation	m ³ , measured in volume of excavation. Determine the volume by the End Area Method using design cross-sectional areas calculated at each change in height or width of the wall.	Include in the rate for excavation: Excavation and backfilling of all types of materials, with no separate rates for earth and rock. The disposal of surplus material. The control of stormwater runoff. Do not include: Drying out wet excavated material or replacement of over excavation beyond the design cross-sectional limits defined above.
1197.5 Unsuitable material below foundation	m ³ , measured as volume of excavation below foundation level which is directed to be removed and replaced.	All operations involved in the excavation and removal to spoil of unsuitable material below the foundation level of concrete footings, backfilling with replacement material and compaction to foundation level.
1197.6 Reinforced concrete footing	m ³ of reinforced concrete.	All operations involved in the supply and placement of formwork, embedments, reinforcement (including starter bars), concrete (including 50 mm mass concrete blinding layer), stepping of footing, joints, curing and backfilling to the footing. Take the volume from the drawings, excluding the volume of the 50 mm mass concrete blinding layer.
1197.7 Installation of conduits	Per linear metre of conduit.	All materials, plant equipment and labour required for installing conduits with required bends, trenching, laying of conduit in trench or structure, backfilling and provision of draw wire.
1197.8 Installation of cable pits	Per each pit installed.	Supply of cable pits, excavation and installation.
1197.9 Installation of poles and columns	Per unit.	All materials, poles, columns, plant, equipment and labour required for installing poles and columns.
Erosion and sedimentation control		To the 1102 Control of erosion and sedimentation (Construction) worksection.

ANNEXURE - REFERENCED DOCUMENTS**The following documents are incorporated into this worksection by reference:**

AS/NZS CISPR 15	2011	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment (CISPR 15:2009, MOD)
AS/NZS 1158		Lighting for roads and public spaces
AS/NZS 1158.1.1	2005	Vehicular traffic (Category V) lighting - Performance and design requirements
AS/NZS 1158.1.2	2010	Vehicular traffic (Category V) lighting - Guide to design, installation, operation and maintenance
AS/NZS 1158.2	2005	Computer procedures for the calculation of light technical parameters for Category V and Category P lighting

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Contract No.		STANDARD DRAWINGS
AS/NZS 1158.3.1	2005	Pedestrian area (Category P) lighting - Performance and design requirements
AS/NZS 1158.4	2015	Lighting of pedestrian crossings
AS/NZS 1158.5	2014	Tunnels and underpasses
AS/NZS 1214	2016	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS/NZS 1554		Structural steel welding
AS/NZS 1554.1	2014	Welding of steel structures
AS 1627		Metal finishing - Preparation and pretreatment of surfaces
AS 1627.1	2003	Removal of oil, grease and related contamination
AS 1627.4	2005	Abrasive blast cleaning of steel
AS 1746	1991	Conductors - Bare overhead - Hard-drawn copper
AS 1798	2014	Lighting poles and bracket arms - Recommended dimensions
AS/NZS 3000	2007	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3008		Electrical installations - Selection of cables
AS/NZS 3008.1.1	2009	Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
AS/NZS 3013	2005	Electrical installations - Classification of the fire and mechanical performance of wiring system elements
AS 3600	2009	Concrete structures
AS 4100	1998	Steel structures
AS 4111	1993	Starters for fluorescent lamps - Performance requirements
AS/NZS 4676	2000	Structural design requirements for utility services poles
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 4782		Double-capped fluorescent lamps - Performance specifications
AS/NZS 4782.1	2004	General (IEC 60081:2000, MOD)
AS/NZS 4782.2	2004	Minimum Energy Performance Standard (MEPS)
AS/NZS 4783		Performance of electrical lighting equipment - Ballasts for fluorescent lamps
AS/NZS 4783.1	2001	Method of measurement to determine energy consumption and performance of ballasts lamp circuits
AS/NZS 4783.2	2002	Energy labelling and minimum energy performance standards requirements
AS/NZS 4847		Self-ballasted lamps for general lighting services
AS/NZS 4847.1	2010	Test methods - Energy performance
AS/NZS 4847.2	2010	Minimum Energy Performance Standards (MEPS) requirements
AS 4934		Incandescent lamps for general lighting service - Test methods
AS 4934.2	2011	Minimum energy performance standards (MEPS) requirements
AS/NZS 5000		Electric cables - Polymeric insulated
AS/NZS 5000.1	2005	For working voltages up to and including 0.6/1 kV (1.2) kV
AS/NZS 60155	2000	Glow-starters for fluorescent lamps
AS/NZS 60598.2.3	2015	Luminaires for road and street lighting (IEC 60598-2-3, Ed. 3.1 (2011) MOD)
AS/NZS 60921	2002	Ballasts for tubular fluorescent lamps - Performance requirements (IEC 60921:1988, MOD)
AS/NZS 60923	1998	Auxiliaries for lamps - Ballasts for discharge lamps (excluding tubular fluorescent lamps) - Performance requirements
AS/NZS 60929	2005	A.C. supplied electronic ballasts for tubular fluorescent lamps - Performance requirements
AS/NZS IEC 60947.4.3	2015	Contactors and motor-starters - A.C. semiconductor controllers and contactors for non-motor loads
AS/NZS 60968	2001	Self ballasted lamps for general lighting services - Safety requirements (IEC 60968:1988, MOD)
AS/NZS 60969	2001	Self ballasted lamps for general lighting services - Performance requirements
AS/NZS 61048	2002	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General safety requirements
AS/NZS 61049	2002	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - Performance requirements
AS/NZS 61347		Lamp controlgear
AS/NZS 61347.1	2016	General and safety requirements (IEC 61347-1:2000, MOD)
AS/NZS 61347.2.1	2002	Particular requirements for starting devices (other than glow starters)
AS/NZS 61347.2.3	2016	Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps
AS/NZS 61347.2.8	2003	Particular requirements for ballasts for fluorescent lamps
Austrroads AGRD		Guide to road design

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Contract No.		
Austrroads AGRD04	2009	Intersections and crossings - General
Austrroads AGRD06B	2015	Roadside environment
SA/SNZ TS 1158.6	2015	Luminaires - Performance
IEC 60188	2001	High-pressure mercury vapour lamps - performance specifications
IEC 60192	2001	Low-Pressure sodium vapour lamps - performance specifications
IEC 60662	2011	High-pressure sodium vapour lamps - Performance specifications
IEC 61167	2015	Metal halide lamps - Performance specification

REVISIONS

REVISION A

- **PAGE 2, 32, 52, 53, 82, 96, 104, 105, 122, 130 & 150 -** INDEX PAGE NUMBERS CORRECTED.

REVISION B (ISSUED 01-OCT-05)

- **PAGE 2 -** "ANNEXUE C STANDARD DRAWINGS INDEX" CHANGED TO "**ATTACHMENT 'A' – DRAINAGE DESIGN GUIDELINES**" & "**REVISIONS**" ADDED.
- **PAGE 23 -**
 - * E1 ENGINEERING DESIGN DRAWINGS AND SPECIFICATIONS "**LANDSCAPING WORKS**" CHANGED TO "**URBAN DESIGN & LANDSCAPING WORKS**"
 - * **K) LIGHTING DESIGN**" ADDED.
 - * **ALL LEVELS TO A.H.D. & PLAN VIEWS TO G.D.A. DRAINAGE DESIGN DRAWINGS TO "D-SPEC" REQUIREMENTS.** ADDED
- **PAGE 24 -** E6 ASSET MANAGEMENT – DELETED
- **PAGE 24 -** E7 "**WORK-AS-CONSTRUCTED PLANS**" CHANGED TO "**AS-CONSTRUCTED – DRAWINGS & SCHEDULE OF QUANTITIES.**"
- **PAGE 24 -** E8 ROAD SAFETY AUDIT "**AS DETERMINED BY THE RESPONSIBLE AUTHORITY.**" ADDED.
- **PAGE 49 -** DRAWING SET-OUT & SHEET TOPICS ALTERED.
- **PAGE 75 -** CLAUSE CHANGED FROM –

*"STREET LIGHTING SHALL BE PROVIDED IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS:
RESIDENTIAL SUBDIVISION – TO BE INSTALLED IN ACCORDANCE WITH THE AUSTRALIAN STANDARD FOR LIGHTING, AS/NZS 1158.
INDUSTRIAL SUBDIVISION – TO BE INSTALLED IN ACCORDANCE WITH AS 1158 CATEGORY B2 STANDARD. MINIMUM MOUNTING HEIGHT 7.5M AND 100W HPSV TO BE USED.
ALL POLES AND LAMPS ARE TO BE IN ACCORDANCE WITH ENERGY SUPPLIER'S STANDARDS.*

TO

"STREET LIGHTING SHALL BE PROVIDED IN ACCORDANCE WITH AZ/NZS 1158. ALL ELECTRIC POWER SUPPLY CABLES & CONDUITS ARE TO BE INSTALLED UNDERGROUND AT THE OFFSETS SHOWN IN COUNCIL'S STANDARD DRAWINGS. THE LIGHTING CATEGORY & AUTHORISATION TO USE NON-STANDARD POLES & LAMPS, IS TO BE OBTAINED IN WRITING FROM THE RELEVANT RESPONSIBLE AUTHORITY & COUNCIL RESPECTIVELY, PRIOR TO SUBDIVISION DESIGN DRAWINGS BEING SUBMITTED."
- **PAGE 91 -** PAVEMENT LAYER THICKNESSES CHANGED.
- **PAGE 92 -** PAVEMENT LAYER THICKNESSES CHANGED.
- **PAGE 120 -** **D5.27 STORM-WATER PUMPS** REMOVED.
- **PAGE 155 -** "ATTACHMENTS" CHANGED TO "**ATTACHMENT 'A' – DRAINAGE DESIGN GUIDELINES 'A.'**"
- **PAGE 156 -** GUIDELINE 2(A) CHANGED FROM "**AUSTRALIAN HEIGHT DATUM SHALL BE USED FOR ALL LEVELS**" TO "**AUSTRALIAN HEIGHT DATUM (A.H.D.) SHALL BE USED FOR ALL LEVELS & ALL PLAN VIEWS SHALL BE TO GEOCENTRIC DATUM OF AUSTRALIA (G.D.A.). ALL DRAINAGE DESIGN DRAWINGS SHALL TO BE TO 'D-SPEC' REQUIREMENTS.**"
- **PAGE 159 -** REVISION LIST ADDED.

REVISION C (ISSUED 01-OCT-06)

- **PAGE 75 -** **D1.21 STREET LIGHTING & ELECTRIC SUPPLY** PARAGRAPH COMPLETELY REVISED.
- **PAGE 120 -** **D5.27 STORMWATER PUMPS** PARAGRAPH ADDED.

REVISION D (ISSUED 01-DEC-07)

- **PAGE 159 -** RAINFALL FREQUENCY / INTENSITY COEFFICIENTS TABLE UPDATED.

REVISION F (ISSUED – JULY 2014)

PAGE 123 Table D5 ARRO – AEP reference added

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REVISION G (ISSUED – AUG-17)

- **PAGE 58 - LIGHTING SCHEDULE/SPECIFICATION & INCLUDING COMPLIANCE DOCUMENTATION – REFER TO ATTACHMENT B AUS-SPEC 1197 STREET AND PUBLIC LIGHTING**
- **PAGE 2 – CONTENTS - ATTACHMENT 'B' – AUS-SPEC 1197 STREET AND PUBLIC LIGHTING**
- **PAGE 181 - ATTACHMENT 'B' – STREET AND PUBLIC LIGHTING GUIDELINES**

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STANDARD DRAWINGS INDEX

STANDARD DRAWING NO.	STANDARD DRAWING TITLE	COMPUTER FILE NAME
00 SERIES – STREET CROSS SECTIONS		
SD 001	RESIDENTIAL STREETS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR ACCESS STREET	SD 001.pdf
SD 002	RESIDENTIAL STREETS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR COLLECTOR ROADS	SD 002.pdf
SD 003	RESIDENTIAL STREETS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR COLLECTOR ROADS WITH SHARED FOOTWAY	SD 003.pdf
SD 004	RESIDENTIAL STREETS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR SERVICE ROAD	SD 004.pdf
SD 005	INDUSTRIAL ROADS – TYPICAL GEOMETRIC CROSS SECTION	SD 005.pdf
SD 006	MAJOR ROADS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR BOULEVARD TRUNK COLLECTOR - 3.2M TRAFFIC LANES	SD 006.pdf
SD 007	MAJOR ROADS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR BOULEVARD TRUNK COLLECTOR - 4.2M TRAFFIC LANES	SD 007.pdf
SD 008	MAJOR ROADS – URBAN ZONES – TYPICAL GEOMETRIC CROSS SECTION FOR ARTERIAL ROADS	SD 008.pdf
SD 009	SERVICE CONDUIT LOCATION DETAILS – FOR LOCAL ACCESS STREETS AND COLLECTOR ROADS	SD 009.pdf
SD 010	TYPICAL CROSS SECTION – ROUNDABOUT CENTRAL ISLAND	SD 010.pdf
SD 011	COURT BOWL DETAILS - RESIDENTIAL	SD 011.pdf
SD 012	COURT BOWL DETAILS - INDUSTRIAL	SD 012.pdf
SD 013	HAMMER HEAD DETAILS	SD 013.pdf
SD 014	RURAL ROADS – TYPICAL GEOMETRIC CROSS SECTION	SD 014.pdf
SD 015	RIGHT OF WAY - TYPE 1 TYPICAL GEOMETRIC CROSS SECTION	SD 015.pdf
SD 016	RIGHT OF WAY - TYPE 2 TYPICAL GEOMETRIC CROSS SECTION	SD 016.pdf
SD 017	SERVICE AUTHORITIES MAINS OFFSETS - WHERE ELECTRICITY SUPPLY IS OVERHEAD.	SD 017.pdf
SD 018	SERVICE AUTHORITIES MAINS OFFSETS - WHERE ELECTRICITY SUPPLY IS UNDERGROUND	SD 018.pdf
100 SERIES – PAVEMENTS		
SD 100	PAVEMENT DETAILS – ACCESS PLACE, ACCESS STREET & COLLECTOR ROAD – URBAN ZONES	SD 100.pdf
SD 101	PAVEMENT DETAILS – TRUNK COLLECTOR – URBAN ZONE; INDUSTRIAL ROAD & RURAL ROAD – NON URBAN ZONE	SD 101.pdf

200 SERIES – DRAINAGE		
SD 200	SIDE ENTRY PIT – TYPE 1A - TO SUIT BARRIER TYPE KERB AND CHANNEL - PIPE DIAMETER UP TO 450MM	SD 200.pdf
SD 201	SIDE ENTRY PIT – TYPE 1B - TO SUIT BARRIER TYPE KERB AND CHANNEL - PIPE DIAMETER EXCEEDS 450MM	SD 201.pdf
SD 202	SIDE ENTRY PIT – TYPE 2A - TO SUIT ROLLOVER TYPE KERB AND CHANNEL - PIPE DIAMETER UP TO 450MM	SD 202.pdf
SD 203	SIDE ENTRY PIT – TYPE 2B - TO SUIT ROLLOVER TYPE KERB AND CHANNEL - PIPE DIAMETER EXCEEDS 450MM	SD 203.pdf
SD 204	PRECAST KERB LINTELS FOR SIDE ENTRY PITS FOR BOTH BARRIER AND ROLLOVER TYPE KERB AND CHANNEL	SD 204.pdf
SD 205	STANDARD PIT LID AND FRAME FOR SIDE ENTRY PITS TYPE 1 AND TYPE 2	SD 205.pdf
SD 206	GRATING PIT – MAIN PIT CHAMBER BEHIND KERB – TO SUIT ROLLOVER KERB AND CHANNEL	SD 206.pdf
SD 207	GRATING PIT – UNDER ROLLOVER KERB AND CHANNEL	SD 207.pdf
SD 208	GRATING PIT – GRATE AND FRAME – ROLLOVER KERB AND CHANNEL	SD 208.pdf
SD 209	JUNCTION PIT – PIPE DIAMETER UP TO 450MM	SD 209.pdf
SD 210	JUNCTION PIT – PIPE DIAMETER EXCEEDS 450MM	SD 210.pdf
SD 211	MAIN DRAIN JUNCTION PIT – PIPE DIAMETER 900MM AND ABOVE	SD 211.pdf
SD 212	EASEMENT PIT	SD 212.pdf
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SD 215	ROADSIDE CATCH PIT - 900 X 600MM	SD 215.pdf
SD 216	COMBINATION GRATE AND SIDE ENTRY PIT FOR BARRIER TYPE KERB AND CHANNEL	SD 216.pdf
SD 217	GRATE AND FRAME DETAIL FOR COMBINATION GRATE AND SIDE ENTRY PIT (SD 216)	SD 217.pdf
SD 218	COMBINATION GRATE AND SIDE ENTRY FOR BARRIER TYPE KERB AND CHANNEL WHERE PIPE IS LOCATED UNDER ROAD PAVEMENT	SD 218.pdf
SD 219	GRATED CATCH PIT FOR USE IN PAVED AREAS	SD 219.pdf
SD 220	GRATED CATCH PIT FOR USE IN UNPAVED (GRASSED) AREAS	SD 220.pdf
SD 221-1	SOAKAGE PIT - SHEET 1 OF 2 SHEETS	SD 221-1.pdf
SD 221-2	SOAKAGE PIT - SHEET 2 OF 2 SHEETS	SD 221-2.pdf
SD 222	LIGHT DUTY STEEL GRATE AND FRAME FOR SOAKAGE PIT	SD 222.pdf
SD 223	PRECAST CONCRETE ENDWALL	SD 223.pdf

200 SERIES – DRAINAGE (CONT'D)		
SD 224	DRAINAGE PIPELINE ANCHOR BLOCK	SD 224.pdf
SD 225	PIPE LAYING DETAIL FOR PIPES NOT UNDER ROAD PAVEMENT	SD 225.pdf
SD 226	SUBSOIL DRAINAGE - NEW WORKS	SD 226.pdf
SD 227	KERB AND CHANNEL RECONSTRUCTION DETAIL – SHOWING LOCATION OF SUBSOIL DRAINS	SD 227.pdf
SD 228	STEP IRONS	SD 228.pdf
300 SERIES – CONCRETE PAVING		
SD 300	VEHICLE CROSSING DETAIL – RESIDENTIAL – BARRIER KERB AND CHANNEL SD 400	SD 300.pdf
SD 301	VEHICLE CROSSING DETAIL – RESIDENTIAL – ROLLOVER KERB AND CHANNEL SD 403	SD 301.pdf
SD 302	VEHICLE CROSSING DETAIL – RESIDENTIAL – FOR USE ON BUSY ROADS ONLY	SD 302.pdf
SD 303	VEHICLE CROSSING DETAIL – INDUSTRIAL – BARRIER KERB AND CHANNEL SD 400	SD 303.pdf
SD 304	VEHICLE CROSSING DETAIL – INDUSTRIAL – ROLLOVER KERB AND CHANNEL SD 403	SD 304.pdf
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SD 906	200 x 200 bollard with rebate for key entries	SD 906
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SD 908	Park vehicular entry gate	SD 908
SD 901	Type A park bollard, 150 x150 with rebate collar	SD 901
SD 902	Type B park bollard, 150 x 150 with plain	SD 902
SD 903	150 x 150 park perimeter post and pipe fence	SD 903
SD 904	125 x 125 oval perimeter post and pipe fence	SD 904
SD 905	200 x 200 bollard with rebate for key entries	SD 905
SD 906	200 x 200 bollard with rebate for key entries	SD 906
SD 907	Advanced tree planting	SD 907
SD 908	Park vehicular entry gate	SD 908