



maitland

city council

MANUAL OF ENGINEERING STANDARDS

2014



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REVISION LIST

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4	Minor Amendments	Feb 2006
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6	Major Revision - draft	Feb 2013
7	Amendments in response to submissions -Adopt 13/5/14 Ccl min 11.1	May 2014

THE MANUAL

1. INTRODUCTION

This Manual sets out the minimum standards and guidelines for engineering design and construction works in the Maitland City Council Local Government Area. It is intended for use in the preparation of development applications and engineering designs for the construction of approved works, as a “Construction Certificate” under the EP& A Act or as consent under the Roads Act. For more general planning and engineering requirements regarding subdivision design, the DCP should be consulted.

The Manual sets out standards applicable to the construction of roads, drainage and associated infrastructure that will be either, constructed on private land and dedicated to the public under the care and control of Maitland City Council, or constructed on an existing public road for primarily, subdivisions within Urban and Rural environments. The recognised standards for this infrastructure are nominated within the Manual, although contained herein are particular emphases or variations that designers should take into account as Council's adopted standard.

Also within the Manual is a chapter setting out standards and guidelines for “small-site developments”.

Where Council has approved development pursuant to any Environmental Planning Instrument and in accordance with the Environmental Planning and Assessment Act, the conditions of Development Consent (assessed and deemed appropriate under Section 80A of the Act) appended to the Notice of Determination together with this document will establish the engineering design and construction requirements.

Where no reference exists in this document regarding particular design and construction details, the designer should determine a course of action based on best design practice, alternative reference material, and appropriate standards. Council may require deviation from this Manual to achieve good design outcomes. Deviations from standards proposed by consultants, shall be justified to Council. Consultants are encouraged to consider equivalent alternative designs or approaches where appropriate. Such alternatives may be desirable due to changing attitudes and standards in engineering and planning disciplines.

This document should be used and interpreted by suitably qualified and experienced consultants and contractors in the fields of land development, subdivision and construction of infrastructure.

2. AIMS & OUTCOMES

The aims of the Manual Of Engineering Standards (MOES) are:

- To recognise and control development within natural landscape of acceptable infrastructure catering for the movement throughout of pedestrians, cyclists and motor vehicles, and for the control of rainfall runoff as part of that infrastructure, and for appearance.
- To identify Council's expectations and requirements relating to information required in engineering plans and standards of engineering design and construction for subdivision and development.
- To promote best engineering practice and quality environmental outcomes.

The desired outcomes in the application of the Manual are (SPEL):

- Safety – for public usage of the built infrastructure
- Politic – for prudent and tactful interaction in the practical matters with affected residents
- Environmental – controls to protect adjoining and nearby residents and ecologies
- Liability – reduction to accepted minimums for Council's ongoing maintenance responsibilities

3. DISCLAIMER

This document is intended to be a technical guide and should not be used as a works specification. It does not remove the need for compliance with all relevant statutory requirements.

Whilst this manual is a policy document of Maitland City Council, the information contained herein at the date of publication, is subject to revision by Council due to changing standards over time. Therefore, no warranty can be given that this document represents current standards and practices at the time of their application in design and construction. The responsibility is on the user of this manual to verify the currency of information contained and referenced herein, prior to implementation.

Subsequently, certified/approved designs for works that are either on existing public lands or on land intended for dedication to the public, and that are older than two years, must be reviewed and rendered acceptable to Council, prior to construction.

GENERAL REQUIREMENTS

1. INTRODUCTION

This chapter is intended to guide the developer, from approval through to construction and issue of a Subdivision Certificate for subdivision development, and assumes that Council has granted consent for the project.

It is generally recommended that the Consultant/Project Manager consult with Council prior to commencement of design and construction to discuss the following requirements:

- conditions of consent,
- local conditions,
- intended design,
- construction methods and materials.

Design and construction shall be carried out in accordance with this Manual and any amendments the subject of a “revision” of any part of the Manual, and being the version current at the time of either the design or the construction. Should elements of a design, for the intended dedicated public works, at the time of construction, be considered by Council to be a variation to this Manual (the version current at the time of construction), the engineering plans under that certificate shall be reviewed and amended where necessary to ensure that the design and construction requirements meet current standards.

2. PROJECT MANAGER & PRINCIPAL CERTIFYING AUTHORITY

On all Subdivisions and Developments that require construction works, a specific person nominated to act as a Project Manager must be appointed. In addition the project must have an appointed Principal Certifying Authority (PCA) for the entire project.

In the case of subdivision or where it is intended that works be dedicated to the public,
Council must be appointed as the PCA.

In the case of works within an existing public road, consent for the works and approval of an engineering design may only be obtained under the Roads Act from either Council or the RMS.

The Project Manager must be readily available and have sufficient authority and ability to discuss and resolve any operational problems that occur during the works.

3. DEFINITIONS

- The Engineer, refers to the Council representative, who is the authorised responsible person for subdivisions and developments.
- Accredited Certifier or Certifier, refers to the authority or person qualified and experienced in their respective disciplines.
-



- The Applicant, (representing the Owner/Developer) refers to the person with authority to make decisions regarding the project, and may be the Project Manager.
- The Contractor, is the person engaged to carry out work.
- Approved, in the context of construction refers to any materials or treatments determined by the Engineer or Certifier to be suitable to meet relevant standards.
- Footpath, or Shared-path refers to the paved path which may be within a footway, pathway or public reserve.
- Footway, refers to the road verge between the road pavement and the road reserve boundary.
- Cycleway, a generic term used to describe a bicycle route, lane or path or that part of a separate path used for riders. It is usually within a road pavement and dedicated by markings for cyclists.
- Zoning, as applied by the Local Environment Plan (LEP) is as follows:
 - General Residential (R1): $\geq 450m^2$
 - Large-lot Residential (R5):
 - R5-V $\geq 2000m^2$
 - R5-X $\geq 5000m^2$
 - R5-Y $\geq 10000m^2$
 - R5-Z $\geq 20000m^2$
 - Business (B1-B6)
 - General Industrial (IN1)
 - Rural (RU): ≥ 40 Ha

All fees and contributions shall be paid in accordance with Council's fees and charges policy. Where a design is certified by an accredited certifier (other than Council), verification shall be made that the project has been designed in accordance with development consent and this Manual.

4. DESIGN & CONSTRUCTION

4.1. PLANS

Detailed engineering plans shall be prepared by suitably qualified and experienced consultants to satisfy the requirements of development consent and this Manual.

4.2. CONSTRUCTION

No work shall commence on the site until:

- the project has “development consent”,
- the engineering designs have been approved,

- the Construction Certificate issued,
- conditions of consent that require action prior to commencement of works, have been satisfied,
- the PCA has been appointed and
- payment of any necessary fees has been made.

Two working days notice in writing to the PCA is required prior to the commencement of site works. Long Service Levee shall be paid prior to the issue of the Construction Certificate. PCA fees shall be paid prior to the commencement of site works.

5. INSURANCE / LEVY

- **Public Liability Insurance Policy:** Contractors engaged on Development or Subdivisional Works are to have current Public Liability Insurance to the value of \$10 million before commencing construction. The policy is to indemnify Maitland City Council and/or the RMS where works occur in a public space.
- **Workers Compensation:** Contractors engaged on Development or Subdivisional works are to have a current Workers Compensation insurance Policy for all employees, as required by legislation.
- **Professional Indemnity Insurance:** Accredited Certifiers shall be insured in accordance with the requirements of the Environmental Planning and Assessment (Amendment) Act and the relevant Accreditation Body.
- **Long Service Leave Levy:** In accordance with the EP&A Act, payment of the levy where applicable, must be paid prior to issue of the Construction Certificate.

6. WORKS ON PUBLIC LAND

Where works within public land such as a “road” or “open space” are necessary or are required through development consent under the EP&A Act, (such as road pavement, kerb & gutter, footpath, drainage, embellishments, etc) those works must be approved and completed to Council's satisfaction prior to issue of either the relevant Subdivision or Final Occupation Certificate issued under Part 4A of the Act, or as stated in the consent.

6.1. COUNCIL APPROVAL

Any works within public land may only be performed following consent issued by Council. That consent may be inherent within a Part 4A Construction Certificate issued by Council for a development project or may be gained separately upon application to Council.

6.2. APPROVED CONTRACTORS

Works within a road reserve or other public land may only be performed by an experienced contractor who is approved by Council. The developer/builder shall apply to Council for that approval of the contracting company. (See also chapter 7).

6.3. COMMENCEMENT OF (MINOR) WORKS

The requirements under this topic relate primarily to minor developments.

Prior to commencement of work, the contractor/builder shall submit to Council:

- evidence of currency of Public Liability Insurance
- the method of works and proposed plant usage
- the proposed duration of the works
- a traffic management plan (if required)
- and shall have received from Council written consent to commence works.

The contractor's representative must be present at the critical inspections required by this Manual.

Regarding works in a road reserve relating to property driveway access and installation of services, general term of conditions for "opening" a road, (such as trenching across a road pavement and/or within the road verge) should be referenced. These documents are available from Council as part of a Road Opening application. Minor works, such as a driveway or stormwater pipe connection to the street drainage system, may be applied for, and consented to, under the Council form "Application to Construct Private Works on Footway"

For matters relating to the disruption of normal vehicle and pedestrian traffic movements and related to works (such as trenching) that may involve temporary or partial road closures, refer to Chapter 7.

6.4. ROAD CLOSURE

Permanent road closures may only be inaugurated by Council. An application to Council is necessary for consideration of such a proposal.

7. PUBLIC UTILITY SERVICES

Electricity, communications, water, sewer (and natural gas where applicable) shall be provided to subdivision developments in accordance with the relevant provider's requirements and in accordance with conditions of development consent.

The Developer is responsible for rectification of any damage to services resulting from construction activity.

All trenching and restoration shall be carried out to the provider's and Council's requirements. Adjustments to services, required by the development, shall be the responsibility of the Developer/Contractor.

7.1. ELECTRICAL POWER

For new urban residential, business and industrial subdivisions, all utility services shall be installed underground. In "large lot" residential R5 zoned areas, power shall be underground unless otherwise agreed with the energy provider. In rural RU zoned areas, overhead services are acceptable, their use being in the form of Aerial Bundled Cable (ABC) as the preferred option.

7.2. STREET LIGHTING

The major purpose of street lighting as defined by Australian Standards is required to *“assist pedestrians to orientate themselves and detect potential hazards and to discourage fear of crime and crime against the person while protecting the integrity of the night time environment through control of light spill and glare”*.

Street lighting shall be provided for all new subdivisions for urban residential and business release as determined by Council, utilising Australian Standard AS1158 part 3 as a design guide, with reference to Council's standard drawing SD001 for pole standard location and footing.

The street lighting design shall be in accordance with Council's requirements lighting guidelines and policy or Australian Standards to include;

- cut-off luminaries that limit adverse effects from glare.
- Adequate lighting for pedestrian activity purposes, as required by Council.
- lamps being the default supply of Ausgrid, (current supply at the adoption of this Manual being 29w Light Emitting Diode type)
- pathway lighting (not part of the roadway) where requested by Council as solar power generated type, unless nominated otherwise by Council.

Specific situations where lighting may require a higher standard, (but not limited to), are:-

- Major-road intersections.
- Minor-road intersection (“flag-lit”)
- Pathways and underpasses.
- Public car parks.
- Taxi ranks.
- Bus stops.
- Stairways.

Lighting supply requirements for specific land-uses are:

- **General Residential (R1) & Business (B1-B6):** In accordance with development consent and Council's policy.
- **Industrial (IN1):** Street lighting shall not be provided.
- **Residential (R5) – large-lot:** Street lighting shall not be provided.
- **Rural (RU1, RU2, E4):** Street lighting shall not be provided.
- **Rutherford aerodrome:** Lighting, in the vicinity of the aerodrome is subject to the requirements of the Civil Aviation Safety Authority's Civil Aviation Regulations “Manual of Standards Part 139”.

Alternative lighting than that nominated above in zonings other than R1 & B will only be considered by Council subject to adequate warrants where special circumstances exist, such as proximity to destination points for potential night-time pedestrian traffic, and then only to Council's specifications.

7.3. OTHER AUTHORITIES

All works shall be carried out in accordance with the requirements of relevant Government Authorities, for issues that relate to Planning, Environment, Fire, WORKCOVER, etc. The developer is responsible for obtaining all required approvals.

8. PUBLIC RESERVES

Public reserves relating to development include:

- areas of land to be dedicated to Council as a nature reserve (generally in its natural condition perhaps with a path or Asset Protection Zone)
- local parks (usually embellished for recreation activities for children)
- drainage reserves (predominately for stormwater drainage devices but may include surrounding recreation amenity, seating etc)
- playing fields (for organised sports)

For assistance in planning for public reserves (including associated playgrounds) developers should consult Council's adopted policies (for example see "Functional Brief: Local Playground") and seek consultation with Council personnel for each purposeful reserve type.

8.1. DRAINAGE & NATURE RESERVES

Land to be dedicated to Council in its natural condition shall be left safe and tidy, free of hazards to public safety and made suitable for mowing (where appropriate, and being slashed prior to final inspection). All areas shall be managed in accordance with the requirements of Chapter 3 of this Manual. Designated reserve areas shall not be used to stockpile deleterious materials or waste. Revegetation shall be required where damage is caused to reserve areas.

Where directed by Council, signposting indicating restricted use of the reserve shall be erected.

Proposed reserves shall be examined for termite nests, by a qualified pest control person. Any identified nest shall be eliminated prior to issue of a Subdivision Certificate.

Defined paths through natural reserves shall be made safe by the removal of trees/limbs and shrubs with potential to either fall onto the path. Adverse screening adjacent to the path caused by vegetation that may impede normal surveillance, or create "entrapment" opportunities shall be removed.

Trees/limbs adjacent to and overhanging adjoining properties shall be removed.

An assessment by an arborist or a Council officer shall be made prior to the work being performed.

Land to be dedicated to Council for drainage purposes shall be planned to ensure safety for areas that may attract public access, provide low-maintenance vegetation, and ease of access and manoeuvrability for mowing plant. A Construction Certificate will be required for all structural elements.

In planning for drainage reserves, the area of land set aside should:

- be kept to a minimum for that purpose except as may be deemed necessary where coincidental with other non-drainage uses.
- Take into account potential expansion of drainage infrastructure for future contributing catchments.

8.2. PARKS & PLAYING RESERVES

Land that is designated through planning strategies to be local parks and playing fields shall be subject to specific development consent. All proposed improvements shall be approved by Council.

Improvements shall be inspected by Council officers and all approved equipment and facilities installed, shall be certified by either the manufacturer or a suitably qualified person, as satisfactory for public use and compliant with Australian Standards or some other appropriate standard.

Parks shall be serviced and enhanced with:

- water supply (including irrigation sprinklers with appropriate safety control devices) for establishing vegetation
- landscaping in accordance with an approved plan conducive for efficient maintenance
- lighting only where specifically required by Council (preferably solar powered)
- path paving at a minimum width of 1.8m and concrete edging around specified areas
- disability access
- maintenance vehicle access and lockable gates
- barriers such as steel bollards, and fencing to deter unauthorised vehicle entry
- signposting nominating restricted activities within the park
- an assessment for suitability of any existing trees, as per Chapter 3 - Environment, Section 4

Where structures such as steps, handrails, ramps, balustrades, retaining walls, and other public use components are provided, they shall comply with the corresponding provisions with design parameters for such items, within the Building Code of Australia. For example stairs must comply with clause D2.13 of Volume 1 of the BCA in regard to their design and construction.

8.3. PLANS OF MANAGEMENT

Plans of Management for public reserves shall be prepared and submitted to Council prior to issue of a Subdivision or Occupation Certificate for each type of reserve indicating the location of infrastructure and services, and including a maintenance and replacement regime for each applicable component.

9. SUBDIVISION CERTIFICATE

Prior to issue of the Subdivision Certificate, the following items (but not limited to those items) shall be satisfied:

- Compliance with the development consent
- Submission of evidence that satisfactory arrangements have been made with the utility authorities.
- Payment of all contributions and fees.
- Submission of bonds (cash or bank guarantee) where necessary.
- Submission of a copy of any instrument required under the Conveyancing Act. Regarding the creation of inter-allotment drainage easements under section 88B of the Conveyancing Act, the person or authority given the power to release vary or modify such easements shall be; *“the lots burdened and the lots benefited, only with the consent of Maitland City Council”*
- Practical completion of construction works.
- Submission of geotechnical reports and test results, including pavement layer details
- Submission of Works-As-Executed Plans.
- Lot classification as determined by AS 2870

9.1. LOT CLASSIFICATION

Lot classification in accordance with AS 2870, is required for land within various planning zones, in accordance with the following guidelines:

- Residential (R1) – the classification shall apply to the whole of the lot.
- Rural– classification is not required
- Large-lot Residential (R5) – the classification shall apply to the whole of the lot or that portion of the lot considered suitable for dwelling construction
- Industrial and business zonings do not attract classification requirements by Council.

Regarding a ‘P’ classification, where subdivision work (such as filling) is performed on the land the subject of development consent, Council’s preference is that the works be performed such that no lot be classified as such. Similarly, land that in its natural state is determined to be “P” classification is considered by Council as not a desirable outcome for release, and the developer should consider performing works to improve the classification.

9.2. ROAD WIDENING

Road widening involves an adjustment to a road reserve boundary such that a part of a property under development may be acquired by, or dedicated to Council as “public road” in accordance with an adopted road widening scheme or as a requirement for planned works within Council’s construction programme. Where a Subdivision Certificate is to be issued for a development, the widening shall be shown on the survey plan.

10. BONDS FOR INCOMPLETE WORK

Bonds may be accepted to enable early release of the Subdivision Certificate. Consideration of a bond shall be given where works are substantially complete and construction items are delayed by circumstances beyond the reasonable control of the Developer or Contractor.

Consideration to the bonding will be subject to the following:

1. The works do not adversely affect the operation of the development.
2. The incomplete works do not present a safety issue that cannot be satisfactorily managed.
3. The completion of the works will not inhibit the commencement of building development on the new lots.

If the proposal meets the abovementioned criteria the following shall be provided/fulfilled:

- A timeframe schedule for the carrying out of the bonded works.
- Suitable security may be cash, a bank cheque or irrevocable bank guarantee to cover the cost of the outstanding works. This shall be 125% of the agreed contractual costs.
- Any bank guarantee shall not have an expiry "sunset" date, including a statement as to Council's absolute right to draw on the security to carry out the works and if required to recover any additional costs incurred in the carrying out of the works.
- Acceptance of unencumbered access for Council to enter the site and carry out works if necessary.
- The payment of a release fee in accordance with Council's Management Plan.

The following works should be in place prior to consideration of a bond for outstanding works:

- roads with a primer seal applied
- disturbed soil stabilised
- drainage systems/structures in place

Items, where justified, for consideration for bonding may typically be:

- asphalt
- footpath paving
- turf beyond that necessary for stabilisation
- signposting and linemarking not considered essential for public safety
- landscaping

11. WORKS AS EXECUTED

Works-As-Executed (WAE) plans (or the equivalent electronic files) shall be prepared by a registered surveyor and be submitted to Council for approval. Where the WAE plans show no variations at the following points of reference, it is to be assumed that no variation to the design exists. Where construction varies from permitted tolerance, Council may require rectification. Additional testing may be required to determine the extent of rectification works necessary (if any). Works-As-Executed plans shall provide sufficient details to accurately define the works and to demonstrate (tolerance) compliance, and shall include: -

- Sub-grade centreline and lip-line levels or “select” where employed. Electronic conformance reports that are generated from field survey during construction at the subgrade level are accepted as an alternative to conventional survey methods, whether surveyed at random point or specific chainages.
- Location and level of kerb and guttering, centreline of road, crown of road, either lip of gutter or top of kerb, rear of footpath (or at boundary) and overland flow paths.
- Location and level of piped and open drainage systems including pipe sizes, subsoil drains/mats and inter-allotment systems.
- Finished surface levels of all cut/fill regraded areas beyond the road reserve.
- Where specifically requested, traffic control devices including pavement marking.

Where construction parameters vary from, or are not specifically nominated and located on, the approved plans, further sub-grade information, as follows, shall be noted on the plans or detailed within a final geotechnical report:

- Sub-grade replacement/modification, type, thickness and extent.
- Sub-base and base-course layer thickness, type and stabilising agent.
- Location of tests carried out on the various material layers.

12. UNAPPROVED WORKS

Where additional works or departures from the approved plans are made without approval, the Works as Executed plans must be accompanied by a report and/or calculations prepared by the Design Consultant providing sufficient justification for acceptance. Such reports shall also address the following:

- An explanation detailing that the departures comply with this Manual, or adequately satisfy the intent of the Manual or some other standard.
- Where works do not comply and are not accepted by Council, the report shall recommend remedial works necessary to rectify non-compliance.

ENVIRONMENT, VEGETATION, LANDSCAPING & HERITAGE

1. INTRODUCTION

Protection of environment and heritage, applies to all engineering works where disturbance of a construction site is inevitable. This may involve the existing surface or any vegetation, horticultural feature, water body or stream, objects and places of Aboriginal or European heritage, or natural vegetation and critical habitat.

2. DEVELOPER RESPONSIBILITIES

2.1. LEGISLATION

Items of the “built” or “natural” environment which have conservation significance are protected by the *Heritage Act*, *National Parks and Wildlife Act*, *Threatened Species Conservation Act*, *Protection of the Environment Operations Act*, *Native Vegetation Act*, and *Maitland Local Environmental Plan* or certain *State Environmental Planning Policies (SEPP)* (for example, *State Environmental Planning Policy No 14 – Coastal Wetlands*, *State Environmental Planning Policy No 22 – Littoral Rainforests*, *State Environmental Planning Policy No 44 – Koala Habitat*), together with Council Policies and Plans including the “*Maitland Greening Plan*” and DCP “*Maitland Conservation and Design Guidelines*”. The *Threatened Species Conservation Act* protects both plants and wildlife.

2.2. HERITAGE CONSERVATION AND PROTECTION

Where a known item of heritage or heritage site is affected by or adjacent to a development, specific conditions of consent will require protection measures during construction. These must be strictly adhered to, or severe penalties (fines and imprisonment or both) may result from action under Section 156 of the *Heritage Act*, Sections 125 and 126 of the *Environmental Planning and Assessment Act*, Section 86 and 90 of the *National Parks and Wildlife Act*.

Where in the course of undertaking development works a person uncovers or discovers a relic (within the meaning of the *Heritage Act*) or Aboriginal object or place, they are to:

- Cease work on the site.
- Take appropriate measures to secure and protect the site or relic including fencing.
- Contact Council's Engineer.
- Notify either the Heritage Council or the Office of Environment and Heritage, as appropriate, of the discovery as required by Section 146 of the *Heritage Act* or Section 89A of the *National Parks and Wildlife Act*.

For the purposes of the *Heritage Act* a relic is any object or material evidence of settlement of the area, which is fifty or more years old, but specifically excluding Aboriginal objects.

For the purpose of the National Parks and Wildlife Act, an Aboriginal object means any deposit, object or material evidence relating to Aboriginal habitation of New South Wales. Similarly, an Aboriginal place means a place declared by the Minister (administering the National Parks and Wildlife Act) that is or was of special significance with respect to Aboriginal culture.

The purpose of these provisions is not to restrict development unnecessarily, but to ensure that valuable historical or cultural information or items are not lost or destroyed. In the majority of cases, work will be able to proceed once data on the item or place has been recorded or the relic excavated. It is advised that there is no advantage to be gained by ignoring the provisions and proceeding with works that result in destruction of items or places of heritage significance.

3. VEGETATION

Environmental and vegetation protection measures shall apply to all works including the preparation of detailed plans of all necessary requirements for approval as part of the Construction Certificate.

Any persons involved with such works and their design, shall as a minimum, abide by the requirements outlined within this chapter, where applicable.

Measures must be taken to ensure that no contaminated material or noxious weeds are transported off site without due care, and with diligence and authorisation for removal and/or disposal.

4. TREES AND HABITATS

It is Council's policy to conserve native vegetation and minimise damage to trees in all new developments. The Maitland Greening Plan 2002, and the LEP requires the preservation of trees with a height of 3 metres or more, or with a hanging branch spread of 3 metres or more in diameter.

Further:

- All areas of Maitland City Council are subject to a Tree Preservation Order (TPO). Consultation with Council will be necessary regarding tree disturbance.
- Council's consent must be obtained prior to the removal of trees, endangered ecological community or mature vegetation via a Development Consent or Construction Certificate.
- Council must be notified of the intention to begin clearing at least two business days before commencing works. Trees to be removed shall be clearly marked on site and correspond with those approved on the development and engineering plans for removal. Precision felling of some trees may be necessary to avoid damage to other trees or structures.
- Consent from the Catchment Management Authority is required if the Native Vegetation Act applies to the development.
- Council's consent does not authorise access onto adjoining lands, such as for temporary storage or disposal of materials.

4.1. TREE DISTURBANCE

Regarding tree disturbance:

- Consent conditions regarding the protection of vegetation must be complied with, during construction.
- Works that are being carried out must be consistent with an approved Environmental Protection Plan, as part of a Construction Certificate. That plan must show, where appropriate, protection of vegetation, soil stockpiles, site (and/or habitat, such as nest boxes or offsets) rehabilitation and replanting and soil erosion and sediment control, and must show the size and spread of existing trees.
- Wherever possible all trees removed shall be recycled either by chipping, tub grinding or reuse as timber product.
- Replacement tree planting consistent with the *Greening Plan* will be required where shown on the engineering plans or as directed by Council's engineer following damage or unauthorised removal of trees.
- All trees and shrubs identified for protection on the engineering/environmental management plans shall be effectively protected by a fence enclosure to ensure:
 - Avoidance of soil compaction by stockpiling of fill material, sheds or car parking.
 - Avoidance of spills or placement of oils, bitumen, distillate concrete or the like within 10 metres of tree(s).
 - Trenching is not carried out within the critical root zone of trees.
 - No topsoil removal within 4 metres of trees.
 - Avoidance of damage to trees by machinery.

4.2. HABITAT TREATMENT

An ecologist shall be on site during the felling of identified trees and ensure that any displaced or injured wildlife is collected and released appropriately. All actions taken by an ecologist shall be reported to Council.

The following shall be satisfied prior to felling any tree or removing/pruning adjacent trees:-

- Determine if the tree constitutes a habitat tree or supports any species listed under the Threatened Species Conservation Act and whether a Section 5A assessment (Significant effect on threatened species, populations or ecological communities, or their habitats) under the Environmental Planning and Assessment Act has been carried out.
- Compliance with any Flora and Fauna Studies are carried out as part of the Development Application.
- Measures should be taken to reduce the potential for injury and death to animals likely to inhabit the tree and may require inspection of hollows, sectional dismantling and/or supervision of works or removal/relocation of animals by a qualified ecologist. Habitat trees include any trees with hollows.
- Retention of hollows should be undertaken where possible on the site, where this is not possible and habitat is not significantly impacted, the tree hollows should be placed where possible in retained vegetation and/or nest boxes should be placed to retain habitat potential.

- Where approved construction work requires the removal of trees, the contractor is to engage the services of a suitably qualified ecologist to inspect the site and identify any tree which is likely to be a habitat tree. The ecologist is also to be on site during the felling of any identified tree and ensure that any displaced or injured wildlife is collected and forwarded to an appropriate Wildlife Rescue Service. All actions taken by an ecologist shall be reported to Council.

5. ENVIRONMENT

Protection of the environment (encompassing its human, natural and built aspects) is considered a priority of design and construction.

When working near a water body further information should be sought regarding adequate precautions.

5.1. FIRE RESTRICTIONS

Burning of vegetation on-site is not permitted.

5.2. NOISE CONTROL

The contractor shall comply with all statutory requirements with respect to noise. All practical precautions shall be taken to minimise noise and to contain works within specified hours of operation. All construction equipment shall be fitted with recommended noise suppressors (see also Chapter 7 - Working Hours).

5.3. DUST CONTROL

The developer shall comply with any statutory controls with respect to dust pollution. Soil-exposed areas shall be progressively mulched or vegetated and watered, or treated with dust suppressants or other means.

When directed by Council, if in Council's opinion dust control is inadequate or that continued works creates a significant dust nuisance, works shall cease until it is considered by Council that works can recommence. (see also – Appendix B).

5.4. SITE STORAGE

Equipment and materials stored on site shall be approved by Council's Engineer so as to prevent damage to the site, roadway, footpath and minimise hazards to person. Materials should be contained on-site to avoid impacting the surrounding properties and environment, and stockpiled in a manner to avoid cross contamination of materials from the action of the weather or vehicle movement.

5.5. CONTAMINANTS

The developer is to dispose of all contaminants oils, liquids, solids etc. in accordance with statutory regulations and produce receipts for appropriate disposal as required. Appropriate records should be available for all soil brought on site to show it complies with an appropriate resource recovery exemption under the POEO Waste regulations. Where it is suspected that soil is contaminated, Council may direct that soil testing is required.

6. SOIL CONDITIONS

Soil issues such as salinity, acid sulphate soils and sodic soils can impact both the environment and infrastructure. Should any of these concerns occur management plans need to be established and provided to Council for approval with the construction certificate.

7. EROSION

For works where there is a possibility of erosion of soil by wind, water or vehicles creating dust and sedimentation problems, an environmental protection proposal shall be prepared for approval as part of the engineering design for the Construction Certificate. (Refer to Appendix B).

7.1. CONTROLS - DURING CONSTRUCTION

Contractors must employ *effective* sediment control measures, to ensure that sediment and pollutants are not carried off the development site, nor eroded by wind and water, nor by “tracking” of vehicles.

It is an offence under the Protection of the Environment Operations Act to pollute the environment as a result of sediment leaving the site. A breach may result in the issue of an infringement notice, and attract a monetary fine. (Refer also to Chapter 7 - Construction)

Designs should be prepared which minimises the extent of disturbed areas, which may involve staging of clearing/stripping such that small areas are exposed and stabilized (perhaps with established grass cover), prior to the next stage commencing.

7.2. CONTROLS - POST CONSTRUCTION

Development and subdivision proposals shall include permanent devices and methods to treat pollutants in stormwater runoff, such as litter, coarse and fine particles, phosphorus, nitrogen and hydrocarbons. (See also chapters 6 - Stormwater & Chapter 8 - Developments).

Such devices and methods to be employed may be:

- Gross Pollutant Traps (pits, racks, basins etc)
- constructed wetlands
- bio-retention (dry basins) and
- combinations of any such devices, as necessary.

Bio-retention facilities are particularly susceptible to uncontained erosion from future building activity within the subdivision, and should therefore be postponed for construction until approximately 80% completed allotment development within the contributing stormwater catchment, or in the case of staged development, prior to issue of the subdivision certificate for a latter stage within the release area. For this purpose an unlimited-time cash bond or bank guarantee shall be submitted to Council for an approved value of the works, plus 50%.

7.3. MATERIAL TRANSPORTATION

All transportation of construction materials, sands, gravels, soils etc to and from the site must be carried out in such a manner as to prevent depositing materials on surrounding streets. The developer shall ensure that adequate control measures are in place to prevent this occurrence or then to rectify the pollution if it occurs. All loads of loose materials shall be covered during transport to and/or from the site.

8. LANDSCAPE AND VEGETATION

Before the lodgement of a Development Application all Landscaping options should be investigated to best integrate the proposed development with existing landscaping and significant vegetation. Landscape and vegetation management should be based upon suitable initial site evaluation and analysis including any existing significant vegetation.

Aspects to be considered are:

- trees and vegetation for retention
- trees and vegetation for removal
- Areas to be undisturbed such as buffer areas and semi natural areas.

Earth mounds, retaining walls and grade changes should be designed so as not to impede normal surveillance, nor to create personal “entrapment” scenarios.

8.1. STREET LANDSCAPING

Unless directed otherwise by Council, all new road reserves shall be landscaped with street trees utilising the following guidelines.

Species - The landscape designer is encouraged to recommend new species and to use variety of species in the designs. Maitland City Council has for reference, a list of suitable street tree species which identifies some local spp and suitable varieties that have been successfully placed as street trees, with the following specific qualifications:

- **Eucalyptus spp / Corymbia spp Angophora spp** are not considered suitable street tree species. These trees are more suitably placed as massed plantings within reserves and not as isolated individual placed specimens. Smaller bred varieties that are below a 10m mature height may be considered most appropriate.
- **Prohibited species** are (by common name) Camphor Laurel, Silky Oak, Pine, Fig, Pepper Tree, Poplar, Liquid Amber.
- **Lophostemon confertus – Brush Box**, considered an attractive and successful street tree in Maitland, may only be considered on footway verges of 4.5m or greater, and without overhead power lines, light poles or a concrete footpath.

Size - Ideally trees should be chosen that reach a mature height of 10-15m, and be able to be undercut to a specified height for safe sight-lines for pedestrians and vehicular traffic.

Grasses - Where disturbed areas require cover or new grass is provided which will be maintained by Council, Couch (spp *Cynodon dactylon*) must be provided. Such areas may be drainage reserves, public reserves and road reserves adjacent to those public land reserves. Other turf grasses are optional for lot frontages.

Design - Where street tree planting is proposed, trees shall be selected by an experienced landscape designer, and be approved by Council, as being suitable species as street trees. Where possible, trees should be chosen to provide longevity and to be compatible with Maitland's climate and soil characteristics, ensuring that the expected mature size of the trees are suitable for a footway/street environment, being consistent with existing vegetation in the area. Very large trees are not acceptable in road reserves. Preference shall be given to tree species that occur naturally in Council's local environment. The location of trees in the footway shall consider street intersection sight-lines and public safety, and shall not impede personnel surveillance.

Design parameters:

- Trees shall be planted and located in the footway in accordance with Standard Drawings SD001, SD002 & SD049, (subject to satisfying standard "clear zone" requirements) generally placed 1.2m from the nominated face-of-kerb and not closer than 0.5m from the edge of a pedestrian/cycle path.
- All large street tree species that are considered to present a risk with root invasions must be provided with root control barriers installed on the kerbside of trees and adjacent to any concrete path.
- In urban areas with a legal speed limit of 60km/h or less, trees must not be placed in the footway of the major road within 15m of an intersecting and/or such that the appropriate line of sight determined by the geometry of the street, is not compromised.
- In rural areas, the exclusion zone for tree planting is 70m along the major road from the property corner boundary at the intersection, so that landscape foliage does not obstruct sight-lines between the corner and the approaching vehicle in the major road.
- Trees, when mature, must be of a size that will sustain foliage undercut to a minimum height of 2m. Shrubs should be chosen/maintained to enable trimming below a height of 1.2m.
- Prior to any excavation work commencing the existence and location of any underground services must be established.
- Where overhead power supply mains exist, consideration must be given to the location of the trees and the mature height of proposed trees, relevant to the soil and moisture conditions, such that the street infrastructure is not affected.
- Tree planting locations should be complimentary with street lighting to optimise pedestrian safety.
- Tree-guards (other than supporting stakes) are not encouraged, but may be placed for interim protection within staged subdivisions, and must be removed upon release of the final stage.
- Shrubs, if approved, must satisfy sight-line requirements.
- Hedges are not permitted.

9. BUSHFIRE PRECAUTIONS

Consideration in the design of developments and subdivisions shall have regard to bushfire hazard. The designer should follow the recommendations of the NSW Rural Fire Service and the requirements of the publication, "Planning for Bushfire Protection".

Subject to that publication where subdivision abuts bushland in a bushfire prone area as defined by the bushfire prone map, the following guidelines should be observed and/or provided:-

- An all-weather, 4 metre wide, perimeter fire trail (with a 1m wide cleared shoulder) incorporating suitable drainage, located within a minimum 6 metre wide cleared and maintained zone.
- A perimeter road located within a nominated fuel reduction zone, located between the subdivision and the bushland.
- A fuel reduction zone, of a width determined by the Rural Fire Service, and dependent upon terrain and aspect.
- Access to the fire trail from the local road system.
- Safe building envelopes within a subdivision
- A blue raised road pavement marker, where required, placed on the road pavement opposite a water hydrant.

ROAD DESIGN

1. INTRODUCTION

This chapter deals with the requirements for the design of roads, vehicle access, paths and associated structures and embellishments. Details are not necessarily comprehensive. The designer should refer to, and be competent with, the standards nominated as references. Generally, the parent documents for road design are the Austroad guidelines and Roads & Maritime Services (RMS) supplements.

Engineering designs should include geometric details of, road and drainage layouts, their gradients, cross sections, and kerb returns. (See appendix for full details). All existing infrastructure, surface features and underground services must be shown on the plans.

All design proposals must be carried out by experienced and competent practitioners.

2. GEOMETRIC DESIGN

2.1. ROAD HIERARCHY AND SPECIFICATIONS

Roadway infrastructure shall be determined and designed in accordance with, "Development Consent" issued by the consent authority, and the requirements of this Manual.

Widths of roads for residential subdivision are defined by their status within Council's road hierarchy, which adopts maximum lot catchments for various road types. The following table **"ROAD TYPES AND DIMENSIONS"** provides details of minimum road parameters according to lot catchment and lot-size; further divided into sub-categories for purposes relating to design traffic specifications. The table relates primarily to "greenfield" sites, generally applicable to large-subdivision release areas.

2.1.1. Road Width for Lot Catchment

For purposes of determining the appropriate road-width for a local lot catchment area, the assessment should be based on an assumed and reasonable traffic distribution analysis of the ultimate development and the contributing lots, along desire-lines to points of destination such as for recreation, schools, shops, workplace, etc.

This approach may vary, resulting in higher hierarchy levels where:

- staged development may significantly increase traffic flow in an intervening period, affecting safety and amenity of the area,
- a new public roadway serves a function greater than the immediate local residential area serviced by the road. This may occur where the specific land-use development consent is over part only of a broader integrated area, with roads connecting other centres of population, a Public Transport route or roads servicing commercial or school precincts, recreation facilities, or other major traffic generating destinations.
- there is potential to utilise a road as a "by-pass" of some traffic related constraint on another road, such as traffic congestion, traffic signals etc. [In this case careful planning should be practiced in order to avoid such circumstances.]

2.1.2. Consistent Road Width

Where lot catchment numbers trigger more than one road type within a defined length of road/street, unless justified, the higher road type shall be adopted. Opportunities where road width may be varied may be at intersections, traffic management device, curving horizontal alignment, or similar.

2.1.3. Impacts on Existing Roads

Where a new subdivision impacts on the existing local road network and road-works such as pavement widening or rehabilitation are required, the road alignment and pavement needs shall be determined by Council independently of the following Road Type table taking into account traffic volume and type, the needs and amenity of the existing road network, and an appropriate service to the community. Road widths greater than those shown in the 'table', may be required.

Where works are required as part of the development to augment an arterial or classified road, Council shall determine independently of this Manual the needs for that road.

[Refer also to Local Area Precinct plans for possible specific parameters for road needs.]

2.1.4. Part-width Roads

Nominal "part-width construction" of roads may be considered for subdivision servicing up to 10 lots (unless justified otherwise for a greater number, with adequate traffic safety and convenience measures), to facilitate shared construction costs across property boundaries, or which share a common road reserve, the subject in each case of separate development consents. Such roads are considered an interim treatment to facilitate subdivision.

Part-width roads may be permitted along a property boundary, and generally parallel to that boundary, and adjoining undeveloped land not part of the subdivision which also has subdivision potential under a planning scheme.

Part-width roads may also be permitted where the proposed road utilises an existing adjoining public road reserve (whether that road is unformed, or formed in-part only) and where undeveloped land not part of the subdivision also adjoins the opposite side of that road, and which has subdivision potential under a planning scheme.

The proposed part-width road must provide adequate safety for two-way traffic movement [one-way traffic movement may also be considered as an interim treatment].

The width of such road pavements may extend beyond the road centreline, and should be a minimum of 5.5m wide for two-way traffic. The overall construction width may be greater than the pavement width, subject to assessment of constraints such as kerb type (rolled type preferred), common boundary fencing type, pavement restraint or shoulder support, subsoil drainage, surface drainage, etc.

Where part-width construction is permitted within an existing road reserve (for roads with a catchment greater than 10 lots) a minimum of 9m is required which includes a bitumen sealed shoulder 0.5m wide.

In all cases of part-width construction, "No Stopping" zones are necessary considerations.

ROAD TYPES AND DIMENSIONS

ROAD TYPE	MAX NO. LOTS	RESERVE WIDTH (m) ^a	CARRIAGEWAY / KERB-KERB (m) ^b	ON-ROAD BICYCLE FACILITY	FOOTWAY VERGE (m) ^c	KERB ^d	FOOTPATH (1.5m WIDE) ^e	DESIGN ESA ^f
Local – Place ^l	10	17	8	Mixed	4.5	Rolled	As Required	1 x 10 ⁵
Local – Access ^l	20	17	8	Mixed	4.5	Rolled	One side	1 x 10 ⁵
Local – Secondary ^l	50	17	8	Mixed	4.5	Rolled	One side	2 x 10 ⁵
Local – Primary ^l	100	17	8	Mixed	4.5	Rolled	One side	5 x 10 ⁵
Collector – Secondary ^l	200	17	8	Mixed (Parking)	4.5	Upright	One side	1 x 10 ⁶
Collector – Primary ^{lv}	300	20	11	Mixed (Parking) ^p	4.5	Upright	One side	1.5 x 10 ⁶
Distributor – Secondary ^v	400	23	14	Mixed (Parking) ^p	4.5	Upright	Both sides	2 x 10 ⁶
Distributor – Primary ^{m v}	500	24	15 ^q	1.5m Lane	4.5	Upright	Both sides	5 x 10 ⁶
Sub-Arterial ⁿ	3500	24.4	15.4 ^r	1.7m Lane ^s	4.5	Upright	Both sides	1 x 10 ⁷ min
Industrial – Secondary	10 ^g	22	13	Mixed	4.5	Upright	As Required	5 x 10 ⁶
Industrial – Primary	> 10	22	13	Mixed	4.5	Upright	As Required	1 x 10 ⁷
School Bus/Public Route ^o			9min / 12min					2/5 x 10 ⁶ min
Business / School Precinct			15.4	1.7m Lane	5.5 min ^h	Upright		1 x 10 ⁷ min

LARGE-LOT SUBDIVISION

LAND USE TYPE	MIN. LOT AREA	RESERVE WIDTH (m)	CARRIAGEWAY / KERB-KERB (m) ⁱ	ON-ROAD BICYCLE FACILITY ^t	FOOTWAY VERGE (m) ^c	KERB ^d	FOOTPATH (1.5m WIDE) ^e	DESIGN ESA ^e
Residential (R5-V)	2000	18	7.5 (k)	Mixed	5.25	Rolled	One Side	per 'lots' above
Residential (R5-X)	5000	18	6.5 (k)	Mixed	5.75	Rolled	One Side	per 'lots' above
Residential (R5-Y)	10000	20	7.5 (f) j	Mixed	6.25 k	Not Mandatory	Nil	per 'lots' above
Residential (R5-Z)	20000	20	7.5 (f)	Mixed	6.25 k	Nil	Nil	per 'lots' above
Rural ^u	40Ha	20 min	7	Mixed	Nil	Nil	Nil	1 x 10 ⁵ min

See *Notes* next page.

Notes:

- a) Reserve width shall be increased where footway verges are greater than 4.5m
- b) Additional width in accordance with Austroads or RMS standards may be necessary where on-road cycle lanes are required.
For a rolled kerb profile the nominal face of kerb shall be 150mm from the back of kerb.
- c) May be reduced to 2.0m for roads up to and including Collector status where there is an adjacent public reserve.
Increased width to 5.5m where shared paths are required. Regardless of road hierarchy, a 5.5m wide footway shall be provided wherever a shared path is required.
Widths may be increased where necessary to accommodate public utility services.
- d) Edge restraints are required for AC wearing surfaces. Concrete edge beams may be permitted.
- e) Where a shared path is required along a street footway, a 1.5m path may be deleted.
Short cul-de-sac may be exempt from footpath paving subject to any connections to the path network.
- f) Minimum Equivalent Standard Axles up to nominated maximum number of lots. Parameters do not include bus access to Local Streets.
- g) Includes corner lots
- h) A shared path 2.5m wide, or where pedestrian traffic is concentrated full verge concrete paving, shall be provided
- i) Formation width includes the whole road pavement as a full-width bitumen seal
- j) Rolled K & G with a 6.5m carriageway width may be provided in lieu of table drains (swales). One-way crossfall and a high-side concrete edge constraint is optional
- k) Provide a 2.0m width of grassed footpath profile within footway verge
- l) Normally classified as "50km/hr roads" servicing the local subdivision only; not through-roads connecting remote areas.
- m) Roads which are within large residential areas only, sometimes referred to by other authorities/documents as 'Collector' roads
- n) Sub-Arterial - Road connecting Arterial Roads to urban districts, and carrying traffic directly from one district or precinct to another. See Austroads Pt 2
Arterial Roads are defined separately to this Manual where location and design parameters are determined by Council. 'Classified' Highways, Regional and State Roads are typically Arterial Roads.
- o) Bus routes for pick-up and set-down of school students in residential areas should be confined to 11m or greater width roads. An absolute minimum of 9m may be considered for special circumstances. For the public bus network and destinations such as business areas, schools and terminals, greater widths will be required.
- p) Line-marking may be required to delineate pavement areas for vehicle travel separation.
- q) Based on a 3.5m travel lane to operate as a bus route. Where it can be shown that the road will not be utilised by busses, the width may be reduced to 3m.
Where the route is planned to carry large numbers of trucks, the travel lane shall be widened to 3.5m. See Austroads Pt 3 section 4.2.5
- r) Based on a 3.5m travel lane
- s) Council may require a dedicated bicycle path fully separated from the road pavement.
- t) To a maximum of 300 lots, otherwise bicycle lanes or paths must be considered
- u) Not through-roads connecting areas remote from the subdivision
- v) For roads greater than 300 lots consideration should be given to safe street crossing points (pedestrian refuges etc)

2.1.5. Crown Roads

Where Crown Roads are intended to be developed as part of a subdivision, such roads shall be constructed in accordance with this Manual and subsequently dedicated to Council (subject to relevant legislation and/or the Minister's concurrence) as public road on the Subdivision Certificate.

2.2. PAVEMENT TREATMENTS

Council will consider the construction of alternative pavement types, colours, textures and widths on their individual merits, but their consideration will be restricted to areas of low lot catchment, and where, for example, residential lots are on one side of the street, or opposite to and adjoining a Public Reserve or "Open Space". Such pavements shall only be provided at the terminal end of residential streets, and shall cater for a maximum number of five properties, including the corner allotment. In addition, such pavements, if being considered as a connection between two streets, must not create an alternative route for "through traffic".

2.3. HORIZONTAL CURVES

The horizontal alignment should be carefully chosen to balance the topography, with the desired speed control and adequate safety, for all road users.

- In urban areas, a changing alignment is encouraged in order to maintain low traffic speeds. Curve radii are generally established by the approved subdivision plan.
- Long straights connected with short (isolated) radii curves are undesirable.
- The maximum deflection for which a curve is not necessary is 1.5 degrees.
- Horizontal curves on urban arterial, sub-arterial and distributor roads shall comply with Austroads standards. The desirable minimum curve length should be 70m and the minimum desirable radius, 400m (due principally to adverse crossfall). [Ref: Urban Road Design, A Guide to the Geometric Design of Major Urban Roads (AP-G69/02)]
- Horizontal curves on rural roads shall comply with Austroads & RMS standards for rural roads
- "Broken-back" curves (created by a short length of intervening straight between two uni-directional curves) should be avoided in an urban street environment regardless of road hierarchy due to an unsafe changing alignment. Such curves are not permitted on roads of Collector status or greater, or within Large-Lot subdivisions. Exceptions may be granted by Council where travel speed necessarily varies appreciably (as may occur at sharp curves/bends approaching 900 or approach to a traffic control facility, interrupting traffic flow) and, where the connecting straight is greater than 150m between tangent points. Regardless, good design practice should prevail with improvement by the substitution of a single curve or a compound curve.
- Compound (uni-directional) curves with common tangent points should provide comparable radii ratios, generally not less than 0.75 (smaller divided by larger), although a lesser value may be considered in constrained urban situations.
- Reverse curves without tangent point separation, are not desirable and should be avoided.
- Where vertical curves are combined with horizontal curves, the combined respective sight distance requirements should ensure compliance with relevant standards.

- All curves must be assessed to accommodate large-vehicle access to urban areas taking into account the road hierarchy and the potential for passing of moving vehicles, and of parked vehicles.
- Travel lane widening for vehicle-tracking must be considered on major roads (roads with a carriageway width greater than an 11m) in relation to line marking and parking requirements. Generally, a 3.3m wide travel lane will accommodate large vehicles. [Ref Guide to Road Design – Part 3: Geometric Design 4.2.4 & 5]

2.4. LONGITUDINAL GRADES

For urban areas centreline longitudinal grade limits are as follows:

LONGITUDINAL GRADES

	FLEXIBLE PAVEMENT	RIGID PAVEMENT
Minimum	0.5%	0.5%
Maximum	16%	25%
Bus route maximum	12%	12%

Grading for an intersecting side-street shall attempt (where applicable) in the first instance to achieve a sag point in advance of the intersection. Where this occurs in deep cuttings, the deletion of the sag in favour of a dished concrete (being flat and wide – 40mm deep x 1.5m wide) may be utilised, subject to acceptable drainage considerations.

2.5. VERTICAL CURVES

Crest vertical curves shall be designed as a minimum for Stopping Sight Distance (SSD) for the nominated design speed. Sag vertical curves shall be designed for riding comfort. Where minor changes in grade (less than 1%) occur, vertical curve lengths shall satisfy appearance criteria.

Reaction times shall be 1.5 seconds for urban and 2.5 seconds for rural areas.

In order to improve gutter flows and pit inlet capacity where grades are less than 1%, sag vertical curves in kerb and gutter design should be eliminated. An increase in the road crossfall in the vicinity of the sag pit to achieve this requirement will ensue.

2.6. CROSSFALL AND SUPERELEVATION

Generally, roads should be crowned in the centre with 3% crossfall. Offset crowns are acceptable where warranted, to achieve satisfactory cross section profiles for adequate gutter/road capacity for stormwater runoff.

One-way crossfall may be applied in special circumstances subject to Council's concurrence (such as in difficult cross-sloping topography) with special attention given to control of the catchment contributing stormwater runoff to the gutter, (such as providing IAD pipelines) that does not exceed gutter capacity.

Superelevation should not be applied, but may be permitted on major urban and rural roads with design speeds of 80 km/h or greater, unless otherwise advised by Council.

2.7. FOOTWAYS, FOOTPATHS, STEPS

Footpath and footway parameters shall be designed in accordance with standard drawings SD001, SD002, SD007, & SD012, section 2.1 and the following:

- Footway minimum widths - 4.5m & 5.5m (subject to footpath width)
- Footway crossfall - 4%.
- Footpath width - 1.5m & 2.5m
- Footpath crossfall - ≤2.5%
- Longitudinal grades of footpaths shall match adjacent roadway/kerb grades.
- Where footpath grades exceed 12% special consideration shall be given to pedestrians.
- Steps are an undesirable element in public space design and should be replaced with ramps wherever possible. Where approved, they shall conform to the Building Code of Australia and handrails shall be provided.

Variation to these parameters will only be considered under exceptional justifiable circumstances.

A concrete footpath within the footway shall be provided, in principle, for lot catchments of generally greater than 10 lots. Footpath warrants, particularly in the vicinity of, or within the desire-line of, commercial and school precincts must be determined in conjunction with such surrounding development (present and planned), and with direction/desire-line destinations. Footpaths in industrial (IN1) and rural (RU1, RU2 & R5) zoned areas are not generally required unless specifically required by a planning instrument.

2.8. BATTERS

Batters of cut and fill should generally comply with the following requirements unless otherwise advised by the geotechnical engineer. This is to ensure that property access, pedestrian safety, and maintenance issues are satisfactorily achieved. Refer to Council's standard drawing SD002.

BATTER SLOPES

	MAXIMUM SLOPE (HOR : VERT)
Road Reserves	4 : 1 ⁽¹⁾
Lots	4 : 1 ⁽²⁾
Public Open Space	5 : 1 ⁽³⁾

Notes:

(1) This slope is nominated primarily for purposes of maintenance rather than batter stability.

- (2) Steeper slopes, up to 3:1 are permitted but should be avoided. Lots with steep batters shall be assessed for acceptable garage locations and driveway grades that conform to Council Standard Drawings SD008.
- (3) Where regular maintenance is expected, 6:1 should be provided. Where maintenance is not required such as for natural bush, 3:1 may be permitted.
 - Confirmation by a geotechnical engineer of suitable batter slopes for particular soil types may be necessary.
 - Cuttings in rock may be near vertical, as recommended by an engineer.
 - Batters for lotfill shall be contained within the lot.
 - Road batters which extend into lots, should intersect with the natural surface level within the building line setback as adopted by Council.
 - Variations outside of these parameters will only be approved where justified.

2.9. CULS-DE-SAC AND KERB RETURNS

A *circular* turning head within a cul-de-sac is the preferred treatment. Other treatments will be considered only where site constraints exist, with a turning head layout that caters for manoeuvres of a single unit Heavy Rigid Vehicle (HRV), typically a garbage truck. See Council's standard drawing SD027.

The minimum pavement crossfall in turning heads shall be 2%. In turning heads where the depth of excavation is significant, in order to reduce the effect of the cutting and batter, the crossfall from the circle centre may be adverse (positive).

NOMINAL KERB FACE RADIUS (MINIMUM METRES)

	RESIDENTIAL	INDUSTRIAL
Cul-De-Sac	10	16
Transition	30	50
Kerb Return (at intersections)	8	12
Kerb Return (at sharp mid-block bends)	15	See note

Note: Sharp mid-block bends are not appropriate in industrial areas. If unavoidable, B-Double turning paths must be satisfied.

3. INTERSECTION DESIGN

Intersections for the control of converging, merging and diverging traffic streams may employ various design elements which are generally referred to as “traffic control facilities”, being, Major Facilities such as, Traffic Signals, Channelized (with auxiliary lanes), Roundabouts in urban and rural environments, and Minor Facilities, such as Local Urban and Rural Intersections, as defined below.

Intersection requirements shall be implemented in accordance with Austroads guidelines and as supplemented by RMS standards, and in accordance with development consent. As generally encompassed by Austroads standards, warrants for typical intersection requirements shall be determined based on design objectives parameters such as: safety, traffic capacity and flow, sight distances, crash history, lighting, consistency, driver expectation, and including: speed, travel time, interruptions, queuing, freedom to manoeuvre, driving comfort and convenience, and operating costs; factors embodied in the Level of Service (LoS) of an intersection.

“General objectives for intersection design are to:

- design the intersection to be as safe as possible
- cater appropriately for the movements of road users
- provide adequate facilities for all road users (including pedestrians, those with a physical impairment and cyclists)
- maximise driver comfort
- minimise costs
- minimise adverse environmental effects.

One option to improve capacity (and safety) is through channelisation and auxiliary lanes, to separate movements on an approach and provide storage space or remove conflicting flows, and to raise capacity by eliminating constraints on the priority flow” (Austroads Pt 6), and to achieve an outcome “to maintain capacity of the through road...to operate with very minor interference to the through movement” (RMS).

Intersections shall be designed to accommodate the legal speed limit of the road existing at the time of construction approval.

Application of an Extended Design Domain (EDD) approach will not be considered unless adequately justified, whereby removal of constraints to achieve Normal Domain Design (NDD) is unreasonable or prohibitive.

For traffic-control design features, Council and RMS Traffic and Development Committee requirements may be inherent within the consent, or otherwise approved through or associated with, the Construction Certificate process for traffic device features such as signposting and linemarking. (See section 4.5.2)

3.1. TRAFFIC SIGNALS

All traffic signal facilities (including those for pedestrians) shall be approved in design and construction by the RMS through appropriate agreements with the RMS (eg. Works Authorisation Deed).

3.2. CHANNELISED INTERSECTIONS

Channelised intersections (CH), together with auxiliary (AU) lanes to provide safety in diverging, storage and continuous flow of vehicles and cyclists, shall be provided in accordance with Austroads guidelines and as supplemented by RMS standards.

Intersections shall incorporate the following (but not limited to):-

- Adequate capacity for the projected design life
- Adequate Stopping Sight Distance (SSD) where applicable, Approach Sight Distance (ASD), Safe Intersection Sight Distance (SISD) and, Minimum Gap Sight Distance (MGSD) where practically possible, as the circumstances require.

[Where an intersection is required in the vicinity of a crest vertical curve, it should be placed at the crest rather than immediately beyond the crest, where sight distance may be compromised.]

- Compliance with “turn treatments”
- Provision of auxiliary lanes
- Provision of islands medians and kerbs where required
- Provision for utility services, cyclists, pedestrians, disabled access, and lighting where required.
- Provision for 19m (and “B-Double” where on an approved route) articulated vehicle turning paths.
- Provision of signposting, pavement markings and furnishings, including raised pavement markers in accordance with RMS standards.
- Intersection angles should be perpendicular wherever possible, otherwise within the limits according to road design standards.

3.3. ROUNDABOUTS

Roundabouts shall be designed in accordance with Austroads and RMS Guidelines.

General geometric layout principles should be confirmed with Council prior to preparation of a detailed design. Particular attention will be given by Council to future traffic needs as they relate to the number and configuration of approach and circulating lanes. Wherever possible and appropriate, two approach lanes should be adopted. Pavement markings shall be utilised for dedicated traffic-lane movements. Two lane circulating roundabouts must employ two travel lanes at departures.

The following principles should also be addressed:-

- Circulating vehicle paths catering for a 19m Articulated Vehicle (AV)
- All roundabout road pavements should be constructed in fibre reinforced concrete. (see chapter 5)
- Adequate design capacity and strength, with a 40-year (min) design life.
- Appropriate sight distance and provision for future services, pedestrians, cyclists, drainage, lighting, signposting and line marking.
- A maximum through-movement deflection radius of 100m.

- An absolute maximum adverse radial crossfall of 4%
- Splitter islands, where pedestrian movement is expected, should be of sufficient width to accommodate “refuge” design parameters
- Suitable landscaping in the central island (where approved) providing sight lines at the adopted design eye-height.
- Subsoil drainage for any landscaped (unsealed) areas.
- Subsoil drainage at the perimeter (upright) kerb returns.
- On-road cycleways are to be provided for arterial and sub-arterial roads and in accordance with the Bike plan.

3.4. MINOR INTERSECTIONS

3.4.1. Urban

In urban environments intersections configured within the standards of kerb radii and road-width within this chapter shall generally be adequate for traffic access needs in local streets. Roads with higher levels of traffic usage such as Collectors or greater, should be assessed regarding traffic volumes and safe traffic usage in accordance with Austroads standards, addressing auxiliary lane potential for left and right turn manoeuvres. Use of regulatory signposting and linemarking in accordance with SD030 can usually accommodate most movements. Entry and exit movements for heavy vehicles that cross the road centreline within high volume roads are not permitted. (See “Kerb Returns” below)

Staggering of intersections, to achieve a desirable minimum separation distance of 40m between opposing road centrelines, is desirable. Four-way intersections should be considered where the separation is below the above standard, employing adequate traffic control measures.

3.4.2. Rural

In rural, or transitional urban/rural environments (being generally where the legal speed limit is greater than 60kms/h), and where single-lane two-way roads are impacted by a new road junction, intersections shall be assessed regarding traffic volumes and safe traffic usage in accordance with Austroads and RMS standards, addressing potential for auxiliary lanes for left and right turn manoeuvres, and flag lighting.

3.5. KERB RETURNS

Kerb returns shall be provided at all road or street intersections. Any variations to this requirement are subject to Council’s determination, such as within RU zoned areas where returns may, if justified, be deleted.

An adequate kerb radius/road-width relationship shall be adopted for the maximum sized expected design vehicle (usually a 19m Articulated Vehicle - AV) to provide acceptable access to a subdivision and for manoeuvrability within intersections. In urban environments the usual minimum standard kerb radius is 8m, although, depending on the type or the Level of Service (LoS) of the intersection, Council shall determine an acceptable sweep path (and hence kerb radii) that may or may not employ cross-lane vehicle manoeuvres.

To cater for single-lane approach and departure for AV requirements at square intersections, the nominal minimum radius is 15m.

4. PUBLIC TRANSPORT (BUS)

A public transport route within this Manual refers to an approved route traversed by a bus. A “bus route” (not being a school bus route) is determined by:

- Transport NSW, together with the Lower Hunter Councils Transport Group or
- A planning instrument or
- Development Consent

School bus route needs shall be assessed by developers in conjunction with the local bus companies and Council, with the aim to provide for locations for buses to stops at intervals along a nominated road that will service the major part of a population walking distance of approximately 400m.

Bus routes should be confined to roads providing a carriageway width of 11m or greater (in R1 & B zoned areas) when determining either the route along an existing road, or determining the alignment of a new/proposed road.

Bus facilities such as bus stop and parking areas, signposting, set-down paving and shelters shall be provided where required by Council, and designed in accordance with Council's requirements and Austroad Standards for individual items, as follows:

- Bus set-down verge paving and shelters where required shall conform to Council's standard
- Bus shelters, unless otherwise approved by Council, shall be the adopted style current at the time of installation.
- Road pavement for bus lay-by parking areas at major destinations such as business and school terminals, shall be provided in concrete

Typically, shelters may be required as part of major release areas and may be located along a route within the release area or on a route nearby or adjoining the area.

For new subdivision release areas the applicant for the development or the designer shall submit to Council verification of arrangements made (or otherwise) with Transport NSW and local bus companies of public transport routes (existing and planned) and of any specific requirements for those routes, such as bus stop/set-down locations, for consideration by Council for implementation within the road design.

5. STRUCTURES

Designs related to concrete, masonry, steel and timber elements, such as for bridges, large culverts, retaining walls, headwalls, subdivision entry features, etc, shall be carried out in accordance with relevant Australian Standards and RMS Design Standards, and shall be certified by a practicing structural/civil engineer.

All precast and pre-assembled structures shall be similarly certified for structural adequacy. Where design elements are ancillary to a Construction Certificate for *Roads & Drainage*, documentation shall be submitted to Council for each component.

5.1. RETAINING WALLS

Retaining walls in this Manual relate to their location, design and construction as part of a major subdivision, and as part of a development (Chapter 8 - Developments) whereby they are an integral part of a development approved with consent under the EP&A Act. These guidelines may be applicable for other scenarios beyond the intent of this Manual.

5.1.1. Location

The location of retaining walls shall be determined by Council and the design engineer and should adopt the following guidelines:

- At public/road reserve boundaries – within the adjoining lots.
- At adjoining lots (common boundaries) – within the uphill lot with the face of the wall on the boundary. An easement 900mm wide within the downhill lot, to prevent excavation and for access for maintenance, shall be created.
- At stormwater overland flow paths – within the dedicated flow path or easement, being of concrete or masonry construction suitable for a flow path.
- Obstructions, such as walls or any other above-surface structures are not permitted within easements that act as overland flow paths. These easements are usually 3m wide, or greater.

Retaining walls within stormwater drainage easements (Inter-allotment Drainage) are not desirable due to the potential interference with the stormwater pipe and difficulty for access to the pipe for maintenance purposes.

- If a retaining wall is permitted/required, then the following guidelines/actions should be considered:
 - Avoidance of adverse impacts on the pipe from any structural elements of the wall
 - Footings shall be finished below the zone of influence * of the drainage line and no loading shall be directly applied to the pipe without a detailed design demonstrating mitigation of the load.
 - * The zone of influence is defined as a line drawn at 1:1 slope from the invert of the pipe.
 - Maintenance of a reasonable means for physical access for personnel and light machinery to “lay, place and maintain a line of pipes” (Conveyancing Act).
 - Adequate measures to eliminate any potential loading on a pipe that passes through a wall or its footing.
- If a retaining wall is permitted/required and an adjustment to the pipeline is also required, a review of the hydraulic design of the pipeline, such as Hydraulic Grade Line, surcharge, pipe capacity, etc, must be made to ensure that there is no compromise to stormwater flows, that may create an adverse affectation on properties that either benefit, or surround the proposed adjustments.

5.1.2. Design

Retaining wall design shall be in accordance with AS 4678 Earth Retaining Structures, and be certified by a qualified engineer, taking into account loads from existing or future anticipated dwellings, pools, vehicles, etc.

Excessive cut and fill and subsequent retaining structures are not desirable. In this regard Council's policy of a maximum height of 1.5m between lots should be maintained. Retaining wall heights beyond 1.5m for other than "lot benching" (such as for road embankments) shall be subject to Council's approval through development consent.

Where approved by Council, retaining walls shall:

- Be designed in accordance with the Australian Standards
- Be of the materials in the specified locations, as nominated in the section of the Manual
- Where supporting a public/road reserves, be constructed in masonry or reinforced concrete.
- Where supporting lots adjacent to public/road reserves may be other than concrete/masonry, being installed in accordance with the manufacturer's recommendations.
- Where located within a public/road reserve, under justifiable circumstances, be constructed of reinforced concrete or an approved masonry specification.

Retaining walls of treated timber walling (sleepers) at common lot boundaries shall be incorporated into galvanised steel I-beam posts set in concrete in accordance with an engineer's design.

6. ANCILLARY DESIGN REQUIREMENTS

6.1. SAFETY AUDIT

A Road Safety assessment, where required by Council, shall be conducted in accordance with the RMS Road Safety Audit process.

6.2. TRAFFIC CONTROL DEVICES (TRAFFIC COMMITTEE)

Traffic control devices may include a sign, signal, marking, structure or other device to direct or warn traffic (incl. pedestrians and cyclists) on a road or road related area that is prescribed by the regulations. Traffic control devices may also be of a type to reduce travel speeds to match urban design requirements where road geometry cannot provide that control. Such devices may also be used in conjunction with street landscaping and furniture.

The devices, including associated signposting and linemarking, shall be designed where applicable, in accordance with RMS, Australian Standards or Austroads guidelines, and Council's requirements, and will be presented to Council's Local Traffic Committee upon receipt at Council of an acceptable engineering design.

Roads with an 11.0 metre (or greater) carriageway width, centreline and/or edgeline marking may be required. Raised pavement markers shall be provided where required by Council at intersections in accordance with RMS standards, in conjunction with line marking at locations that warrant particular traffic safety considerations.

The manoeuvrability of an articulated design vehicle shall be considered for traffic control devices.

6.3. STREET NAME SIGNS

Street signs shall be provided to Council's standard specifications and Standard Drawing SD029. An application for new street names shall be lodged with Council, and be supported by adequate justification for the proposed names. Names shall conform to the guidelines of the Geographical Names Board.

6.4. GUARDFENCE & GUIDEPOSTS

Guardfence refers to any approved type of safety barrier such as concrete barrier/kerb, steel W-Beam or wire rope. Where possible, effective road design should aim to negate the need for guardfence. Where there is a warrant, and where unavoidable, guardfence shall be provided in accordance with the current RMS Design standards or as directed by Council. Guardfence on the outer edge of a road carriageway shall be located within a constructed or extended road shoulder which shall be bitumen-sealed.

Guideposts shall be provided in accordance with Roads and Maritime Services Design Guide.

6.5. PAVEMENT EDGE RESTRAINTS

Concrete restraints such as kerbs, flush edge-beam restraints or kerb & gutter shall be provided on both sides of all roads on urban residential subdivisions as determined by Council.

6.6. TEMPORARY TURNING HEAD

Where a road is terminated for staged construction, a temporary turning head with a two coat bitumen seal (as a minimum treatment) shall be provided, with optional layouts complying with those shown in SD027. The facility may not be necessary where it is adjacent to an intersecting street, enabling a 3-point turn.

The road pavement may be constructed either as an extension of the adjoining section (catering for future extension), or a lesser pavement by special design.

A chevron sight board shall be placed at the termination of the temporary turning head on the prolongation of the centreline of the road.

6.7. VEHICLE TURNING PATHS

Vehicle manoeuvring templates, in accordance with Australian Standards or an approved computer application shall be employed for each appropriate vehicle type. Public roads shall cater for Articulated Vehicles (AV) turning paths. Where a "B-Double" route exists, the appropriate turning path shall be employed.

6.8. CYCLEWAYS & SHARED PATHS

Cycleways shall be provided on routes as defined by the Maitland City Council Bike Plan or in accordance with any Development Control Plan or condition of development consent.

Off road cycleways (ie, beyond the road pavement) are usually nominated “shared paths” being 2.5m wide for both cyclist and pedestrian usage, and shall be constructed in accordance with standard drawings SD012 & SD020. Such paths, usually located within footways that are 5.5m wide (See SD001) may also be located in open space corridors. Council may consider a shared path 2.0m wide where justified by special circumstances such as constraints of available corridor widths.

Shared path or cycleway connectivity between a road (ie. a road reserve either existing or proposed, with or without a path) and the main path shall be constructed as a shared path, 2.5m wide.

6.9. KERB RAMPS

Kerb ramps (pram ramps) shall be provided at locations to cater for road crossings but only when directing pedestrians to a continuing path, in accordance with Council's Standard Drawing SD019. The surface of the kerb ramps shall be coloured with a terracotta colour oxide, with a stretcher bond brick stencilled finish. Ramps and their texture shall be perpendicular to the road and aligned to be directly opposing, to assist directional orientation of sight impaired persons.

6.10. PATHWAYS

Public pathways within dedicated land shall link common destinations such as schools and commercial precincts and recreation areas. They may also act as stormwater overland flow paths (see chapter 6). Pathways shall be provided with concrete footpaths in accordance with development consent and Council's standard drawing SD012 & SD037. Typical pathway reserve widths between allotments shall be a minimum of 3.0m containing concrete path 1.5m wide, and 3.5m wide containing concrete paths 2.5m wide.

Street crossing points, for cyclists, shall be provided where appropriate and pedestrian refuges where traffic volumes are greater than 3000vpd.

6.11. ACCESS CORRIDORS FOR DRIVEWAYS

Unless approved otherwise under development consent, the following minimum dimension (subject to an acceptable cross section design incorporating pavement, underground drainage & services and good quality landscaping) shall apply to access corridor “handles” (see also chapter 8).

HANDLE WIDTH (M)

ZONING ¹	SINGLE HANDLE ²	DUAL HANDLES ³	PAVEMENT WIDTH ⁴
Residential (R1)	3.5	3.0 ^{5,6}	2.7 ⁷
Residential (R5-V & X)	3.5	3.0	2.7
Residential (R5-Y)	4.5	3.0	2.7
Residential (R5-Z)	6.0	3.0	2.7
Business (B) & Industrial (IN1)	6.0 ⁸	4.0	3.3 min ⁹
Rural (RU)	6.0	4.0	3.5

Notes:

- (1) For zoning criteria see chapter 2.
- (2) For a single allotment.
- (3) Each handle width for two adjoining lot handles, with a single driveway covered by a full-width reciprocal ROC.
- (4) For single lane.
- (5) Three metres (x2) permits vehicle passing within o/a 6m width for each residential zone. It is assumed regular conflict is unlikely and "give-way" will apply in residential zones.
- (6) Where lots are >600m² (excluding handle), having potential for further subdivision, adopt 3.5m.
- (7) Where lots have potential for high density development with regular traffic movements, adopt 4.8m, preferably as two carriageways with a 400mm grassed separation.
- (8) Increase to 8m where regular two-way conflict is likely.
- (9) Generally for one-way or minor two-way movements with "give-way". For two-way movements with regular traffic conflict 6.0m min should be provided.

6.11.1. Dual Handles

Adoption of the dual handle widths considers potential for:

- Independent individual usage for each lot if necessary
- Good quality landscaping (excluding trees)
- Provision for vehicle passing bays, emergency access or breakdown clearance

6.11.2. Rights of Carriageway (No Handle)

Where site constraints dictate, particularly within the existing built environment, a right of carriageway in lieu of an access handle may be considered.

6.11.3. Underground Services

Services, including stormwater conduits, shall be provided within and along the full length of individual access handles.

6.11.4. Pavement

Driveway pavements shall be provided along the full length of the access corridor handle prior to issue of a Subdivision Certificate in accordance with standard drawing SD012, including splays at each end and may be shared between adjoining properties. Pavements within Rights of Carriageway for all zone areas shall be provided as heavy-duty “commercial/industrial standard” slab type reinforced concrete, or to a greater design as determined by expected usage.

In single-lot residential areas concrete drive wheel-strips within the handle length are encouraged in order to reduce impervious surfaces and hard surface expanse. Pavement widths are subject to an assessment for the potential for vehicle-passing and turning movements.

7. **ROADS FOR LARGE-LOT RESIDENTIAL**

For road dimensions refer to the table in section 2.1 of this chapter. Subject to Council approval the follow design elements should be applied/considered:

- Road pavements shall be provided with an asphaltic concrete wearing surface in accordance with the requirements of this Manual.
- The requirement for a table drain (swale) on the low side of the road is subject to specific design geometry such as downhill batter slope, road longitudinal grade and swale-drain relief. In situations where the batter slope is significant, the longitudinal grade is low and the catchment area is small the swale may be deleted.
- In lieu of a swale, one-way crossfall on the road pavement against the natural topography is optional.
- Swale (or table drains) that may be crossed for vehicle access should be designed wherever possible to provide vehicle clearances for a dished invert crossing in accordance with AS2890, to avoid the necessity for a pipe crossing. Acceptable grades can often be achieved with reshaping of the natural surface within the property.
- In cut situations where a dished crossing is not practical, a 5m long, 375mm (minimum diameter) Class 4 concrete or equivalent FRC pipe, with attached sloping headwalls, shall be provided for each new lot, preferably in the centre of the lot. The pipe size shall provide sufficient capacity for the 10-year ARI storm event for the contributing catchment area, ensuring that major overflows can be contained within the road reserve. Driveway details are shown on Council’s standard drawing SD013.

8. **RURAL ROADS**

Rural roads in this Manual are assumed to be new roads within RU zones that either, service rural properties fronting the road, or roads (new or existing) that extend access to those roads from an existing public road. Such roads do not usually relate to existing rural roads under Council’s control, such as a classified “main road”, although Council may apply the design principles herein to those roads where works on those roads are necessarily the subject to development consent.

The parameters shown in the table under section 2.1 of this chapter are specific to subdivisions with a minor vehicle catchment, particularly as “no-through” roads; otherwise rural road & drainage design shall conform generally to the parameters required by Council based on Austroads and RMS design guidelines.

8.1. RURAL DESIGN ELEMENTS

Subject to Council approval the follow design elements should be applied/considered:

- Rural roads shall be provided with a two-coat bitumen flush seal wearing surface across the full formation width.
- Table drain (swales) shall be grassed with a stable medium such as a jute-mesh type product or similar means.
- Driveways for vehicle access shall be provided, including a recessed access where appropriate where a vehicle with trailer can park clear of the road pavement.
- Clear zones shall be provided in accordance with the Austroads & RMS Design standards.

PAVEMENT DESIGN

1. ROAD PAVEMENTS

All road pavements shall be designed in consideration of design traffic loadings and evaluation of subgrade materials, environmental factors and available materials.

1.1. PAVEMENT TYPES

Typical pavements types are as follows:

- Unbound granular flexible pavement which may contain one or more modified layers
- Bound granular flexible pavement
- Rigid pavements (concrete)

1.2. DESIGN REPORT

For purposes of determining an acceptable sub-grade & pavement design, designers should satisfy themselves that the pavement materials available in the general geographical area will perform to achieve the desired pavement life, and that the design will satisfy characteristic deflection testing for construction purposes.

Refer to chapter 7 – Construction and Appendix D for pavement material specifications and testing requirements.

A pavement design for all new roadworks shall be prepared for approval, subject to a geotechnical engineer's report. The report shall utilise 4 day soaked "Californian Bearing Ratio" (CBR) testing undertaken on the relevant subgrade in accordance with AS1289 and shall recommend a design CBR and a pavement design thickness, determined using the methods outlined in Austroads standards for pavement design, based on Council's minimum standard Equivalent Standards Axle (ESA) requirements. Sub-grade and/or pavement material modification may form part of the design. The geotechnical report and pavement design report shall be submitted with the engineering plans. The engineering plans shall show pavement layer thicknesses (including the nominated ESA and design CBR parameters) based on the reports. Where alternative pavement designs are offered, the decision for the final adopted design shall be confirmed by the supervising geotechnical engineer and be reported to Council prior to construction of the pavement. Generally, pavements shall be consistent over long lengths of road, such that alternative designs for short sections of pavement are avoided.

In deep cuttings, fills or other instances where testing of subgrade is not possible until completion of bulk earthworks, pavement design or re-evaluation of a design, may occur upon assessment at subgrade level.

1.3. MINOR WORKS

For minor works within a public road (such as short lengths of shoulder, kerb & gutter in-fill, or access works) full testing described above may not be necessary, subject to an engineer's assessment.

Minimum requirements may be as follows:-

- 30mm AC10 over a 10mm primer seal or a 2 coat bitumen seal
- 300mm compacted thickness of a granular base course material (200mm may be considered for very minor traffic loadings)
- a compacted and stable subgrade

Alternatively, the developer may submit a design report for alternative pavement treatments.

1.4. AS-BUILT RECORDS

Records of actual pavement construction, where pavement amendments occurred, or where alternative pavements were approved, together with any subgrade replacement or modification, shall be collated as a final report to accompany the WAE plans.

2. DESIGN TRAFFIC LOADINGS

The design traffic loadings of Equivalent Standard Axels (ESA) are given in the following table. The nominated values may be increased by Council, subject to an assessment of any special circumstances for subdivision or development, where a higher value is adopted, based on ultimate traffic generation for the catchment area, originating from:

- strategic planning for future rezoning of land
- ultimate development of current zoned land
- staging of works and the resultant development and construction traffic

Council or the RMS reserve the right to nominate specific ESA's for Arterial roads such as a State or Regional roads. A general minimum of 1×10^7 will apply.

DESIGN TRAFFIC LOADINGS

ROAD TYPE	ESA'S	MAX NO. LOTS
Local - Place	1×10^5	10
Local - Access	1×10^5	20
Local - Secondary	2×10^5	50
Local - Primary	5×10^5	100
Collector - Secondary	1×10^6	200
Collector - Primary	1.5×10^6	300
Distributor - Secondary	2×10^6	400
Distributor - Primary	5×10^6	500
Sub-Arterial	1×10^7 min	3500
Industrial - Secondary	5×10^6	10
Industrial - Primary	1×10^7	>10
School Bus / Public Route	$2/5 \times 10^6$ min	
Business / School Precinct	1×10^7	

LARGE-LOT SUBDIVISION

ROAD TYPE	ESA'S
Residential (R5-V)	Apply ESA's as categorised above
Residential (R5-X)	Apply ESA's as categorised above
Residential (R5-Y)	Apply ESA's as categorised above
Residential (R5-Z)	Apply ESA's as categorised above

3. SUBGRADE EVALUATION

Investigation and testing of existing subgrade materials shall be performed by a practicing geotechnical engineer through a NATA registered laboratory. A pavement design report, including subgrade investigation and 4 day soaked CBR test results establishing a “design CBR”, shall accompany the Construction Certificate (and engineering design), and be submitted to Council or the Accredited Certifier for approval.

Assessment of the supporting subgrade strength shall be in accordance with APRG Report No. 21 or Austroads Pavement Design.

All pavement investigations and design by the Geotechnical Engineer shall provide comment in respect to APRG Report No. 21 with reference to extent of testing, site investigation and assessment and pavement design.

4. SUBSURFACE DRAINAGE

Subsurface drainage must be provided to protect the subgrade and pavement in locations that necessitate its use such as boxed construction, cuttings or areas with high water tables or in areas where subsurface moisture requires treatment.

Subsoil drainage pipes shall be provided on both sides of road pavements and where required by design, at new-to-existing pavement joints (see SD003, SD035 & SD032)

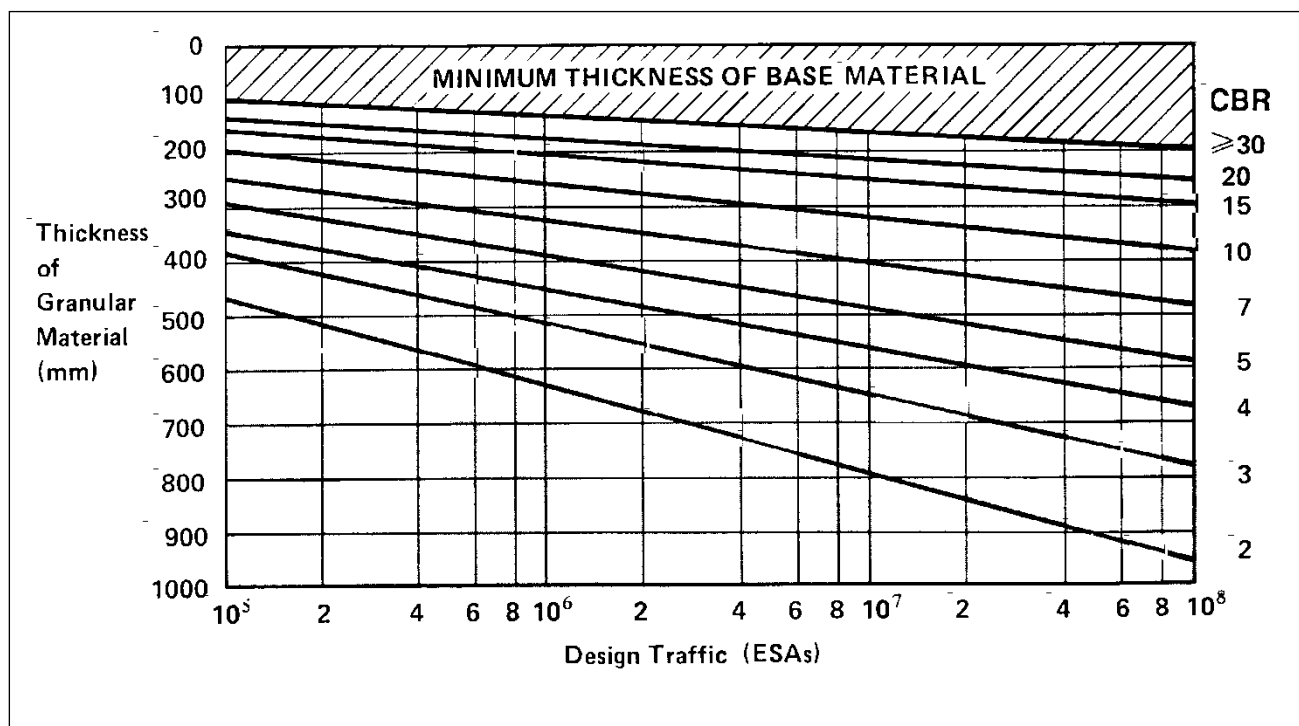
Where highly expansive soils and/or high moisture conditions are encountered special care should be taken for the placement of subsoil drains with respect to the any potential adverse affects upon the road pavement from significant moisture removal from the deeper levels of the subgrade.

5. PAVEMENT DESIGN

Public road pavements shall comprise of at least one subbase layer and one basecourse layer with a sealed wearing surface. Pavement layers may be combined into a single layer of base course material.

5.1. FLEXIBLE PAVEMENT

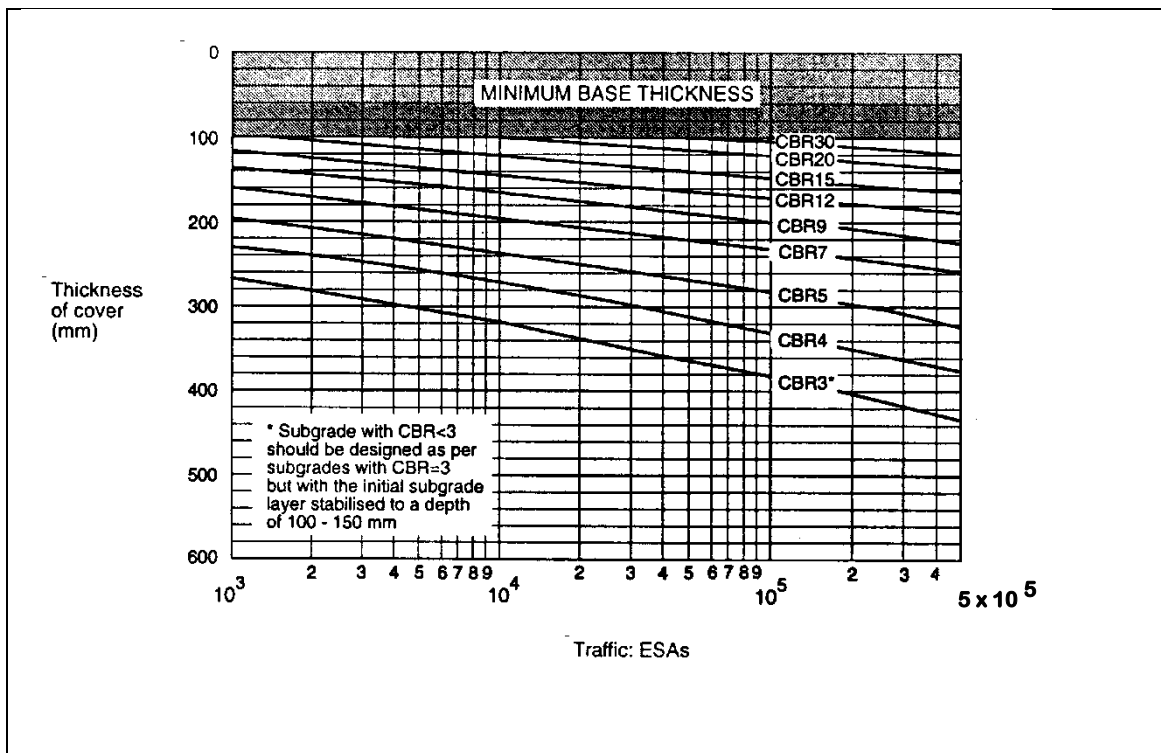
Pavement thickness designs shall be based upon assessed subgrade strength and the following charts, with the nominate/approved traffic loadings.



DESIGN CHART FOR GRANULAR PAVEMENTS WITH THIN BITUMINOUS SURFACING FROM AUSTROADS PAVEMENT DESIGN GUIDE

The minimum pavement thickness for flexible pavements will be derived as follows:-

- Overall pavement thickness shall be a minimum of 300mm
- Base-course shall be determined from the Pavement Thickness Design Chart, where the minimum thickness is 100mm.
- Sub-base thickness shall be determined from the Pavement Thickness Design Chart, using the relevant CBR curve by subtracting the base-course layer thickness from the required total pavement thickness. Irrespective of the foregoing, the minimum sub-base thickness shall not be less than 125mm.
- Asphaltic concrete thickness shall be a minimum of 30mm and may be included as pavement "depth" in determining the pavement thickness. Two coat flush bitumen seals shall not be considered part of the pavement thickness.
- The pavement designer should be satisfied that the design will meet the requirements of this Manual in respect to permissible deflection and pavement life.
- Where a combined sub-base/base single-layer (with for example bound materials) pavement is proposed, a geotechnical engineer shall report on the proposal, nominating the materials (source) and relevant compaction and testing methods.



**DESIGN CHART FOR GRANULAR PAVEMENTS WITH THIN BITUMINOUS SURFACING,
BASED ON A 90 PERCENT CONFIDENCE LEVEL
(for minor rural roads)**

5.2. RIGID PAVEMENT (CONCRETE)

Rigid pavements on public roads shall be designed in accordance with the following documents:

- Concrete Pavement Design for Residential Streets - Cement and Concrete Assoc. of Aust.
- Pavement Design - Austroads Standards
- RMS supplements and directory notes to Austroads standards.
- RMS Concrete Pavement Manual.

Minimum thicknesses shall be:

- Sub-base - 150mm minimum
- Base - 170mm minimum

The base shall be jointed, reinforced concrete.

Details prepared by an engineer, are required for (but not limited to):

- a. subgrade preparation to achieve a design CBR
- b. a proposed sub-base concrete mix adopting 5MPa minimum characteristic strength

- c. a proposed base concrete mix adopting 32MPa minimum characteristic strength
- d. a nominated maximum slump and testing procedure (with reference to chapter 7)
- e. a proposed thickness for sub-base and base courses
- f. steel reinforcement
- g. joint types and locations
- h. interface treatments between layers
- i. placement, compaction, surface texture and curing methods
- j. Nominating the finished surface to be rake-textured in accordance with the RMS rake specifications
- k. Nominating the application of a curing agent.

5.3. SEGMENTAL BLOCK PAVEMENT

Segmental block pavements, where permitted, shall be constructed of concrete or clay pavers. Such pavements shall be designed in accordance with the following:-

- Clay segmental block pavements:-
 - Up to 10^6 ESAs – Clay Segmental Pavements – Design manual, Clay Brick and Paver Association.
 - Between 10^6 ESAs and 10^7 ESAs – The design will involve the above document and Austroads Pavement Design Manual with the method producing the thicker design to be adopted.
 - Over 10^7 ESAs – Austroads Pavement Design Manual.
- Concrete segmental block pavements:-
 - Up to 10^6 ESAs – Cement and Concrete Association Technical Note 35.
 - Over 10^6 ESAs – Austroads Pavement Design Manual.

Concrete pavers shall be 80mm thick Shape 'A'; clay pavers being 65mm thick Class '4' being laid in a herring bone pattern. All areas of block paving shall be provided with a suitable concrete edge restraint. Large paved areas shall be bedded and laid in accordance with the supplier's guidelines. Allowance must be made for an adequate number of expansion joints and restraining beams.

Shape "C" concrete pavers may be permitted in small infill areas such as residential street thresholds. (see below)

5.4. ACCESSWAYS

Accessways to specialty-use areas or facilities such as public utility plant, parks, pollution control devices etc. where heavy vehicles are expected to gain access, shall be a minimum of 3.0 metres wide and constructed in concrete in accordance with the publication by the Cement and Concrete Association of Australia – "Concrete Pavement Design for Residential Streets".

Generally the following parameters shall be maintained (see SD012):

- 150mm thick
- 32 MPa 28 day strength
- Two layers of SL72 mesh fabric
- Sub-base, 100mm compacted thickness of “road-base” material

5.5. ROUNDABOUTS

All roundabout pavements shall be designed for construction with fibre-reinforced concrete, with reference to “rigid pavement” RMS standard design and construction requirements. The minimum concrete design mix specification shall provide 32MPa characteristic strength, 4.25 Flexural strength, with 50kg/m³ of steel fibre (Reo Pave 25 or equivalent). Where construction constraints are significant such as major traffic flow impediments, consideration may be given to alternative pavement types, such as deep-strength asphalt or similar, where justified.

5.6. INTERSECTION THRESHOLDS

Where intersection thresholds are approved they shall be provided in accordance with standard drawing SD025 – sheet 1, as a “heavy duty” plain concrete pavement as shown on SD012, with reference to SD026 where a dished drain is necessary.

Coloured concrete is not considered a satisfactory long-term treatment, but where approved, colour additive must include hardener (75-90MPa), be applied as a minimum of two coats and be sealed with a polymer solvent based sealer. Texture may be applied to a maximum depth of 5mm.

5.7. PAVEMENT JOINTS

All vertical pavement joints (new-to-existing), whether longitudinal or transverse, shall be benched a minimum of 300mm. (with reference to SD032)

Unless the adjoining pavements consist of the same material, and satisfactory compaction bonding of those materials can be achieved, subsoil drainage shall be provided in accordance with RMS QA Spec R37 “Intra-pavement Drains” at the direction of Council or the geotechnical engineer.

6. WEARING COURSE

For the application of bituminous surfacing, refer to Chapter 7 - Construction.

For alternative decorative finishes, Council's approval is required to use such finishes in public roads. Smooth and/or irregular surfaces for roads and footway crossings, such as "deep-stamped" or "exposed river gravel" paving, is not permitted. Supporting documentation shall be submitted with any request to decorative finished products and shall include:-

- Full specifications of the product.
- Durability and colour fastness
- Skid/abrasion resistance.

7. EXISTING PAVEMENT RECONSTRUCTION

Where required by Council, existing road pavements shall be reconstructed, rehabilitated or re-surfaced. A pavement design shall be prepared for and approved by Council based on this chapter adopting an ESA value as determined by Council.

Where new works about an existing natural gravel pavement, it is preferred that the new pavement materials be an approved natural gravel in accordance with the specifications of this Manual. (Refer to "Pavement Joints" above).

Circumstances where construction works may be necessary are:

- Where either the existing pavement or surface quality are assessed by Council as incapable of sustaining the additional traffic loads from the development
- Where vehicle turning movements occur, such that an asphalt wearing surface is appropriate to control premature surface deterioration
- Where a longitudinal surface profile is significantly irregular
- Where surface shape (eg. crossfall) does not conform to standard design parameters
- Where small local "patching" type pavement failures are required by Council.
- Where works coincide with Council's Forward Works *Management Plan*.

The limits of such works shall be determined by Council, but will normally be applied to development that:

- creates new intersections onto an existing road
- requires shoulder or parking lane works
- warrants new or replacement kerb and gutter
- has frontage to, or requires vehicle access along an existing road that exhibits stress and/or has significant surface deterioration, and (subject to geotechnical testing) exhibits a failure to meet design requirements in this Manual.

Best design practice shall be employed such that a holistic approach is achieved, eliminating partial ("patchwork"), or part-lane, pavement sections.

STORMWATER DRAINAGE

1. GENERAL

This chapter addresses stormwater design for the development of land (principally as greenfield subdivision sites), and does not assume coincidental influence from Hunter River flooding beyond normal flow levels, nor addresses drainage structures which may be affected by flooding of the Hunter River. Drainage structures inundated by such flooding are not prohibited by this Manual, although particular requirements may apply.

Stormwater drainage systems shall be designed to achieve the following goals:-

- An underground “minor system” of conduits that eliminates inconvenience to traffic and pedestrians.
- An overland “major system” that conveys stormwater flows within suitable velocity/depth limits, generally located within public land, or where approved or unavoidable, within private land covered by an easement.
- Detention of stormwater flows that mimics natural, pre-developed flows for all storm events up to and including the 100 year ARI event.
- Retention of stormwater flows to achieve target water quality standards.
- Control of stormwater flows to minimise the impacts of erosion and sediment in the environment.
- Consideration of upstream and downstream catchments in their ultimate developed state to achieve a total system which does not adversely affect existing systems or properties within the flow path and catchment.
- Minimisation of the maintenance burden of Council
- Enhancement of the urban landscape.
- Employment of principles of Water Sensitive Urban Design and Stormwater Reuse.

2. DESIGN STANDARDS

Drainage design for roads, reserves and inter-allotment systems the subject of this chapter, shall adopt the principles of a major/minor drainage system in accordance with the publication Australian Rainfall and Runoff (AR&R) and Australian Runoff Quality (ARQ) and as specified in this Manual. Other accepted reference material may be used, with acknowledgement.

All calculations must be carried out by competent persons, qualified and experienced in hydrologic and hydraulic design, utilising drainage models that are accepted as current industry standards.

The requirements of Council’s Hunter River Floodplain Management DCP shall be observed for all developments.

3. HYDROLOGY

3.1. RAINFALL DATA

Design Intensity Frequency Duration (IFD) relationships shall be derived in accordance with Australian Rainfall and Runoff for the particular catchment. (See tables in appendix C)

MUSIC Input Parameters for the Maitland area are available from Council.

3.2. RECURRENCE INTERVAL

Minimum design Average Recurrence Intervals (ARI) for the major/minor systems are:-

MINOR SYSTEM AVERAGE RECURRENCE INTERVAL

MINOR SYSTEM	ARI (YRS)
Residential 'R1' & 'R5' (Streets and IAD)	10
Business 'B' & General Industrial 'IN' (Streets and IAD)	10
Public & Drainage Reserves (acting as flow paths)	10 ⁽¹⁾
Rural 'RU' - Longitudinal Drainage	5

MAJOR SYSTEM AVERAGE RECURRENCE INTERVAL

MAJOR SYSTEM	ARI (YRS)
Urban trunk drainage conduit at road crossing	20 min ^(2,3)
Rural – Low-point Culvert Crossings	20 ⁽⁴⁾
Overland flow paths & trunk drainage	100
Structural adequacy of major drainage items	PMF ⁽⁵⁾
Land depressions with no outlet	PMF

Notes:

- (1) May be reduced (minimum being 2 year ARI) only in special circumstances, subject to specific design merits
- (2) Freeboard at the road reserve may be ignored
- (3) Depending on road hierarchy. Typically (subject to Council approval), Distributor Roads and higher should provide flood-free access up to the 100 year ARI. Lower order roads may be inundated, with a design aim to maintain at least single-lane traffic movement in the 100 year ARI event.
- (4) Applies to minor roads. The 100 year ARI event shall be catered for, typically including a causeway with signposting and water depth markers.
- (5) Probable Maximum Flood

As a first step approach, the designer should attempt to contain the whole of the major storm discharge within the road and footway cross section. (see AR&R technical note 5 & table 1.12). Where flow widths and depths within the road reserve are critical, the designer may provide for greater pipe capacity based on the inlet pit capacities with blockage factors applied.

Other than for large, or residue, lots with traversing natural gullies, potential for stormwater surcharge across private property will only be accepted if the piped system is designed for the 100-year ARI flows, with a 50% blockage factor applied for pit entry capacities. An emergency overland flow path, over or adjacent to the piped system, shall be provided, covered by an easement. The easement surface/shape shall be protected against alteration or by obstruction by a “restriction” on the property title.

Council may require that the design ARI's for the subject drainage system be varied in certain circumstances.

3.3. CATCHMENTS

The catchment at an outlet is defined as the limits from where surface water will make its way by either natural or man made features to this outlet.

Catchment area land-use shall be taken into consideration and be based upon current and possible future planning constraints and zonings. The ultimate developed state of each catchment shall be adopted. Notwithstanding the table below, in some areas Council may nominate design parameters regarding higher urban density uses.

Catchment plans showing the proposed pipeline layout shall be included in Engineering Design plans.

3.4. FRACTION IMPERVIOUS

Hydraulic calculations shall be based on the following fraction impervious figures:

FRACTION IMPERVIOUS RATES FOR LAND USES

LAND USE	FRACTION IMPERVIOUS
Residential Lot size < 1000m ²	0.6
Residential Lot size > 1000m ²	0.4
Road Reserve	0.7
Business Areas	1.0
Industrial Areas	0.9
Public Recreation Areas (mowed and with improvements)	0.5
Parkland, Natural Public Reserve	0.1

3.5. COEFFICIENT OF RUNOFF

Coefficients of runoff shall be determined in accordance with Australian Rainfall and Runoff. Full details of coefficients used shall be provided in the calculation documents.

Fraction impervious effects on the coefficient of runoff, "C", shall be consistent with the following table:

RUNOFF COEFFICIENTS

FRACTION IMPERVIOUS	C ₁	C ₅	C ₁₀	C ₂₀	C ₁₀₀
0.0 - 0.1	0.35	0.41	0.43	0.46	0.52
0.2	0.39	0.46	0.49	0.51	0.58
0.3	0.43	0.51	0.54	0.56	0.65
0.4	0.47	0.56	0.59	0.62	0.71
0.5	0.51	0.61	0.64	0.67	0.77
0.6	0.55	0.66	0.69	0.73	0.83
0.7	0.60	0.71	0.74	0.78	0.89
0.8	0.64	0.76	0.80	0.84	0.96
0.9	0.68	0.81	0.85	0.89	1.00
1	0.72	0.86	0.90	0.95	1.00

3.6. PARTIAL AREA EFFECTS

Partial area effects shall be considered in the design process. In urban catchments this applies, for example, where large paved areas are directly connected to the pipe inlet, and the sub-catchment discharge is based on a larger pervious area. Similarly, partial area effects can also occur where a large open space catchment, contributes to an urban catchment, with a time of concentration substantially different to the urban catchment. Other factors of influence may be catchment shape, or variation in slope and land use within the catchment.

In areas where this is critical, such as industrial or high density residential development, a partial area check, based on times of concentration of impervious areas directly connected to the pipe system, is necessary.

3.7. RATIONAL METHOD

Rational method calculations to determine peak flows shall be carried out in accordance with Australian Rainfall and Runoff, utilising the Kinematic Wave equation or an appropriate computer programme. See Appendix C for an overland travel time aid derived from Technical Note 3 in Australian Rainfall and Runoff.

3.7.1. Time of Concentration

The time of concentration (tc) is the time required for storm runoff to flow from the most remote part of the catchment to the catchment outlet. The adopted time of concentration shall be for the ultimate developed catchment, catering for the greatest flow. Care should be exercised in adopting a time of concentration that is a reasonable estimation for the upper reaches of the drainage system within a developed catchment.

The general maximum time of concentration, in urban areas shall be 20 minutes, unless justification is provided to the contrary. The time of concentration in rural areas shall be calculated in accordance with Australian Rainfall and Runoff.

Where the flow path traverses areas having different flow characteristics or various surface types, the flow-time of each portion of the flow path shall be calculated separately.

3.7.2. Coefficient of Roughness

The surface roughness coefficient (n^*) is similar to, but not identical with, Mannings “n” for open channel design. Whilst Australian Rainfall & Runoff provides typical values, Council’s recommended values should be adopted from the table below.

ROUGHNESS COEFFICIENT

SURFACE TYPE	ROUGHNESS COEFFICIENT N^*
Parks	0.35
Large-lot Residential R5 X-Z	0.35
Urban Residential R1 to R5-V	0.21
Industrial	0.06
Business	0.04
Asphalt	0.02
Concrete	0.01
Gravel	0.02

3.8. ALTERNATE HYDROLOGICAL MODELS

Alternate models may be utilised, providing the requirements of Australian Rainfall and Runoff are met. Summary of calculations shall be provided within Engineering plans. Where computer analyses are used, details of all programme input parameters and output data files shall be provided. The following DRAINS (or their equivalent) parameters shall be used:

MODELLING PARAMETERS

PARAMETER	VALUE
Soil Type	as reported
Antecedent Moisture Content	3
Grassed Depression storage	5mm
Paved Depression storage	1mm

4. HYDRAULICS

4.1. HYDRAULIC GRADE LINE

Hydraulic calculations shall substantiate the hydraulic grade line (HGL) adopted for the design of the system and shall be shown on the drawings.

Controls for a downstream hydraulic grade line design are as follows:-

- Hydraulic grade line levels based on downstream calculations including pit losses at the starting pit in the design event.
- If the downstream start point is an existing pit and the HGL is unknown, a level of 0.15 metres below the pit inlet in this pit shall be adopted.
- If the downstream start point is an outlet into an open channel and;
 - i) the design storm is the minor event, the outlet pipe shall be the downstream control,
 - ii) the design storm is the major event, and the design flood levels in the channel are unknown, the top of the outlet pipe shall be the control,
 - iii) The flood levels are known, the control shall be the 100 year ARI flood level.
- Where appropriate the Hunter River Flood shall be considered as an outlet control.
- The HGL level in drainage pits shall be not higher than 150mm below the top of the inlet grate, gutter or lid.

4.2. UNDERGROUND DRAINAGE SYSTEM

Drainage systems shall generally be designed as gravity systems and as an overall pipe design having due regard to upstream and downstream systems.

4.2.1. Pipe Conduits

Minor drainage pipe/conduit systems shall conform to the following requirements:-

PIPED CONDUIT REQUIREMENTS

PARAMETER	REQUIREMENT
Minimum pipe size	375mm
Minimum box culvert size	600mm wide x 300mm high
Minimum flow velocity	0.6m/sec.
Maximum flow velocity	8.0m/sec ⁽¹⁾
Minimum pipe grade	0.5% ⁽²⁾
Minimum pipe class	'2' normally, and '3' for road crossings (subject to cover)

Notes:

(1) Subject to scouring considerations and velocity/depth coefficient.

(2) Unless otherwise approved by Council.

(3) Pipe size reduction, from large upstream pipes to smaller downstream pipes is not permitted, unless approved by Council.

The designer shall nominate on the plans all specific pipe details and their alignment and level. All drainage pipes within Council controlled drainage systems shall be of steel reinforced concrete (SRC) or fibre reinforced concrete (FRC), rubber ringed jointed spigot and socket type. Concrete pipes shall comply with AS 4058 "Precast Pressure and Non-Pressure Pipes". The class of pipe proposed will be determined to suit the design-use and shall comply with the Concrete Pipe Association of Australia (CPAA) minimum cover or Australian Standard 3725 "Loads on Buried Pipes" requirements.

Conduits that will not be under Council ownership/control (such as IAD systems) may be, concrete (as detailed above), polyethylene, or UPVC complying with AS 1254 for un-plasticized PVC (UPVC), and PE & PP pipes.

Pipes should be provided with sufficient cover to avoid conflict with service conduits, to ensure adequate protection from damage during construction and, (at a minimum), to ensure that pipe collars do not protrude into the road pavement.

4.2.2. Box Conduits

Precast reinforced concrete box culverts (RCBC) shall comply with AS 1597. The minimum size shall be 300mm high by 600mm wide.

4.2.3. Pipeline Radii

The minimum radius on which pipes may be laid shall not exceed the manufacturer's recommendation. Where smaller radii are required, the designer should consider short pipe lengths, extended collars or alternative chord configuration.

4.3. TRENCH STOPS

Thrust blocks/collars shall be provided generally where pipe grades exceed 12% and/or in embankments for storing water, to prevent seepage piping.

4.4. PITS

4.4.1. Pit inlet capacity

Shall be provided to satisfy the chart attached at appendix C. Blockage factors of 0.5 (50% blocked) for sag and 0.8 (20% blocked) for on-grade pits shall apply.

4.4.2. Pit locations

shall be provided to:

- prevent ponding,
- allow change of alignment, grade or pipe size/number
- enable adequate vehicle entry points to lots. Preferably, pits should be located:
 - i) in the central section of lot frontage in residential areas, and
 - ii) at the high side of each lot in industrial areas, immediately downstream of the prolongation of the common side boundary, in order to provide direct discharge points for each individual lot, and/or IAD drainage systems
- prevent gutter flows crossing an intersection and/or a pram ramp
- limit flow widths to table below:

OVERLAND FLOW PARAMETERS

ROAD TYPE	CARRIAGEWAY WIDTH (M)	WIDTH OF FLOW (M)	DEPTH IN GUTTER (MM)
Local-Place & Minor	8	3.0	105
Local-Secondary & Primary	8	2.0	75
Collector-Primary & Secondary	8-11	2.0	75
Distributor-Secondary & Primary	14-15	2.5	100
Arterial or Sub Arterial	15.4	3.0	115
Rural Residential (R5-V)	7.5	2.5	90

Subject to the above table, the maximum recommended spacing of pits is:-

RECOMMENDED PIT SPACINGS

PIPE SIZE (MM)	SPACING (M)
Less than 1200	80
1200 or larger	100

4.4.3. Pit construction

Pit Construction shall conform to Council's standard drawings. Non- standard pits, greater than 2.5m high or 900 long, or 1450 wide and with oversized soffits, shall be designed by an engineer, and the details provided in Engineering design plans.

4.4.4. Extended Kerb Inlet (EKI)

Lintels shall have a desirable maximum nominal length of 3.6 metres and a minimum nominal length of 1.8 metres. The general maximum in industrial areas shall be 2.4m to avoid potential breakage due to heavy loads. Nominated kerb inlet length refers to clear opening length, (refer to SD039 for details). A 150mm minimum race depth shall be provided at lintels.

4.4.5. Step irons

Step Irons shall be provided in pits deeper than 1.2 m

4.4.6. Benching

Benching shall be provided in all pits.

4.4.7. Grates

Grates shall be provided at all pits unless directed by Council or as specified on the plans. Grates in road/public reserves shall be provided with lock-down 'J' bolts. Road gutter grates shall be a minimum of 900mm long and shall include RHS steel reinforcement supports of the grate at both the lip line and the gutter line. Grates in pathways shall be "bicycle safe" to avoid tyres entering grate, to the manufacturer's recommendations.

Grate loadings shall conform to the intended use of the grate or adjacent area.

Class B type grates may be utilised in parks and reserves. Class D type grate shall be utilised in roads.

Grates within flowpaths such as table drains, catch drains and watercourses, shall be "raised" (see SD041).

Grates which may be subject to blockage by tree branches, twigs, leaf litter etc, shall, unless approved otherwise by Council, be typically an RMS "median pit" raised grate (RMS Drawing No. MD.R11.B33.A.1 or similar), providing a grid opening of 150mm x 200mm.

4.5. HYDRAULIC LOSSES

The pressure change coefficient "K" shall generally be determined from the 'Missouri Charts' and the 'Hare Equations'. The Hare Equations shall only be used as a guide and the Missouri Charts shall have precedence where discrepancies between the two exist.

Computer program default pressure change coefficients (K) shall not be acceptable unless they are consistent with the above statement.

Pipe friction losses and pipe sizes in relation to discharge shall be determined using the Colbrook White Formula with the following coefficients for roughness, unless circumstances exist that may give effect to "poor" pipe surface quality:-

PIPE FRICTION LOSSES

PIPE TYPE	ROUGHNESS COEFFICIENT
Concrete Pipes	0.15
FRC, PVC, PE, PP	0.03

5. OVERLAND FLOW PATHS

5.1. GENERAL

Flow paths shall be provided to convey runoff from rainfall events that exceed the minor pipe system capacity. Flow paths shall cater for the 100-year ARI flows. These flow paths should generally be public roads and pathways linked to provide a continuous flow at acceptable velocities and depths.

For reasons of public safety, the coefficient of velocity and depth, should not exceed 0.4 for the major storm event ($v.d < 0.4$). Higher velocity, depth products may be permitted by Council where a risk assessment shows limited adverse affect to public safety such as in rural areas.

Where flow paths other than the normal road reserve are necessary, the minimum width shall be 3.5m (see chapter 4), and shaped to contain the 100-year flows.

Overland flow paths within a pathway should generally have, as a minimum treatment, a concrete invert, and the remaining area of the flow path fully turfed with couch grass (beyond any concrete paving). The flow path shape shall provide reasonable access for vehicles where necessary for maintenance purposes and on the low side of a road should incorporate a weir within the section of the footway crossing, ensuring that property boundary levels are flood-free (with 100mm minimum freeboard), thence graded to direct the major storm flow downstream. A Typical flow path section is shown on standard drawing SD037.

5.2. FREEBOARD

For the calculated 100-year ARI flow level in the road gutter and for major flow paths in drainage reserves, a minimum of 100mm freeboard (being measured from the top of water level) shall be provided to properties boundary surface levels. Particular care should be given to properties at levels lower than the footpath or reserve. Where design allows, greater freeboard heights should be achieved.

6. OPEN CHANNELS

Open channels generally form part of the trunk drainage system that cater for major 100-year ARI events and shall be designed with smooth transitions with adequate access for maintenance and cleaning.

Design of open channels (including safety and maintenance matters) shall be in accordance with Australian Rainfall and Runoff providing:

- A minimum of 300mm of freeboard to the top of the channel (600mm in mine subsidence areas).
- A minimum of 500mm freeboard to adjacent dwelling floor levels.
- Maximum side slopes on conventional grass lined channels shall be 4H :1V.
- Friction losses in open channels shall be determined using Mannings “n” values, or as approved by Council.
- Provision for low flow structures within open grass lined channels shall be provided. In addition subsurface drainage may be required to prevent water-bogging of the channel bed. The low-flow design parameters shall be nominated in the design and be approved by Council.

The following design features should be avoided:-

- Hydraulic jumps/supercritical flow
- Transitional changes in cross section
- Superelevated flows

Channels shall be signposted with a "WARNING" sign in accordance with standard drawing SD038.

7. MAJOR DRAINAGE STRUCTURES (BRIDGES & CULVERTS)

Major structures shall be designed to cater for the ARI event referred to in section 3.2. Major structures in rural areas shall be designed to accommodate flood events as nominated by Council. Bridges shall generally be designed to provide a waterway area catering for the 100 year ARI event for the contributing catchment, including afflux (300mm minimum).

A certified structural engineer's design shall be required for bridges and major structures and shall be in accordance with Australian Standard AS5100, and culverts designed in accordance with Austroads Waterway Design.

8. STORMWATER FLOW & QUALITY CONTROL

The purpose for the control of flow-rate and quality of stormwater runoff from new development is to minimise potential adverse affects generated from development on the downstream environment, and to maintain as close as practically possible the pre-developed flow regime, with the employment of storage structures for retention such as earth basins, usually incorporating pollution control facilities (wetlands, GPT's etc).

8.1. DETENTION BASINS

8.1.1. Type & Location

Detention basins may be typically "wet" or "dry". Wet basins may include an artificial wetland facility, usually incorporating a deep water zone.

Dry basins drain to empty but may include a bio-retention treatment and/or a localised silt trap at pipe inlets. Within a "dry" detention basin, trickle flow channel or pipe drainage, together with a grid of subsoil drainage shall be provided across the basin floor. The minimum slope of a dry basin floor should be 2%.

Basins should be located where they are readily accessible for inspection and for maintenance vehicles from a public road, and should be contained within the Public Road or a Public or Drainage Reserve.

Where a basin is located in a flood plain the design should achieve its maximum elevation (RL) to limit inundation by flood waters. The lowest desirable level of the spillway should aim to be higher than the 20 year ARI event in the flood plain.

8.1.2. Capacity & Discharge

Detention basins retaining stormwater runoff shall be designed so that peak discharges from new development are not increased beyond that of the pre-developed environment for nominally the critical 1, 10 and 100 year ARI storm events. Basin design should result in a “flowrate which fills the basin to the greatest extent, or possibly the longest time. Where a drainage system is complex, it is likely that storms of different durations will be critical for various parts of the system” (AR&R – 1.6.3). To satisfy this requirement it is expected that a multi-staged outlet will be necessary to control the outflow, ensuring adequate flow-rate control for the more frequent storm events. A drainage report and calculations shall accompany the detailed design proposal.

Flood routing should be modelled by methods outlined in this Manual and shall include assessment for a basin catering for the total contributing catchment, inclusive of the catchment with its potential of being fully developed.

8.1.3. Overflow

The overflow weir, or high-level outlet for any basin shall be set at a level and have the capacity to maintain the 100-year ARI flood event for the pre-developed catchment.

The overflow weir (and spillway) should be designed in accordance with weir design principles. The weir crest shall be constructed in concrete, keyed into the embankment, and be designed to avoid possible failure in extreme storm events (greater than the 100yr event). The spillway down the embankment wall and at its toe should be protected from erosion with, as a minimum treatment, an approved robust stabilised (reinforced) earth/turf treatment including protection against turbulence/erosion at the embankment toe.

8.1.4. Outlet

Pipe systems shall contain the design outflow through the detention basin embankment with suitable bulkhead (trench-stop) protection to prevent water infiltration and “piping” between the conduit and the surrounding material. The pipe inlet structure shall be designed to avoid blockages, where a catchment may be the source of significant amounts of vegetation matter (see “Grates” above). Outlets shall include a device for energy dissipation.

8.1.5. Water Depth

Temporary water depth calculated for the 20-year ARI event, in either a wet or a dry basin, shall be limited to a maximum of 1.2m. Where justified by reason of restrictive access, available area or other reasons, a greater depth may be considered.

8.1.6. Embankment

Permanently inundated side slopes shall be no steeper than 6H:1V (excluding deep water zones). Maximum embankment slopes for mowing purposes shall be 5:1 (4:1 may be considered where available area or topography is restrictive). Naturally vegetated external slopes at 3:1 may be considered where maintenance is not required.

The embankment shall be designed, and supervised in construction, by an engineer. The embankments shall be founded on and bonded to sound natural clay material incorporating a keyway and be compacted to (density and moisture) specifications prepared by a geotechnical engineer. Full details shall be shown on the plans. The embankment, batters and basin floor shall be fully turfed with couch grass.

8.1.7. Dams

Existing dams that are intended to remain or be adjusted for use as part of a detention system shall be reported by geotechnical investigation for adequacy for the purpose. The report shall be submitted as part of the engineering design.

8.1.8. Gross Pollutant Traps & Basin Inlets

All basins should incorporate permanent Gross Pollutant Traps (GPT), to collect silt, trash and litter from the road drainage system.

As a temporary arrangement, road drainage discharge should be treated, within the basin floor with a sediment-pond/silt-trap. This area should generally be confined to the basin inlet pipe discharge point(s), being located and/or protected (eg. off-line to accept minor flows only) to avoid scour and dislodgement of sediment. Such traps may eventually become redundant upon stabilisation of the subdivision catchment, and may be removed by Council.

A note shall be included on the plans to ensure that the pollutant traps shall be cleaned out prior to issue of “practical completion”.

Where practical, basin inlet pipes for inter-allotment drainage may be separated from the road inlets and associated pollution controls due to the relatively “clean” nature of the stormwater discharge.

8.1.9. Safety

Detention basins shall be signposted with a “WARNING” sign in accordance with standard drawing SD038.

The designer shall take into account the requirements (in terms of potential risk/threat to downstream property/community) of the NSW Dams Safety Committee regarding a basin/dam proposal making reference to the NSW Dams Safety Act.

8.2. STORMWATER QUALITY

Stormwater runoff from areas that may be a source of pollutants, such as roads and gardens, shall be treated to provide a means of “polishing” of the runoff prior to its discharge beyond the site. Constructed wetlands, bio-retention filters, silt traps, gross pollutant traps etc, shall be employed for this purpose. Exposed areas of soil/gravel shall be stabilised against erosion.

Design and construction parameters for constructed wetlands, silt traps, swales, bio-retention filters, etc, shall be determined with recognised computer software such as *MUSIC*, with supporting reference made to the publication “*The Constructed Wetlands Manual*” (1988); Water by Design publication “*Construction and Establishment Guidelines - Swales, Bioretention Systems and Wetlands*”; Landcom publication “*Managing Urban Stormwater – Soils & Construction*” or their equivalent.

The following table shall be used as a target for pollutant retention goals.

POST CONSTRUCTION STORMWATER MANAGEMENT TARGETS

POLLUTANT	RETENTION CRITERIA
Suspended Solids	80% of average annual load
Total Phosphorus	45% of average annual load
Total Nitrogen	45% of average annual load
Gross Pollutants >5mm	70% of average annual load
Litter > 50mm	Retention up to the 3 month ARI peak flow
Oil and Grease	90% of average annual load

The above retention criteria relate to “reduction of average annual load” of stormwater pollutants that may be expected from a fully developed catchment or site.

8.3. CONSTRUCTED WETLANDS

For wetlands to operate efficiently they should be “off-line” accepting, typically, flows up to the 1-year ARI storm event. General objectives for wetland area design are as follows:

- The shape of the wetland should be designed to optimise the treatment of the flows with lengthy flowpaths through the wetland.
- Wherever possible, existing natural drainage gullies should form part of a stormwater and runoff drainage management system incorporating detention basins and/or wetlands to alleviate stormwater peaks and retain pollutants.
- Wetlands should be well-designed creating an attractive, safe amenity and be highly visible for both the adjoining residents and passers-by.

- Walking paths should have frequent contact adjacent to the wetland edge
- Vegetation should be designed such that generous unobstructed view of the wetland is provided, but with dense planting where access should be restrictive, such as near deep water
- The design should ensure that emergent macrophytes are minimal and manageable
- Surrounding slopes to wetlands should be gentle and offer convenient tractor-mowing access – general maximum of 5H:1V

The planting list for each section of the wetland shall be provided with the design. (See council's preferred species list available in standard drawing SD048).

A management plan, including lifecycle costing (MUSIC), shall be submitted with the design indicating a Programme of On-Going Maintenance, appropriate for the particular wetland design. All wetlands shall be provided with a valve/pipe mechanism (other than mechanical pumping) to drain to the lowest possible level for periodic "clean-out" and harvesting of vegetation growth. A typical cross-section of a constructed wetland utilising the general objectives above is shown in standard drawing SD050.

For wetland maintenance purposes, vehicle access around the wetland, and an all-weather access road and standing area to GPT's shall be provided.

Wetlands shall be signposted with a "WARNING" sign in accordance with standard drawing SD038.

8.4. SWALES

Swales assist in the attenuation of flow and the removal of pollutants. Swales are most effective as source controls as opposed to end of pipe solutions.

Vegetated swales are suitable for catchments where they are able to convey flows longitudinally, with ultimate relief into a drainage conduit, device or system, and are commonly used as an alternative to kerb and gutter within the road. Swales are intended to be non-trafficable and should only be employed where vehicle crossing is not required, such as within medians of dual carriageways and adjacent to reserves.

Where for a particular reason vehicle access is required, a concrete driveway may be provided across swales either within the swale invert or with a culvert/pipe.

Swale velocity depth coefficient should be kept below 0.4 and longitudinal slope of the swale should be kept between approximately 1% and 4%.

Swales must be fully vegetated on a sandy loam topsoil to ensure maximum filter effectiveness, and plantings, other than couch grass, will be considered on their low-maintenance merits, having regard to flow capacity and long-term maintenance. Woodchip is not permitted. Refer to SD046.

8.5. BIO-RETENTION SYSTEMS

Bio-retention systems are filtration devices usually located within detention basins which comprise of porous subsurface soil layers and pipes and in some circumstances suitable vegetation (other than grass turf) to filter stormwater.

Like swales, these systems must be non-trafficable and designed for easy maintenance.

8.6. OTHER WSUD TREATMENTS

Examples of other common WSUD treatments that may be provided include:

Primary Treatments:

- Pit inlet protectors
- Trash Racks
- Gross Pollutant Traps (eg. Baramy Traps, CDS Units, ECOSOL Units, Humeceptor, Humeguard or other manufacturer's equivalent)

Secondary Treatments:

- Wet Basins
- Bio-retention swales
- Infiltration systems
- Vegetated Filter Strips
- Sand Filters
- Surface Retention
- Porous Paving

Tertiary Treatments:

- Constructed Wetlands
- Bio-retention

8.7. REFERENCES FOR WSUD DESIGN

- WSUD Technical guide for Western Sydney (Upper Parramatta Catchment Trust 2004)
- WSUD Basic Procedures for "Source Control" of Stormwater – a handbook for Australian Practice (Argue 2004)
- WSUD Engineering Procedures Stormwater (Melbourne Water 2005)
- Australian Runoff Quality – A guide to WSUD (Engineers Australia)
- SE Qld WSUD Engineering Design Guidelines (Healthy Waterways, June 2006)
- Water Smart Model Planning Provisions (HCCREMS 2007)
- Water Smart Practice Notes 1 to 11 (HCCREMS 2007)

8.8. FENCING

Warrants for fencing of permanent water wetlands, ponds, basins, and GPT's shall be determined based on a risk assessment. Where pool-fencing style is approved, the fence shall be installed with tamper-proof screws (as approved by Council) or be welded to deter vandalism/theft.

See also standard drawing SD057 for Council's "wire rope" style fence option.

9. ALLOTMENT DRAINAGE

This section addresses in principle major subdivision works with multiple lot connections. For small projects such as two or three lot subdivisions refer to Chapter title *Developments*.

9.1. PIPES

Inter-allotment drainage (IAD) shall be provided to every lot that cannot adequately drain to its street frontage. The drainage shall be designed to accept concentrated developed flows from each lot for 10 year ARI event. Where new lots adjoin existing properties minor/major flows from those existing uphill properties shall be catered for, with a pipe/pit/flowpath system. Depending on circumstances benefiting easements may be necessary.

Pipes shall be a minimum diameter of 150mm UPVC, PE or PP and have minimum cover of 300mm (where not subject to vehicle loads), designed to flow full without surcharging at pits. Minimum grade shall be 0.5%. Where IAD pipes are laid parallel to sewer mains, a clearance of 750mm between pipe centrelines should be provided. Where pipes are 300mm diameter or greater, the clearance shall be 450mm. If practical, the sewer shall be laid closest to the dwelling being served.

Subject to hydraulic design the following pipe sizes may be used as a guide.

INTER-ALLOTMENT DRAINAGE LINE PIPE SIZES

NO. OF DWELLINGS SERVED	PIPE DIAM (MM)
Up to 2	150
3 to 6	225
7 to 10	300

For single-allotment drainage, each lot within a subdivision that drains to the road, shall be provided with a galvanised steel pipe or rectangular hollow section (RHS) with a minimum sectional area equivalent to a 100mm diameter pipe (7850mm²) across the footway. The conduit shall be located adjacent to the side boundary or at the lowest point of the lot frontage, connected to kerb outlet insert and extended into the lot being serviced.

9.2. PITS

Grated pits shall be provided to the low corner of each lot serviced, in accordance with standard drawing SD043, unless otherwise approved. Pits shall be concrete, to the following dimension:

INTER-ALLOTMENT PIT DEPTH : SIZE RELATIONSHIP

DEPTH (MM)	SURF. DIM. (MM)
< 900	450 x 450
900 - 1200	600 x 600
> 1200	600 x 900

Pits shall be depressed 100mm below the surrounding ground level, to provide efficient surface water inflow. A 450mm wide turf strip shall be laid around the perimeter of the pit. Segmental pit risers shall be adequately sealed at the joints

Each pit shall have a capped stub for the dwelling connection, and all pit/pipe joints mortared. (Refer SD043). Where pit depth is designed to drain low areas of lots, the riser shall enter the pit at its base.

10. DRAINAGE EASEMENTS

Within lots, easements shall be provided over pipe systems and overland flow paths. The minimum width of easements shall be as follows:-

PIPED DRAINAGE EASEMENT WIDTHS (MINIMUM)

TYPE AND DIAMETER	EASEMENT WIDTH (M)
IAD up to and including 300mm dia.	1.5m ⁽¹⁾
IAD greater than 300mm dia.	2.5m
Public Drainage System up to & including 1200mm dia.	3.0m
Public Drainage System 1350mm dia and greater	5.0m

Notes:

(1) Where site constraints exist, such as in-fill developments, 0.9m wide IAD easements may be considered.

For pipe diameters larger than specified and for multiple pipe systems, the minimum clearance from the edge of the pipe to the easement limits shall be of 1.0m.

The specified easement widths may require widening where excessive pipe depth occurs.

11. STORMWATER OUTLET

Permanent, durable, and effective scour protection and/or energy dissipaters shall be provided at pipe outlets (and inlets where warranted).

In the absence of a defined natural watercourse or stream, points of discharge of concentrated stormwater onto an adjoining property, shall not be permitted without the agreement of the affected property owner. Where an agreement is reached with the adjoining owner, a letter and a drawing shall be signed and submitted to Council or the accredited certifier as evidence of the agreement, prior to issue of the Construction Certificate. Drainage easements shall be created, as necessary, prior to or upon certification under part 4A of the EP&A Act.

Where permitted, piped discharge shall be in a suitable watercourse and shall extend a minimum of 10 metres past a building or future building envelope.

Similarly, discharge through parks or reserves, if permitted under the plan of management, should be directed to suitable watercourses. Easements may be required.

12. SUBSOIL DRAINAGE

Subsoil drainage shall be designed for installation in areas that are susceptible to groundwater seepage into the pavement and subgrade, and may be in the form of pipes, strips and/or mats.

Subsoil drains shall be placed on each side of all road pavements and in all stormwater pipe trenches within the road pavement in accordance with standard drawing SD035 & SD003 with flush points placed behind the kerb (level with the kerb), as a screw-locked plastic fitting in a concrete surround and should be placed at approximately 60m intervals. Flush points within drainage pits are not permitted.

The design should indicate a subsoil drain "lead-in", 3.0m long installed in Inter-Allotment Drainage lines where the line connects to the road pit, and at every second pit upstream within the IAD pipeline.

Subsoil drainage shall be shown at new pavement interfaces with existing pavements.

All subsoil pipes shall be, nominally, 100mm diameter, and be "socked" with geotextile fabric.

13. ACCESS RESTRICTION TO DRAINAGE STRUCTURES

A risk assessment shall be undertaken on any open drainage structure that could be readily accessed by the public. If that assessment indicates a necessary treatment, and/or at Council's discretion, a barrier grate shall be provided.

CONSTRUCTION – ROADS, DRAINAGE, CONCRETE

ALL WORKS SHALL BE PERFORMED TO THE REQUIREMENTS OF THIS MANUAL AND
AS DIRECTED BY MAITLAND CITY COUNCIL

As the Principal Certifying Authority, Council must be notified two days prior to commencement of any works and may inspect works, where necessary, at any stage of construction.

Appropriately qualified and experienced Contractors shall carry out all work in a competent manner, in accordance with the approved Construction Certificate plans, this manual, relevant occupational health and safety and WorkCover requirements.

In all respects relating to construction activity, the contractor should be aware of his/her responsibility regarding any relevant Act of Parliament and associated Regulations.

1. TRAFFIC

1.1. TRAFFIC CONTROL

Where impacts are expected within the existing road network, traffic control plans in accordance with Roads & Maritime Services "Traffic Control at Worksites" shall be prepared by a certified person and be submitted to Council for acceptance prior to the works commencing.

The control of works shall be undertaken to assist the passage of motorists and pedestrians through the worksite. Signposting shall ensure separation of motorist traffic and pedestrian traffic, and each from workers and machinery.

It is the developer/contractor's responsibility to maintain all temporary signposting for the duration of the construction works, which includes regular checking of the signposting to avoid accidental disturbance, displacement, interference or vandalism. Signs and their placement shall be in accordance with Roads & Maritime Services "Traffic Control at Worksites". Council reserves the right to request additional signposting where it is considered appropriate to enhance safety for road users.

All **Traffic Controllers** are subject to RMS regulations & WORKCOVER requirements. Controller certification and their traffic control methods are subject to inspection and if necessary, enforced compliance with the relevant standards.

1.2. PARTIAL ROAD CLOSURE

Minor closures such as footway and parking lanes or road shoulders constitute a temporary partial road closure to vehicular and/or pedestrian access for construction purposes. A more significant partial closure may include the closure of a vehicular traffic lane and the subsequent need for traffic control for single lane flow.

- Permission for the closure must be obtained from Council, and such a closure may only occur in normal daylight working hours, unless special circumstances exist where night-work is essential. Such controls must be employed with the standard signposting, and manual or signalised traffic flow controls. Two-way flow for vehicle traffic must be reinstated for each night.
- Acceptance of a Traffic Control Plan prepared by a certified traffic controller must be received from Council prior to implementing the plan.

1.3. FULL ROAD CLOSURE

Permission to temporarily close the whole of a public road to vehicular or pedestrian traffic for construction purposes must be obtained from Council - a fee applies. Application for road closure must be received at Council at least six week prior to the desired closure date.

1.4. ROAD OPENING PERMIT

Permission to “open” public roads by excavation for purposes of installing underground structures, services and conduits must be obtained from Council – a fee applies. The area defined by a public road is any part within the road reserve. Council may require under-boring methods under road pavements and paving. General term of conditions are available as part of the application.

1.5. HAULAGE ROUTES

Haulage routes to, or from, the development or work site will be subject to approval by Council prior to the commencement of work. The Contractor shall ensure carriers comply with approved routes.

1.5.1. Damage To Roads

Damage to roads directly attributed to operations of construction plant serving the development shall be repaired to the satisfaction of Council, at no cost to Council.

It is advised that the Project Manager accompany Council’s representative on the assessment of the approved haulage route and document the condition of the approved route. Such documentation prepared by the Project Manager shall be in agreement with Council.

Where required by Council, a bond shall be submitted to Council to cover possible pavement rectification due to damage of the haulage route roadway.

1.5.2. Overweight Vehicles

Where required by Council, a vehicle that is suspected of being overloaded, carrying a weight in excess of the legal limit for the vehicle, the vehicle shall be directed to a public weighbridge for confirmation with compliance, or otherwise, at no cost to Council. The vehicle shall not leave the weighbridge site until any necessary adjustment of weight is rectified.

1.6. DETOUR ROUTES

Where it is determined by Council that there is a need for a temporary road detour route to be established during development-related works, the proposed route(s) must be submitted to Council for approval, and the contractor shall be responsible for the on-going maintenance of the road pavement along the detour route.

When choosing a detour route, it must have where possible, a similar capacity for the expected traffic to that of the temporarily closed road.

An assessment of the risks associated with detouring vehicles onto other roads should be made regarding potential inclement weather. The existing condition of the chosen detour route must be recorded prior to the commencement of development works, and any damage caused, rectified, as discussed under "Haulage Routes".

2. CONTRACTORS

Contractors shall be experienced and competent to carry out all work, in accordance with the approved Construction Certificate and plans, this manual, relevant occupational health and safety, and WORKCOVER requirements, with the appropriate certification for all relevant aspects of the project.

In all respects relating to construction activity, the contractor should be aware of his/her responsibility regarding any relevant Act of Parliament and associated Regulations.

No variation from the plan shall be made unless authorised in writing by the Accredited Certifier, or Council, whoever issued the Construction Certificate. This may require submission of a redesign for approval.

2.1. SUB-CONTRACTORS

Upon request the identity of sub-contractors and their proposed scope of works shall be supplied to the certifier or Council. The certifier or Council reserves the right to preclude any particular sub-contractor.

2.2. WORKING HOURS

Construction work-hours, particularly relating to noise generation, shall not be performed outside the hours that apply under legislative requirements or as determined through development consent conditions.

As a guide, time restrictions (as stated by State Government guidelines "*Construction Noise*") are:

<i>Monday to Friday:</i>	<i>7am to 6pm</i>
<i>Saturday:</i>	<i>8am to 1pm if audible on residential premises, otherwise 7am to 1pm</i>
<i>Sunday & Public Holidays:</i>	<i>No construction work.</i>

Construction activity such as "emergency" or "night" work should be notified to Council. Construction works that may be considered to generate offensive noise may be subject to restrictions.

2.3. SAFETY

All adequate safety precautions in accordance with WORKCOVER and relevant legislation and codes of practice shall be the responsibility of the contractor. This will include matters related to public safety where interaction is expected (and may include fencing), traffic related matters discussed above and adequate induction and assistance for site visitors. Council or the RMS will not be liable for any consequence from the developer's inaction or omission.

3. SITE MANAGEMENT

3.1. SURVEY MARKS

Adequate precaution shall be taken to protect and preserve all survey marks, such as SSM, PM, etc., relative to or affected by the work. New survey marks and replaced marks shall be installed by a Registered Surveyor. An appropriate plan of survey showing the relocated marks shall be prepared by the Surveyor and lodged for registration in accordance with the Survey Practice Regulation. Survey marks for the purpose of property boundary definition shall not be placed in any concrete path or kerb.

Survey set-out for the purposes of construction of the works shall be performed by a surveyor. Recovery marks or stakes are not to be placed in locations that present a hazard to pedestrian or vehicular traffic unless suitably protected.

3.2. MATERIAL STORAGE

Storage of pipes, gravel and other materials on public roads or reserves is not permitted unless extenuating circumstances prevail, whereupon Council approval must be obtained. Any damage shall be made good to the satisfaction of Council or costs met where Council performs the restoration works.

Storage of material shall be in a non-hazardous manner and shall include the use of safety barriers, fencing and sediment controls as appropriate to the material. (See also Chapter Environment, Sections 5.4 & 5.5)

3.3. ADJOINING LAND

The Contractor shall liaise with adjoining property owners affected by the work and take precautions to prevent deterioration of or damage to private property, public roads, public utilities and reserves during construction. Such property may include dwellings. It is recommended that the Contractor organise preconstruction inspections with adequately qualified independent inspectors to identify existing structural conditions that are within proximity of the proposed works, and should keep written and photographic records for future reference.

4. INSPECTIONS

Inspections are required at certain hold points of construction as set out below. Principal Certifying Authorities and Accredited Certifiers shall be bound by this Manual's construction and inspection requirements.

4.1. LIMITATIONS ON APPROVALS

During construction, approval of any critical stage of the work (as nominated below), will be given in regard to structural standard *only at the time of inspection*, and does not absolve the Contractor of responsibility for rectification of any damage or deterioration occurring before “final inspection” and/or “practical completion”.

Where a third party certifier is involved in the inspection regime (such as a geotechnical engineer) who gives approval for works, that approval will not be construed to be an approval of Council. Council reserves the right to take any course of action, or make a decision regarding the progress of works, deemed necessary to rectify a construction problem or disputation.

4.2. INSPECTION MEETINGS

The Contractor shall be present during each inspection to receive approval or otherwise of the works prior to proceeding to the next stage of works. Amended works may be subject to re-test or an additional inspection, and therefore may attract a fee for that inspection.

4.3. INSPECTIONS OUTSIDE NORMAL HOURS

Inspections of work outside of normal working hours may be possible with prior arrangements. For Council's attendance, the cost of the inspection, in accordance with Council's fees and charges, shall be borne by the Developer/Contractor. At Council's discretion, a suitable qualified person may be appointed for an inspection to which Council cannot attend.

4.4. APPROVAL OF WORKS

Approval to proceed through the critical stages of the various components of works must be obtained. "Critical Stage" approval does not absolve the developer from responsibility to correct defects or failure in the work that may become apparent prior to “practical completion” and/or dedication to Council. It is also the Contractor's responsibility to obtain any necessary approvals from the appropriate Certifier and Council prior to proceeding to subsequent stages.

4.5. ADDITIONAL WORKS

Additional requirements beyond the Construction Certificate design plans, which become apparent during construction, shall be completed as directed. Where such works do not require in the opinion of the Principal Certifying Authority, a new design, additional works shall be shown on the Works-As-Executed (WAE) Drawings.

4.6. INSPECTION REGIME

The minimum occasions as “hold points” for the following critical works, requires inspections to confirm that the nominated standards and approvals given under this Manual are met.

1. TRAFFIC

Temporary signs and markings

2. ENVIRONMENTAL

Erosion controls

Vegetation clearing (optional)

3. STORMWATER

Stormwater Pipes - prior to backfill above the haunch zone of type, class, bed, haunch, alignment, clearances, joints, plugs etc

Subsoil drainage pipes - prior to backfill of filter material

Stormwater pits – prior to concrete pour of forms and reinforcement

4. SUBGRADE (Natural or Select)

Proof-roll of full prepared width

String-line – at centre, kerb-line and intermediate points, alternatively, confirmation by electronic field survey

Density test (compaction and moisture)

5. SUB-BASE

Proof-roll under K & G

Proof-roll full pavement width

String-line – at centre, kerb-line and intermediate points, alternatively, confirmation by electronic field survey

Density test (compaction and moisture)

6. BASE

Proof-roll full pavement width

String-line – at centre and intermediate points, alternatively, confirmation by electronic field survey prior to application of primer seal

Density test (compaction and moisture)

Benkelman Beam, prior to final wearing course

Primer seal prior to final wearing course

7. CONCRETE

Paths, driveways and pits and other structures prior to concrete pour

8. RETAINING WALLS

Foundations, backfill and drainage. Council will accept a geotechnical engineer's report for backfill and reinforced earth where required by design.

9. FINAL

General workmanship of all works including pit/lintel/grate finish.

Notes:

- (1) Some items will require certification by a practising professional in the respective discipline
- (2) Council/PCA reserves the right to request additional tests where considered necessary
- (3) Council shall not be responsible for expenses arising from testing
- (4) Inspections requested and either not ready at the appointed inspection time or work is obviously incomplete, may incur a re-inspection fee
- (5) In the event that a Council officer is unavailable for a particular inspection, an inspection report from an independent professional may be permitted
- (6) Inspections are only appropriate where the work is uncovered and capable of being inspected. IT IS NOT POSSIBLE to certify an inspection retrospectively where work has been completed and covered prior to being inspected
- (7) Failure to call for an inspection or failure to carry out any rectification works found to be defective may result in certification being withheld
- (8) Where an inspection reveals unsatisfactory or defective results, a re-inspection may be required and fees may be applied for any subsequent or additional inspections. Continuation of further works reliant on defected works is PROHIBITED until such times as a satisfactory inspection has been carried out and/or approval to continue is obtained
- (9) All inspections must be booked with Council no later than 3.00 p.m. on the day before the inspection is required. Inspection bookings may be made by telephone to Council in normal office hours
- (10) Inspections will generally be carried out between 8.30 a.m. and 4.30 p.m. on the requested day

5. ENVIRONMENT

This section relates to environmental controls and safeguards within a construction site and the requirement to maintain a “clean” environment in the surrounding area where works may impact that area.

5.1. CONTAMINATION

Measures must be taken to ensure that no contaminated material or noxious weeds are transported off site without due care, and with diligence and authorisation for removal and/or disposal. No contaminants, contaminated material or noxious weeds shall be transported onto the site. The contractor shall employ methods to discourage illegal dumping of waste materials on the construction site, and if occurring, remove the waste to an approved waste disposal depot.

Transported loose material must be covered to prevent loss.

5.2. EROSION

The Contractor shall take any necessary steps to prevent erosion occurring on the construction site. Effective sediment control measures must be employed. For works where there is a possibility of dust or water erosion problems, the Engineer’s endorsement of treatment methods is required.

It is an offence under the Protection of the Environment Operations Act to pollute the environment as a result of sediment leaving the site, and that a breach may result in the issue of an infringement notice, attracting a monetary fine. Reference should be made to Council’s standard drawings and the Landcom/Dept of Housing manual, "Managing Urban Stormwater - Soils & Construction" for examples of methods of control.

Regarding erosion control, Council may request certain preventative measure to be implemented, such as watering loose surface areas or by construction of silt traps. Silt traps shall be employed in advance of existing downstream systems, basins, wetlands, natural gullies, etc.

5.2.1. Maintenance of Devices

Erosion control devices must be inspected on a regular basis, particularly following any rainfall event, and cleaned where necessary or as instructed, to ensure the devices are in working order.

5.3. TREE CLEARING

For purposes of road infrastructure construction, the extent of clearing shall be limited to the road reserve and associated drainage facilities, and service corridors.

Unless inherent within the engineering design or explicit within Development Consent, approvals must be sought and obtained for site clearing beyond these limits prior to works commencing.

The Contractor should be made, or make him/herself aware of the developer’s responsibility regarding tree and habitat disturbance, and of the services of a suitably qualified ecologist engaged to supervise the site’s clearing activities. (See also Chapter 3 - Environment).

Any trees associated with the development/subdivision works, considered by the engineer to be hazardous to traffic or pedestrian activity, shall be removed or pruned accordingly.

5.4. VEGETATION DISPOSAL

Disposal of vegetation that is chipped or tub-grinded may be either, spread over the site at specified locations, (particularly avoiding stormwater inundation or significant/major flow-path areas) as stabilising mulch (approximately 100mm thick), or stockpiled. Excess material not used as mulch shall be removed from site.

Approval for disposal by dumping to Council's "waste facility" may be considered.

6. EARTH - FILL

This section relates to earth-fill material within subdivision construction projects, and within existing and/or proposed public land projects; its quality, importation, placement and retention with walls or batters.

The Protection of the Environment Operations (Waste) Regulations allows for certain materials to be used under the resource recovery exemptions. These materials are permitted to be used if they are shown to Council to be fit for purpose. Usage of the materials must be in accordance with the approved development consent.

6.1. STANDARDS

Filling of lots for residential development must be performed under specific controlled conditions. Lot-fill on residential land shall be consistent with the requirements of AS 2870, and reported by a geotechnical engineer verifying that compaction of fill-material on the lots is in accordance with AS 3798, providing 95% Minimum Relative Compaction (for cohesive soil) employing a "Level 1" inspection and testing regime adopting Type 1 Density Test frequency.

The geotechnical engineer's report verifying satisfactory results shall be submitted to Council.

Further:

- Where isolated surface disturbance (such as tree removal) is filled, the filling shall be reported in accordance with the Australian Standard.
- Road fill batters that extend onto lots are considered lot-fill under this clause.

Filling of land for purposes other than residential development (such as open space, parks or playing fields) may be at a reduced standard than that for residential, subject to its type of use and the possibility of future building construction, as determined by Council for each specific site.

6.2. TOPSOIL

The contractor shall reclaim and stockpile topsoil won from construction works where it is suitable for re-use on site. Where topsoil is imported it shall be in accordance with the resource recovery exemptions under the Protection of the Environment Operations (Waste Regulation) and shall be friable, of porous nature, relatively free of weeds contain no rocks, tree roots, clay lumps, chitter, ash or building waste.

6.3. RETAINING WALLS

Retaining wall location and design is addressed in chapter 4 – Road Design.

The removal of any existing fence adjoining the works for purposes of constructing a retaining wall is the responsibility of the developer/contractor, together with the need for shoring and/or negotiations with adjoining owners regarding any adverse works affecting those properties.

6.4. DAMS

Earth embankments constructed for the purpose of retaining stormwater runoff with or without permanent water storage shall be constructed in accordance with an engineer's design as part of a Construction Certificate.

6.4.1. Redundant Dams

Where redundant dams are to be removed and filled, the contractor shall attend to the following matters:

- Flocculation of turbid water prior to release
- Dewatering without causing erosion, such as by pumping
- The removal of silt and organic matter prior to filling and its disposal in an approved manner
- Backfilling under geotechnical supervision, and in accordance with this Manual.

7. ROAD FORMATION

Material for road formation shall generally be won as a cut/fill operation within the site. Where material is imported to balance earthworks, it shall comply with Section 6 above.

7.1. MATERIALS & TESTING

All materials required for the project, whether won as natural earth or as a processed soil or granular or man-made, shall be in as new/original condition and of an approved standard, free of contamination or defects. If required, the contractor shall provide full testing information with respect to the materials. Test results of particular proposed imported materials shall be submitted to the Certifier or Council for approval prior to placement.

Materials (from established suppliers) that are subjected to a regularly testing programme, and have been accepted by the Engineer as Quality Assured material, may be used without further testing. The Engineer/Council may instruct the amendment or removal of works or material not in accordance with the approved plan, specification, standards or best practice.

In the event of dispute of material quality, the subject material will be submitted for testing/examination by a certified body or company registered with NATA qualification. The cost of testing shall be met by the developer/contractor.

7.1.1. Compaction Tests

Compaction of the natural or select subgrade to a minimum of '100% standard' shall be confirmed by a geotechnical engineer/NATA laboratory and tested at 50 metre intervals or part thereof for compliance under AS1289. The location of intermediate tests shall be at random locations. The compacted sub-grade shall extend a minimum 250mm behind the rear of kerb and gutter.

Where subgrades are modified or stabilised, the application process shall be tested and reported for compliance with an approved geotechnical report.

Moisture content of the fill material shall be specified by the geotechnical engineer and shall be observed and/or tested.

7.1.2. Proof-Roll Test

Monitoring the results of natural or select subgrade compaction by "proof-roll" testing shall be observed by Council, or at Council's discretion, by an appropriate Certifier. The contractor should be confident that the prepared surface is ready for test, prior to the inspection. If re-inspection is required, an additional fee may apply.

Acceptable machinery to perform the test may be selected from; a three-point roller, a large grader or a fully laden water-cart, with preference in that order. The test shall be performed by a person experienced in road construction testing representing Council or geotechnical engineer. Works that are considered by that person to be deficient, shall be rectified.

7.2. FILL

Fill material shall be approved by a geotechnical engineer and shall be uniform, sound and free from deleterious material. Approved fill shall be placed in compacted layer thickness of 200mm (max) and spread evenly for the width of formation, subject to the discretion of the geotechnical engineer. Placement of loose material over partially compacted filling to achieve road width is unacceptable.

Adequate support benching shall be provided in fill, on side grades in excess of 20%, or where considered necessary by the engineer to improve stability. Fill containing rocks or clay lumps will not be permitted in footways.

Batter faces shall be stabilised in accordance with erosion control procedures, typically, scarified, topsoiled and strip turfed and seeded between strips. The turf strips shall be run either along the contour or at a flat angle to the contour in order to intercept runoff.

7.3. CUT

7.3.1. Catch drains

Are required at the top of cuttings intercepting large catchments or as directed. Catch drains shall be sized for the contributing catchment.

7.3.2. Batter faces

Shall be cut clean and free of loose or overhanging rocks. Where cuttings exceed 5.0 metres in height they shall be benched with catch drains at the toe of each batter step. Where proposed cuttings exceed 2.0 metres in height, geotechnical assessment is required to determine adequate batter slopes or treatments. Batter faces shall be stabilised in accordance with erosion control procedures, typically, scarified, topsoiled and strip turfed and seeded between strips. The turf strips shall be run either along the contour or at a flat angle to the contour in order to intercept runoff.

7.4. SUB-GRADE (NATURAL)

The road subgrade shall comprise of sound material compacted and trimmed evenly to design levels and cross-fall. The depth of cut/fill to subgrade level shall be governed by the approved pavement depth making allowance for cross-fall at any point of measurement, in particular at the centreline and the gutter lip ensuring a straight profile between each point.

Any unsuitable material shall be removed and replaced with approved material in layers and compacted to the required density. Where sub-grade replacement with a granular pavement material (ie. not using the natural soil/clay) is proposed, the excavation shall extend, and grade to, a subsoil drainage system. Subgrade replacement shall be inspected and tested as per normal sub-grade inspection requirements.

Rock sub-grade shall be thoroughly ripped up to a depth of 300mm below sub-grade level and shall extend to the edge of the pavement. Ripped material shall be compacted to provide a sub-grade layer of homogenous density.

Construction works shall not proceed until the sub-grade has been certified as complying.

7.5. SUB-GRADE (SELECT)

A “select” subgrade where required, shall be of an approved material and be constructed similar to the requirements for natural sub-grade. The material specification shall be consistent with the expected performance requirements of a geotechnical engineer. The engineer shall approve the proposed material for use as “select”.

8. STORMWATER DRAINAGE

8.1. SUBSOIL DRAINAGE

Subsoil drainage shall be provided on both sides of the road pavements and in all road stormwater pipe trenches in accordance with Council’s standard drawings SD035 & SD003, and additionally as required by Council, or the geotechnical engineer where for example, drains are considered necessary where sub-soil moisture problems are encountered. The type, location and extent of subsoil drainage may vary depending on pavement materials or in-situ conditions.

A subsoil drain “lead-in”, 3.0m long, shall be installed in Inter-Allotment Drainage lines where the line connects to the road pit, and at every second pit upstream within the IAD pipeline.

Subsoil drainage shall be installed at new pavement interfaces with existing pavements at the direction of Council or the geotechnical engineer. (see chapter 5 – Pavement Design & SD032)

All subsoil pipes shall be, nominally, 100mm diameter, and be “socked”

8.1.1. Trenches

Trench dimensions shall suit the size of the pipe/conduit used but generally trenches shall be a minimum of 200mm wide. The depth of trench shall be 600mm below subgrade level or deeper where it is necessary to drain intersecting service trenches. Depths less than 600mm may be considered by Council where sub-grade warrants exist, such as in rock.

The minimum grade on subsoil drainage shall be 0.5%.

8.1.2. Filter Material

Unless approved otherwise, the filter material shall conform to RMS (3580) or Austroads specification for subsoil drainage, reproduced as follows:

RMS TYPE A FILTER MATERIAL

GRADE	AGGREGATE SIZE (mm)
F20	20
F14	14
F10	10
F7	7
F5	5



RMS TYPE S FILTER MATERIAL

SIEVE SIZE (mm)	WEIGHT PASSING (%)
4.75	100
2.36	95 - 100
0.425	20 - 80
0.300	0 - 30
0.150	0 - 10
0.075	0 - 1

AUSTROADS TYPE A (SAND) FILTER MATERIAL

TYPE A	PERCENTAGE PASSING SIEVE (%)					
	A1	A2	A3	A4	A5	A6
DESCRIPTION OF FILTER	DUNE SAND	COURSE WASHED SAND		5mm ONE SIZE	6 - 8mm ONE SIZE	SANDY GRAVEL
37.5mm						100
26.5mm						
18.0mm					100	85 - 100
13.2mm					90 - 100	
9.50mm		100	100	100	70 - 100	65 - 100
4.75mm		90 - 100	90 - 100	70 - 100	28 - 100	45 - 82
2.36mm	100	75 - 100	70 - 100	0 - 50	0 - 28	30 - 60
1.18mm	95 - 100	50 - 98	40 - 65	0 - 10	0 - 8	15 - 40
600µm	70 - 98	30 - 80	12 - 40			5 - 25
300µm	30 - 60	10 - 40	0 - 16	0 - 5	0 - 5	0 - 10
150µm	0 - 12	0 - 7	0 - 4			0 - 5
75µm	0	0 - 3	0 - 3	0 - 3	0 - 3	0 - 3

AUSTROADS TYPE B (AGGREGATE) FILTER MATERIAL

TYPE B	PERCENTAGE PASSING SIEVE (%)			
DESCRIPTION OF FILTER	B1	B2	B3	B4
	5mm ONE SIZE	6 – 8mm ONE SIZE	10mm ONE SIZE	19mm ONE SIZE
37.5mm				
26.5mm				100
18.0mm		100	100	70 - 100
13.2mm		90 - 100	90 - 100	0 - 30
9.50mm	100	70 - 100	40 - 70	0 - 10
4.75mm	70 - 100	28 - 100	0 - 15	
2.36mm	0 - 50	0 - 28	0 - 5	0 - 5
1.18mm	0 - 10	0 - 8		
600µm				
300µm	0 - 5	0 - 5		
150µm				
75µm	0 - 3	0 - 3		0 - 3

Other materials, not meeting the specifications in this Manual, may be considered subject to confirmation from a geotechnical engineer of compliance as free-draining to achieve a sustained flow rate of 8m per day. (See below regarding common trenching where stormwater pipe support should be considered)

Where “one-size” aggregate material is proposed as a medium surrounding the subsoil pipe, the material shall be wrapped in a geotextile fabric at its interface with adjoining natural or imported material and the pipe shall be un-socked.

8.1.3. Common Trench (with water main)

Where it is practical to provide common trenching with a water-main, the location and materials are specified on Council's standard drawing SD035.

8.1.4. Flush Points

Flush points shall be provided generally at the crest point of the road and adjacent to drainage pits or at intervals of approximately 60 metres. Flush points shall be plastic screw-caps with concrete surrounds, placed behind the kerb and gutter in urban areas, or in road shoulders in rural areas. Flush points shall not be placed within stormwater pits.

8.2. PIPE CONDUITS

Unless nominated on the construction plans, all drainage pipes within Council controlled drainage systems shall be of steel reinforced concrete (SRC) or fibre reinforced concrete (FRC), rubber ringed jointed spigot and socket type and installed in accordance with the manufacturer's guidelines. Conduits that will not be under Council ownership/control (such as IAD systems) may be, concrete (as noted above), polyethylene, or UPVC complying with AS 1254 for un-plasticized PVC (UPVC), and PE & PP pipes.

8.3. PIPE INSTALLATION (CONCRETE)

Concrete Pipes shall be laid in the location as shown on the engineering plans, or as varied by the superintendent, with Council's approval. In general, the road formation should be completed to at least subgrade level prior to pipe installation. The appropriate excavation, bedding, backfill and cover shall be provided as specified by the manufacturer and/or in accordance with the Concrete Pipe Association of Australia (CPAA) or Australian Standard 3725 "Loads on Buried Pipes".

The minimum pipe support type under roads shall be "HS2".

The minimum pipe support type in other public areas shall be "H2".

For pipes of 900mm diameter and less, the trench excavation shall provide a minimum of 150mm clearance to the pipe. Pipes greater than 900mm diameter, should provide a clearance of 'D/6'.

Thrust blocks/collars shall be provided where shown on the plans, or as directed by Council, being generally where pipe grades exceed 12% and/or in embankments for storing water, to prevent seepage piping.

8.4. PIPE BED, HAUNCH & SIDES

The "bed zone" shall be a minimum of 100mm thick for pipes up to 1500mm drain. For pipes greater than 1500mm, the bed thickness shall be a minimum of 150mm.

The bed, haunch and side zone material shall be a graded material in accordance with AS3725 or similar.

BED & HAUNCH ZONE

SIEVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
2.36	50 - 100
0.600	20 - 90
0.300	10 - 60
0.150	0 - 25
0.075	0 - 10

SIDE ZONE

SIEVE SIZE (mm)	WEIGHT PASSING (%)
75	100
9.5	50 - 100
2.36	30 - 100
0.600	15 - 60
0.075	0 - 25

Compaction of the bedding material shall comply with AS3725 providing 60% Density Index for cohesionless material, and 90% Dry Density Ratio for cohesive materials. Where FRC pipes are proposed bedding shall be a cohesive material (such as road-base) compacted to 95% Dry Density Ratio.

With all pipes the "haunch and side zones" shall be compacted to a minimum overall depth of 50% of the pipe diameter, with the haunch zone height being 0.3 x Diameter. For practical purposes the side zone material may be substituted with the haunch material.

In wet ground conditions pipes shall be laid on crushed rock and/or low strength concrete to the requirements of the engineer. Unsuitable material such as soft clays, irregular broken rock or saturated soils shall be removed and replaced with an approved support material.

The side zone shall not be considered to be effective in supporting pipes unless the trench walls or surrounding embankment have density and stiffness not less than those of the adjacent compacted fill. (AS3725)

The contractor shall produce, when requested, evidence that the specified or approved material is the material in use.

8.4.1. Common Trench (with subsoil drainage)

It should be noted that where subsoil drainage is installed with the stormwater pipeline the haunch, side and overlay/backfill zone materials must display, when compacted, both the desired characteristics of those zones for pipe support/cover, and the characteristics of a filter medium in terms of “filter material” for subsoil drainage (as stated in this chapter), within the area of the trench effectively acting as “subsoil drainage”.

The material should exhibit zero or low occurrence of fine particles, and may be a uniformly graded aggregate either compacted or otherwise to achieve the objectives for a cohesionless material nominated above. A geotechnical engineer’s concurrence, that the proposed material meets these objectives, shall be submitted to Council.

Pipe support material for each side of the pipe, must be the same material.

The contractor shall produce, when requested, evidence that the specified or approved material is the material in use.

8.5. PIPE OVERLAY

Other than in roadways the “overlay zone”, shall be an approved suitable/workable natural material, (not being large lumps of clay) compacted to a minimum depth of 150mm above the top of the pipe, not containing any stones larger than 150mm, nor more than 20% with a size between 75mm and 150mm.

The “overlay” zone in the roadway shall satisfy the parameters detailed under “pipe backfilling” below.

8.6. PIPE BACKFILLING

Other than in roadways, backfilling shall comprise of natural available earth material, suitable for adequate compaction to avoid surface slumping.

Where pipes are laid in roadways, backfill to the road sub-grade level shall be with approved crushed rock or sand filter materials. Compaction shall be by mechanical, and/or flooding or other approved means. Mechanical tampers shall be utilised for compaction in layers of not more than 300mm to “95% Modified” (for cohesive materials) and 65% density index (for sand) in accordance with AS 1289.

8.7. TRENCH COMPACTION TESTING

Compaction of backfill materials in excavations for conduits and pits, usually within road and public reserves (or elsewhere as directed by Council), shall be certified by a geotechnical engineer as compliant with the standards within this Manual. Testing locations shall be chosen by the engineer at random locations that are considered to be representative of the works, generally being one test per 200m of stormwater pipe trenching and at two service crossings per project.

8.8. PRECAST BOX CULVERTS

Precast concrete box section crown units and slabs shall comply with RMS Specifications for supply and delivery of precast RCBC sections, and shall be installed to comply with AS 1597.

Where rock is encountered it shall be neatly excavated to the underside of the bedding material. Unsound material shall be removed and replaced with compacted and approved select material.

Bedding shall be either mass concrete or lightly bound approved granular material unless otherwise approved by geotechnical and structural recommendations.

No bedding shall be placed until the foundations have been inspected and approved by the engineer or Council.

Mass concrete bedding shall be not less than 50mm thick. Granular bedding shall be a minimum of 100mm thick, compacted to 95% modified maximum dry density in accordance with AS 1289.

8.9. BASE SLABS

In-situ base slabs shall be constructed as shown on the approved engineering plans. Slabs shall not be poured until the reinforcement and formwork has been inspected and approved by the engineer or Council, and upon completion, the slab shall be cured in adverse weather conditions. Cells shall not be applied to the slab until the concrete has reached at least 70% of the design strength. Cells shall subsequently be placed on a bed of mortar in the recessed edge of the slab. Transverse cell joints shall be covered with a bituminous strip located centrally over the joint and adequately secured. Longitudinal joints in multi-cell components shall be mortar-filled.

8.10. PITS

Pits and associated drainage structures shall be constructed in concrete, in accordance with (firstly) Council's standards or the approved plans, thereafter RMS Standards, and in accordance with the requirements of AS 3600 - Concrete Structures. All drainage structures (pits, wingwalls, slabs etc) shall be constructed on a compacted granular foundation.

All cast-in-situ pits shall be constructed with 25 MPa (minimum) concrete, including soffits and grate support, and shall be constructed using formwork. The base (reinforced concrete floor) shall be poured first. Standard pits, up to 2.5m high, shall be reinforced as noted on the standard drawings in this Manual. Reference should be made to an engineer's design for non- standard pits. Minimum floor, wall and soffit thickness for in-situ pits shall be 150mm.

All "cold" joints shall have "starter" reinforcing steel consistent with drawing SD039 or the special pit design. Pit wall-to-base connections shall have "starter" reinforcing of N12 "L" bars (450 legs), at 400mm (max) centres.

Where precast units are utilised, the units shall be transported stacked/stored and installed in accordance with manufacturers specifications.

Pits shall be benched in the base, and subsoil drainage pipe outlets within pits shall be installed at the same level as the invert of the upstream pipe, regardless of pit-benching.

Grates at road kerb inlets shall be galvanised and of the type that provides an RHS support along both edges of the grate, (see SD039), and shall be hinged within a frame with a lock-down J-bolt.

Where pits are greater than 1.2 metres in depth step-irons shall be installed (see SD039).

8.10.1. Pit Formwork & Backfill

All external formwork shall be removed (stripped) before backfilling. Reference should be made to the requirements of AS 3610, but also generally, as follows:

- Formwork shall not be removed from:

walls:

- within an **18** hour period from the time of the pour
(ie. when air shade temperature is between 5⁰C and 12⁰C) or
- within a **12** hour period from the time of the pour
(ie. when air shade temperature is between 12⁰C and 20⁰C)

soffits:

- within a **5** day period from the time of the pour
- No backfill shall be placed against a wall, within an **18** hour period from the time of the pour, and then only loose material for purposes of a working platform.
- No compaction of backfill by means of “flooding” shall occur within a **24** hour period from the time of the pour
- No compaction of backfill by means of mechanical vibration shall be applied adjacent to a wall until the concrete has reached a compressive strength of at least **15MPa**, (generally achievable after 96 hrs - 4 days with 25MPa design strength) unless effectively supported by horizontal struts, and then not before a **48** hour period has expired.
- No backfill shall be placed on a soffit for a period of **5** days from the time of the pour unless effectively supported by propping and then not within a **3** day period, preferably with internal formwork in place.
- No construction loads or compaction of backfill by means of mechanical vibration shall be applied over a soffit for a period of **7** days from the time of the pour, and then not without effective propping supports, preferably with internal formwork in place.
- Whilst under construction loads, propping shall remain in place until full design strength is reached (nominally 28 days).

The above criteria may be *extended or shortened* by the engineer subject to air shade temperature falls or rises beyond that specified. Backfill material shall be placed, and be of a type, similar to that required for pipes. All strutting and propping shall be to the satisfaction of the engineer.

8.11. GROSS POLLUTANT TRAPS

Gross pollutant traps shall be constructed as shown on the approved plans, with all steel items being hot-dipped galvanised or stainless steel. Large top grates shall be lockable and removable, with lifting hooks, and shall include a hinged access grate component.

8.12. SCOUR PROTECTION

Scour protection at headwall outlets, shall be caged rock or plain concrete, or large rocks that will remain stable under full flow conditions, to a distance of generally 4 times the pipe diameter (see standard drawing SD045), and be returned up the bank adjacent to the end of the wing-wall approximately 300mm. Rock mattresses shall have a geo-textile fabric underlay. Rocks within a wire cage shall be a size sufficient to be contained by the cage.

8.13. OPEN DRAINS

Temporary catch drains shall be constructed in accordance with the plan or where considered necessary by the Engineer. Drains shall be sized to suit the catchment area. Drains may require erosion prevention measures. Temporary drains shall be backfilled and restored to the natural surface upon completion of works.

Permanent catch drains and batter drains shall be lined for protection against erosion, to the shape and location as shown on the approved plans. Prior to the placing of the lining material the foundation shall be shaped and compacted to form a firm base. Concrete lined inverts shall be a minimum of 600mm wide.

Concrete wing drains shall be constructed as cast-in-place or sprayed concrete. Weepholes shall be provided at regular intervals.

Stone pitching of open drains shall be of sound durable rock not less than 100mm thick and laid on approved geotextile fabric.

8.14. INTER-ALLOTMENT DRAINAGE

Inter-allotment drainage details are also referenced in the above sections of this chapter.

Pipes shall be constructed as shown on the approved plans, and laid centrally within easements, subject to sewer pipe location.

The following installation criteria shall be employed:

- Pipe “cover” shall be a minimum of 300mm (where vehicle loads are not expected)
- Trench “side” clearance to the pipe shall be a minimum of 100mm.
- The “bed” shall be a free-draining sand (or crushed rock aggregate – 14mm max.) and shall have a minimum compacted thickness of 75mm.
- The “side” support shall be a compacted, free-draining sand (or crushed rock aggregate) and shall extend to the top of the pipe.
- The “overlay” shall be an approved suitable/workable natural material, (not being large lumps of clay) compacted to a depth of 150mm above the top of the pipe, not containing any stones larger than 150mm, nor more than 20% with a size between 75mm and 150mm.
- The installed pipe shall be inspected prior to placement of the overlay zone.
- The “backfilling” shall comprise of natural available earth material, suitable for adequate compaction to avoid surface slumping
- A 3m length of socked subsoil pipe shall be installed upstream at every second pit within IAD pipe system.
- All disturbed surfaces shall be fully restored.

Each IAD pit shall have a capped stub for the dwelling connection, and all pit/pipe joints shall be mortared flush with the pit. (see SD043).

8.15. CULVERTS

Culvert type road crossings shall be constructed such that granular bedding or subsoil drainage is well confined by a cut-off wall, wingwall and compacted clay embankment backfill. Where subsoil pipes are approved the inlet end shall be raised to the surface and capped.

8.16. PIPE TOLERANCES

Allowable construction tolerances for pipelines shall be as follows:

PIPE CONSTRUCTION TOLERANCES

ALLOWABLE CONSTRUCTION TOLERANCES FOR PERMANENT PIPES, CULVERTS AND DRAINS	
Grade Line (Vertical Alignment)	Tolerance per 2.4m Length or part thereof deviation from the design grade line level
Less than 1%	10mm
1% to 4%	15mm
4% to 7%	20mm
>7%	25mm
Horizontal Alignment	50mm

Notwithstanding the above each 2.4 metre length of pipe shall have fall in the direction of the design grade line.

9. PAVEMENT CONSTRUCTION

See Section 7 of this chapter for subgrade preparation.

9.1. FLEXIBLE PAVEMENT

A flexible granular pavement, whether of modified material or otherwise, shall be constructed in accordance with the approved construction plans or as amended through geotechnical advice, with Council approval.

Nominated pavement depths refer to the compacted material depths of each layer.

9.1.1. Tolerances

The following table of construction tolerances, relative to the approved design for flexible unbound pavements, shall apply to subgrade, sub-base and base courses, and asphaltic concrete (AC10) wearing surface.

The approved design thicknesses/levels are to be achieved generally throughout the work. Variations of “Construction Tolerance” should not be assumed as a general variation, and will only be accepted as an exception for minor areas.

PAVEMENT CONSTRUCTION TOLERANCES

TOP OF LAYER	CONSTRUCTION TOLERANCE (FROM DESIGN LEVEL)	SHAPE (DEVIATION FROM 3M STRAIGHT EDGE)
Sub-Grade	+ 0 to – 50mm	
Sub-Base	+ 10mm to – 20mm	Not greater than 20mm
Base	+ 15mm to – 0mm	Not greater than 10mm
Wearing Surface, AC Thickness ⁽¹⁾	-5mm to + 20mm	Not greater than 7mm

Notes:

- (1) The minimum AC Thickness is 30mm.

Sub-grade, sub-base and base course finished surface levels, at the gutter lip-line and the “crown”, shall be verified by Council. Where requested by Council such measurements may be subject to verification by survey prior to adding of any subsequent layers.

The finished wearing surface shall not be lower than the lip of the gutter or edge constraint.

9.1.2. Pavement Materials

All pavement materials shall comply with the requirements of:

- RMS Specification QA 3051 for unbound base and unbound sub-base or,
- ARRB Special Report No 41 and APRG Report No 21 for granular materials, or
- the material properties detailed at appendix D

The use of materials not meeting these specifications may be considered for Council's approval, subject to an evaluation by a geotechnical engineer. Materials subjected to treatment by a suitable modifying/stabilising agent must be through a mechanical mill and must meet the relevant specification for modified material. Each pavement layer at compaction shall have moisture content between 60% and 90% of Optimum Moisture Content (OMC).

For subgrade bearing capacity under pavements, the use of geotextile materials is permissible subject to recommendations by the Geotechnical Engineer and suitability of use with location.

Where a combined sub-base/base single-layer constructed pavement is proposed, such a layer shall consist of base course material only. (See ‘testing’ below).

The following table provides details of acceptable material types:

ACCEPTABLE MATERIAL TYPES

DESIGN TRAFFIC	BASE	SUB-BASE
$= > 1 \times 10^7$	DGB20, GMB20	DGS20, DGS40, GMS40
$=> 4 \times 10^6 \text{ \& } < 1 \times 10^7$	DGB20, GMB20	DGS20, DGS40, GMS40
$=> 1 \times 10^6 \text{ \& } < 4 \times 10^6$	DGB20, GMB20	DGS20, DGS40, GMS40
$=> 1 \times 10^5 \text{ \& } < 1 \times 10^6$	DGB20, GMB20, NGB20-2c	DGS20, DGS40, GMS40, NGS20, NGS40
$< 1 \times 10^5$	DGB20, GMB20, NGB20-2c, NGB20-2d	DGS20, DGS40, GMS40, NGS20, NGS40

Generally, plasticity indices shall be restricted to 6 (max) for base material and 12(max) for sub-base material.

The pavement designer should be satisfied that the pavement material type and quality will, with suitable construction methods, meet the requirements of this Manual in respect to compaction and deflection standards for the nominated CBR & ESA requirements.

9.1.3. Pavement Compaction

Unless the subject of special design, pavement layers (including “select material”) shall be placed in compacted layers not exceeding 200mm and not less than 100mm thick.

Minimum dry density compaction requirements are as follows:

PAVEMENT COMPACTION REQUIREMENTS

LAYER	COMPACTION REQUIREMENT (MIN)	STANDARD
Sub-Base	95% Modified	AS1289
Base	98% Modified	AS1289

Where a combined sub-base/base single-layer constructed pavement is proposed, testing shall be undertaken in accordance with RMS RN73 Clause 9. Such a layer shall be base course material only.

9.1.4. Pavement Testing

Pavement testing for compaction density and deflection shall be undertaken by a NATA registered laboratory and a certificate of compliance shall be issued together with test results. All layers shall be tested.

Density testing by sand replacement, nuclear densometer or other NATA approved means is required at the start and finish limits of the work (within the first and last 5.0 metres) and thereafter as "Random Testing" in accordance with RMS or Australian Standards. A minimum of two tests shall be carried out for any road less than 50 metres in length.

Testing within cul-de-sac turning heads shall occur, as directed.

The location of tests within the road cross section shall be randomly selected to ensure that the full width of the road pavement undergoes representative testing.

Proof-roll testing shall be observed at each layer using acceptable machinery to perform the test, such as a three-point roller, a large grader or a fully laden water-cart, with preference in that order. The test shall be performed by a person experienced in road construction testing representing Council or geotechnical engineer.

Individual pavement layers shall not be covered by succeeding layers until test results have demonstrated that the layer has passed the nominated standard. Where a combined sub-base/base single-layer constructed pavement is proposed, testing shall be undertaken in accordance with RMS RN73 Clause 9.

All test results shall be submitted to Council and accepted as compliant, prior to granting of "practical completion".

Where test results fail to meet nominated standards additional testing shall be carried out to isolate the failed area prior to reworking and retesting showing that nominated standards have been achieved.

Prior to application of the wearing surface, an assessment of the pavement shall be undertaken according to the elastic rebound deflection test, in accordance with Test Method T160, utilising the Benkelman Beam or an equivalent method. The resultant Characteristic Deflection for a section of pavement, calculated as the "mean" plus "standard deviation", should not generally exceed the values (for unbound pavements) in the table below.

As part of the assessment, for roads greater than Distributor (secondary) status, a "reliability" product factor ($f=1.65$) should be applied to standard deviation. The coefficient of variation ("standard deviation" divided by "mean") should not exceed 0.3. Subject to assessment, upon failure of a test, further testing may be employed to "track" possible improvement and ultimate compliance of test results.

Frequency of testing shall be on alternate wheel paths at generally 15 metre (max) intervals.

BENKELMAN BEAM DEFLECTION REQUIREMENTS

ROAD TYPE	ESA'S	CHARACTERISTIC DEFLECTION	MAXIMUM DEFLECTION
Local - Place	1×10^5	1.20	1.80
Local - Access	1×10^5	1.20	1.80
Local - Secondary	2×10^5	1.15	1.60
Local - Primary	5×10^5	1.10	1.40
Collector - Secondary	1×10^6	1.10	1.40
Collector - Primary	1.5×10^6	1.00	1.30
Distributor - Secondary	2×10^6	0.90	1.10
Distributor - Primary	5×10^6	0.77	1.00
Sub-Arterial	1×10^7 min	0.70	1.00
Industrial - Secondary	5×10^6	0.77	1.00
Industrial - Primary	1×10^7	0.70	1.00
School Bus / Public Route	$2/5 \times 10^6$ min	1.00 min	1.30 min
Business / School Precinct	1×10^7	0.70	1.00
Residential (R5-V)	Apply deflections as per lot catchment and ESA's defined under road type and dimensions table		
Residential (R5-X)	Apply deflections as per lot catchment and ESA's defined under road type and dimensions table		
Residential (R5-Y)	Apply deflections as per lot catchment and ESA's defined under road type and dimensions table		
Residential (R5-Z)	Apply deflections as per lot catchment and ESA's defined under road type and dimensions table		
Rural	1×10^5 min	1.10	1.60

9.1.5. Pavement Joints

Where new pavements abut existing pavements (whether longitudinal or transverse pavement joints), benching of the base course to a minimum width of 300mm shall be provided to achieve an effective key-in. Longitudinal joints located along wheel paths should be avoided. (See SD032)

9.2. RIGID PAVEMENT (ROADS)

Rigid concrete pavements shall be constructed in accordance with RMS R82 "Lean-Mix Concrete Sub-Base & R83 "Plain Concrete Base" guidelines. Australian Standards shall apply with respect to concrete:

- supply - materials
- delivery - mixing, transport, time, consistency
- placement - compaction, evaporation rates, texture
- curing - method/product, protection
- texture – cove, broom, rake etc
- jointing - cutting, filling

9.2.1. Materials

Material quality requirements for base and sub-base concrete, shall be as specified in the RMS Concrete Pavement Guidelines.

9.2.2. Components

The following limited details are summary guidelines for good-practise concrete road construction.

Sub Base

Concrete shall be compacted by means of "needle" immersion vibrators. Screeding may be by hand or vibrating screed. The surface shall be finished with a steel float and shall be covered with an approved curing agent. A bond-breaker shall be applied to the surface of the sub-base.

The sub-base shall not be subjected to traffic until the concrete has attained a compressive strength of 4MPa.

Base

Concrete shall be compacted by means of "needle" immersion vibrators and two passes of a vibrating screed. If required, the surface shall be finished with a steel float.

The surface shall be covered with an approved curing agent.

The base shall not be subjected to traffic until joints are sealed and the concrete has attained a compressive strength of 20MPa (generally at 7 days for specified 32MPa). High early strength concrete may be used if earlier traffic use is necessary, where approved by the engineer.

Anchors & Terminal Slabs

Anchors shall extend over the full width of the base (not under the kerb and gutter) and the associated joints shall be no closer than 2m from other pavement joints. Terminal slabs shall be constructed adjoining bridges and at junctions with flexible pavements.

Characteristic concrete strength shall be a minimum of 32MPa.

Sub-grade Beams

Sub-grade beams shall be constructed flush with the sub-grade level. The beams shall be compacted by mechanical vibrator equipment, finished with a steel float and cured and de-bonded as per the sub-base specification.

Characteristic concrete strength shall be a minimum of 25MPa.

Tie Bars

Tie bars shall be N12(min) galvanised bar of a minimum length of 25 times bar diameter, and spaced at 900mm (in a 200mm thick slab).

Curing & Texture

Control of moisture for evaporation and curing shall comply with the requirements of RMS R83. Methods for moisture-loss control shall be by the application of an evaporation retardant (such as an aliphatic alcohol) followed by curing with a water-based hydrocarbon resin or similar. Unless approved otherwise, road pavements shall be texture with an RMS type "rake" finish.

9.2.3. Concrete Testing

Concrete testing for hand-paved placement shall be sampled in accordance with AS1012 and AS1379, and tested at a minimum for each continuous pour, as follows:

Base & Sub-Base

Slump

- the first three truck-loads of the project first-day pour and,
- each truck load during continuous pour-days at compression testing site visits

Compression – one test being, 1 pair at 7day & 1 pair at 28 day

- one test from the first load,
- thereafter one test per 50m³ or part thereof.

For small quantity "infill" pours, compression testing may be waived at Council's discretion (with 24 hrs notice to batching plant)

Base

Flexural (SFRC only)

One test per 50m³ or part thereof.

10. KERB & GUTTER

Kerb and gutter and other concrete edged construction shall be graded and aligned in accordance with the approved engineering plans. Kerb, gutter and edge restraint profiles shall be provided as shown on standard drawing SD004.

Kerb and gutter shall be laid on an approved sub-base material of a minimum 150mm compacted thickness in accordance with the requirements for sub-base within this chapter, with no loose material beneath the concrete, and may be placed on an approved and tested “kerb-run” of sub-base material of an adequate width, or be the prepared road sub-base.

Minor construction variations of up to 20mm in line and 10mm in level over a distance of 5 metres may be accepted, providing the design layout (particularly for traffic control devices), appearance and drainage are not compromised. Construction works that exhibit ponding will not be accepted.

Kerb Outlets for roof stormwater discharge to the street for allotments shall be provided in the kerb usually on each side of each lot (or as directed by Council for unusual lot layouts or as appropriate for corner-lots), within 1.0 metre from the side boundary alignment, in accordance with Council's standard drawing SD036.

Pipe crossings (x2) to each lot within a subdivision that drains to the road shall be provided across the footway generally adjacent to each side boundaries of each allotment, connected to kerb outlet inserts and extended into the lot being serviced. The pipe shall be 100mm sewer grade PVC.

10.1. CONCRETE SUPPLY & PLACEMENT

All concrete for kerb and gutter shall have a minimum compressive strength of 32 MPa at 28 days. Documentary evidence of concrete testing for compliance shall be submitted to Council as part of the final report. Concrete Slump shall be as follows:

Machine extruded: 10-20mm

Manually formed and poured: 70-80mm

Contraction joints shall be cut to within 50mm of the base of the kerb front and rear at 3 metre intervals. Gutter crossing laybacks, where required, shall be poured integral with the gutter. Kerb transitions are to be shaped into a lipless flattened section for a future (dowelled) pram ramp connection.

Concrete in kerb and guttering shall be placed in accordance with the general requirements for concrete within this Manual and Australian Standards. The surface shall have a smooth steel-trowel finish.

Excessive amounts of concrete expelled from the extruder onto the sub-base material shall be removed to leave a near vertical face.

11. WEARING SURFACE

The wearing surfaces shall generally be as follows:-

ACCEPTABLE WEARING SURFACES

ROAD TYPE	ACCEPTABLE STANDARD
Residential	Asphalt (AC10 "residential mix") 30mm (min) depth
Business and Industrial	Asphalt (AC14) "Heavy Duty" 40mm depth.
Rural	Bitumen flush seal 1st coat 14mm, 2nd coat 10 or 7mm.
Classified Roads	Bitumen flush seal 1st coat 14mm, 2nd coat 10mm, OR Asphalt (AC14) "Heavy Duty" - 40mm depth.

Variations to the above table may be required where an existing road surface type may dictate the specification for any abutting works.

The application of a single-coat reseal shall be nominally, a 10 or 7mm seal. Documentary evidence of wearing surface testing and/or application shall be submitted to Council as part of the final report.

11.1. BITUMEN FLUSH SEAL

All design material, quality and field procedures for sprayed sealing shall be in accordance with the Roads & Maritime Services Sprayed Sealing Guide and Australian Road Research Board Sealed Local Roads Manual.

Works shall be carried out by contractors with established competence in hot bitumen sealing.

All new roads shall be surfaced for the full extent as shown on approved plans and shall merge with the existing to neatly match levels. Minimum overlap for top-coat spray seals onto existing bitumen surfaces shall be 300mm.

All flush seals shall comprise of two coats of bitumen and two coats of aggregate.

All aggregates shall be "pre-coated".

Areas of high torsional loads may require polymer modified asphalt.

All binders for sprayed sealing shall have added an approved adhesion agent in accordance with manufacturer's recommendations.

11.2. PRIMER SEAL

A 10mm primer seal shall be placed under all asphaltic concrete wearing surfaces.

A minimum of fourteen days duration shall apply prior to application of subsequent asphalt layer(s). That period may be extended or shortened by Council subject to justifiable reason such as:

- providing an extended “test” period to monitor performance
- reduction (minor) due to weather or contractual influences

Primed areas subjected to damage shall be re-primed prior to placement of asphalt to the satisfaction of Council.

11.3. ASPHALT

Asphalt wearing surfaces shall be provided in all new residential, commercial and industrial roads, other than where concrete or segmented block paving is proposed. No asphalt shall be placed until the base course construction has been approved by Council.

The asphalt mix shall be designed in accordance with Roads & Maritime Services Specification R116 or similar for dense graded asphalt.

Works shall be carried out by contractors with established competence in asphalt application.

Construction practice for asphalt works shall be in accordance with Roads & Maritime Services Specification R106 and R116 and Australian Road Research Board Sealed Local Roads Manual.

Hand placement of asphalt shall be kept to a minimum and only permitted for minor correction works or in areas where placement by paver is impracticable.

The contractor shall rectify any damage to the pavement surface adjoining the area of works. Minor depressions may be filled with asphalt and compacted as directed prior to placement of the final pavement wearing surface.

The finished asphalt surface adjacent to the concrete gutter lip or edge restraint shall not be lower than the concrete surface.

12. CONCRETE ITEMS

Premixed concrete shall be from an approved supplier and must conform to Australian Standard 1379. Formwork shall conform to Australian Standard 3610 – Formwork for Concrete. All concrete components shall be designed in accordance with Australian Standard 3600 – Concrete Structures.

12.1. DRIVEWAY ACCESS HANDLES

Construction shall be in accordance with the approved plans, or where additional detail is required, Council's standard drawing SD012. Inspection is required of formwork and reinforcement prior to concrete placement.

12.2. PATHS

Concrete footpaths shall be constructed and provided where detailed on the engineering plans, and in accordance with Council's standard drawing SD002, SD007, SD012 & SD019. Variations on the location of the footpath may be required depending upon special site circumstances.

Joint layouts shall ensure that acute angles forming narrow triangular shapes are avoided.

Protrusions into paving such as service authority pits should be avoided, but where necessary shall have full depth compression joint fillers on all sides and at least two joints projecting from opposite corners of the pit, to the edge of the paving.

Unplanned cracks in paving slabs may render such slabs unacceptable, resulting in their removal and replacement.

Adjacent surface levels shall be such that they do not intercept, pond or concentrate stormwater flows onto footpaths.

12.3. CONCRETE LININGS

Where concrete lining of small open drains inverts is required, the minimum thickness of concrete shall be 100mm. Sprayed concrete less than 1.0 metre wide, will not be permitted in drains, and the final surface being uniform and free of depressions.

Sprayed concrete shall conform to Australian Standard 3600 and all contractors shall be skilled and experienced in its application. Mix proportions, procedures etc. shall be submitted to Council or the Engineer for approval prior to placement.

Earth subgrade surfaces shall be graded, compacted, shaped and dampened prior to applying concrete. Concrete can either be coloured to match surrounding conditions or natural (plain).

12.4. CONCRETING PLACEMENT & PRACTISE

12.4.1. Sub-Base

Concrete shall be placed on an approved base material comprising either 50mm of sand, or 100mm compacted approved granular material or minimum 50mm thickness mass concrete, with this being placed on a firm subgrade. An approved plastic sheet underlay or sufficient wetting of the subgrade surface shall be provided.

12.4.2. Reinforcement

All reinforcement shall conform to Australian Standard 1302 – Steel Reinforcing Bars for Concrete, Australian Standard 1303 – Steel Reinforcing Wire for Concrete and Australian Standard 1304 – Welded Wire Reinforcing Fabric for Concrete and be free of excessive rust, oil, grease or other deleterious matter.

All steel shall be overlapped as specified on the approved drawings (or if not stated, generally 30 x diameter) and securely tied at joints to provide a rigid matrix and correct load transfer.

Steel shall be supported by ‘bar chairs’ or metal hangers of the necessary dimensions to provide the specified cover and adequate support at maximum 1.0 metre spacings ensuring that the steel is not dislodged during the concrete pour and compaction.

12.4.3. Placement

Concrete shall be compacted to expel air voids and where specified or directed, vibration by mechanical means. “Vibrators” shall not be left in one position for greater than 30 seconds and shall not vibrate reinforcement or formwork.

12.4.4. Joints

Joining of works shall provide the completed section with a clean cut off with residue concrete removed and an approved joint placed before recommencement of works. Expansion, contraction, tied, dowelled, longitudinal and construction joints, including joints between precast units, shall be provided where shown on the approved plans or where nominated by the Engineer.

Generally, contraction joints, consisting of narrow transverse vertical grooves 30mm deep shall be formed or cut at intervals that provide individual slab side/length ratios of approximately 1:1.5. Expansion/construction joints with a filler material shall be full depth (see standard drawings). Joint filler material shall extend the full depth of the joint.

12.4.5. Surface

Pedestrian trafficked areas shall have an approved non-slip finish such as a light broom or cove-trowel finish. Trimming with steel edging tools shall be over-works with a textured finish (broom or cove). Minor imperfections in stripped concrete shall be repaired.

12.4.6. Curing

Newly placed concrete shall be protected from rain by PVC sheeting. Curing of concrete shall be obtained with an approved curing compound or covering.

12.4.7. Damage

Concrete that is damaged or vandalised shall be repaired or replaced at the discretion of Council.

12.4.8. Testing

Council may require testing of concrete by slump or core samples (post-construction), if it is considered that the concrete mix may be sub-standard.

12.4.9. Weather

Concrete works shall not be carried out during adverse weather conditions such as when ambient temperatures are higher than 30°C or lower than 10°C without taking appropriate precautions. If temperatures exceed 35°C or fall below 5°C, placement should not take place. Council may direct that concrete placement be postponed. The following graph may be used as a guide to determine acceptable whether conditions to allow unprotected placement in order to achieve a rate of evaporation of 1.0 or less.

Precautions shall be taken to ensure that moisture content in the concrete is not reduced due to dry foundations.

(RTA COPYRIGHT AND USE OF THIS DOCUMENT - Refer to the Foreword after the Table of Contents)
R83 **Jointed Concrete Base**
A4.3.5 Prevention of Moisture Loss

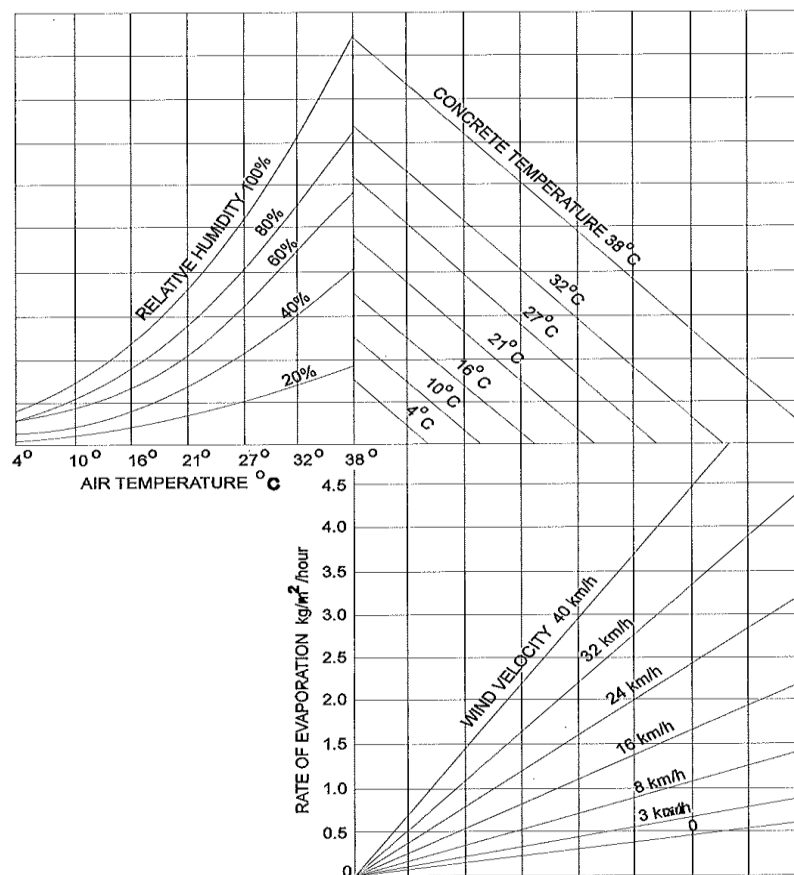


Figure A3.2 - Evaporation from Concrete Freshly Placed on Site

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete. An example follows:

With air temperature at 27°C, relative humidity at 40%, concrete temperature at 27°C, and a wind velocity of 26 km/h, the rate of evaporation would be 1.6 kg/m²/hour. To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), and move vertically to intersect the curve for relative humidity encountered (here 40%). From this point move horizontally to the respective line for concrete temperature (here 27°C). Move vertically down to the respective wind velocity curve (in this case interpolating for 26 km per hour) and then horizontally to the left to intersect the scale for the rate of evaporation.

Source: Gelber, S, 1984, "Predict evaporation rate and reduce plastic shrinkage crack", Concrete International (ACI) v5 n4, 19-22

13. CONDUITS & ROAD CROSSINGS

All "Road Crossings" for primary services shall be laid in conduits and backfilled and thoroughly compacted no later than subgrade stage, and shall be at a depth to ensure they are not damaged during the pavement construction process.

In urban areas the location of all crossings shall be marked (but not painted) on the top of the kerb as follows:

Flushing points	"FP"
Water	"W"
Power	"E"
Communications	"T"
Gas	"G"

Water supply shall be provided to a point within each lot.

14. SURFACE RESTORATION

14.1. GENERAL

Any existing pavements, lawns etc, adjoining the works shall be protected from damage. If damage does occur, all remedial works shall be performed to restore the original item or surface, to the satisfaction of Council.

14.2. FOOTWAYS

Footway verges shall be constructed as shown on the plans and shall be fully topsoiled 150mm thick and stabilised with grass seed or be fully turfed. Where concrete paths are provided the area between the kerb and the path shall be fully turfed.

A turf strip shall be placed along the edge of all concrete slabs. Additional turf strips may be required across the footpath on steeper longitudinal grades to prevent erosion.

Turf type is optional and may be Couch, Buffalo or Kikuyu.

14.3. TRENCHES

Backfill of trenches shall be placed sufficiently high to allow for settlement. Further backfilling shall be carried out to restore ground conditions over trenches to match adjacent surface levels.

Backfilling of trenches through existing road pavements must be immediately restored to the existing surface. Where the trench crosses a bitumen or asphalt surface, pre-mixed asphalt shall be used for restoration. Any subsequent settlement of trenches not adequately filled or compacted shall be made good by the contractor.

14.4. ALL-WEATHER SURFACES

An all-weather surface is defined as a surface capable of being trafficable in all-weather condition and will generally consist of an approved gravel material. For minor access treatments, a pavement 4 metres wide and with 150mm compacted pavement thickness should be the minimum treatment. Cement modifying material may be utilised to bind the surface if bitumen seal is not proposed.

Where bitumen seal is proposed, the pavement thickness shall be increased to 200mm. Pavement crossfall, of 4% minimum shall be applied, and adequate longitudinal and transverse drainage installed. The engineer may consider the use and treatment of alternate materials where proposed.

14.5. MULCH AND TURF

All disturbed earth areas shall be topsoiled (100mm minimum thickness) and seeded, together with turf strips on slopes likely to scour. Distinct flow-paths shall not be protected with mulch/woodchip. Holding-berms shall be installed as directed. All batters shall be similarly treated and must include turf strips. For areas that will be maintained by Council, turf and grass shall be "couch". Other areas may employ species other than couch grass, such as Buffalo or Kikuyu.

All constructed earth drainage structures, such as basins, channels, overland flow-paths etc, shall be topsoiled (100mm minimum thickness) and fully turfed with couch grass to a point where scour is unlikely. Grassing of footways adjacent to lots may be Couch, Buffalo or Kikuyu types.

14.6. STREET TREES

Street trees in the footway shall be planted and located in accordance with Standard Drawings SD001, SD002 & SD049. Refer to Chapter 3 for species, design and installation details.

15. LINEMARKING & SIGNPOSTING

All linemarking, pavement markers and signposting shall be set out in accordance with the approved plan or as varied by Council. All linemarking set-out shall be inspected by Council prior to placement.

Application rates for beads and paint shall be in accordance with RMS standards.

All new linemarking and signposting works on existing public roads must be completed, subsequent to "sweeping" of loose aggregate (if applicable), as soon as practicable upon completion of the wearing surface, and preferably within one week of completion. Warning signs and temporary pavement marks must be employed in any interim period.

Where linemarking becomes defective with a loss of effect due to deterioration of contrast and aggregate loss, Council reserves the right within one month of its application to request that the linemarking be re-marked.

Any linemarking that has been applied to a road surface as a temporary traffic management treatment, or is redundant due to new works, shall be eliminated by either:

- a) covering with a single coat bitumen spray seal with 10mm (max) aggregate over an existing spray seal utilising a bitumen-spraying vehicle (or an alternative approved method for very minor needs) or,
- b) removal by sandblasting or grinding on an existing asphalt surface

16. LOCKS & KEYS

Where requested by Council, items such as gates, nominated grates, bollards etc, shall be locked with a padlock (and chain where necessary). The keys shall be delivered to Council.

17. SITE PRESERVATION

Upon completion of works, all buildings, construction plant, spoil, debris and excess material used for the development shall be removed and the site left in a safe, clean and restored condition. Where a significant time delay between “practical completion” and issue (or registration) of the Subdivision Certificate has occurred, Council will reinspect the works for any possible defects that may have arisen. Inspection fees may apply. The developer is responsible for the continued maintenance of all roads/drainage systems and reserves during the period, prior to “dedication”.

18. COMPLIANCE CERTIFICATES

Compliance Certificates shall be issued when the following conditions are satisfied:

- Works are completed in accordance with the Construction Certificate and Development Consent.
- All necessary testing has been carried out and satisfactory test results achieved.

Compliance Certificates shall apply to the following works:

Pavement Material - Certification by a NATA registered laboratory that pavement materials are in accordance with an approved Geotechnical Report and this Manual

Pavement Density - Certification by a NATA registered laboratory that compaction and moisture content, comply with an approved Geotechnical Report and this Manual

Pavement Deflection - Certification by a NATA registered laboratory that rebound deflection testing (by Benkelman Beam) satisfies the parameters of this Manual for the appropriate Equivalent Standard Axle (ESA)

Trench Backfill Density - Certification by a NATA registered laboratory that trench backfill for conduits such as for stormwater and services satisfies the parameters of this Manual.

Structural Elements – Where not inspected by Council, certification by a suitably qualified engineer that concrete, masonry, steel and timber structural elements constructed in-situ are compliant with an approved design.

Where requested by Council, certification for precast and pre-assembled structures.

Additional Certificates - Any additional certificate required by Council, in order to issue a Subdivision or Occupation Certificate

DEVELOPMENTS

1. INTRODUCTION

This section provides guidelines regarding vehicular access and drainage for developments other than major subdivision (being the subject of other sections within this Manual). In general terms this includes all development requiring vehicle access to property from a public road. Specifically, this section provides extended detail for industrial, business, medium density residential developments, small-scale subdivision without creation of a public road, (generally applying to the creation of up to 4 lots) and where re-subdivision of original residential lots is proposed for purposes of development over and above a single dwelling on the land.

2. RESPONSIBILITIES

Particular attention is drawn to relevant responsibilities and requirements of developers and consultants within Chapters 1, 2, & 3 of this Manual.

2.1. INSURANCE

The applicant/contractor/land owner should ensure that he/she has sufficient and current insurance cover for Public Liability and Workers Compensation particularly in respect to works on the public road, in relation to this Manual. A Householder's Policy may not be adequate for works on a road reserve.

2.2. PUBLIC UTILITIES

It is the applicant's responsibility to check whether the proposed works affects any Public Utility mains installation or any proposal for new mains. Council cannot guarantee that future "openings" within the road reserve for the installation of mains, will not be required.

Where underground works within the road reserve are required or necessary for supply of services to the development site (such as water, sewer, electricity, gas), further consent for a "*Road Opening*" must be obtained from Council.

Contact:

"DIAL BEFORE YOU DIG"

(for telephone, gas, electricity, water and sewer locations)

2.3. SAFETY OF WORKS

For works within the road reserve, the applicant or contractor, or land owner is responsible to erect and maintain approved standard safety devices such as fencing, barricades, signs and where necessary, lights in accordance with Council's standards and requirements. The work-site shall be kept in a tidy condition, and maintained safe for pedestrian access for the duration of the work.

Upon completion of works and removal of formwork, barricades, etc, the adjacent footway shall be filled or trimmed along the edges of the works to an even grade with a maximum slope of 1 in 8 (i.e. a 100mm rise or fall over a distance of 800mm).

2.4. REMOVAL OF DEFECTIVE WORKS

Council retains the right to alter, repair or in some cases, remove and replace any work on public reserve/land for which approval has not been obtained, or that has not been carried out in accordance with this Manual, or is considered unsound or unsafe, or is of poor workmanship. The work would be undertaken by Council at the full cost of the responsible person, recoverable in accordance with the Roads Act.

3. DRIVEWAYS (AND ASSOCIATED WORKS WITHIN THE ROAD RESERVE)

The objective of this part is to ensure that development has a safe, practical and a durable vehicular access between the property boundary and the public roadway, and that the driveway within the property satisfactorily caters for vehicle loads and manoeuvring with acceptable gradients. Driveway design must take into account safety for all road users maximising sight distances based on design guidelines detailed in Austroads standards Part 3 (particularly relevant to a rural environment), and in Australian Standards 2890 for access driveway locations and exits, (being particularly relevant to an urban environment). (See also section 5 as follows and the topic *Intersections*)

Works within the road reserve must not commence until an approval is gained from Council through the "Application to Construct Works on Footway" form which is available on the Council web-site.

3.1. DRIVEWAY SPECIFICATIONS

3.1.1. Width

For residential development a "single" driveway slab pavement width of 2.7 metres is a desirable minimum. Tapered splays up to generally maximum overall width of 3.5m at the roadway are desirable to assist vehicle approach entry to the property. A "double" driveway servicing a dwelling may generally be up to 6.0m wide. Where drive-strips are installed their width should taper to cater for vehicle turning wheel paths (see SD015).

For business & industrial developments the driveway shall cater for the expected design vehicle turning paths determined by AS 2890.

For rural access the width shall be sufficient to cater for the expected usage and be a minimum of 5.0m, with additional width for splays at the junction with the edge of the road.

3.1.2. Construction Specifications

For urban residential developments the driveway, incorporating the gutter crossing, shall be provided in accordance with Council's Standard Drawings SD007, SD008, SD009, SD010, SD011 & SD012 as either, reinforced concrete, segmental pavers on a concrete base, or bitumen/asphalt seal on a compacted gravel pavement.

For heritage areas vehicular driveways shall comply with standard drawings SD014 & SD015. Concrete colour should be employed in accordance with Council's requirements for heritage areas.

For business & industrial developments, the driveway, incorporating the gutter crossing, shall be provided in accordance with Council's Standard Drawings SD007, SD008, SD010 & SD012, as "Commercial/Industrial Driveway" concrete construction, or as designed by an engineer to cater for the expected (heavy) vehicle loads.

For rural developments, the driveway shall be provided in accordance with Council's Standard Drawing SD013. Driveways crossing roadside table drains should be installed as a dished crossing. Where the depth of the drain renders a dish impractical, a 5m long, 375mm diameter (min) concrete class 4 pipe (or equivalent Fibre Reinforced Concrete pipe) with headwalls, shall be provided. The table drain shall be diverted so that the pipe is located a minimum of 2m from the edge of the road bitumen. The pipe size shall provide sufficient capacity for the 10-year ARI storm event for the contributing catchment area with larger overflows being contained by the road pavement/reserve. The crossing shall be of compacted gravelled (200mm minimum thickness), with a 2-coat or asphaltic bitumen seal from the edge of the existing road seal to the property boundary or as shown on Council's standard drawing SD013.

3.1.3. Profiles

Driveway profiles shall be designed and drawn showing levels for both the design surface and the existing surface, complying with the specifications for high/low level driveway construction indicated on Council's Standard drawing SD008.

The designer/builder should endeavour to match the existing surface levels as close as possible whilst complying with the standard profile. Minor cuts and fills of up to 120mm may be acceptable in a footway provided 14:1 slopes are achievable as transitions to the adjoining existing surface levels. The slope across the driveway must follow the same grade of the kerb and gutter up to a point 3.2m from the kerb face, from which point the slope may be varied to suit property/garage levels. Where requested by Council, provision of a 1.5m wide section within the driveway crossing, with a grade of 2.5%, for a future footpath, shall be applied. See standard drawings examples SD058 & SD059.

The designer/builder should ensure that, for a property on the low side of a road, the potential for major stormwater flow within the road pavement/gutter to enter the property via the driveway, is avoided. The purpose of the design profile is to contain flows in the roadway.

3.1.4. Clearance

Driveways should provide an absolute minimum of 300mm (desirable minimum, 500mm) clearance from the edge of obstacles such as trees, poles etc. The minimum clearance to stormwater drainage lintels/grates shall be 600mm (layback transition).

3.1.5. Table Drain Crossings

Where driveways cross a roadside table drain, a concrete dish crossing is the preferred option of crossing within the table drain in accordance with Council's Standard Drawing SD004. To achieve this, re-grading the surface by cutting within the verge and into the property may be necessary to avoid "scraping" of the vehicle.

3.1.6. Public Laneways (Existing)

Where permitted by consent, access within an existing public laneway (or unformed or informal "paper road") to property development is subject to an assessment of the existing road pavement (if any) and include construction or rehabilitation of the laneway to Council's standards, which shall be with either a bitumen sealed gravel or a reinforced concrete pavement, unless justified otherwise. Works shall be constructed in accordance with this Manual and the pavement shall be a minimum width of 3.0m. Pavement width may vary depending on type and ultimate volume of traffic usage, passing opportunity, length of works, sight distances, etc.

3.1.7. Driveway Crossings over Paths

Where an existing concrete path crosses the driveway, the path shall be retained such that the path appears continuous.

3.1.8. Removal of Paths

Where path removal is necessary, due to damage, added strength or level adjustment or for drainage pipes, the path shall be removed to the nearest existing joint and reinstated to match the existing path appearance (usually plain concrete) dowelled to existing concrete and constructed in accordance with Council's Manual of Engineering Standards.

3.1.9. Verge Damage

Damage to any existing verge or path, due to building construction activity, should be avoided. Restriction of access to the building site should be made to confine potential damage to a single point. Any necessary reinstatement of the verge (with full turf cover) or path (with new reinforced concrete) must be made prior to "Occupation" of the development, and be in accordance with Council's requirements.

3.1.10. Redundant Laybacks

Redundant laybacks shall be removed and reinstated with integral kerb and gutter, and footways and road surfaces restored to match existing surfaces.

3.1.11. Lintel & Grate Adjustments

Council will only permit adjustments to street drainage pits, whereby extended kerb inlet lintels are replaced with heavy duty “V” grates, if the designer can demonstrate that the stormwater inlet capacity of the street drainage system is not compromised. Otherwise the applicant must construct a replacement pit with an EKI lintel to Council’s standards. The surplus lintel and/or grate shall be delivered to Council’s depot in good condition.

4. DRIVEWAY HANDLES (WITHIN THE PROPERTY)

Driveway access handles should be designed to achieve:

- Opportunity for landscaping to avoid the “gun-barrel” effect (particularly for Residential areas)
- Reduced impervious surfaces, and to introduce a “soft” appearance such as utilising driveway wheel-strips (for Residential only)
- Opportunity for passing and storage of vehicles with adequate pavement width at the end of the handle adjacent to the road reserve (or in long or angled handles, part-way where adequate sight-lines are available) for vehicle storage/passing within the handle. In residential areas, typically passing areas adjacent to the public road should be a minimum of 5.5m wide for a length of 8m from the road boundary, with splays at the edge of the roadway to an overall width of 9m.
- Provision for services to properties within and along the full length of each individual access handle
- Avoidance of concentrated stormwater runoff onto adjoining properties

Rights-Of-Carriageway, in lieu of “handles” may be acceptable, but only due to site constraints, such as an existing dwelling where building setback distance may be problematic.

4.1. DRIVEWAY CORRIDOR WIDTH

In the absence of any approved corridor widths under development consent, see section 4.5 in this Manual. The table of widths is reproduced below.

HANDLE WIDTH (M)

ZONING ¹	SINGLE HANDLE ²	DUAL HANDLES ³	PAVEMENT WIDTH ⁴
Residential (R1)	3.5	3.0 ^{5,6}	2.7 ⁷
Residential (R5-V & X)	3.5	3.0	2.7
Residential (R5-Y)	4.5	3.0	2.7
Residential (R5-Z)	6.0	3.0	2.7
Business (B) & Industrial (IN1)	6.0 ⁸	4.0	3.3 min ⁹
Rural (RU)	6.0	4.0	3.5

Notes:

- (1) For zoning criteria see chapter 2.
- (2) For a single allotment.
- (3) Each handle width for two adjoining lot handles, with a single driveway covered by a full-width reciprocal ROC.
- (4) For single lane.
- (5) Three metres (x2) permits vehicle passing within o/a 6m width for each residential zone. It is assumed regular conflict is unlikely and “give-way” will apply in residential zones.
- (6) Where lots are >600m² (excluding handle), having potential for further subdivision, adopt 3.5m.
- (7) Where lots have potential for high density development with regular traffic movements, adopt 4.8m, preferably as two carriageways with a 400mm grassed separation.
- (8) Increase to 8m where regular two-way conflict is likely.
- (9) Generally for one-way or minor two-way movements with “give-way”. For two-way movements with regular traffic conflict 6.0m min should be provided.

4.2. DRIVEWAY SPECIFICATIONS

4.2.1. Width

A driveway pavement width of 2.7 metres is desirable, with a general maximum of 3.0m. A “double” driveway shall be 5.0m to 6.0m wide subject to the type of vehicle usage.

4.2.2. Construction Specifications

Driveways for residential land-use shall be constructed in reinforced concrete, segmental pavers, bitumen or asphalt on a suitable depth of compacted road-base materials. “Shared” driveways covered by a Reciprocal Right of Carriageway, Common/Community Property, etc and driveways for business and industrial land-use shall be reinforced concrete. All driveways shall be constructed in accordance with Council’s standard drawing SD012.

4.2.3. Grade

The recommended maximum driveway grade is 4 Hor : 1 Vert (25%). Refer to standard drawing SD008. Wherever possible, driveways within the property should be graded to evenly shed water runoff to adjacent landscape/grassed areas within the property, such that runoff is not directed as concentrated flow directly onto adjoining property. Stone/sand-filled trenches adjacent to drives are desirable to enhance infiltration, providing a subsoil outlet is available at the low-point in the trench-line. Otherwise, stormwater collected from the driveway should be piped to the on-site, or street, drainage system.

5. VEHICLE ACCESS, PARKING AND TURNING

Vehicle access to on-site parking areas shall comply, as a minimum requirement, with Australian Standard AS 2890. Layout geometry for manoeuvring and parking should in the first instance be assessed under Council's Citywide DCP, catering for the design vehicle appropriate for the development. Vehicle movement to and from the site shall conform with best practice design for sight distance, approach angle, pedestrian and cyclist safety, convenience and safety for traffic for through-traffic and turning-traffic flow, and must be executed in a forward direction for exiting traffic. Generally, only for single-lot residential access may traffic reverse onto a public road, although special circumstances such as high traffic volumes, sight distance, adjacent, traffic facilities, etc may dictate otherwise, at Council's discretion.

5.1. PAVEMENT

5.1.1. Sealed

Off-street vehicle parking shall comprise of a wearing surface of either a 2 coat bitumen seal, asphaltic concrete, rigid concrete, or segmental block pavement on a constructed foundation (pavement), designed by an engineer. Heavy-vehicle loading and manoeuvring areas should be rigid pavements.

5.1.2. Unsealed

Where pavement "hardstand" is intended to be un-sealed for purposes of storage of materials or similar use, it is essential that silt controls are put in place. Controls should be implemented by means of surface flow with perimeter (or internal) grass swales (instead of an internal pipe system) and a depressed grassed silt trap retention area incorporating a pit-trap at/near the point of discharge from the site (usually within a landscaped area). The built-in detention features provided may be quantified for the hardstand catchment area only. The hardstand material shall be stabilised with lime or cement depending on the sourced material.

5.2. TURNING PATHS

Vehicle manoeuvring templates, in accordance with Austroads or Australian Standards shall be employed for each appropriate vehicle type for the nominated land-use.

Turning paths shall be applied for the appropriate vehicle to maintain unobstructed "free-flow" conditions within the site for service vehicles such as small rigid vehicles (SRV) and heavy rigid vehicles (HRV) where required.

5.3. INTERSECTIONS

Where determined by Council, and generally for developments that generate high/heavy-vehicle traffic movements an access intersection treatment may be required at the junction with the public road. An example of an absolute minimum intersection treatment (catering for basic right and left turns) is shown on Council's Standard Drawing SD031 and incorporates treatment for one or more of the following aspects:

- Access entry/exit
- Passing lane
- Deceleration lane

Council's preferred treatment for access to such developments is for intersections that comply with the "Warrants for Basic, Auxiliary, and Channelised Turn Treatment" types as set-out in Austroads Standards (Part 4A). Guidelines for intersection/driveway demand may be determined from Section 3 of AS2890.1 whereby the "Access Facility Category" for categories 3, 4 & 5, in the first instance be assessed as "intersections" rather than "driveways" (See section 3.2.3). Despite such warrants and demands, particular consideration shall be given to providing a protected right-turn and a separated left-turn capability. Left-turn treatments should allow generous turning paths to facilitate continuous free-flow manoeuvres. Such features as describe above may include road reserve and road pavement widening.

Intersections for access shall cater for Articulated Vehicle (AV) turning paths, including "B-Double" where required (and approved) by the type of the development.

6. ANCILLARY OFF-SITE WORKS

All works within the road/public reserve shall be designed and constructed in accordance with this Manual. Road works cannot commence without consent under the Roads Act.

6.1. ROAD, FOOTWAY AND DRAINAGE

Works may be required through development consent, to up-grade the existing road verge and/or pavement, and/or drainage system, generally limited to the frontage of the development site, although may be extended beyond the property frontage to connect to existing infrastructure.

Warrants for such works may be:

- continuation of existing adjoining, or nearby, infrastructure to cater for the additional usage needs created by the development and to enhance the streetscape
- where works coincide with Council's *Management Plan*.
- where pedestrian, cycle and vehicle traffic movements/parking are significant or where "desire-lines" of travel result from the development activity.

Typically, works that may be required are:

- Re-shaping and turfing of footway
- Concrete paths
- Concrete dish drain or integral kerb and gutter
- Road shoulder pavement including a bitumen wearing surface
- Pipe and pit drainage

Materials for new pavement works shall be consistent with or similar to the existing adjoining road pavement in accordance with the specifications of this 'Manual'.

6.2. CONCRETE WORKS

Concrete works, such as paths, shall be designed and constructed in accordance with this Manual, with particular attention given to:

- Depth and Strength
- Formwork and Reinforcing
- Joints
- Curing
- Testing (where requested by Council)
- Weather Conditions

6.3. INSPECTION OF WORKS

All works within the road/public reserve are subject to testing, and inspection by Council to ensure compliance with this Manual and/or manufacturer or material supplier specifications where not covered by this Manual. Refer to chapter 7 regarding the inspection regime.

7. STORMWATER DRAINAGE

7.1. AIMS AND OBJECTIVES

The following development standards should be used to provide

- best practise hydraulic engineering designs for development sites and,
- to provide a sensitive approach to the environment by the employment of Water Sensitive Urban Design (WSUD) principles.

The objectives of this section are to ensure that:

- the wider community is not disadvantaged by any one individual development
- the development site caters for stormwaters discharging onto the site
- stormwater discharging from the development site satisfies any Council planning scheme and water quality objectives for overall public drainage systems within the wider area.
- the redirection and concentration of stormwater runoff onto adjoining properties, is avoided.

The outcomes of these objectives are to ensure that :

- collected stormwater is discharged in an appropriate manner to a servient drainage system or public drainage system
- development which generates increased flow rates from stormwater runoff (greater than the site's "pre-developed" rate) from impervious areas such as driveways, paths and roofs, adequately addresses potential adverse affects on downstream properties.
- stormwater runoff entering the site from an adjoining upstream catchment, satisfactorily passes through the site without adversely affecting the development site by means of inter-allotment drainage benefitting the appropriate adjoining property(s).
- development sustainably manages the water cycle with sensitively designed, constructed and maintained systems, that may include,
 - rainwater collection for use within dwellings and on landscaping
 - minimising impervious surfaces
 - water retention within landscaping
 - underground stormwater infiltration
 - treatment of stormwater leaving each site, to a satisfactory level of quality
 - construction sites that are adequately protected to prevent the movement of litter, sediment, nutrients and hydrocarbons from the site during wet weather.

7.2. DESIGN PLANS

Design plans should be prepared by a suitably qualified person and should reflect the following principles:

- All developments that generate stormwater runoff from impervious surfaces, and where landscaping, filling/cutting or contouring reshapes or alters flow paths, must be detailed on a stormwater drainage plan. The plan should be consistent with the landscaping design, but should be provided as a separate drawing.
- The design should address potential impacts, such as erosion and downstream discharge effects.
- The stormwater drainage plan should be submitted with the development application, and should include details of; natural and design surface levels, building floor levels, driveway layout, down-pipes and underground pipes and their sizes, overland flow paths, easements (if any), on-site detention tank (if required), pits and any relevant object that may affect drainage, such as gardens, kerbs, retaining walls etc.
- The plan, whilst not necessarily adequate for construction purposes should be prepared by a person who is qualified and competent in drainage design principles, and upon approval, will subsequently be the basis for a Construction Certificate prepared and certified by a qualified person showing full construction details.

7.3. DESIGN STANDARDS

Drainage design shall adopt the principles of major/minor drainage system in accordance with the publication Australian Rainfall and Runoff (AR&R) and as detailed at chapter 6 of this Manual. All calculations shall be carried out by persons competent, qualified and experienced in hydrologic and hydraulic design, utilising drainage models that are accepted as current industry standards.

The major system shall provide safe overland flow conveyance for the 1% AEP storm event, whilst the minor system shall be capable of conveying runoff from minor storm events within underground pipes.

7.4. CALCULATIONS

Calculations (if required by Council) shall show all adopted coefficients to determine peak flows in accordance with Australian Rainfall and Runoff and this Manual.

The adopted time of concentration shall be for the ultimate developed catchment. The general maximum time of concentration shall be 5 minutes for catchments up to 2000m², although a range of 5 to 10 minutes may be justified in certain circumstances.

7.5. DISCHARGE FROM THE SITE

7.5.1. Gravity Pipe Flow

Final discharge of collected stormwater runoff from development sites shall be directed:

- by pipe to the roadside table drain or drainage channel with a concrete headwall/outlet protective structure or,
- by pipe to the street kerb and gutter with a kerb adapter in accordance with Council's Standard Drawing SD036 or, if Heritage Stone Kerb is located in the road kerb, by coring (refer to Maitland City Wide DCP and the Morpeth Management Plan) or
- by pipe to the kerb outlet provided in the existing kerb or
- to the existing pipe provided at the property boundary or
- by pipe to the rear of the existing drainage pit in the street with a flush-mortared finish or
- to an Inter Allotment Drainage line junction point provided for the property.

In the absence of inter-allotment drainage, points of discharge of concentrated stormwater onto an adjoining property, is not permitted without the written approval of the affected property owner(s). This scenario may apply to adjoining large residential or rural properties.

7.5.2. Charged Pressure Head

Charged pressure head systems are permitted where options for a gravity system are not available. The following criteria should be satisfied:

- a minimum of 1m of head, subject to design requirements
- a completely sealed system to the property boundary
- metal or high-grade plastic downpipes (90mm PVC pipe not permitted)
- 100mm stormwater grade underground pipes (90mm PVC pipe not permitted)
- A cleaning flush-point into a soakage pit/well
- Gravity flow from the boundary to the drainage system

7.5.3. Pumping

Collection of stormwater runoff for pumping to a high-level discharge point is not desirable and may only be permitted by Council in special circumstances, such as carparking areas and associated driveway ramps.

7.5.4. Footway Crossing

The minimum conduit treatment for the footway crossings shall be with 100mm diameter sewer grade PVC pipe. In some situations where there is potential for pipe damage due to heavy loads, galvanised rectangular hollow section (RHS) steel may be desirable/required.

Where a pipe is to pass under a concrete path, and it is necessary to remove the path, a complete jointed section must be removed and replaced with a similar dowel-jointed slab section in accordance with this Manual. (See SD012).

Contractors should inquire regarding the possibility of the presence of an existing discharge point provided at the property boundary. Where a pipe exists the contractor must check that the pipe is not damaged and is operating satisfactorily. Damages must be repaired.

7.6. INTER – ALLOTMENT DRAINAGE (IAD)

Within a subdivision or development, where inter-allotment drainage is necessary the following applies:

7.6.1. Pipes

The pipe system shall be designed to accept concentrated flows from buildings and paved areas on each lot for 10 year ARI storm event, without surcharge, and be based on impervious fractions nominated in chapter 6 of this Manual. Careful design should ensure that surface flows are directed into the new drainage system.

For the conveyance of flows from a subdivision for single dwelling allotment to the public drainage system (typically through an easement on an adjoining property or along a battle-axe handle) the minimum requirements shall provide for a 100mm stormwater grade PVC pipe at a minimum grade of 1%. Such a pipe may only be utilised for the single lot. Where other stormwater discharge is necessary for an adjoining development, the pipe must be upgraded to the appropriate size (typically 150mm for two dwellings) or be an independently piped system. Pipes shall have minimum cover of 300mm where concentrated surface loads are not present. The absolute minimum grade shall be 0.5% and is subject to design to ensure adequate capacity. Where more than one pipe occurs at the property boundary a grated surcharge pit shall be installed within the property and a single pipe in accordance with this Manual, provided across the footway.

7.6.2. Pits

Pits shall be provided generally to the lowest point of the lot served, and shall be provided for maintenance access, change in pipe direction, grade or size of pipe and at multiple pipeline junctions. As a guide, pit dimensions may be adopted similar to those shown in chapter 6 of this Manual. Pits within the easement shall be concrete, of minimum size of 450mm x 450mm, with a galvanised steel grate. The pit should be depressed below the surrounding surface by 100mm (min) to enhance entry flows.

7.6.3. Easements

Where an agreement is reached regarding stormwater drainage, inclusive of an easement, a letter and a plan of the easement shall be signed and submitted as evidence of the agreement, prior to issue of development consent and the easement be registered, or lodged for registration, prior to issue of any Occupation Certificate.

Easements shall be provided over pipe systems and overland flow paths (where necessary). The general minimum width of easements shall be 1.5m. Overland flowpath widths may determine that the easement be a greater width. For single dwelling drainage an easement width of 0.9 is acceptable. Refer to chapter 6. Also from Chapter 6: "Where new lots (or development) adjoin existing properties, minor/major flows from those properties shall be catered for with a pipe/pit/flowpath system, covered by benefiting easements."

Where an existing drainage line traversing a development site does not have a covering easement, that pipeline shall be covered by an easement registered onto the title of the property prior to issue of any Occupation Certificate.

7.6.4. Structures / Easement Relationship

Generally, building of a structure over a drainage easement is prohibited due to possible restriction to accessibility. Exceptions may be considered by Council where the structure is relatively light and readily removable, such as a carport or garden shed.

For any concrete slabs extend over an easement, the slab shall be dowel-jointed on the line of the easement. Segmental pavers are acceptable.

Where an overland flow path exists within an easement, obstructions (such as kerbs, gardens, sheds etc) and structures are not permitted. Correctly shaped concrete slabs, such as for a driveway are permitted.

7.7. FREEBOARD

Habitable floor levels adjacent to a flow path or surface detention area shall have a minimum freeboard of 300mm. Non-habitable floor levels, such as garages, shall have a minimum of 150mm freeboard.

7.8. ON SITE DETENTION (OSD) OF STORMWATER

In principle, on-site stormwater detention shall be provided for industrial, business and residential developments where provision has not been made for those developments within the public drainage system. Despite the provisions of this section development consent may nominate specific details of Council's requirements.

In support of the implementation of Water Sensitive Urban Design (WSUD), the basic principles of water reuse, "slow" release discharge and in-ground infiltration of runoff, are required, and are considered part of the detention principles. Therefore, despite alternative methods of calculation, a drainage design is deemed to be satisfactory if the following guidelines (parameters) are adopted in the drainage system.

7.8.1. Industrial & Business

For industrial and business development sites that are located in areas that contain major downstream detention facilities consistent with chapter 6 of this Manual, OSD is not required.

("Retention" of stormwater runoff for pollution control and to achieve WSUD treatments may be necessary, independent of OSD requirements - see Section 8)

Otherwise, in areas without public-facility detention, or where due to particular downstream constraints detention is considered by Council as necessary, the following parameters apply:

INDUSTRIAL/BUSINESS DETENTION PARAMETERS

OSD MINIMUM (PER 1000m ² SITE AREA)	PSD MAXIMUM (PER 1000m ² SITE AREA)
19m ³	9 Litres / Second

In areas where downstream detention is provided, but is limited and may not conform to chapter 6 of this Manual, the above parameters may be apportioned appropriately.

(In particular, the Rutherford Industrial area bounded by Racecourse Rd, Shipley Dr & Bradmill Ave, an OSD volume of 12m³ per 1000m² and a PSD of 12 litres /second per 1000m² may be adopted)

7.8.2. Residential

Stormwater detention for residential development applies to new development where an additional dwelling (or dwellings) creates impervious surfaces beyond that of an average single dwelling. This principle includes subsequent development of a subdivision of an original “parent” allotment within residential areas where site density of the nominal parent allotment is increased as a result.

Within a vacant site the development as a whole provides detention as specified under this section. Where the new development is on a site with an existing dwelling, only that part that is new provides the specified detention - detention is not required for the existing dwelling.

Where the development footprint creates small amounts of impervious areas (such as for one or two bedroom units) the designer should rationalise the site and apportion the areas against an average dwelling, and apply detention on a pro-rata basis.

Refer also to “General Requirements” below.

7.8.3. Detention with “BASIX” rainwater harvesting

For the usual residential development sites, OSD principles can be satisfied with a minimum detention volume of 2.5m³ per dwelling. Note that this amount is in addition to BASIX requirements.

For purposes of achieving Water Sensitive Urban Design (WSUD) principles, the nominated 2.5m³ should be apportioned between the tank and in-ground infiltration/storage, with (not less than) 1.5m³ within the tank, and (subject to section 8 below), not less than 4.5 lineal metres of underground “Infiltration Trench” achieving the principles of standard drawings SD052 & SD053. The first flush by-pass from the roof drainage (for cleansing purposes), and the tank overflow pipe, should be connected to the infiltration trench.

The designer should reference ‘BASIX requirements’ for the development in order to provide adequate tank size for both water re-use and for detention storage volumes.

Within such a system all roof water runoff (some exceptions may include small patio covers) should be collected and the tank must be plumbed into the household water supply. A slow release outlet in the tank at the necessary height shall be provided (see SD052).

7.8.4. Detention without “BASIX” rainwater harvesting

For residential development where rainwater tank detention as part of the BASIX system is not employed, whether in existing (older) or in new subdivision areas, the following guidelines for OSD apply:

INDUSTRIAL/BUSINESS DETENTION PARAMETERS

OSD MINIMUM (PER 1000m ² SITE AREA)	PSD ^(A) MAXIMUM (PER 1000m ² SITE AREA)
7m ³ ^(b)	15 Litres / Second

Notes:

- (1) Permissible Site Discharge (PSD)
- (2) Up to a maximum of 3.5 m³ per dwelling

For purposes of detention of impervious ground surfaces, up to 50m² of runoff from those areas may discharge from the site, un-detained.

Detention of impervious areas exceeding 50m² such as long driveways and large vehicle-turning areas, shall be provided at an equivalent rate of 1.8m³ per 100m² with a PSD of 1.5l/s per 100m². This detention calculation must be based on the total impervious ground-surface area, including the first 50m².

7.8.5. General Requirements

Stormwater detention may be provided either as under-ground, surface depression or above-ground storage, or by a combination of any of those methods, providing the site PSD is maintained.

In recognition of physical constraints, Council will consider alternative site-specific designs.

Where a medium density development is proposed, OSD systems shall be calculated for the whole-site area and should be apportioned between the structures, relative to their contributing surface areas.

Where medium density development may be subject to future subdivision, Torrens or Strata, each dwelling/unit should be provided with an independent detention system. If independence is not achievable, drainage easements may be necessary.

At locations deemed by Council to be subject to special circumstances due to downstream drainage problems or for other reasons, the above requirements may be altered by Council to suit those circumstances.

When Council provides drainage plan certification and inspection for construction compliance, a fee, as per Council's Schedule of Fees and Charges, must be paid to Council prior to issue of the Construction Certificate. The fee applies to single development sites as approved under development consent.

Where development sites are greater than 3000m², the following requirements apply:

- Design plans and calculations shall be certified by a suitably experienced civil engineer, a registered surveyor, or other persons with acceptable competency and experience in Hydraulic and Hydrological design.
- Storage volumes shall be calculated in accordance with the principle set out in Australian Rainfall & Runoff. Large storage volumes shall be based on modelling using time area hydrograph methods.
- Calculations shall be submitted to Council.

In all cases where OSD is employed, the following matters shall be addressed:

- Drainage detention and storage devices shall be designed in accordance with Australian Standard for Plumbing and Drainage AS3500.3
- All metal components shall be hot dipped galvanised steel (after fabrication), aluminium or stainless steel, and fastened using 10mm (min) stainless steel fasteners.
- Maximum depth of ponding shall be 200mm in driveway/parking areas and 300mm (desirable maximum) in accessible landscaped areas.
- The volumes of hydraulically independent (with different surface ponding levels) detention areas shall be calculated separately and shall have separate outlet controls.
- The detention area shall be designed such that the major storm event (100-year) can safely overtop the area with no adverse impacts on the immediate surrounds, buildings and adjoining properties. An overland flow path must be incorporated in the design.
- Detention outlet design shall assume maximum pressure head.

As the development site requires, OSD designs may need to address the following matters:

- A hydraulic grade line assessment based on outlet control operating at the major flood level
- Potential for backwater pressure from the street drainage system to enter the detention system
- A "staged" pit-controlled discharge other than an outlet choke/conduit arrangement providing a tamper-proof orifice such as a buried pipe reducer (see SD052). Minimum orifice choke size shall be 25mm. An outlet less than 90mm diameter shall be screened using a mesh screen.

7.9. CERTIFICATION & WORKS AS EXECUTED DRAWINGS

Stormwater drainage, involving On Site Detention (OSD), shall be certified in construction, by a suitably qualified person. Works-As-Executed drawings may be required by the Principal Certifying Authority to verify works, in particular, finished surface levels and storage volumes. The certification and/or WAE drawings shall verify:

- finished surface levels
- the pipe/pit system
- storage volumes
- discharge control devise(s)
- overland flowpaths

8. STORMWATER QUALITY

Developments that generate stormwater runoff from areas that may be a source of pollutants shall provide a means of “polishing” of the runoff prior to its discharge from the site. Of particular importance are sealed car-park areas servicing industrial and business complexes. For unsealed pavements see “Pavement” section above).

8.1. MAINTENANCE OF DEVICES

The stormwater drainage systems incorporating runoff quality control treatments must be inspected on a regular basis and maintained in working order. A “Stormwater Maintenance Plan” for on-going execution by the owner/operator of the site shall be included in the stormwater design for the site, nominating an inspection and cleaning/replacing regime for all drainage components. The following items (but not limited to) should be included:

- pits, with filter materials, silt traps in the base, orifice plates and litter grates, ensuring satisfactory operation
- detention tanks, ensuring clean and satisfactory operation
- pipes, ensuring clean and free-flowing
- surface swales and silt-trap basins, ensure mowed and removal of collected silt
- open discharge points, ensuring clear of debris and satisfactory scour protection
- non-return valves, ensuring satisfactory operation
- overland flow paths, ensuring free from obstruction

8.2. WATER SENSITIVE URBAN DESIGN (WSUD)

8.2.1. General Requirements

All developments covered by this chapter are required to incorporate Water Sensitive Urban Design (WSUD) principles regarding the treatment and discharge of stormwater runoff. Developments will generally require a combination of a number of treatments to be provided which is known as a “treatment train”. Such treatments may include:

- Rainwater Tanks
- Gross Pollutant Traps (GPT)
- Bio-retention Beds – Surface vegetated depressed area underlaid by a bio-retention filter layer and subsoil pipe, which do not generally involve flow conveyance but have an overflow to the drainage system. Refer to SD047.
- Infiltration Systems –Underground storage in voids, combined with a filtering sandy soil depression (where possible), for infiltration into the surrounding soil. This method does not involve surface-flow conveyance, but has an overflow to the drainage system. (Refer to SD053 which provides for slow release of stored water via a socked subsoil pipe where infiltration into saturated surrounding soil becomes ineffective). Refer also to the publication Australian Runoff Quality section 11 regarding trench locations in various soil types.
- Wet Basins
- Dry Basins
- Vegetated Filter Strips
- Sand Filters
- Contour banks/berms
- porous paving
- Constructed Wetlands

In order to achieve an effective WSUD “treatment train” is suggested:

- Drainage System to collect and deliver stormwater from impervious areas to the treatment train, eg roof gutters, downpipes, paths and driveways, etc.
- Pre-treatment system, eg leaf guards, first flush device, where leaves and dust may be prevalent.
- Rainwater tank for non potable reuse including toilet flushing, washing machines and site irrigation.
- On site detention (OSD). Note OSD for small medium density developments may be provided by a combination of upsizing and reconfiguring the rainwater tank and by providing additional storage and water quality in an underground infiltration trench. Refer to this chapter above and SD052 and SD053.
- Rain Garden.
- Vegetated Filter Strip.
- Mulching
- Garden Bed or Contour Bank.
- Porous Paving.
- Turf.

Regarding underground infiltration (SD053) the system should:

- not be trafficked unless specifically designed so.
- be located such that structural foundations and adjoining properties are not adversely affected.
- be provided with a subsoil drain relief pipe in clay soils.

8.2.2. Erosion & Sediment Control (ESC)

Pollutants carried in stormwater runoff, generated from building activity, vehicle parking, manoeuvring, and hardstand areas should be assessed for the potential adverse effects of sediment movement (by wind, water and wheel-tracking), and vehicle-sourced hydrocarbon pollution. Appropriate measures must be taken to contain pollutants, both during construction and as long term permanent treatments. Reference should be made to Landcom/Department of Housing guidelines “Managing Urban Stormwater”. An ESC Plan should be prepared as part of the drainage design for the site.

9. DRAINAGE EXTERNAL TO THE SITE

Stormwater runoff either entering or leaving the development site must be adequately addressed as part of a drainage design. Adjoining land should be investigated regarding natural surface flows and any existing piped discharge points. Where discharge of stormwater involves works on a public road reserve (other than that permitted in this chapter) such as adjustment of existing pits, new pits, extended pipelines beyond the immediate vicinity of the property, Council approval under the Roads Act must be obtained prior to commencement of works. Development consent under the EP&A Act does not apply for this purpose.

9.1. DISCHARGE FROM UPSTREAM

Where stormwater discharges onto the development site from adjoining properties that discharge must be catered for. Allowance should be made for discharge from a fully developed upstream catchment, (consistent with designated zoning), with provision made for major and minor storm events.

9.2. DISCHARGE DOWNSTREAM

Where stormwater discharges from the development site is at a level that prohibits discharge at the surface, consideration shall be given to the provision of standard underground street drainage (see chapter 6) to the closest point of discharge, such as an existing pit, pipe or channel. All pipes entering Council's existing piped drainage system from private property shall be connected at or with a concrete pit constructed in accordance with this Manual, or as a "saddle pit" over the existing pipe in accordance with an engineer's design.

Piped discharge shall be (for example, in large-lot and rural development) to a suitable watercourse and shall extend a minimum of 10 metres past a building or building envelope.

9.3. DOWNSTREAM DRAINAGE UPGRADE

The existing downstream drainage system may require investigation for its adequacy to accept stormwater runoff from the development site. Works may be required to provide an up-graded pipe system, being either a new pipe system where none exists, or an open channel, to an existing approved discharge point.

APPENDIX A

ENGINEERING DESIGN PLANS

GUIDELINES FOR THE PREPARATION OF DEVELOPMENT & ENGINEERING DESIGN PLANS

1. PLANS

Plans shall be presented in a professional manner to normal industry standards and generally in accordance with AS1100. Any plan sets submitted to Council shall be clearly marked with an issue/revision number, together with the associated date on each sheet.

DWG files shall be provided to Council. All hardcopy plans shall be presented on A1 drawing size.

2. SCALES

Roads and drainage	1:500 minimum or as required for clarity
Site plans	1:1000 min.
Long sections	1:500 horizontal & 1:100 vertical
Cross sections	1:100 natural or 1:200
Catchment plans	1:1000 or sufficient to cover area and provide clarity
Kerb profiles	1:200 H and 1:20 V

3. DETAILS TO BE SHOWN ON PLANS

The plan set should have the following information:-

- Property description.
- Owner/developer.
- Surveyor/engineer/designer and contact details
- Scale, benchmark and datum.
- Plan number and sheet number (sequential).
- Description of works on each sheet.
- Panel for signature of designated Council officer or Accredited Certifier.
- Plans shall show the location by survey or by service authority plans of all utility services.
- General, or Construction notes must include the following statement:

All works shall be carried out in accordance with the approved plans, subject to Maitland City Council's "Manual of Engineering Standards"

Other notes such as the following are recommended for inclusion.

3.1. SURVEY

All levels shall be obtained from established benchmarks to Australian Height Datum (AHD).

3.2. TRAFFIC

Traffic control measures shall be in accordance with the RMS document "Traffic Control at Worksites"

3.3. TREES

All trees within the allotments and reserves (other than road reserves) shall be retained, unless otherwise nominated by an approved landscape plan.

Removal of trees for the establishment of fire-breaks shall be carried out in consultation with the Fire Control Officer and/or Council's Environmental Officer.

3.4. UTILITIES

Points of conflict between new construction and existing utility service mains shall be identified, exposed and reported to the Project Manager prior to construction.

Service conduits shall be laid in positions as approved by the relevant authority.

3.5. ADJOINING ACCESS

Provision shall be made for suitable protection of the existing road pavement, kerb and gutter and footpath formation.

Vehicular access and all services to adjoining properties affected by construction works, shall be maintained at all times.

3.6. SOIL/GRASS

Topsoil, 150mm thick shall be applied to all footpaths and filled areas. Where turf is not requested, all exposed topsoil shall be seeded immediately upon completion of the soil spreading operation.

A turf strip shall be placed along each side of concrete pathways, drainage structures, driveways, pedestrian/cycleways and at rear of all kerbs.

3.7. EROSION CONTROL

All silt control measures shall be placed prior to commencement of earthworks. Such measures shall be subject to further additions or alterations, where considered necessary, as directed by the Project Manager or Council, during the progression of works.

All final erosion prevention measures including establishment of grass shall be completed prior to the “final” inspection.

3.8. SUBSOIL DRAINAGE

Subsoil drains shall be provided as shown on the plans. Additional drains shall be provided where considered necessary, by Council or a geotechnical engineer.

3.9. MATERIALS & TESTING

All materials and products for installation and construction shall comply with Australian Standards.

Monitoring testing (“string-line” and “roll”) where specified by Council’s Manual of Engineering Standards, to be performed by Council, shall be arranged 24 hours in advance. Where a Council officer is not available, a geotechnical engineer may perform such tests.

4. PLANS

4.1. LAYOUT PLANS

Road plans as a minimum shall contain the following:-

- Locality sketch.
- Site location.
- Centreline chainages as pegged.
- The chainage shall be aligned with the long section and run left to right across the plan for plans and long section.
- North point
- Location and description of benchmarks (BM’s) to AHD or other appropriate datum.
- Subsoil drainage location and a typical section.
- Existing road names and proposed road names, (determined prior to release of engineering plans).

- Proposed lane widths and types of kerbs.
- Dimensions of all linemarking.
- All existing services to location and level.
- All drainage and structures with pipe and lintel sizes.
- Kerb radii.
- Existing drainage and road feature and their levels.
- Existing and proposed contours at 0.5 metre interval or 0.2 metre in flat terrain.
- The determined High Flood Level (HFL).
- Cut and fill batter limits and road reserve boundaries.
- Major trees or natural features affected by the design.
- Intersection and cul-de-sac details including lot boundaries, streetsign location, pram ramps, pits, vehicular crossings, pipe crossing locations and contours (for abnormal complex shapes).

4.2. LONGITUDINAL SECTIONS

The chainage should run left to right across the page and shall include:-

- Chainages.
- Natural surface levels on pegged centreline or design control line.
- Design surface levels.
- Vertical alignment details.
- Grade lines, vertical curves and lengths, high points (HP), low point (LP) and RL of intersection points (IP).
- Datum of long section.
- Chainage, conduit size and location of public utilities.

4.3. CROSS SECTIONS

Cross sections shall be shown generally at no more than 20 metre intervals and at all key points for design purposes, i.e. access, intersection or kerb service locations. Where appropriate for level control designs may require cross sections down to 5 metre intervals.

Cross sections shall be laid out from left to right, bottom to top, on sheets sequentially numbered with the appropriate chainage shown in the title block.

Cross sections shall extend for the full width of the road reserve or sufficient to detail batters and shall show enough detail to transition to existing works such as grades, distances, etc. and crossfalls to such new works shall be generally within the range of 2% to 7%.

Details on cross sections shall include:-

- Road centreline.
- Offset chainage.
- Existing surface RL and design surface RL.
- Design crossfall in % batter slope ratio and access grades.
- Design centreline shift, offset crown or transitions if applicable.
- Public utility location for offset distance and RL.
- Existing and proposed road reserve boundaries and levels.

A Typical Cross Section shall be included and shall show (in addition to the points above):

- Crossfalls & batter slopes.
- Subsoil drainage.
- Footpath and/or cyclepath.
- Turfing (strip & full).
- Road pavement details including a table of pavement parameters, with design CBR and ESA details.
- Dimensioned widths.

5. KERB RETURN PROFILES AND PLANS

Each profile should have a kerb return number (e.g. KR1) corresponding with a KR1 number shown on the plan view. The profile chainages should follow the flow of traffic direction.

The details to be shown include:-

- The horizontal and vertical scale.
- Chainage. The running face of kerb chainage related to the profile, together with the chainage related to the road centrelines, generally tangent points (TPs).
- Design level, specifying either top of kerb or lip of gutter.
- Existing kerb levels where appropriate.
- The applicable road/street names/numbers leading into the profile.
- An extension of a minimum of 15 metres beyond the tangent points to ensure a smooth profile is achieved.
- Show location and number of proposed drainage structures.
- Datum RL of kerb return.

Kerb or pavement profiles should be provided for traffic islands etc. at large, complex intersections and roundabouts to provide additional level control.

6. STORMWATER

The stormwater detail sheets shall show catchment plans including areas outside of the development, calculations, pit sub-catchments numbered or referenced, and overland flow paths for the 100 year ARI storm event including flow path capacity calculations.

Stormwater plans shall include the following:-

- North point.
- Numbering of drainage lines.
- The pit/structure nomenclature.
- The location of any pit utility mains/services crossing influenced by the pipeline or pit.
- The location and centreline chainage of any applicable drainage structure.
- Note referring to type of bedding.
- Location and width of existing or proposed drainage easements.
- Overland flow paths, typical sections and capacities.
- The 100-year flood contour/line, whether from the Hunter River or the local catchment.

Drainage longitudinal section sheet shall show the chainages running left to right across the sheet starting at the upstream end of the system.

Details on the longitudinal section shall include:-

- Consecutive centreline chainages and finished surface levels.
- Pipe design invert level, grade and existing surface level.
- Inverts of existing drainage open channels where necessary.
- Pipe size, class and type and hydraulic grade line.
- Public utilities affected.
- Pit structure, type and reference number.
- Datum RL to AHD.
- Capacity and design flow.
- Bulkheads, trench stops and any bedding requirements.

7. ENGINEERING SURVEY

Engineering survey of the proposed development/subdivision shall accurately show landform and features. Prior to any layout design all physical features that may affect design and construction shall be located, levelled and plotted on the plan including:-

- Rock outcrops.
- Trees, their diameter and canopy spread.
- Watercourses, dams, springs, etc.
- Any man made structures, drainage, kerb and gutter, buildings, property access etc.
- Existing utilities and services.
- Top and bottom of banks, gullies, etc.
- Contours to 0.5 metre intervals (or 0.2 metre in flat terrain).

7.1. DATUM / BENCH MARKS

Bench marks related to Australian Height Datum (AHD), shall be located clear of any proposed works with a maximum spacing of 150 metres. Bench marks shall be clearly shown on the plans with origin of levels and datum. Road pegging shall commence at zero at the centreline of any intersecting road. The centreline shall be approximately indicated and labelled at each chainage.

Unless adequately justified, all survey shall be related to Australian Height Datum (AHD) and the appropriate grid, in accordance with Survey Practise Regulations.

7.2. CROSS SECTIONS

Cross sections shall be located at 20 metre (max.) intervals on straights and 15 metre (max.) on curves. Cross sections shall also be located at tangent points (TP) of curves and to superelevation widening transitions. The above spacings are a maximum and additional cross sections may be necessary in difficult terrain or unusual features.

Cross sections shall be provided at least 60 metres along any existing intersecting roads to assist a satisfactory design match.

7.3. LONGITUDINAL SECTIONS

Longitudinal sections shall extend a minimum of 60 metres along any intersecting roads to assist a satisfactory design match. The long section for cul-de-sacs shall be carried 20 metres beyond the kerb or to the recovery peg on the centreline prolongation.

Long sections on offset cul-de-sac heads shall be along a curve between the TP and centreline and shall also extend beyond the kerb a minimum of 20 metres. Hammerhead turning areas shall be treated similarly.

8. EROSION & SEDIMENT CONTROL PLANS

These plans shall be clear and legible and show the location and type of each structure or device.

Details on sediment control plans shall show:-

- Capacity of structures.
- Batter slopes and lengths.
- Maintenance access – fences, spillways.
- Proposed staging of restoration/vegetation works.
- Stockpile sites and treatment.
- Construction entry/exits.
- Details of type of control (sketch).

9. TRAFFIC MANAGEMENT PLANS (& TRAFFIC CONTROL PLANS)

Traffic/Pedestrian Management Plans shall be provided where the works impact on public roads and footpaths, in accordance with AS 3742.3 or RMS Traffic Control at Worksites.

The plan shall be certified by an approved designer and shall include (but not be limited to) the following:-

- Total area of works and management features.
- Constructional stages resulting in changed provisions.
- Pedestrian movements and safe barriers.
- Detailed signposting, barricading, linemarking, lighting or any temporary works of such nature.
- Construction Zone speed restrictions including traffic control signals and signposting will necessitate liaison with the RMS for approval.
- Partial or full road closures (if permitted) will require liaison with Council and/or the RMS through Traffic Committee. Any advertising or public notification of such requirements will require adequate lead-time.

The Traffic Management Plan, may be amended by Council's engineer, (or the RMS or Police where necessary), at any time during construction, as the need arises. No works shall commence prior to Council or RMS concurrence to the plan.

10. MISCELLANEOUS

Sufficient survey, design and drawing detail to define all works on the plan of the proposed development or subdivision shall be shown. These details shall include:

- Site regrading (cut and fill).
- Batters.
- Retaining walls and structures, heights, structural design details.
- Drainage transitions/connections.
- Limits of works.
- Terraced areas including long sections and typical cross sections.
- Treatment of trees to be retained.
- Restoration or transition of new works to existing infrastructure.
- Pathways and overland flow routes.
- Detention basins/gross pollutant traps.
- Battleaxe handle, access grades and transitions/connections.



APPENDIX B

EROSION & SEDIMENT CONTROL

EROSION & SEDIMENTATION CONTROL

1. INTRODUCTION

Works shall be carried out in accordance with this document relating to the design, construction and maintenance of erosion and sediment control structures. Such structures may be either temporary or permanent.

The contractor shall carry out all works with an approach that is well planned and which minimises the likelihood of erosion and sediment affecting downstream lands, watercourses, wetlands or water bodies.

Developers are reminded of their obligations under the Environmental Planning & Assessment Act, the Protection of the Environment Operations Act and regulations and ordinances under those Acts, and the Local Government Act.

It is the responsibility of the developer, and/or representative, to be fully informed of their obligations with respect to legislative requirements. Neglect of these requirements may result in the issue of infringement notices, attracting appropriate fines.

The following guidelines should be understood in their context with the overriding parent publication "Managing Urban Stormwater – Soils & Construction", the *"Blue Book"*

2. SOIL EROSION & SEDIMENT LOSS

Soil erosion and sediment loss can either result from disturbance to land by the subdivision construction processes or development.

Soil disturbance is an integral part of development, however it is essential that construction activities limit exposure to erosion. This may be achieved by:-

- Limiting the area of site disturbance.
- Isolating catchment areas of the site so that clean (upstream) water is not directed through the works area.
- Retain and stockpile topsoil for reuse and revegetation.
- Control runoff and sediment movement at point source by the implementation of protection measures.
- Progressively vegetate disturbed areas as the work proceeds to minimise area of exposure.
- Provide large sediment capture systems where appropriate sized to the contributing catchment.
- Filtering/polishing of the trapped water prior to release to receiving watercourses/drainage system.

3. EROSION & SEDIMENT CONTROL PLAN

Designers and consultants must be familiar with the principles and objectives of soil erosion and sediment control prior to the preparation of such plans.

No works shall commence on the site until the erosion and sediment control plan has been approved by the Engineer or Accredited Certifier. The design plan shall in all cases be site specific and not a generalisation of soil erosion and sediment control philosophies.

The erosion and sediment control plan shall include, but not be limited to, the following:-

- Existing site catchment topographic details and contours of natural surface and regrade areas.
- Lot layout, sewer, water, roads and areas of disturbance.
- Nominated and fenced "NO-GO" areas to retain existing vegetative cover.
- Site works staging where appropriate and location of critical vegetation areas & watercourses
- Location of soil stockpiles, sediment control fences and other sediment control works.
- All hydrological information and calculations relative to sediment traps and basin designs.
- Type and location of 'clean water' diversion works.

Council must be provided with at least two days notice, prior to the commencement of construction.

The contractor shall strictly follow the works and recommendations contained within the soil erosion and sediment control plan and must discuss and gain approval for any possible changes for improvement.

4. MAINTENANCE

Transportation of materials to and from the site shall not cause deposition of material onto surrounding roads. Any inadvertent deposition shall be immediately removed from the road.

The contractor shall maintain all erosion control devices such that runoff from all disturbed areas shall be free from sediments and pollutants.

5. TEMPORARY MINOR EROSION & SEDIMENT CONTROLS

5.1. GENERAL

Such barriers, traps and point source control measures shall generally cater for catchments of less than 0.5 hectares. They shall be used on the downstream side of disturbed areas or around drainage pits below water outlet sites, and around culvert inlets and outlets.

5.2. HAY BALE BARRIERS

Hay bales should be installed on a similar basis to Silt Fences.

5.3. SILT FENCES

Silt fences shall be employed to filter runoff leaving the site, to trap sediment. They are normally placed on the contour with slight convex to the contour to form a pond for water collection. Each fence should be no longer than 20 metres, should be overlapping, and they should not capture large or concentrated flows.

Areas below silt fences should be undisturbed or revegetated. They should also have a stable outlet condition. Silt fences shall receive regular maintenance. The base of silt fences should be buried to prevent stormwater flows passing beneath the fence.

5.4. STORMWATER PIT & INLET TRAPS

Such sediment traps shall be used to protect constructed inlet pits, stormwater piping, culvert inlets and outlets etc. They can either be built from hay bales, silt fence or silt fence 'sausages', gravel filled or rock filled wire baskets. The choice of material depends upon the catchment area, type of material and the structure type shall be protected. These traps must be regularly maintained.

5.5. BUFFER ZONES

Buffer zones are corridors of existing vegetation intervening between the area of works and necessary areas of stormwater, gullies, creeks, Hunter River and the like. The vegetation filters impede solids and reduce nutrient levels in runoff. Wetlands, streams, rivers and remnant bushland on Council reserves and public land shall be protected by buffers. Buffer zone performance increases as catchment area and slope gradient decreases. 35 metre wide buffer zones generally provide adequate protection.

BATTER SLOPES

SLOPE (%)	BUFFER LENGTH (M)
2	15
4	20
6	30
8	40
10	50
12	60
14	70

Such areas are required to be fenced where shown on the approved engineering plans as directed by the Engineer. Such fencing must be plainly visible to all machine operators.

Buffer zones and “no access” vegetation areas may sometimes be utilised as minor filter systems for small catchments. Council may also require binding upstream of buffer zones to divert surface waters and/or stilling ponds to slow water and stop weed invasion into bushland areas, particularly adjoining sensitive environmental sites or wetlands.

5.6. DIVERSION BANKS & DRAINS

Runoff from natural areas and disturbed areas shall be controlled by the construction where appropriate of diversion drains. These may be in the form of earth or lined drains/banks, hay bales, sandbags or pipelines. They may require progressive implementation and frequent alteration as works proceed. Diversion drains shall be provided along haul roads and access tracks where such roads are considered to constitute an erosion hazard.

5.7. LEVEL SPREADERS

These are generally used at the outlet to diversion drains and have a level cross section to convert concentrated flows into non-erosive sheet flows. They may only be used to dissipate flows from small catchments.

5.8. SHAKE DOWN AREAS/ACCESS TO SITES

Shake down areas shall be provided to vibrate loose material adhering to the wheels and bodies of vehicles and plant. They shall be provided at the entry/exit to construction sites and are to reduce the tracking of sediments onto roadways from sites. They can be provided by a bed of large aggregate or cattle grid or similar.

6. PERMANENT OR SEMI-PERMANENT CONTROLS

These are control devices that intercept sediment from catchments generally greater than 0.5ha and mainly at the outlet or discharge point of the site. They should not be considered for use in isolation of the temporary or point source measures. There are generally two types:-

- The dry basin.
- The wet basin (wetland).

Basin designs must meet the following:-

- Volume/capacity of the trap shall be at least 250m³/ha of the site for the undisturbed area of the contributing catchment, dependent on soil types.

The capacity shall be measured below the invert of the lowest incoming flow into the trap. A secondary or emerging stabilised spillway shall be provided to prevent overtopping the structure. The basin shall have a 0.3 metre freeboard at the spillway.

The basin internal batter slopes shall be no steeper than 6h:1v in accordance with safety requirements of Australian Rainfall and Runoff. External batter slopes shall be no steeper than 2h:1v.

An all weather access shall be provided to the basin to allow access for maintenance in all conditions.

The basin shall have an arbitrary length to width ratio of 3:1 to encourage sediment settlement and longer distance travel.

Depending on the type of basin, discharge from the basin shall usually be via a perforated riser outlet encapsulated within a filter medium adequately joined to a pipe extending through the embankment to outlet to an approved area.

7. CHANNEL STABILISATION

Channels should be stabilised where high flows or velocities may cause erosion and scouring of the channel. Techniques employed depend upon the velocity of the flow and materials. Materials for stabilisation should be chosen accordingly. Such materials comprise:-

- Jute mesh.
- Reinforced turfing.
- Revetment mattress
- Geotextile or plastic lining.
- Stone pitching concrete or rip rap.

8. INSTALLATION OF SERVICES

It is the responsibility of the contractor and developer to install the necessary structures to services, which require protection. Such protection shall include the following:-

- Minimise the time any trench is open.
- Protect all road drainage pits and inlets.
- Progressively backfill all other service authority trenches.
- Revegetate specific areas, i.e. turf strip or grass seed and mulch.
- Place backfill on side of trench away from road.
- Surplus material removed immediately to stockpile.

- Protect stockpiles with silt control.
- Divert runoff away from trenches.

8.1. WIND EROSION

The developer shall comply with statutory controls.

An exposed site that is susceptible to wind generated dust particles, shall be progressively vegetated and watered. Where vegetation is not yet possible, dust suppression by constant watering shall be provided.

Mulching should be provided to minimise wind erosion. In some cases the provision of wind-breaks may be necessary in highly exposed or sensitive areas. These requirements will be considered on merits.

8.2. SOIL STOCKPILES

Soil stockpiles shall be located as shown on the approved plans and shall:-

- Be located outside of watercourses or flow paths.
- Be no higher than 3.0 metres, (however 1.0 metre is preferable)
- Slopes shall not exceed 2:1.
- Revegetated with a seed mix of oats, rye or Japanese millet or similar.
- Provision of soil erosion protective measures shall be placed around the stockpile.

9. PROGRESSIVE REVEGETATION

- All disturbed areas should be revegetated immediately after construction with the provision of topsoil, grass seeding or turf, or a combination of each.
- Footpaths shall be topsoiled following provision of all services and a turf strip placed behind the kerb.
- Staging of works shall allow for the progressive revegetation of disturbed areas to minimise potential for erosion.
- All large disturbed areas (such as within lots) must be scarified to a depth of 75mm and topsoiled to a minimum depth of 50mm. Should the Engineer or Accredited Certifier deem that the topsoil stockpiled is unsuitable for use, then he/she will direct that the contractor import suitable topsoil for the works.
- Hydromulching of all disturbed areas is recognised as an effective and speedy method of achieving revegetation and will be considered by the Engineer or Accredited Certifier as an acceptable practice where appropriate. Hydromulching shall be provided in accordance with the experienced and accredited supplier's specifications.



10. HAY MULCHING

10.1. SURFACE PREPARATION

Surface preparation shall comprise topsoil over the area scarified to achieve a 50mm depth massed into a scarified 75mm subgrade. Seed and fertiliser to be sown at specified rates. Hay shall be applied must be free from thistle or other woody species of acceptable quality and not rain affected.

Hay shall be applied at the rate of 5 tonne/ha evenly spread over the soil surface. The hay shall be tacked with amnionic bitumen emulsion at the rate of 2,500 litres/ha.

The following is a recommended seed mix:-

- Spring/Summer
 - 12 kilograms per hectare of Japanese millet.
 - 8 kilograms per hectare of Perennial rye grass.
 - 3 kilograms per hectare of Red Clover.
 - 3 kilograms per hectare of White Clover.
 - 5 kilograms per hectare of Hulled Couch.
- Autumn/Winter
 - 15 kilograms per hectare of Oats or Black Winder rye corn.
 - 10 kilograms per hectare of Wimmera rye grass.
 - 5 kilograms per hectare of Red Clover.
 - 5 kilograms per hectare of White Clover.
 - 5 kilograms per hectare of Couch

The above seed mixtures are appropriate for urban areas only. Where any “bush” areas or reserves shall be seeded with native species these will be determined by Council.

“Rhodes Grass” sown at 3kg/ha may be included in harsh environments, e.g. quarry sites or similar.

10.2. FERTILISER

Fertiliser at the rate of 250kg/ha should be provided where approved.

10.3. WATERING

The developer is responsible for the adequate watering of all revegetated areas and turf to ensure its natural regrowth from the time of planting through to issue of the subdivision certificate, although, if within a reasonable time beyond that date it is determined by Council that the works have failed to provide the intended result, the developer shall make good the defect.

Upon completion of construction works and full revegetation temporary sediment control structures shall be removed and those areas once containing the structures shall be revegetated and made good.

Mowing of revegetated areas and turf strips adjacent to kerb and gutter and pathways etc. shall be carried out to maintain the subdivision/development works in a tidy and presentable state.



APPENDIX C

STORMWATER DRAINAGE

STORMWATER DRAINAGE

1. RAINFALL INTENSITY FREQUENCY DURATION CHART – rainfall intensities

DURATION	1 YR	2 YR	5 YR	10 YR	20 YR	50 YR	100 YR	200 YR	500 YR
5 min	76.07	98.03	128.09	146.13	169.82	201.35	225.75	250.79	285.09
6 min	71.24	91.79	119.92	136.79	158.94	188.44	211.26	234.68	266.75
10 min	58.16	74.92	97.81	111.53	129.56	153.55	172.10	191.14	217.21
12 min	53.73	69.20	90.32	102.98	119.61	141.74	158.84	176.40	200.44
15 min	48.52	62.49	81.53	92.30	107.92	127.87	143.29	159.11	180.76
18 min	44.47	57.26	74.69	85.12	98.84	117.09	131.20	145.67	165.48
20 min	42.22	54.36	70.89	80.79	93.80	111.11	124.49	138.21	157.00
24 min	38.49	49.56	64.61	73.62	85.46	101.22	113.39	125.88	142.97
30 min	34.24	44.07	57.43	65.43	75.94	89.92	100.73	111.80	126.97
45 min	27.39	35.25	45.90	52.27	60.65	71.78	80.38	89.21	101.27
1.0 hr	23.22	29.88	38.89	44.27	51.35	60.77	68.03	75.49	85.68
1.5 hr	18.21	23.43	30.50	34.72	40.27	47.65	53.35	59.20	67.19
2.0 hr	15.27	19.65	25.57	29.11	33.77	39.96	44.74	49.65	56.35
3.0 hr	11.88	15.29	19.90	22.65	26.28	31.10	34.82	38.63	43.85
4.5 hr	9.24	11.88	15.47	17.61	20.42	24.17	27.06	30.02	34.08
6.0 hr	7.73	9.94	12.94	14.73	17.08	20.21	22.63	25.11	28.50
9.0 hr	6.01	7.73	10.06	11.46	13.29	15.73	17.61	19.54	22.18
12.0 hr	5.03	6.47	8.43	9.59	11.13	13.17	14.74	16.36	18.56
18.0 hr	4.01	5.14	6.64	7.52	8.69	10.24	11.44	12.66	14.32
24.0 hr	3.41	4.36	5.59	6.32	7.28	8.55	9.53	10.53	11.89
30.0 hr	2.99	3.82	4.88	5.50	6.33	7.42	8.25	9.10	10.26
36.0 hr	2.69	3.43	4.36	4.90	5.63	6.59	7.32	8.06	9.07
48.0 hr	2.25	2.87	3.63	4.06	4.65	5.42	6.01	6.61	7.42
72.0 hr	1.73	2.19	2.74	3.06	3.49	4.05	4.47	4.90	5.48

STORMWATER DRAINAGE

2. OVERLAND FLOW TRAVEL TIME AID

Table of 'k' values being $t \cdot I^{0.4}$ where: t = time in min and I = intensity in mm/h

DURATION	1 YR	2 YR	5 YR	10 YR	20 YR	50 YR	100 YR	200 YR	500 YR
5 min	28.27	31.29	34.83	36.71	38.99	41.74	43.70	45.58	47.97
6 min	33.06	36.59	40.72	42.91	45.57	48.78	51.06	53.25	56.04
7 min	37.69	41.71	46.41	48.91	51.93	55.58	58.18	60.67	63.86
8 min	42.18	46.67	51.92	54.72	58.10	62.19	65.09	67.88	71.45
9 min	46.54	51.50	57.30	60.39	64.11	68.62	71.83	74.90	78.83
10 min	50.80	56.21	62.54	65.91	69.98	74.90	78.40	81.76	86.04
12 min	59.04	65.34	72.69	76.60	81.33	87.05	91.11	95.01	100.00
14 min	66.98	74.12	82.45	86.89	92.25	98.73	103.34	107.77	113.42
16 min	74.65	82.60	91.89	96.83	102.81	110.03	115.16	120.08	126.38
18 min	82.10	90.84	101.04	106.48	113.04	120.98	126.61	132.03	138.95
20 min	89.35	98.86	109.96	115.86	123.00	131.63	137.76	143.65	151.17
22 min	96.43	106.69	118.65	125.02	132.72	142.02	148.63	154.98	163.09
24 min	103.35	114.34	127.15	133.97	142.21	152.17	159.25	166.05	174.73
26 min	110.12	121.84	135.47	142.73	151.51	162.11	169.65	176.89	186.13
28 min	116.77	129.18	143.63	151.32	160.62	171.86	179.84	187.51	197.30
30 min	123.29	136.40	151.64	159.75	169.57	181.43	189.85	197.94	208.27
40 min	154.42	170.81	189.84	199.96	212.21	227.02	237.53	247.63	260.53

THE KINEMATIC WAVE EQUATION

$$t = 6.94(L \times n^*)^{0.6} / I^{0.4} \times S^{0.3} \quad \text{and} \quad K = 6.94(L \times n^*)^{0.6} / S^{0.3} = t \times I^{0.4}$$

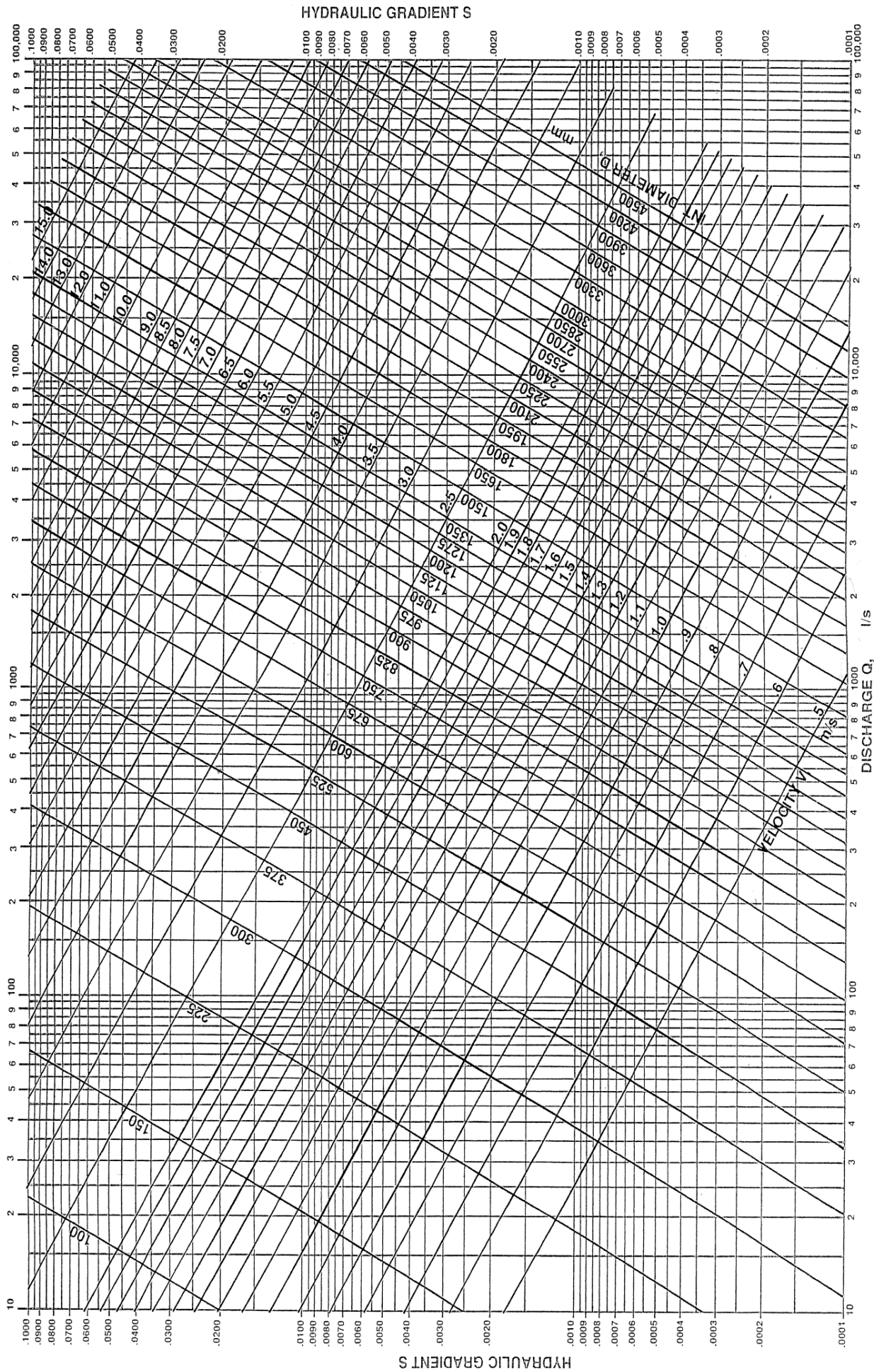
Where t is overland flow time (minutes)
 L is flow path length (m)
 n* is a surface roughness or retardance coefficient
 I is rainfall intensity (mm/hr)
 S is slope (m/m)

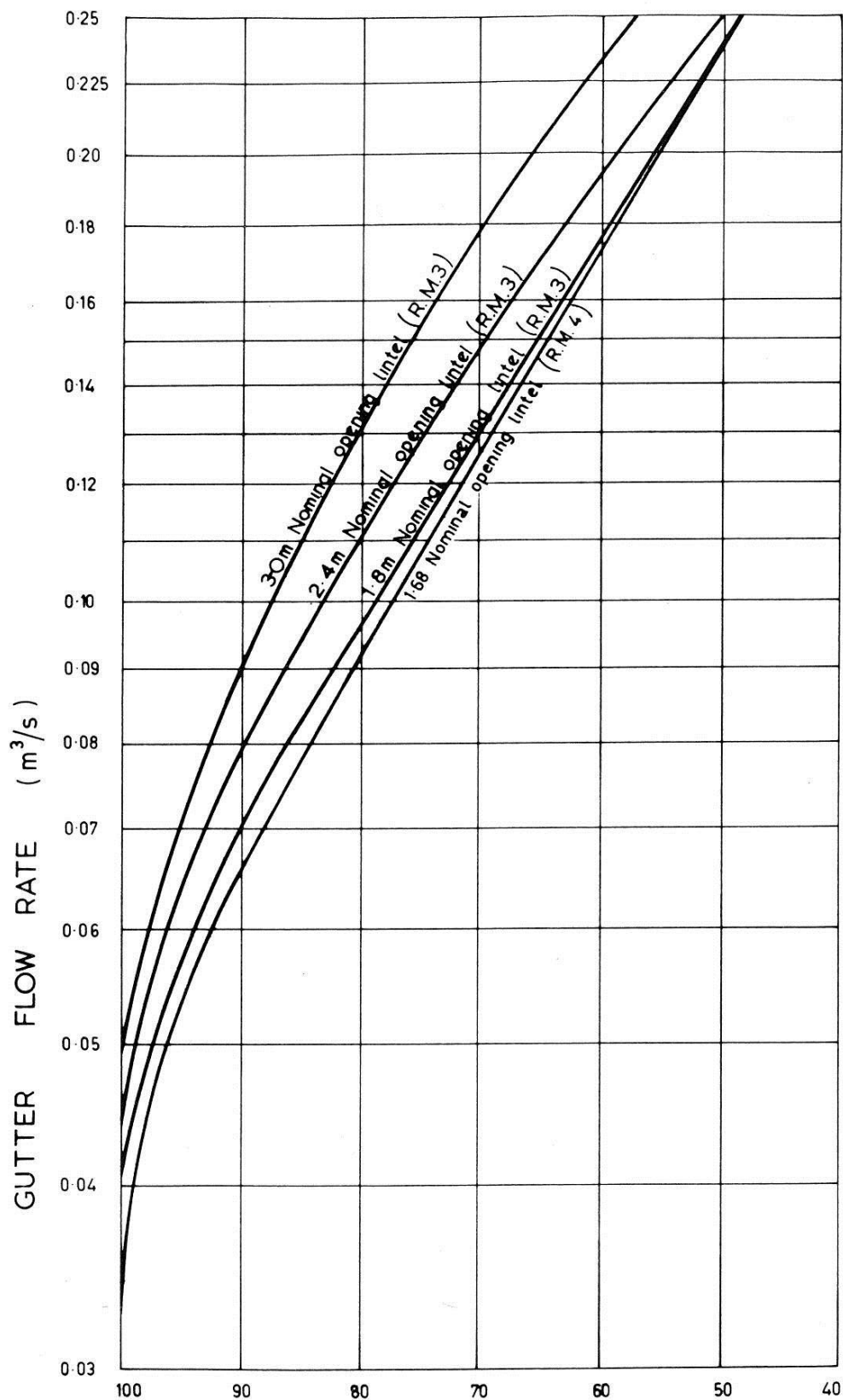
3. SURFACE ROUGHNESS OR RETARDANCE FACTORS

SURFACE TYPE	ROUGHNESS COEFFICIENT
Concrete or Asphalt	0.010 – 0.013
Bare Sand	0.010 – 0.016
Gravelled Surface	0.012 – 0.030
Bare Clay-Loam Soil (eroded)	0.012 – 0.033
Sparse Vegetation	0.053 – 0.130
Shod Grass Prairie	0.100 – 0.200
Lawns	0.170 – 0.480

Eg: For a sub-catchment length of 60m, a slope of 2 percent and a roughness of 0.05.

K = 43.38 For a 10 year ARI and the Overland Land Travel Time is 6 minutes.





$$INLET\ EFFICIENCY\ (I_{eff}) = \frac{FLOW\ INTO\ PIT}{APPROACH\ FLOW} \quad (\%)$$

SOURCE P.W.D. HYDRAULICS LABORATORY (MANLY)

APPROVED

[Signature]

RM.10 PIT INTAKE CURVE
ROADS

DEPARTMENT
OF
HOUSING

FIGURE

9-3

APPENDIX D

PAVEMENT MATERIAL PROPERTIES

TABLES FROM AUS-SPEC / C242

TABLE 242.3 – UNBOUND BASE MATERIAL PROPERTIES – AUS-SPECS

TEST METHOD	DESCRIPTION	BASE MATERIAL REQUIREMENTS			
		DGB20	GMB20	NGB20-2C	NGB20-2D
AS1289.3.6.1	Coarse Particle Size Distribution				
	% pass 75.0mm sieve	-	-	-	-
	% pass 53.0mm sieve	-	-	-	-
	% pass 37.5mm sieve	-	-	-	-
	% pass 26.5mm sieve	100	100	100	100
	% pass 19.0mm sieve	95-100	95-100	93-100	93-100
	% pass 13.2mm sieve	-	-	-	-
	% pass 9.5mm sieve	-	-	71-87	71-87
	% pass 6.7mm sieve	50-70	30-55	-	-
	% pass 4.75mm sieve	-	-	47-70	47-70
	% pass 2.36mm sieve	35-55	20-30	35-56	35-56
	% pass 0.425mm sieve	-	-	14-32	14-32
	% pass 0.075mm sieve	-	-	6-20	6-20
AS1289.3.6.3	Fine Particle Size Distribution Ratios expressed as % (for that portion of the material passing 2.36mm sieve)				
	A. Pass 425µm sieve %	35-55	30-50	-	-
	B. Pass 75µm sieve %	35-55	30-50	-	-
	C. Pass 13.5µm sieve %	35-60	-	-	-
AS1289.3.1.1	Liquid Limit (if non plastic) ▼	max 20	max 20	max 20	max 20
AS 1289.3.3.1	Plastic Limit (if plastic)	max 20	max 20	max 20	max 20
AS 1289.3.3.1	Plasticity Index ■	max 6	max 6	max 6	max 8
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve. (only applies if Plasticity Index is less than 1)	min 1.7 MPa	min 1.7 MPa	min 1.7 MPa	min 1.7 MPa
AS 1141.14	Particle Shape by Proportional Calliper. % misshapen (2 : 1)	max 35	max 35	-	-
AS 1141.22	Aggregate Wet Strength (kN) ◊				
	For category 1 or 2a	min 80	min 150	-	-
	For category 2b or 2c	min 70	min 130	-	-
	For category 2d	min 60	min 100	-	-
AS 1141.22	Wet/Dry Strength Variation ◊				
	<u>Dry - Wet</u> %				
	Dry				
	For category 1 or 2a	max 35	max 30	-	-
	For category 2b or 2c	max 40	max 30	-	-
	For category 2d	max 45	max 30	-	-
AS 1289.F1.1	4 day Soaked CBR (98% Modified Compaction)	-	-	80	60

NOTES ON TABLE 242.3

Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75 per cent of the particles larger than 6.70mm.

- ✓ The maximum value of the Liquid Limit may be increased to 23 for non-plastic material, provided that the value determined is not influenced by the presence of adverse constituents.
- For category 2d base materials the maximum Plasticity Index shall be 8.
- ◇ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested. The other fractions do not need to be tested unless there is a risk in the opinion of the Superintendent that such fraction may fail the specification. Any fraction at risk of failing must be tested.

TABLE 242.4 – UNBOUND SUB-BASE MATERIAL PROPERTIES – AUS-SPECS

TEST METHOD	DESCRIPTION	SUB-BASE MATERIAL REQUIREMENTS				
		DGS20	DGS40	GMS40	NGS20	NGS40
AS1289.3.6.1	Coarse Particle Size Distribution					
	% pass 75.0mm sieve	-	-	-	-	-
	% pass 53.0mm sieve	-	100	100	-	100
	% pass 37.5mm sieve	-	-	-	-	95-100
	% pass 26.5mm sieve	100	-	-	100	80-97
	% pass 19.0mm sieve	95-100	50-85	50-75	96-100	-
	% pass 13.2mm sieve	-	-	-	-	-
	% pass 9.5mm sieve	-	-	-	65-89	48-85
	% pass 6.7mm sieve	50-70	30-55	15-35	-	-
	% pass 4.75mm sieve	-	-	-	47-80	35-73
	% pass 2.36mm sieve	35-55	25-50	5-15	32-67	25-58
	% pass 0.425mm sieve	-	-	-	14-42	10-33
	% pass 0.075mm sieve	-	-	-	6-26	3-21
AS1289.3.6.3	Fine Particle Size Distribution Ratios expressed as % (for that portion of the material passing 2.36mm sieve)					
	A. Pass 425µm sieve %	35-55	35-60	25-50	-	-
	B. Pass 75µm sieve %	35-55	35-60	25-50	-	-
	C. Pass 13.5µm sieve %	35-60	35-65	-	-	-
AS1289.3.1.1	Liquid Limit (if non plastic)	max 23	max 23	-	max 23	max 23
AS 1289.3.3.1	Plastic Limit (if plastic)	max 20	max 20	-	max 23	max 23
AS 1289.3.3.1	Plasticity Index	max 12	max 12	max 12	max 12	max 12
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve. (only applies if Plasticity Index is less than 1)	min 1.0 MPa	min 1.0 MPa	-	1.0 MPa	1.0 MPa
AS 1141.14	Particle Shape by Proportional Calliper. % misshapen (2 : 1)	max 35	max 35	max 35	-	-
AS 1141.22	Aggregate Wet Strength ♦ For category 1 or 2a For category 2b or 2c For category 2d	min 50kN	min 50kN	min 130kN	-	-
AS 1141.22	Wet/Dry Strength Variation ♦ <u>Dry - Wet</u> % Dry	max 60	max 60	max 30	-	-
AS 1289.F1.1	4 day Soaked CBR (98% Modified Compaction)	-	-	-	30	30

NOTES ON TABLE 242.4:

Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75 per cent of the particles larger than 6.70mm.

- ◆ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested. The other fractions do not need to be tested unless there is a risk in the opinion of the Superintendent that such fraction may fail the specification. Any fraction at risk of failing must be tested.

Where the proposed unbound base material complies with all of the requirements of Table 242.3 except gradings (AS1289.3.6.1 and AS1289.3.6.3), the Contractor may propose the use of the material, subject to approval of the Superintendent, if the material complies with the RMS Modified Texas Triaxial Classification Number (T171) requirements specified in Table 242.5, (T171 tested at not less than 85 per cent of Optimum Moisture Content and 98 per cent of Maximum Dry Density as determined by AS1289.5.2.1).

TABLE 242.5 - RMS MODIFIED TEXAS TRIAXIAL CLASSIFICATION NUMBER REQUIREMENTS

TRAFFIC CATEGORY	MODIFIED TEXAS TRIAXIAL CLASSIFICATION NUMBER (TEST METHOD T171)
1	max 2.0
2a	max 2.2
2b	max 2.5
2c	max 3.0
2d	max 3.0

MAITLAND CITY COUNCIL STANDARD DRAWINGS

THIS DOCUMENT

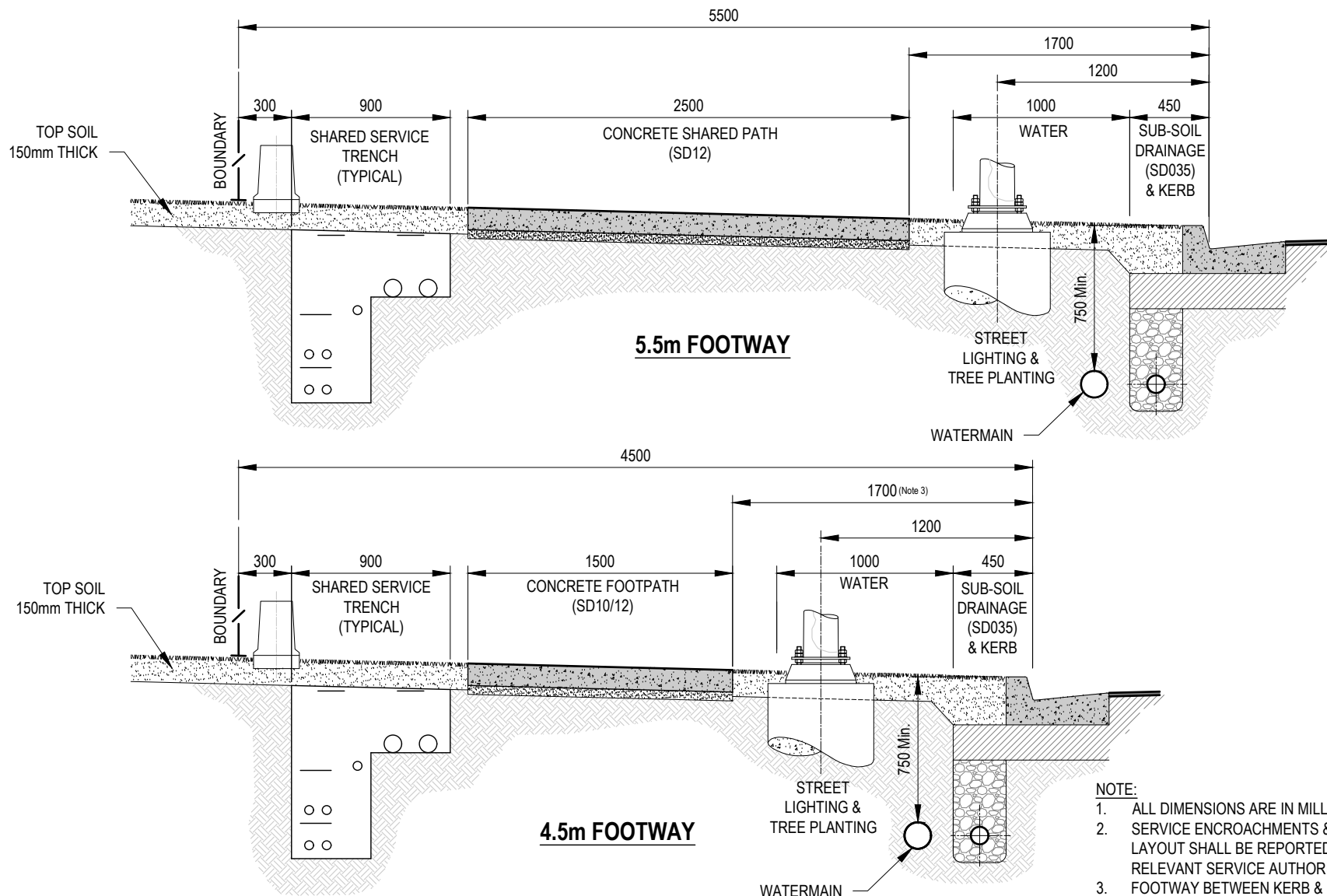
To be read in conjunction with:

- Maitland City Council's 'Manual of Engineering Standards'
- Relevant Australian Standards
- Austroads guidelines
- Roads & Maritime Services supplements
- Any copy of these documents is uncontrolled. Check the revision date of each sheet against the document held on Maitland City Council's website for currency
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SD001	FOOTPATH ALLOCATIONS FOR SERVICES & ACCESS	SD032	PAVEMENT WIDENING TO NEW KERB & GUTTER
SD002	FOOTWAY PROFILE - NEW SUBDIVISIONS	SD034	SILT TRAP & SWALE FOR UNSEALED HARDSTANDS
SD003	TYPICAL CROSS SECTION - RURAL RESIDENTIAL ROADS - NEW SUBDIVISIONS	SD035	SUB-SOIL DRAINAGE
SD004	STANDARD KERB PROFILES	SD036	KERB STORMWATER OUTLETS & KERB ADAPTOR
SD007	FOOTWAY DRIVEWAY CROSSING - GENERAL ARRANGEMENT	SD037	FOOTWAY FLOWPATH
SD008	DRIVEWAY PROFILES - RECOMMENDED MAXIMUM GRADES	SD038	FLOOD WARNING SIGNAGE
SD009	DRIVEWAY LOCATIONS - OBSTACLES & OFFSETS	SD039/1	GRADED GULLY PITS WITH EXTENDED KERB INLETS
SD010	DRIVEWAYS & KERB LAYBACKS - CONSTRUCTION DETAILS	SD039/2	GRADED GULLY PITS WITH EXTENDED KERB INLETS
SD012	DRIVEWAY, FOOTPATH & CYCLEWAY CONSTRUCTION DETAILS	SD040	SURFACE INLET PIT
SD013	RURAL DRIVEWAYS - PIPED CROSSING	SD043	INTER ALLOTMENT DRAINAGE PIT
SD014-15	KERB CROSSINGS	SD045	HEADWALL SCOUR PROTECTION - TYPICAL TREATMENT
SD019/1	FOOTPATH & KERB RAMP LOCATIONS AT INTERSECTION	SD046	DRAINAGE SWALE
SD019/2	KERB RAMPS	SD047	BIORETENTION SYSTEM (PLANTING BED)
SD020	SHARED FOOTPATH / CYCLEWAY SIGNAGE	SD048	WETLAND SPECIES LIST
SD023	BUS STOP FACILITIES - RURAL & URBAN SITES WITH & WITHOUT SHELTERS	SD049	STREET TREE PLANTING - TYPICAL TREATMENT
SD025/1	CONCRETE ACCESSES & THRESHOLDS	SD050	CONSTRUCTED WETLAND (WITH DETENTION)
SD025/2	CONCRETE ACCESSES & THRESHOLDS - JOINTS & LAYOUTS	SD052/1	ON-SITE STORMWATER DETENTION PIT
SD025/3	CONCRETE ACCESSES & THRESHOLDS - JOINT DETAILS	SD052/2	ON-SITE STORMWATER DETENTION TANK & DISPOSAL TRENCH
SD025/4	CONCRETE ACCESSES & THRESHOLDS - JOINT DETAILS	SD052/3	ON-SITE STORMWATER DISPOSAL TRENCH
SD026	CONCRETE DISH CROSSINGS AT INTERSECTIONS	SD057	FENCING
SD027	CUL-DE-SAC OPTIONS	SD058/1	STANDARD ACCESS GATE - GENERAL ARRANGEMENT
SD029	STREET NAME SIGN POSTING	SD058/2	STANDARD ACCESS GATE - COMPONENTS
SD031	MINIMUM INTERSECTION TREATMENT FOR HIGH/HEAVY TRAFFIC GENERATING DEVELOPMENTS		

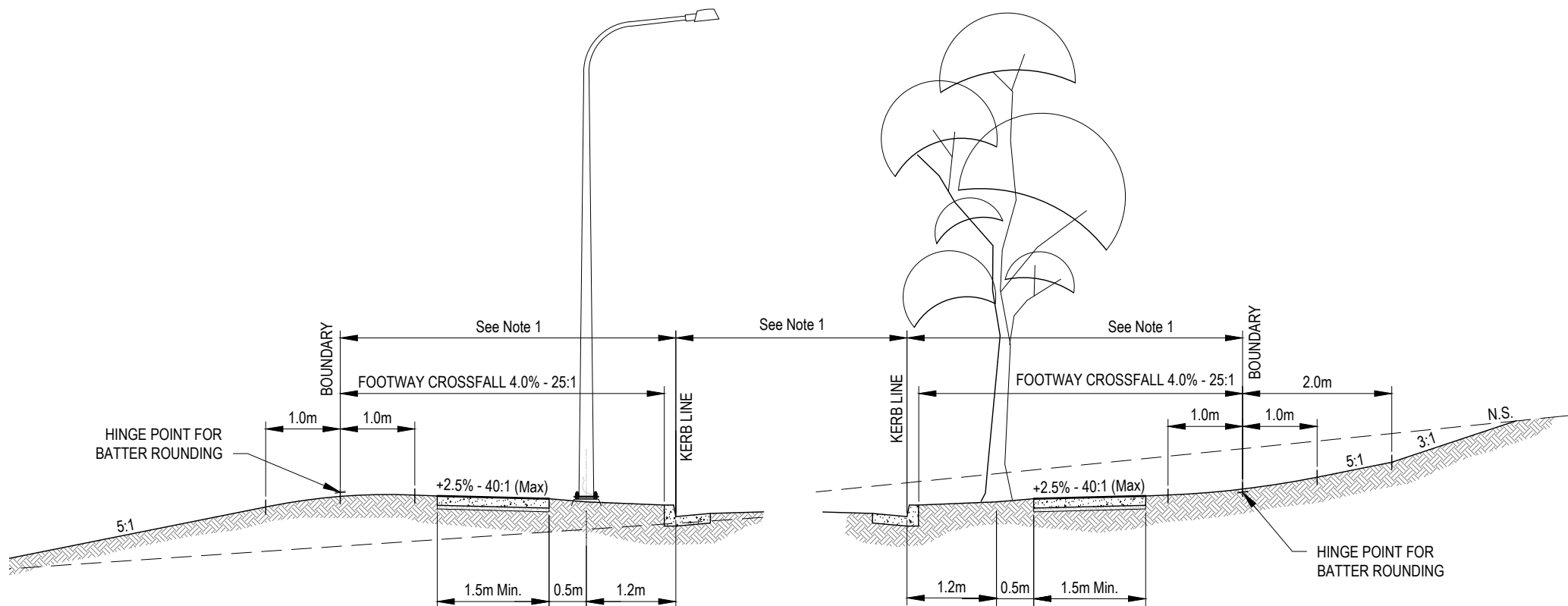




NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. SERVICE ENCROACHMENTS & VARIATIONS TO THIS LAYOUT SHALL BE REPORTED TO COUNCIL & THE RELEVANT SERVICE AUTHORITY.
3. FOOTWAY BETWEEN KERB & FOOTPATH TO BE FULLY TURFED





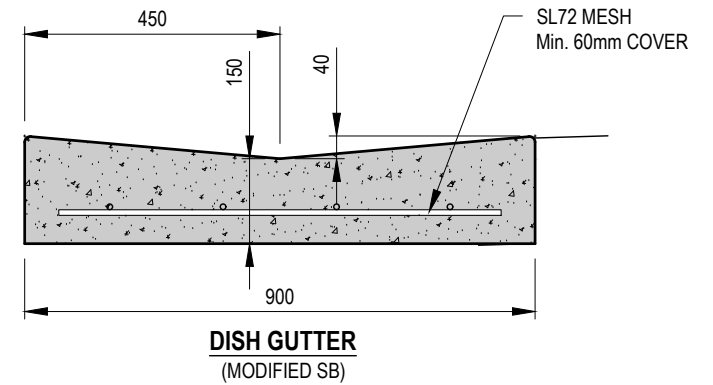
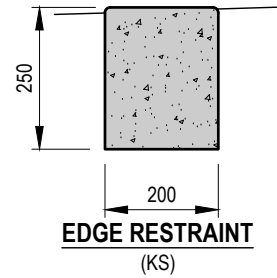
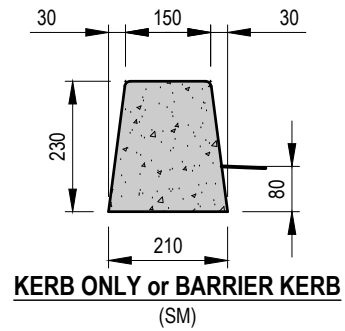
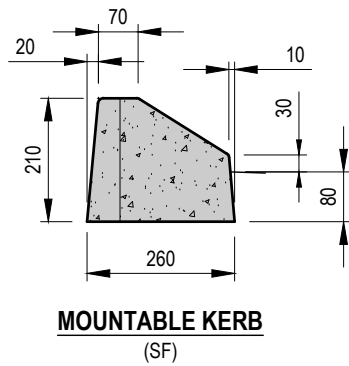
FOOTWAY ON FILL

FOOTWAY IN CUT

NOTE:

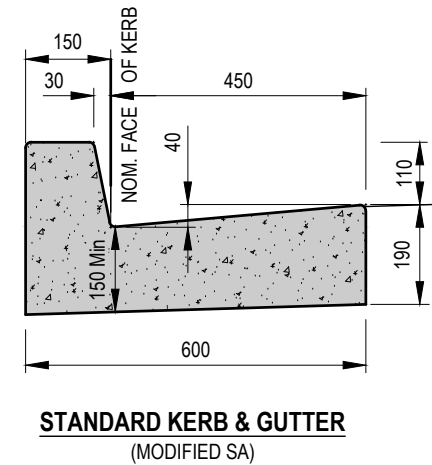
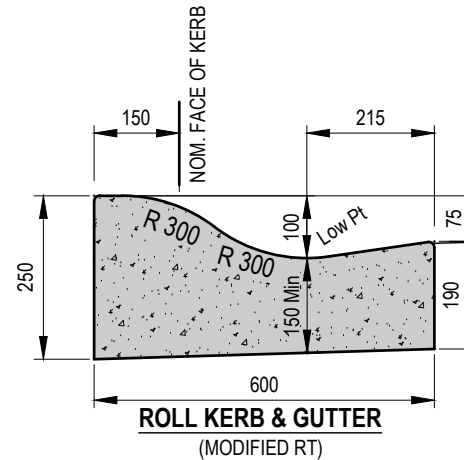
1. FOR CARRIAGEWAY, FOOTWAY & FOOTPATH WIDTHS SEE ROAD DESIGN SECTION OF "MANUAL OF ENGINEERING STANDARDS"
2. TYPICAL CROSSFALL ON CARRIAGEWAY TO BE -3% FROM CENTRELINE
3. TYPICAL CROSSFALL ON FOOTWAY TO BE +4.0% (25:1) FROM TOP OF KERB TO BOUNDARY
4. FOR PUBLIC UTILITY ALLOCATIONS IN FOOTWAYS SEE SD001
5. FOOTPATH WARRANT - SEE ROAD DESIGN SECTION OF "MANUAL OF ENGINEERING STANDARDS"
MINIMUM FOOTPATH WIDTH 1.5m, CROSSFALL TO BE +2.5% MAXIMUM WITH DESIGN TO SD012 & SD019
6. TREES TO COUNCIL'S "STREET TREE SELECTION GUIDE" OR AS APPROVED - PLANTING IN ACCORDANCE WITH SD049

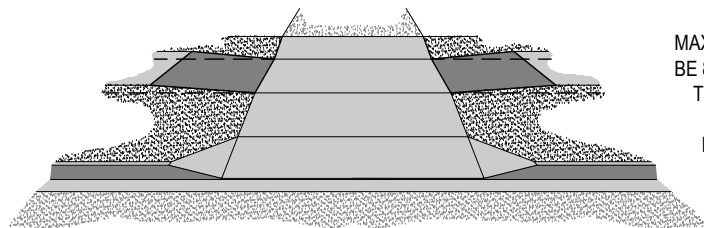




NOTE:

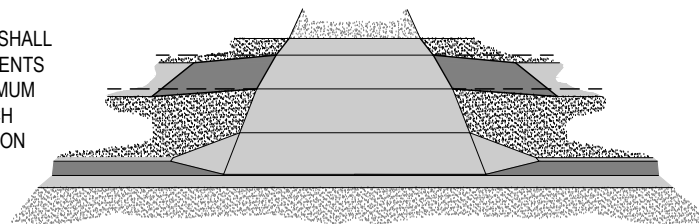
1. ALL DIMENSIONS IN MILLIMETRES
2. CONCRETE TO BE 32 MPa UNLESS OTHERWISE SPECIFIED
3. ALL EXPOSED CORNERS RADII 10mm UNLESS SPECIFIED OTHERWISE
4. MINIMUM THICKNESS OF CONCRETE TO BE 150mm





LOW LEVEL FOOTPATH CROSSING

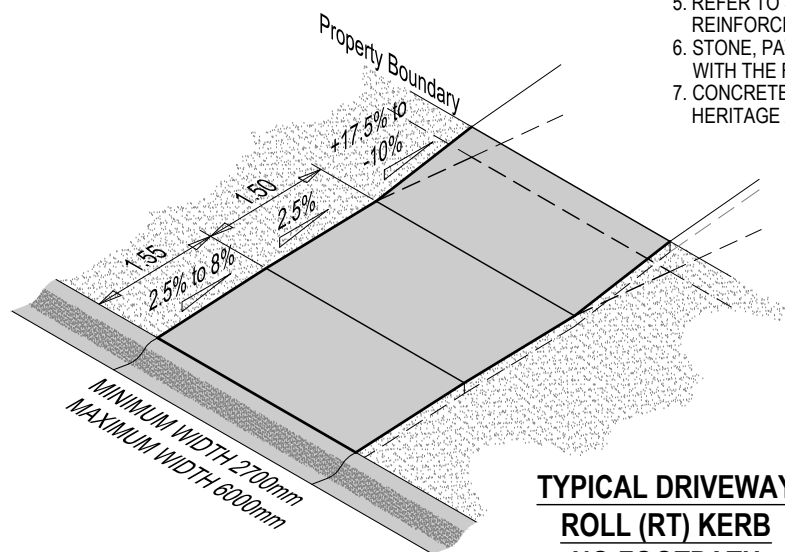
FOOTPATH GRADES MAY BE ADJUSTED TO ACHIEVE COMPLIANT DRIVEWAY GRADES. MAXIMUM GRADE FOR CONNECTING RAMPS SHALL BE 8:1 FOR 1.5m OR 14:1 FOR LONGER ADJUSTMENTS. THE FOOTPATH IS TO BE REPLACED WITH A MINIMUM WIDTH OF 1.5m. COLOUR & FINISH TO MATCH EXISTING FOOTPATH. MAXIMUM CROSSFALL ON FOOTPATH SECTION IS 2.5%



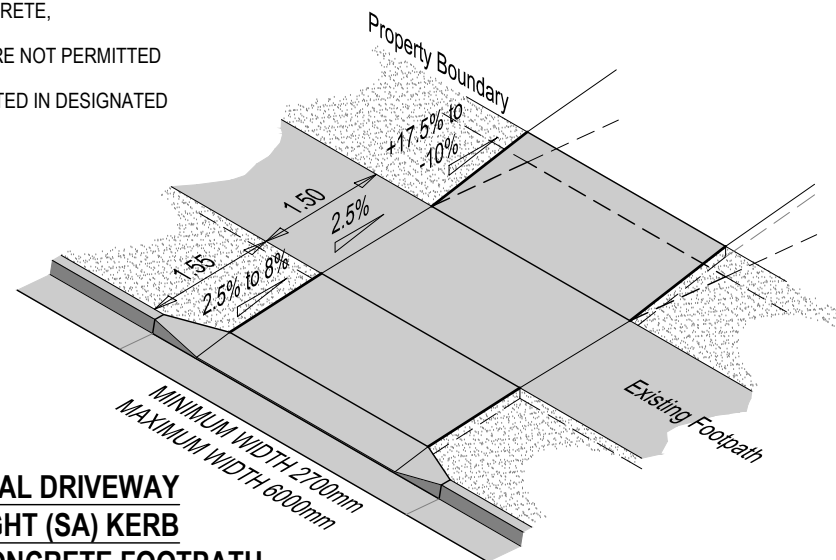
HIGH LEVEL FOOTPATH CROSSING

NOTE:

1. MINIMUM WIDTH OF THE FOOTPATH SHALL BE 1.50m IRRESPECTIVE OF EXISTING FOOTPATH WIDTHS.
2. ALL FINISHED SURFACE LEVELS OF THE FOOTWAY CROSSING SHALL PROVIDE SATISFACTORY VEHICULAR ACCESS TO AS2890.1 OR BETTER. THIS SHALL BE AT ALL POINTS OF THE FOOTWAY CROSSING PROFILE FROM THE KERB SIDE LANE TO BEYOND THE PROPERTY BOUNDARY.
3. FINISHED SURFACE LEVELS SHALL COMPLY TO SD008.
4. VARIATIONS TO THESE STANDARDS WILL REQUIRE INSPECTION & ACCEPTANCE BY COUNCIL'S APPROVING OFFICER.
5. REFER TO SD010 AND SD012 FOR LAYBACK, CONCRETE, REINFORCEMENT & SUB-BASE DETAILS.
6. STONE, PAVER OR FLAG DRIVEWAY SURFACES ARE NOT PERMITTED WITH THE FOOTWAY AREA.
7. CONCRETE STRIP DRIVEWAYS ARE ONLY PERMITTED IN DESIGNATED HERITAGE AREAS

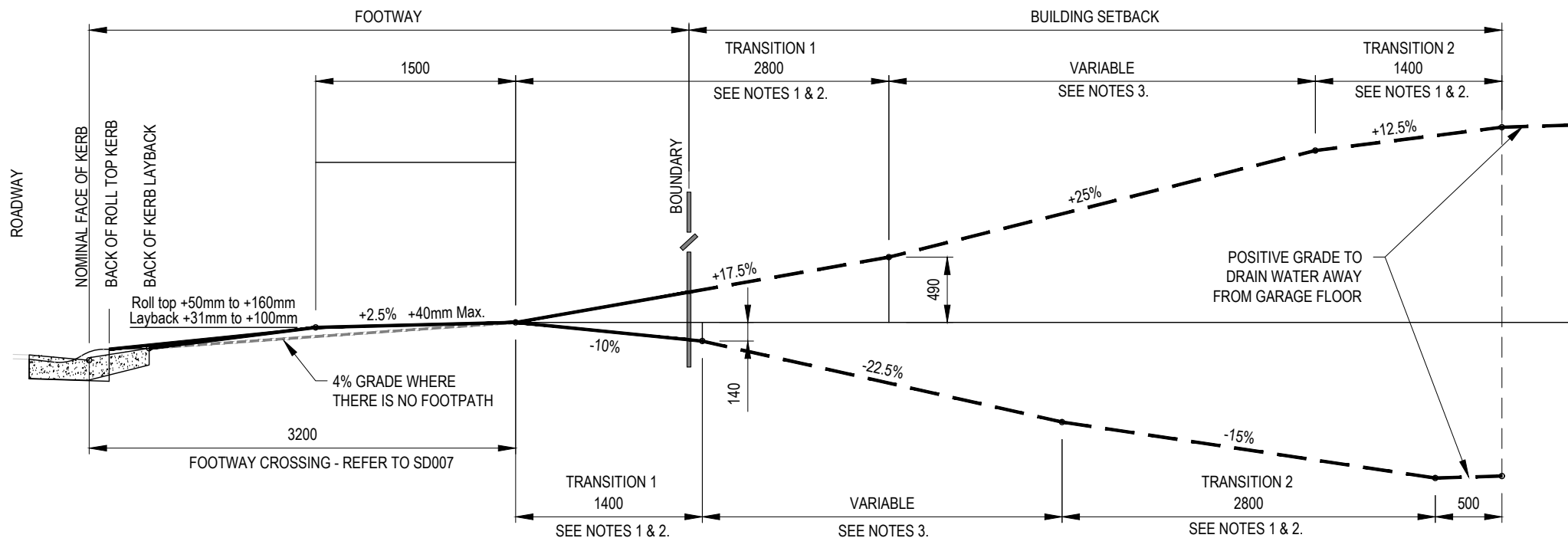


**TYPICAL DRIVEWAY
ROLL (RT) KERB
NO FOOTPATH**



**TYPICAL DRIVEWAY
UPRIGHT (SA) KERB
EXISTING CONCRETE FOOTPATH**





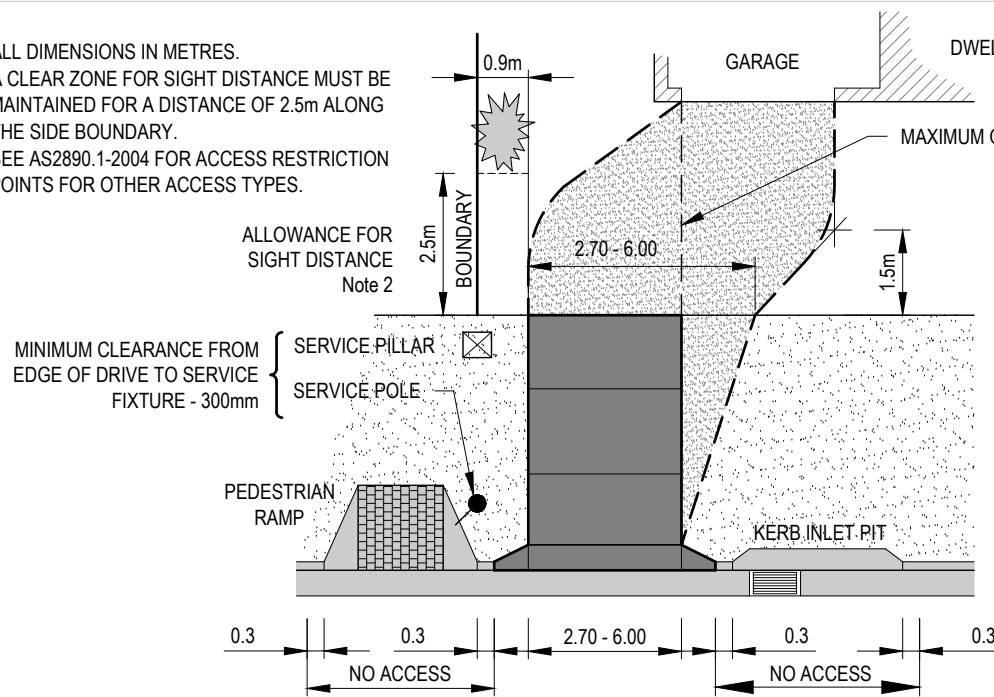
LONGITUDINAL SECTION

NOTE:

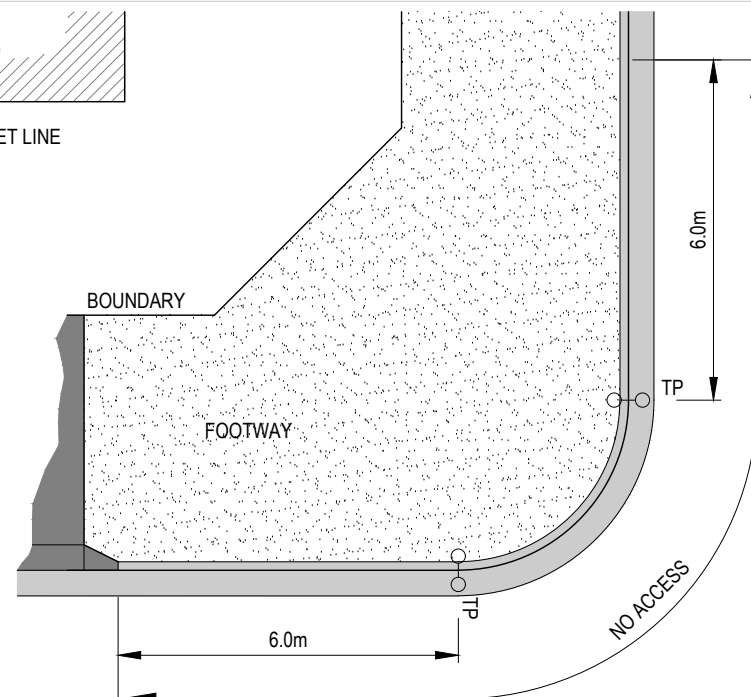
1. CONFORMS TO AS2890.1-2004 GROUND CLEARANCE TEMPLATE FIGURE C1 B85 VEHICLE - MAXIMUM 2.8m WHEELBASE, MINIMUM 120mm GROUND CLEARANCE.
2. PROFILES WITH GRADES LESS THAN THE MAXIMUM MAY NOT REQUIRE TRANSITIONS OR MAY HAVE ALTERNATE TRANSITION TREATMENTS.
3. CHANGES OF GRADE BETWEEN SECTIONS SHALL NOT EXCEED 15% IN SAGS OR 12.5% OVER CRESTS.
4. MINIMUM LENGTH OF TRANSITION SHALL BE 2.8m FOR A POSITIVE CHANGE IN GRADE AND 1.4m FOR A NEGATIVE CHANGE IN GRADE.
5. MAXIMUM GRADE SHALL BE 25% (1 in 4) WITHIN THE PROPERTY.
6. FOR APPROVAL, DESIGN PROFILES SHALL SHOW EXISTING & FINISHED SURFACE LEVELS AT KERB, AT CHANGES OF GRADE & AT GARAGE FLOOR OR PARKING AREA.
7. PROFILE TO BE APPLIED TO "WORST CASE" SIDE OF DRIVEWAY BEING SIDE WITH SHORTEST LENGTH, AND/OR GREATEST HEIGHT DIFFERENCE BETWEEN KERB AND GARAGE FLOOR LEVEL

NOTE:

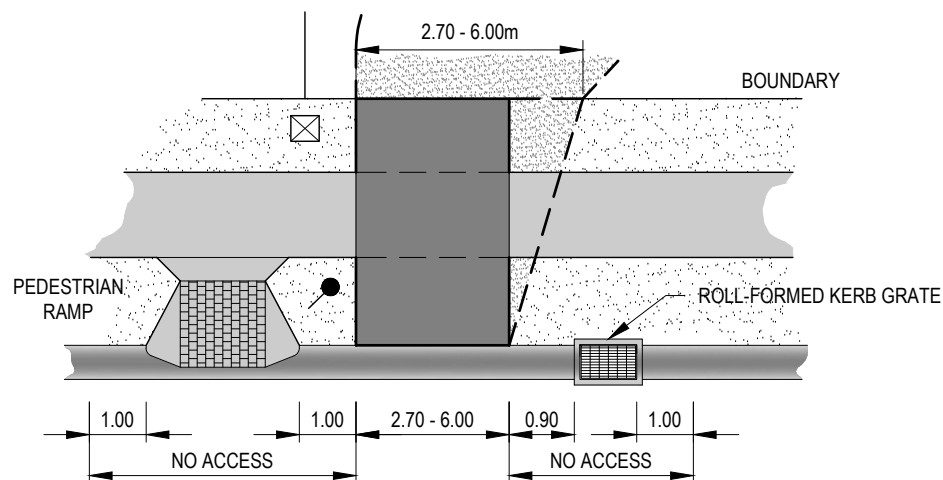
1. ALL DIMENSIONS IN METRES.
2. A CLEAR ZONE FOR SIGHT DISTANCE MUST BE MAINTAINED FOR A DISTANCE OF 2.5m ALONG THE SIDE BOUNDARY.
3. SEE AS2890.1-2004 FOR ACCESS RESTRICTION POINTS FOR OTHER ACCESS TYPES.



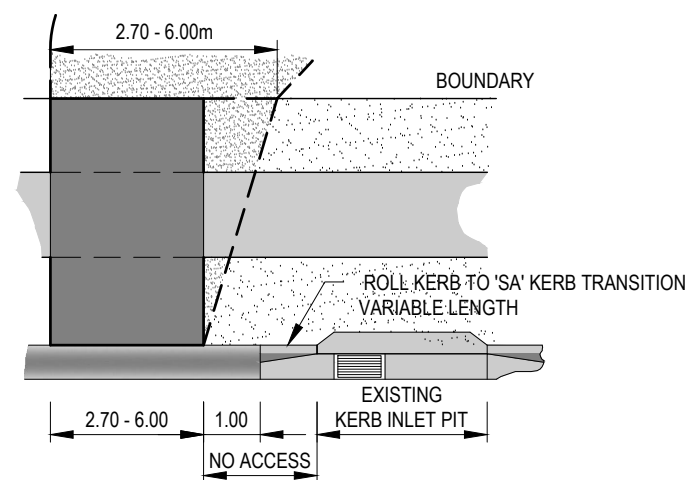
UPRIGHT 'SA' KERB



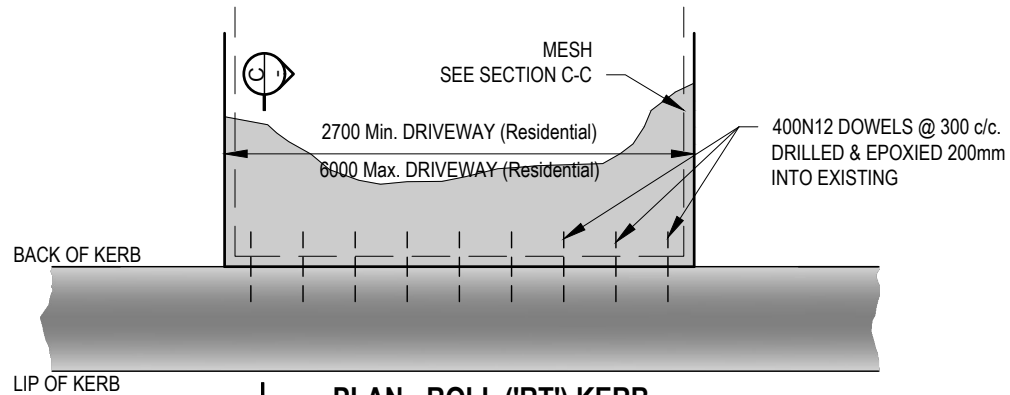
ACCESS RESTRICTION - INTERSECTIONS



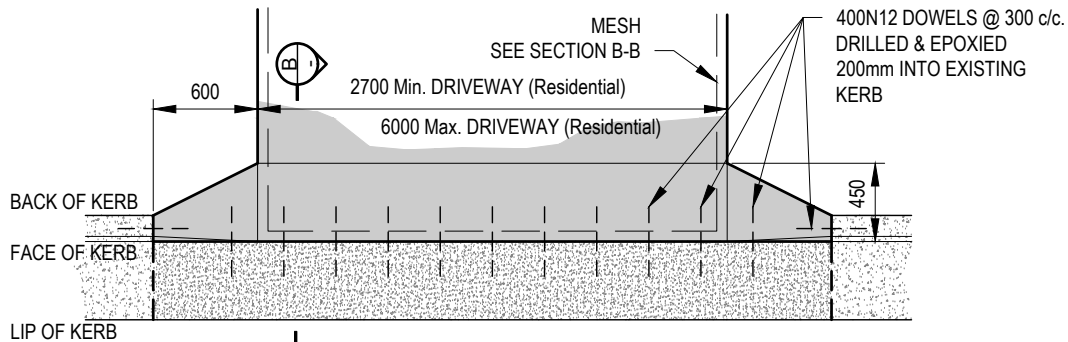
ROLL 'RT' KERB WITH KERB GRATE



ROLL 'RT' KERB WITH 'SA' KERB INLET



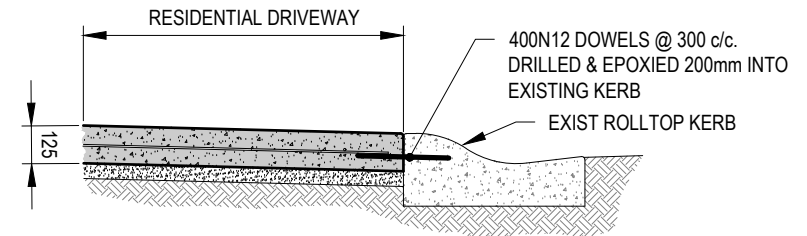
**PLAN - ROLL ('RT') KERB
RESIDENTIAL ONLY**



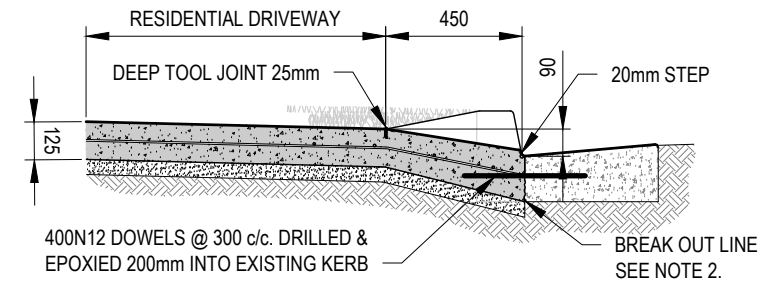
**PLAN - UPRIGHT ('SA') KERB
FOR RESIDENTIAL AND COMMERCIAL**

NOTE:

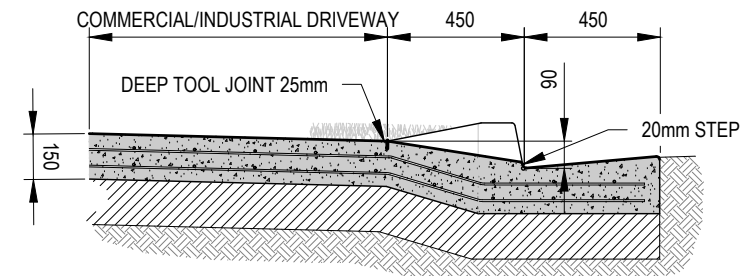
1. ALL DIMENSIONS IN MILLIMETRES
2. ALL CONCRETE TO BE 32MPa
3. SAWCUT BREAKOUT LINE TO MINIMUM DEPTH OF 75mm (NO MASTIC JOINTS PERMITTED).
4. PROVIDE FULL DEPTH EXPANSION JOINT AT BOUNDARY LINE.
5. FOR COMMERCIAL AND INDUSTRIAL ACCESSSES - WIDTH AND LAYOUT ARE SIZED TO SUIT TURNING MOVEMENTS OF DESIGN VEHICLES.



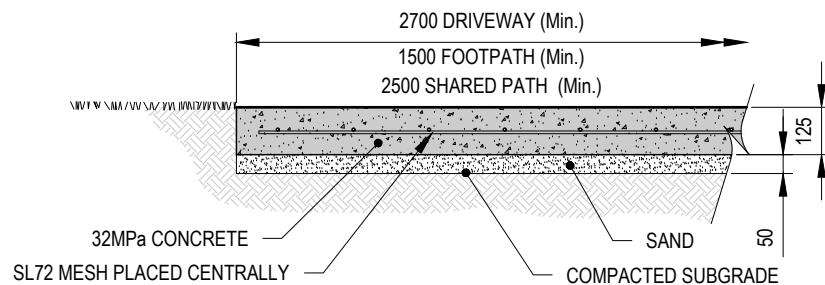
**SECTION C-C - ROLL ('RT') KERB
RESIDENTIAL**



**SECTION B-B - UPRIGHT ('SA') KERB
RESIDENTIAL**



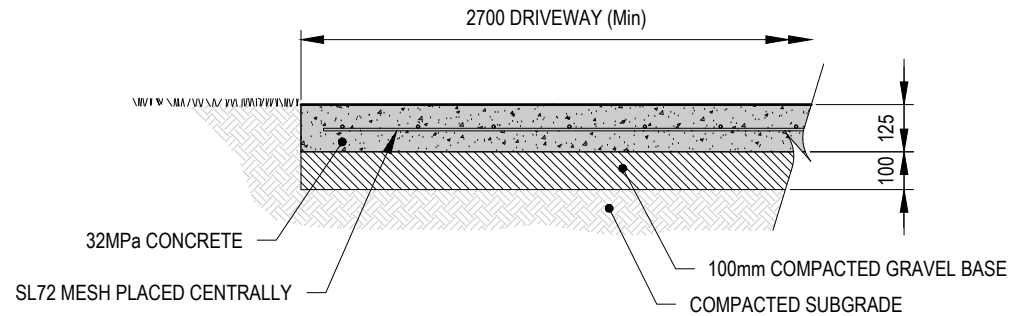
**SECTION B-B - UPRIGHT ('SA') KERB
COMMERCIAL/INDUSTRIAL**



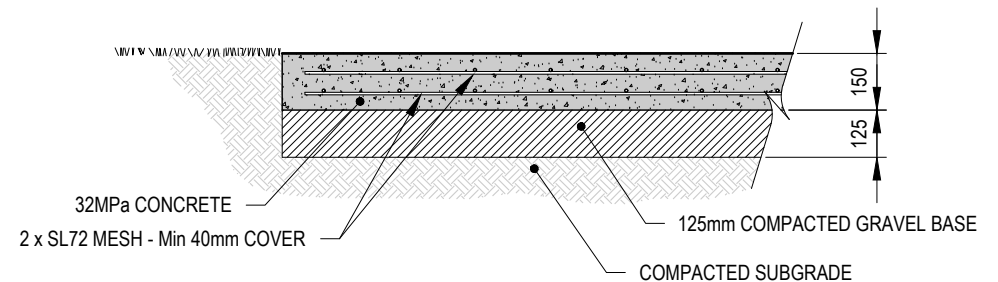
RESIDENTIAL DRIVEWAYS, CYCLEWAYS & FOOTPATHS

NOTE:

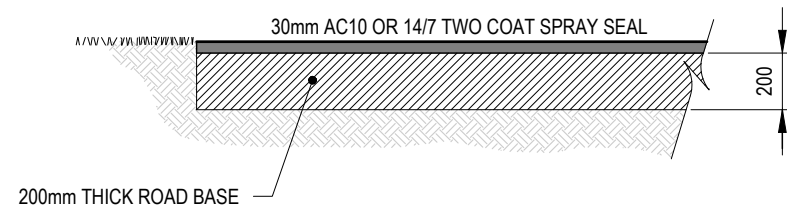
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. PROVIDE TRANSVERSE EXPANSION JOINTS AT 8.0m INTERVALS WITH R12 DOWELS, 300mm LONG AT 300mm CENTRES. REFER TO SD025 SHEET3 - JOINT FILLER SHALL BE FULL DEPTH
3. PROVIDE TOOLED DUMMY JOINTS AT 2.0m INTERVALS FOR PAVEMENTS LESS THAN 2.0m WIDE AND AT 4.0m INTERVALS FOR PAVEMENTS UP TO 3.0m WIDE. CUT EVERY 2nd BAR AT JOINT
4. JOINTS WITH EXISTING CONCRETE FOOTPATHS TO BE DOWELLED WITH R12 DOWELS, 300mm LONG AT 300mm CENTRES.
5. ALL DISTURBED EARTH OR GRASSED AREAS TO BE TURFED.
6. FOOTPATH WIDTHS TO SD001.
7. LAYBACKS AND CONNECTIONS TO SD010.
8. RURAL DRIVEWAY TO SD013.
9. KERB RAMP CONNECTIONS TO SD019.
10. CYCLEWAY AND FOOTPATH FINISH TO BE "LIGHT BROOM".



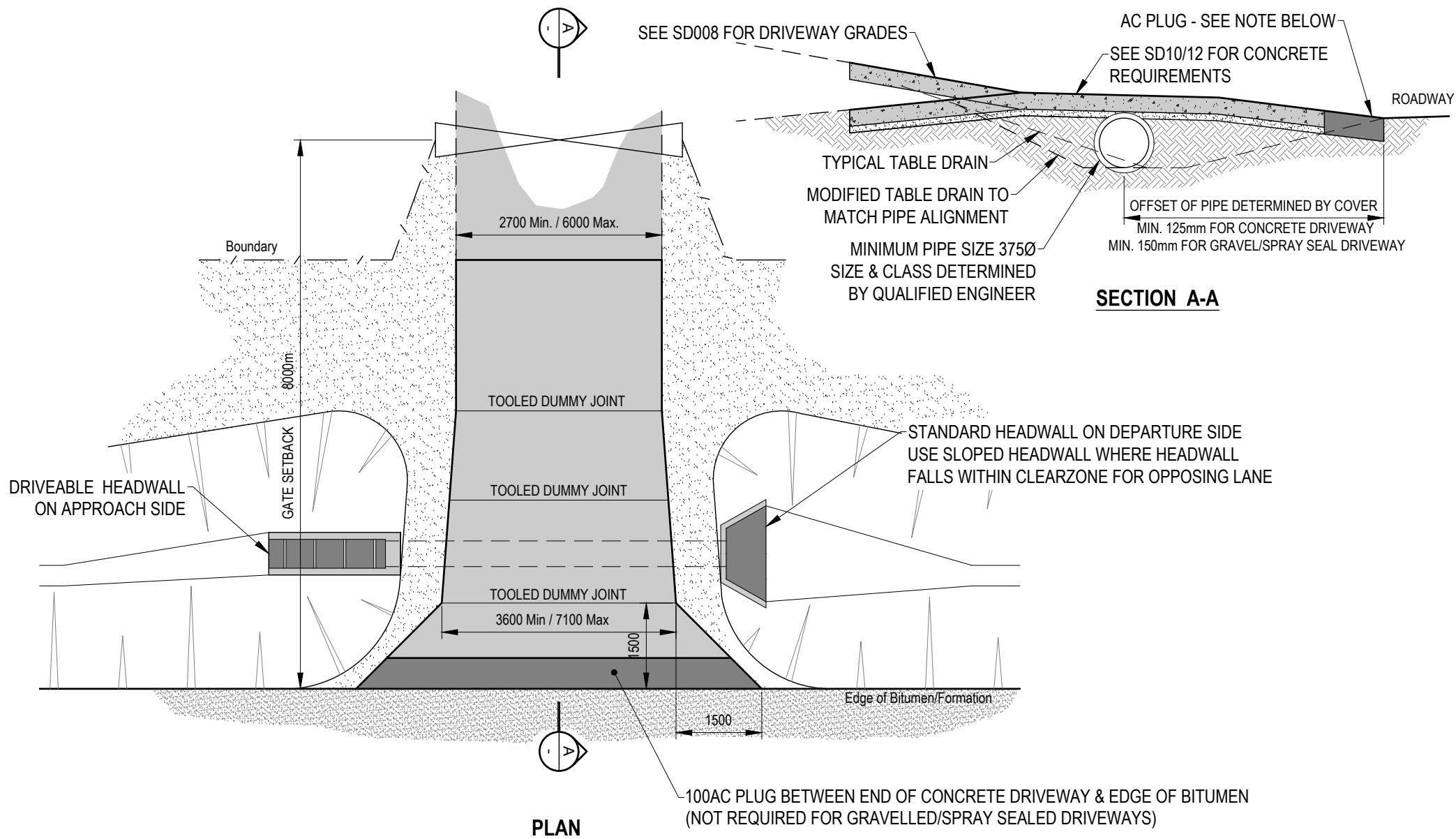
SHARED DRIVEWAYS & ACCESSWAYS INCLUDING MAINTENANCE VEHICLE ACCESS

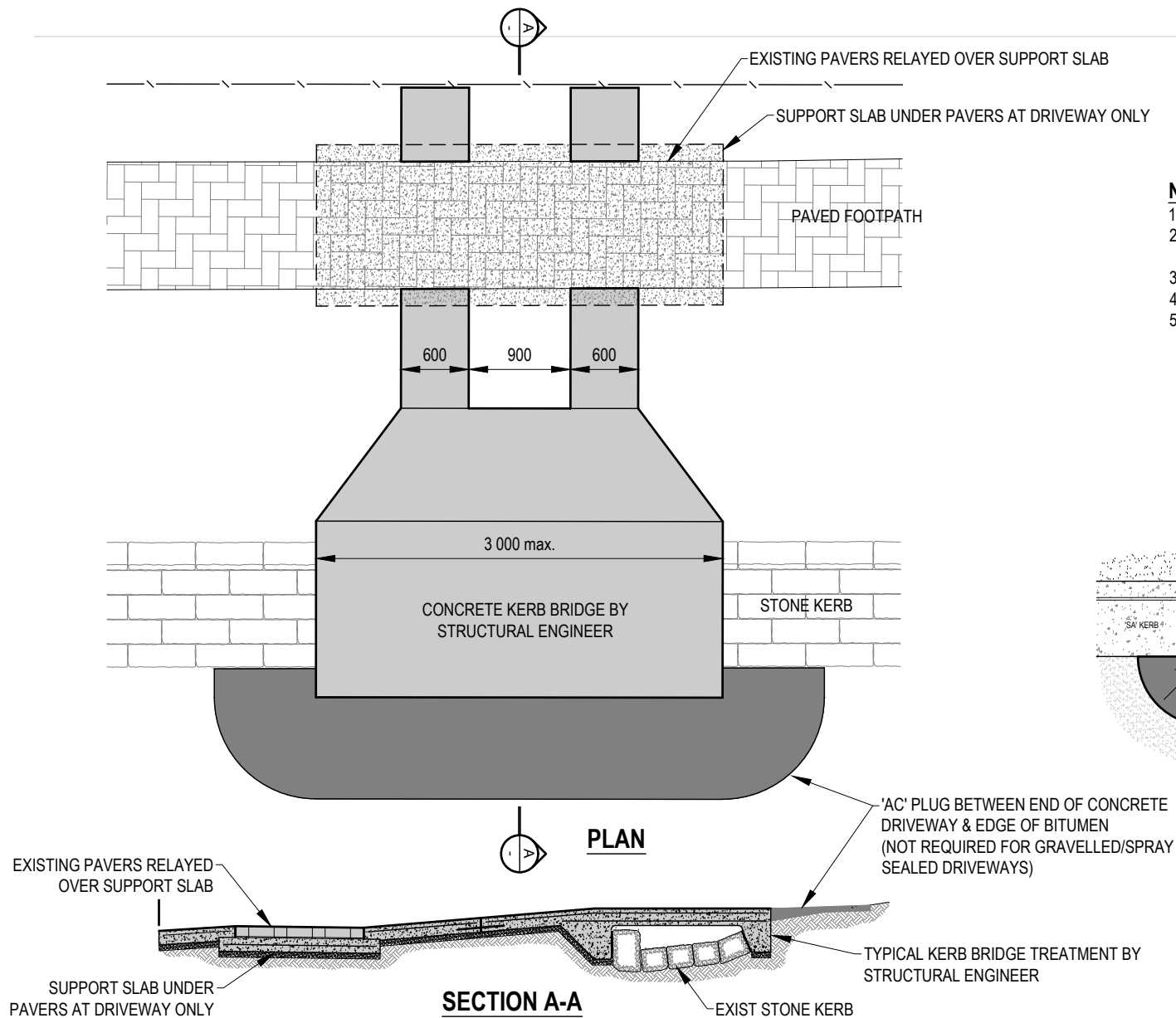


COMMERCIAL / INDUSTRIAL DRIVEWAY



RURAL DRIVEWAY

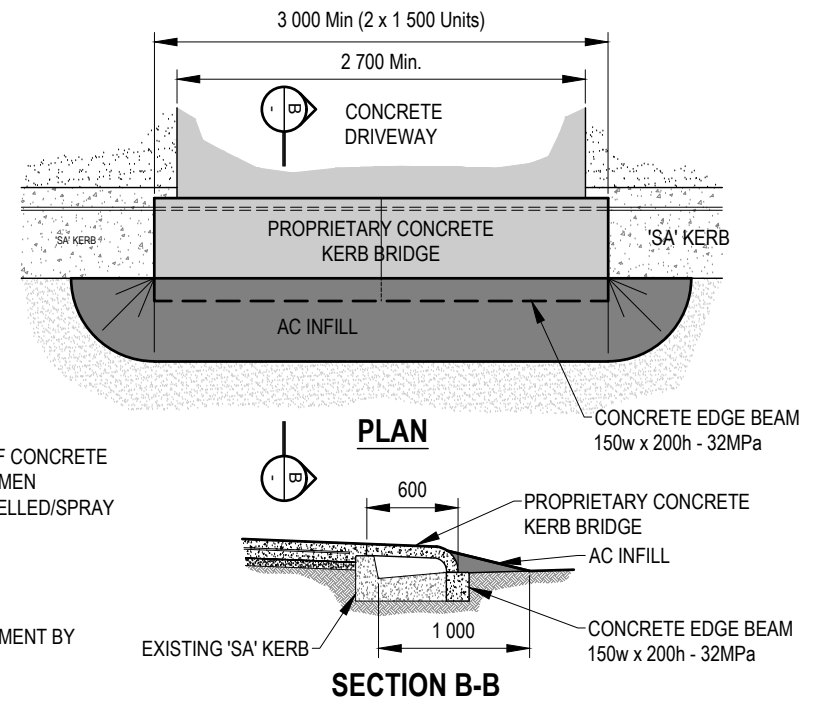




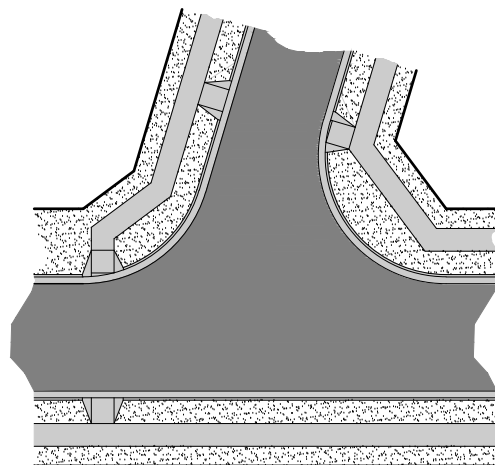
TYPICAL KERB CROSSING FOR STONE KERBS IN HERITAGE AREAS

NOTE

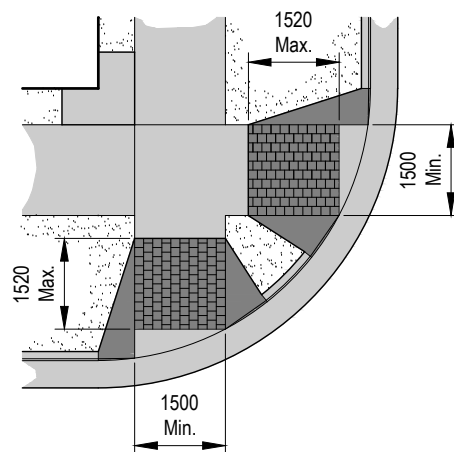
1. EXISTING KERB STONES ARE NOT TO BE DISTURBED
2. FOR HERITAGE AREAS, ALL EXPOSED CONCRETE TO BE "MORPETH MIX"
3. ALL CONCRETE TO BE 32MPa
4. CONCRETE STRIPS & FOOTPATHS TO COMPLY TO SD010/12
5. ALL FORMWORK & DEBRIS TO BE CLEARED FROM WATERWAY AFTER COMPLETION



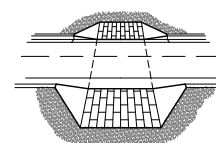
KERB CROSSING FOR UPRIGHT 'SA' KERBS



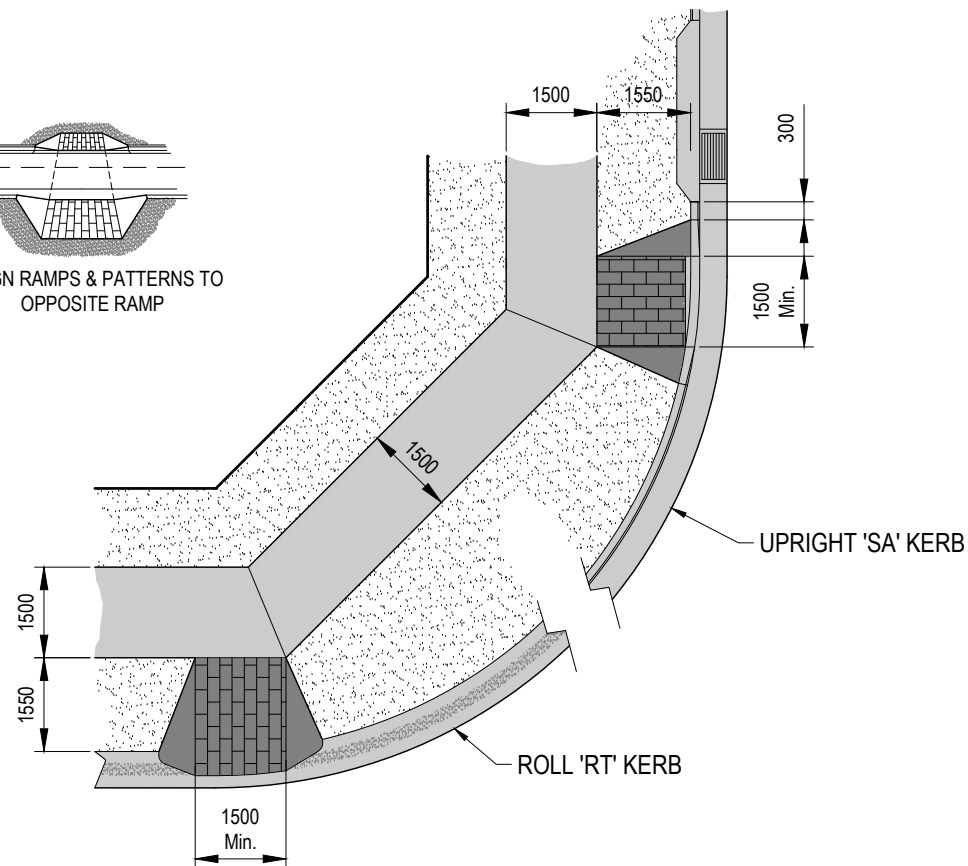
TYPICAL FOOTPATH TREATMENT AT INTERSECTIONS



**RAMP & FOOTPATH LAYOUT
EXISTING KERB RETURNS**



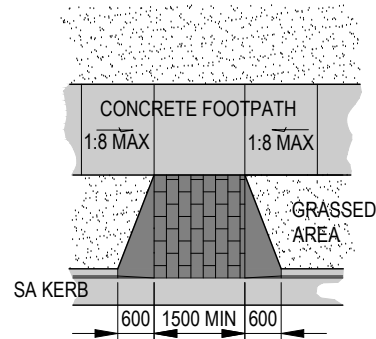
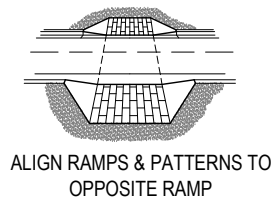
**ALIGN RAMPS & PATTERNS TO
OPPOSITE RAMP**



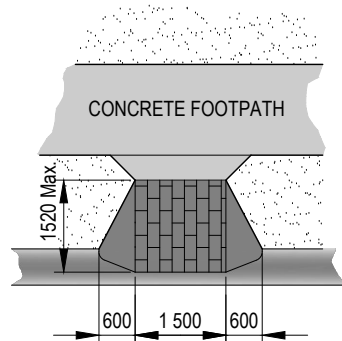
**RAMP & FOOTPATH LAYOUT
NEW WORKS**

NOTE:

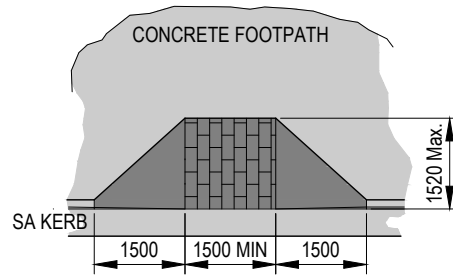
1. JOINTS TO EXISTING PAVEMENTS TO BE DOWELLED WITH 300R12 DOWELS @ 300c/c
2. ALL DISTURBED EARTH OR GRASSED AREAS TO BE TURFED
3. NEW SECTIONS OF FOOTPATH TO BE CONSTRUCTED IN ACCORDANCE WITH SD10/12



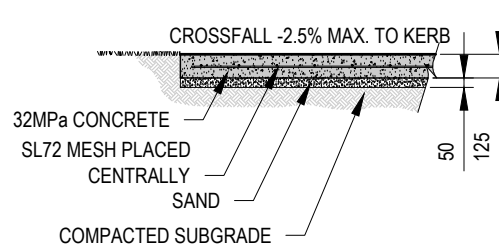
RAMP IN GRASSED FOOTWAY



RAMP - ROLL 'RT' KERB



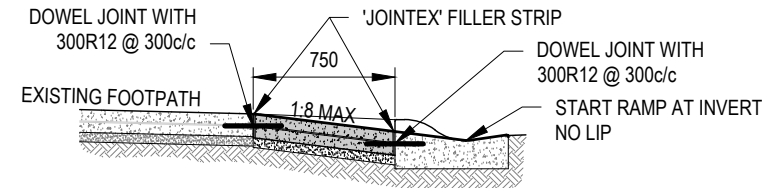
RAMP IN FULL CONCRETE FOOTWAY



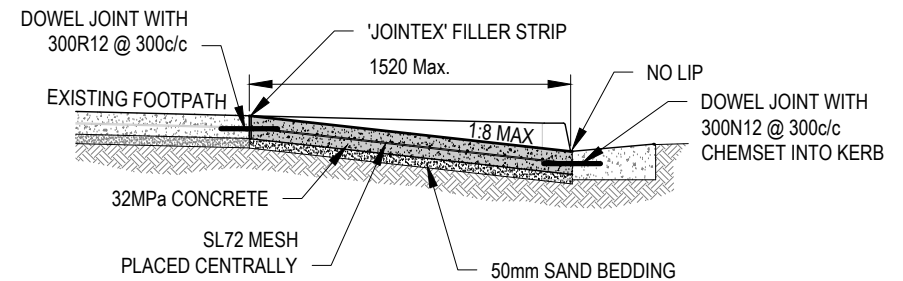
TYPICAL SECTION CYCLEWAYS & FOOTPATHS

FOR CONCRETE FOOTPATHS:

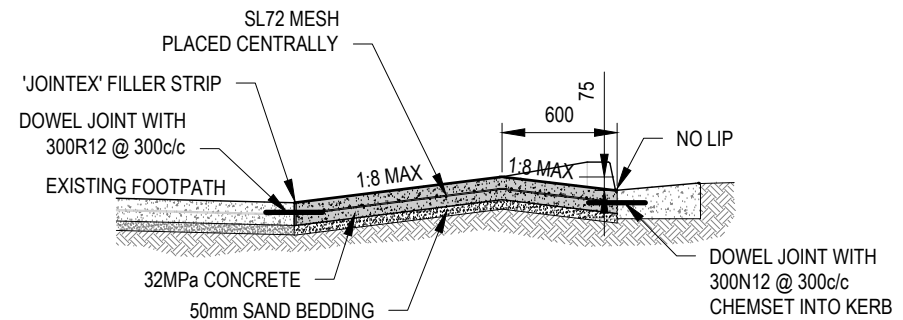
1. PROVIDE TRANSVERSE EXPANSION JOINTS EVERY 8.0m WITH 300R12 DOWELS @ 300 c/c
2. PROVIDE TOOLED DUMMY JOINTS EVERY 2.0m FOR PAVEMENT LESS THAN 2.0m WIDE & 4.0 m FOR PAVEMENTS OVER 2.0m WIDE
3. FINISH TO BE 'LIGHT BROOM'. BROOM OVER JOINTS



TYPICAL SECTION - ROLL 'RT' KERB



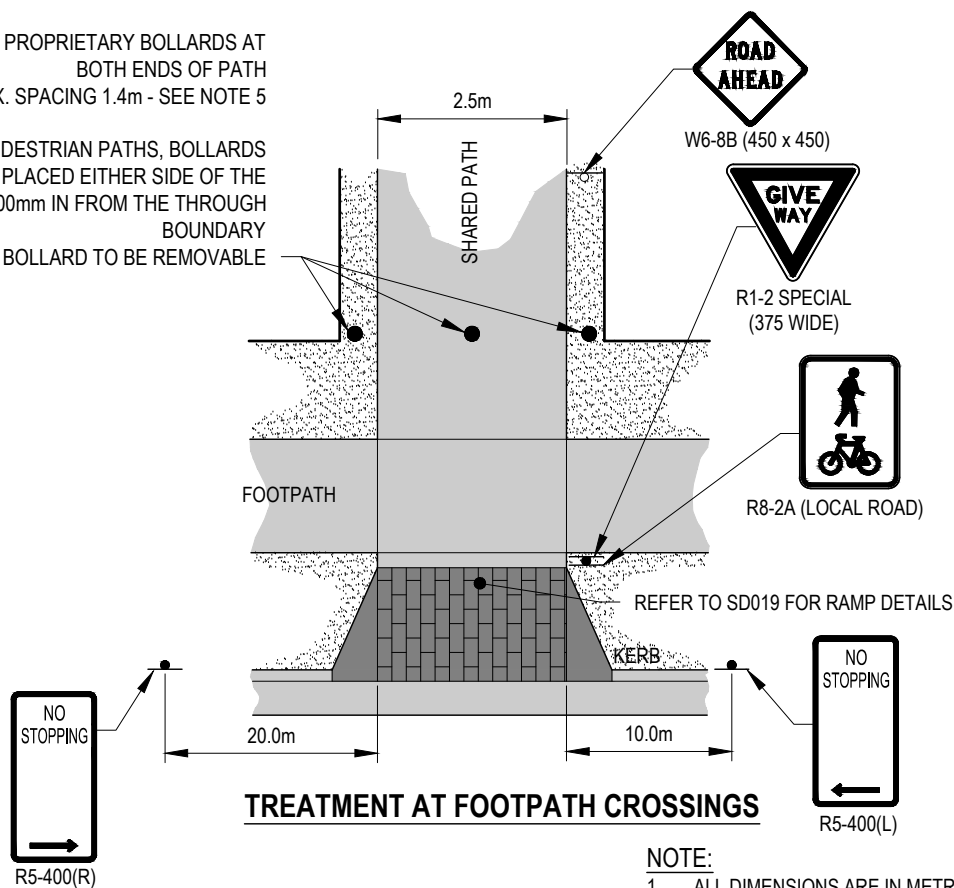
TYPICAL SECTION - UPRIGHT 'SA' KERB



TYPICAL SECTION - LOW LEVEL FOOTPATH

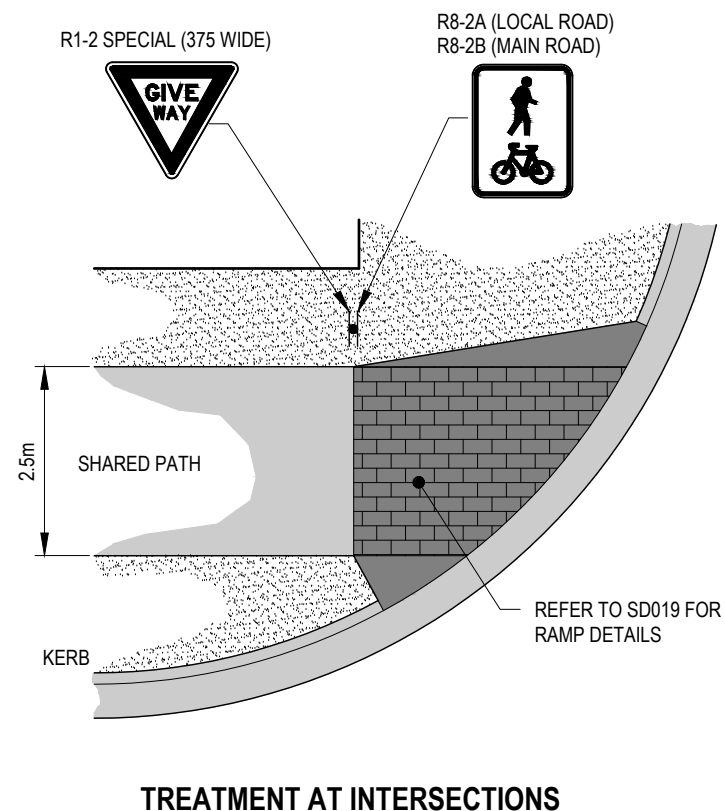
INSTALL PROPRIETARY BOLLARDS AT
BOTH ENDS OF PATH
MAX. SPACING 1.4m - SEE NOTE 5

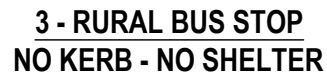
FOR PEDESTRIAN PATHS, BOLLARDS
ARE TO BE PLACED EITHER SIDE OF THE
END & 100mm IN FROM THE THROUGH
BOUNDARY
CENTRE BOLLARD TO BE REMOVABLE



NOTE:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN.
2. PAVEMENT MARKINGS MAY BE SUBSTITUTED FOR SIGNS.
3. REFER TO SD012 FOR CYCLEWAY PAVEMENT DETAILS.
4. ALL REGULATORY SIGNAGE SHALL BE APPROVED BY COUNCIL'S LOCAL AREA TRAFFIC COMMITTEE
5. WHERE PATHWAYS ARE USED FOR MAINTENANCE OR EMERGENCY VEHICLE ACCESS THE BOLLARDS ARE TO BE REMOVABLE & LOCKABLE

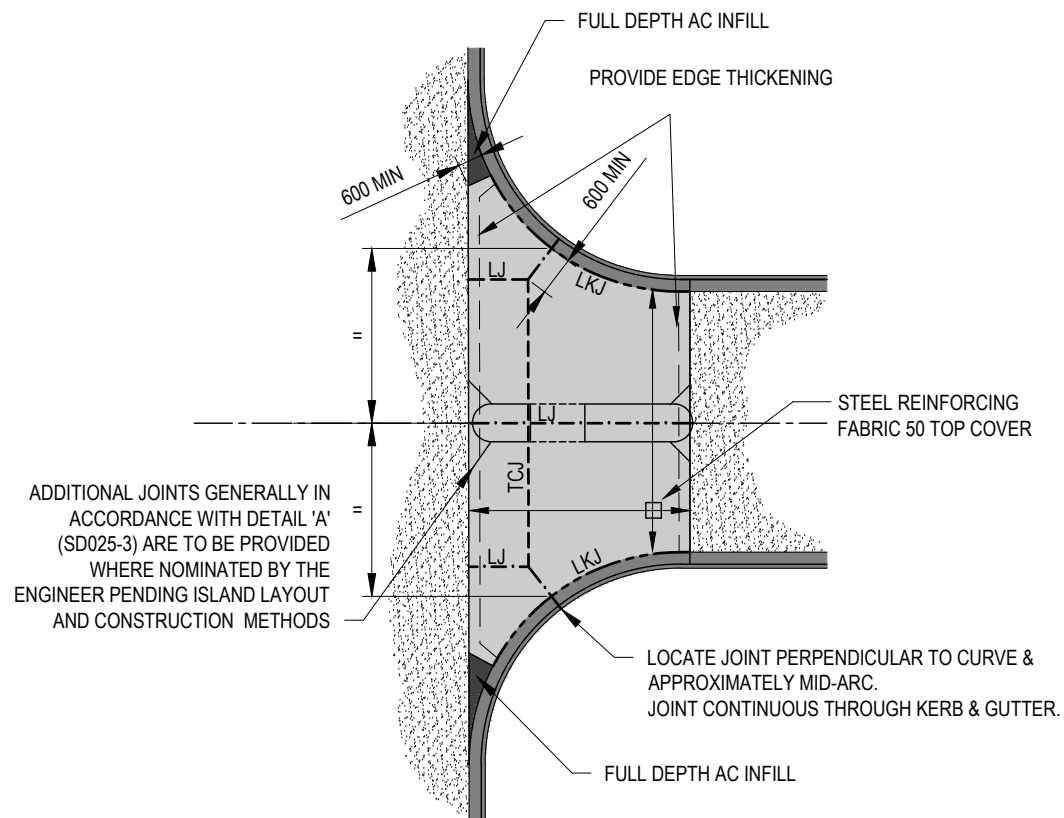




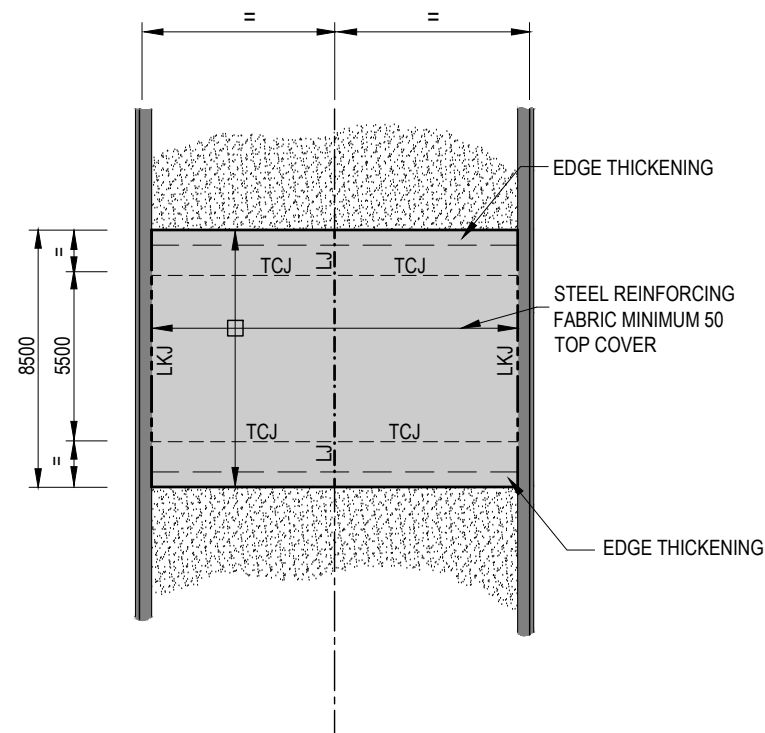
2 - URBAN BUS STOP - SHELTER

1. DIMENSIONS ARE BASED ON BUS STOP SIGN POLE & BACK OF KERB
2. BUS STOP SIGN TO BE NOMINATED BY COUNCIL'S TRAFFIC SECTION
3. ALL SIGN POLES TO BE FIXED IN V-LOCK MOUNTING SOCKETS
4. APPROACH & DEPARTURE ZONE LENGTHS MAY BE AFFECTED BY ADJACENT TRAFFIC FACILITIES
5. DIMENSIONS WILL VARY DEPENDING ON SIZE OF SHELTER
6. ALL CONCRETE TO BE 32MPa & 150mm THICK WITH SL72 MESH PLACED CENTRALLY & DOUBLED UNDER SHELTER AREA
7. WHERE THROUGH ACCESS 1.50m WIDE IS NOT AVAILABLE BEHIND THE SHELTER, THE SHELTER MAY BE MOVED BACK TO THE BOUNDARY.





'T' INTERSECTION THRESHOLD PLAN



MID-BLOCK RAISED THRESHOLD PLAN

LEGEND

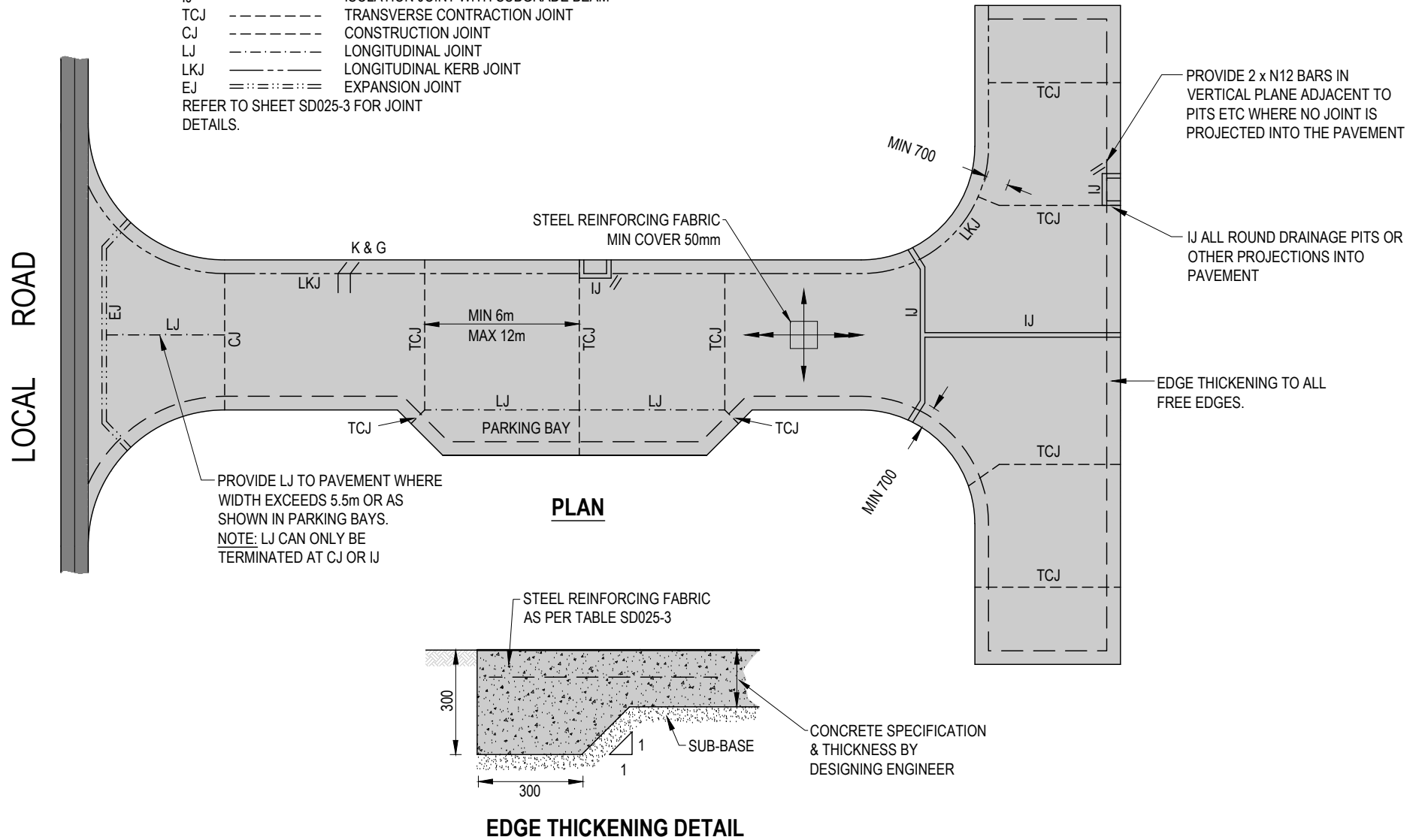
IJ	=====	ISOLATION JOINT WITH SUBGRADE BEAM
TCJ	-----	TRANSVERSE CONTRACTION JOINT
CJ	-----	CONSTRUCTION JOINT
LJ	-.-.-.-.-	LONGITUDINAL JOINT
LKJ	-----	LONGITUDINAL KERB JOINT
EJ	==::==::==	EXPANSION JOINT

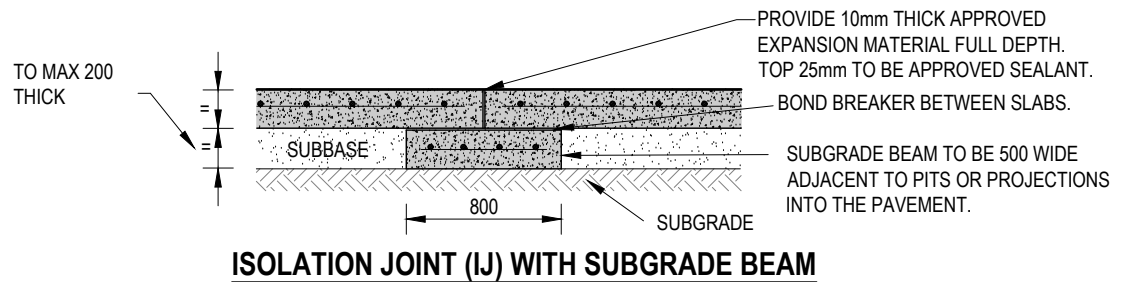
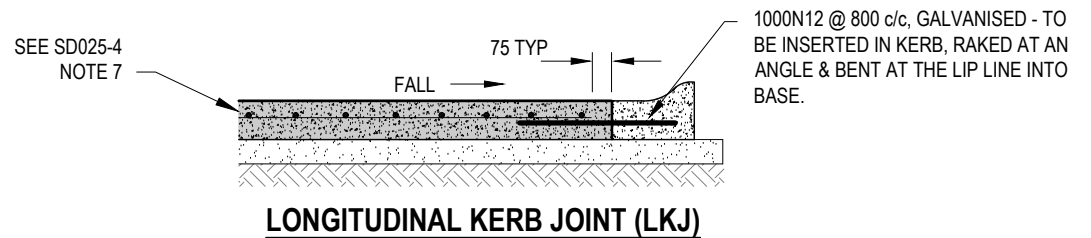
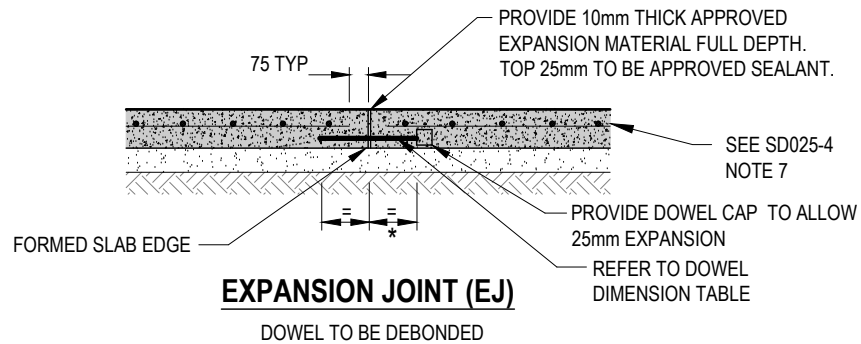
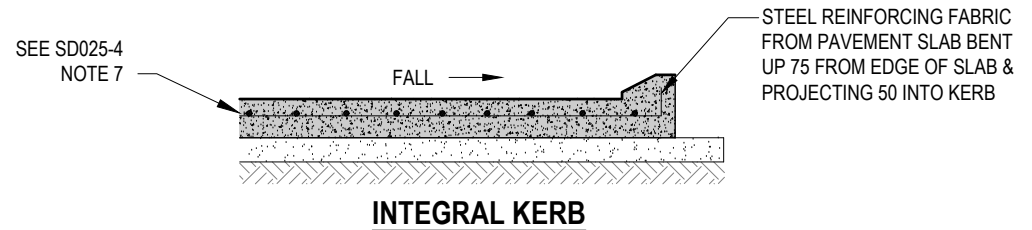
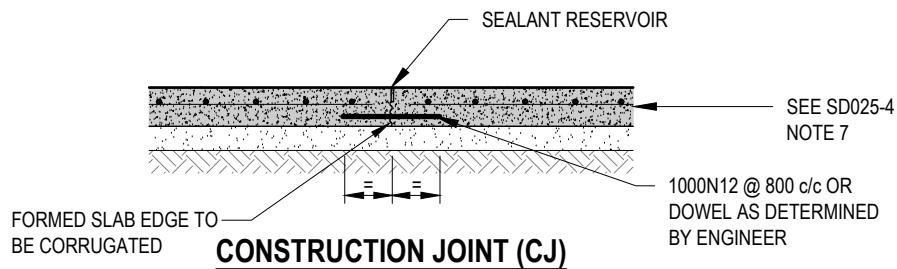
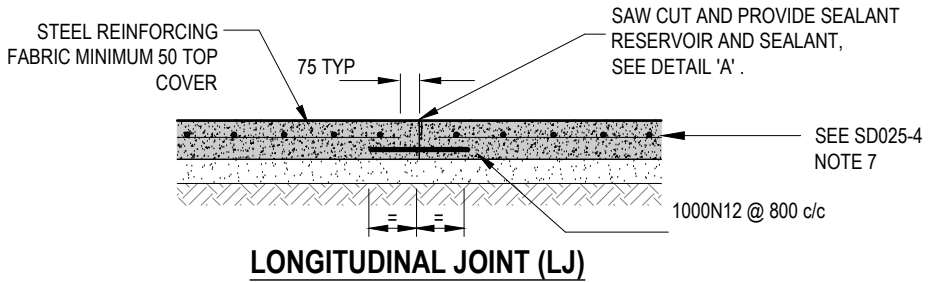
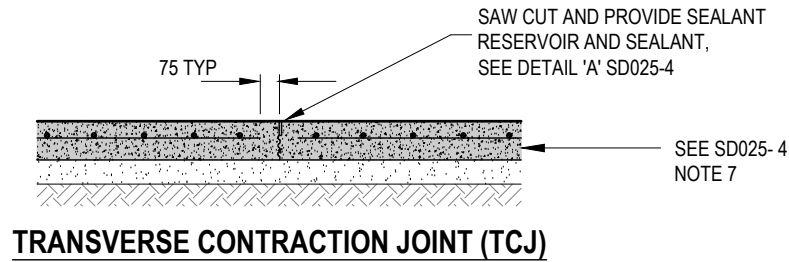
REFER TO SD025-3 FOR JOINT DETAILS.

* PEDESTRIAN RAMPS
OMITTED FOR CLARITY

LEGEND

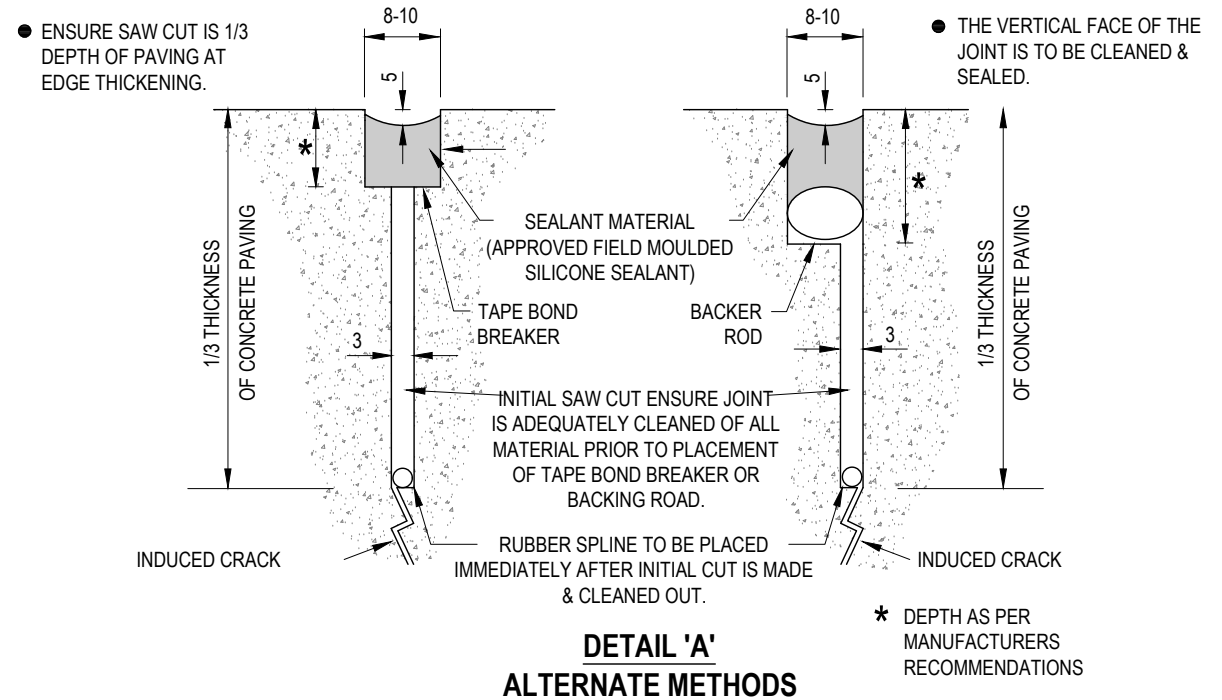
IJ	=====	ISOLATION JOINT WITH SUBGRADE BEAM
TCJ	-----	TRANSVERSE CONTRACTION JOINT
CJ	-----	CONSTRUCTION JOINT
LJ	-----	LONGITUDINAL JOINT
LKJ	-----	LONGITUDINAL KERB JOINT
EJ	=====	EXPANSION JOINT
REFER TO SHEET SD025-3 FOR JOINT DETAILS.		





NOTE:

1. ALL DIMENSIONS IN MILLIMETRES
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH MAITLAND CITY COUNCIL ENGINEERING REQUIREMENTS.
3. ALL EXPOSED CONCRETE EDGES TO BE ROUNDED TO A 5mm RADIUS.
4. ALL DOWELS TO BE EFFECTIVELY DEBONDED WHERE SPECIFIED.
5. SAW CUTS TO BE CARRIED OUT AT A TIME TO ENSURE CRACKS ARE INDUCED AT THE JOINT LOCATIONS AND TO MINIMISE SPALLING.
UNPLANNED CRACKS IN SLABS MAY RENDER THEM UNACCEPTABLE.
6. PROVIDE APPROVED CURING COMPOUND TO FINISHED CONCRETE SURFACE IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
7. REFER TO STEEL REINFORCING FABRIC TABLE.
8. ALL DOWELS & DEFORMED BARS TO BE PLACED CENTRALLY.
9. PAVEMENT THICKNESS, JOINT LAYOUT & TYPE SUBJECT TO GEOTECHNICAL INVESTIGATION, DESIGN & APPROVAL BY COUNCIL'S REPRESENTATIVE.
10. THESE STANDARDS ARE TO BE READ IN CONJUNCTION WITH THE "CEMENT & CONCRETE ASSOCIATION OF AUSTRALIA". CONCRETE PAVEMENT DESIGN FOR RESIDENTIAL STREETS (T51).
11. MINIMUM COMPRESSIVE STRENGTH (FC) TO BE MIN. 32MPa AT 28 DAYS (INCL. ADJACENT KERB & GUTTER & SUBGRADE BEAM).
12. PAVEMENT EDGE THICKENING WILL BE REQUIRED WHERE NO KERBING IS PROPOSED UNLESS OTHERWISE APPROVED.
13. LATERAL SUBSOIL LINES WILL BE REQUIRED AT THE INTERFACE OF FLEXIBLE AND RIGID PAVEMENTS IN ADDITION TO COUNCIL'S STANDARD REQUIREMENTS.
14. WHERE LONGITUDINAL GRADES EXCEED 15% OR PROTECTION OF ADJACENT PAVEMENTS OR STRUCTURES IS NECESSARY, SLAB ANCHORS (ANCHOR BLOCKS) SHALL BE PROVIDED.
15. JOINTS IN KERBS SHALL BE OF ADEQUATE DEPTH TO ENSURE POSITIVE CRACK INDUCTION (NOT TOOLED DUMMY JOINTS) & ARE TO BE LOCATED TO ALIGN WITH JOINTS IN ADJACENT PAVING OR K&G.
16. ALL DEFORMED BARS TO BE GRADE 500Y.



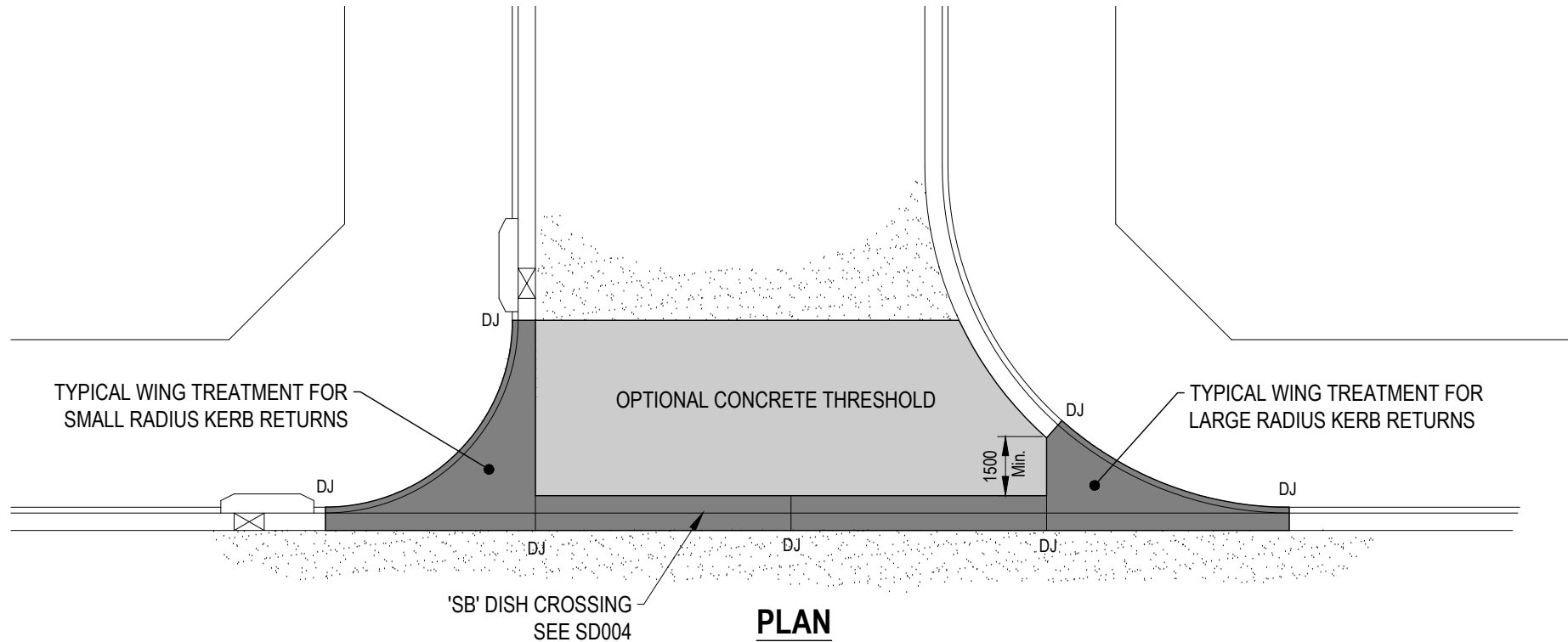
MESH

CONCRETE THICKNESS (mm)	STEEL REINFORCING FABRIC (AS 1204)
165 min	F82 or F828
175	F82 or F828
200	F82 or F828

DOWELS

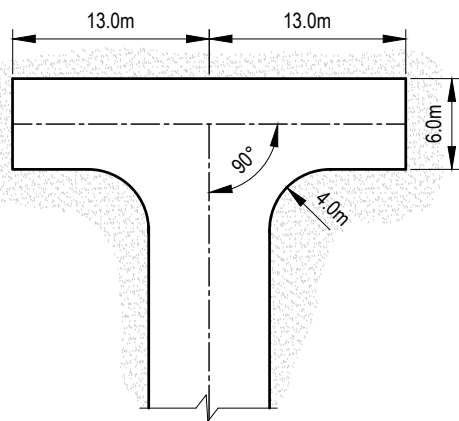
CONCRETE THICKNESS (mm)	DOWEL DIAMETER (mm)	DOWEL LENGTH (mm)
165 min	28	450
175	28	450
200	33	450
ALL DOWELS PLACED AT 300mm CENTRES TO BE GRADE 250R STEEL BARS		

NOTE: ALL DOWELS WITHIN A JOINT ARE TO BE ALIGNED PARALLEL WITH THE LINE JOINING THE CENTROIDS OF ADJOINING SLABS.

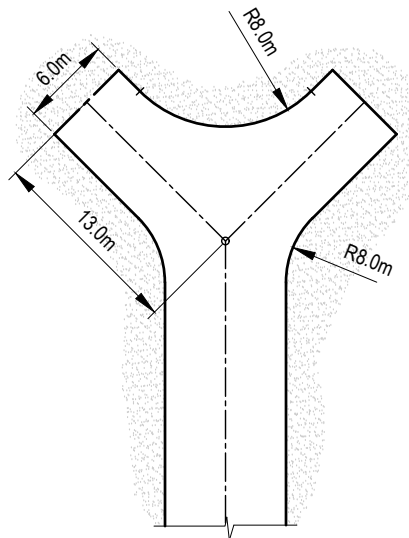


NOTE:

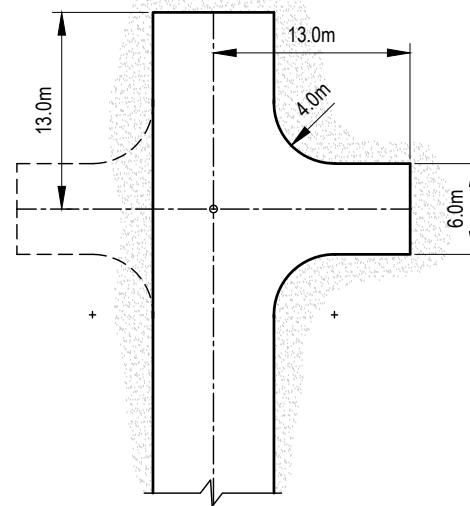
1. ALL DIMENSIONS IN MILLIMETRES
2. DISH DRAIN TO BE MINIMUM 150mm THICK, REINFORCED WITH SL72 MESH PLACED CENTRALLY
3. WINGS TO BE FORMED & POURED INTEGRAL WITH KERB
4. ALL CONCRETE 32MPa
5. 'DJ' ALL JOINTS TO BE DOWELLED (400 N12 @ 300c/c)
6. KERB RAMPS DELETED FOR CLARITY. SEE SD019/1 & SD019/2 FOR LOCATIONS



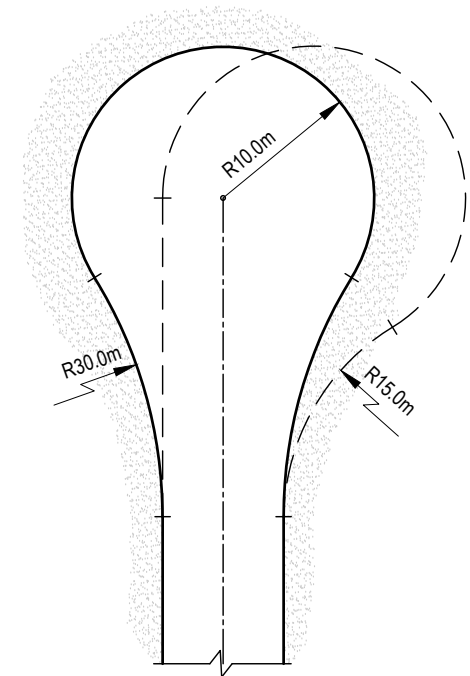
T-HEAD



Y-HEAD



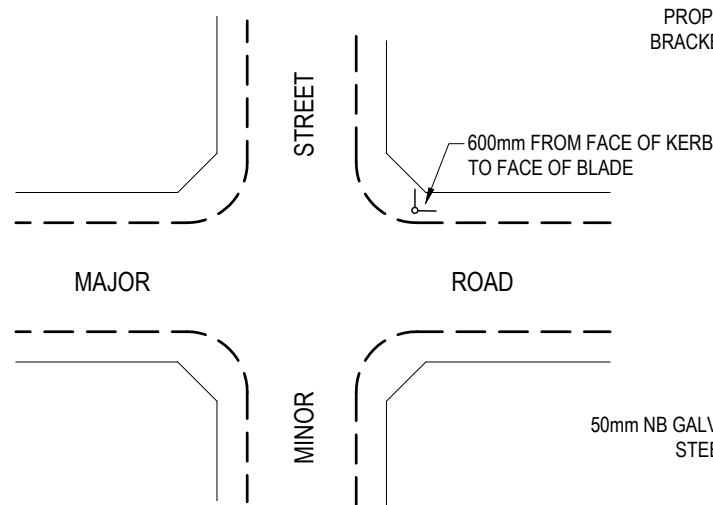
MODIFIED T-HEAD



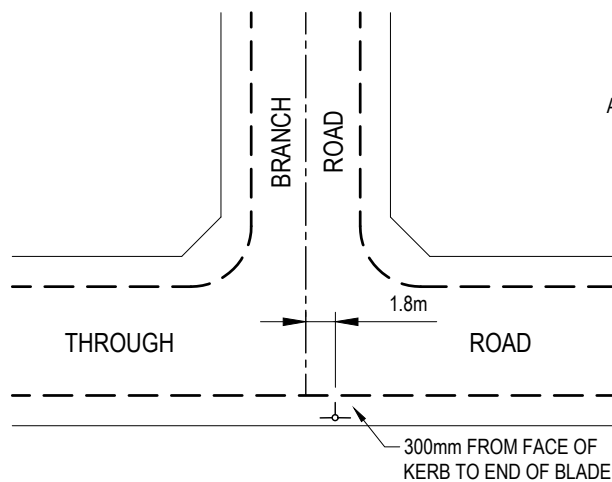
CIRCULAR HEAD

NOTE:

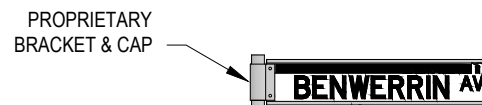
1. INCOMING WIDTHS DETERMINED BY ROAD CATEGORIES SETOUT IN THE ROAD DESIGN SECTION OF COUNCIL'S "MANUAL OF ENGINEERING STANDARDS".
2. NOTWITHSTANDING THE ABOVE DIMENSIONING, AUSTRALIAN STANDARD AS 2890.2 - PARKING FACILITIES PART 2: OFF-STREET COMMERCIAL VEHICLE FACILITIES SHALL BE USED TO VERIFY ADEQUATE MANOEUVRING AREA.
3. ALTERNATIVE LAYOUTS WILL BE CONSIDERED BY COUNCIL.



CROSS STREET INTERSECTION



"T" INTERSECTION



50mm NB GALVANISED STEEL POST

V-LOCK BASE SOCKET IN CONCRETE PAVING

ANTI-TURNING PIN

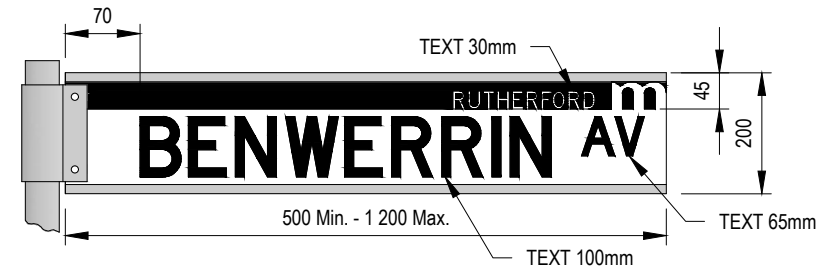
MASS CONCRETE

POLE

SIGN LOCATION

1. STREET NAME SIGNS TO BE PROVIDED AT ROUNDABOUTS AND MAJOR INTERSECTIONS WHERE SHOWN ON THE APPROVED ENGINEERING PLANS OR AS DIRECTED BY THE ENGINEER.
2. SIGN POST LOCATIONS MAY BE VARIED BY THE ENGINEER WHERE POWER POLES OR SIMILAR OBSTRUCT VIEW.

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. SIGNS ARE TO BE ERECTED BY THE DEVELOPER UNDER COUNCIL'S SUPERVISION.
3. NON-STANDARD SIGNS MAY BE USED SUBJECT TO PRIOR APPROVAL BY COUNCIL.



FINGER BOARD

SIGN SPECIFICATION

SIGN COLOUR

STREET NAME BLADE :BLACK LETTERS ON WHITE REFLECTORISED BACKGROUND
DIRECTIONAL SIGN BLADE : BLACK LETTERS ON WHITE REFLECTORISED BACKGROUND

SIZE & SHAPE

SIGNS SHALL BE RECTANGULAR, HAVE A BLADE WIDTH OF 200mm, A MINIMUM LENGTH OF 500mm & MAXIMUM LENGTH OF 1200mm.

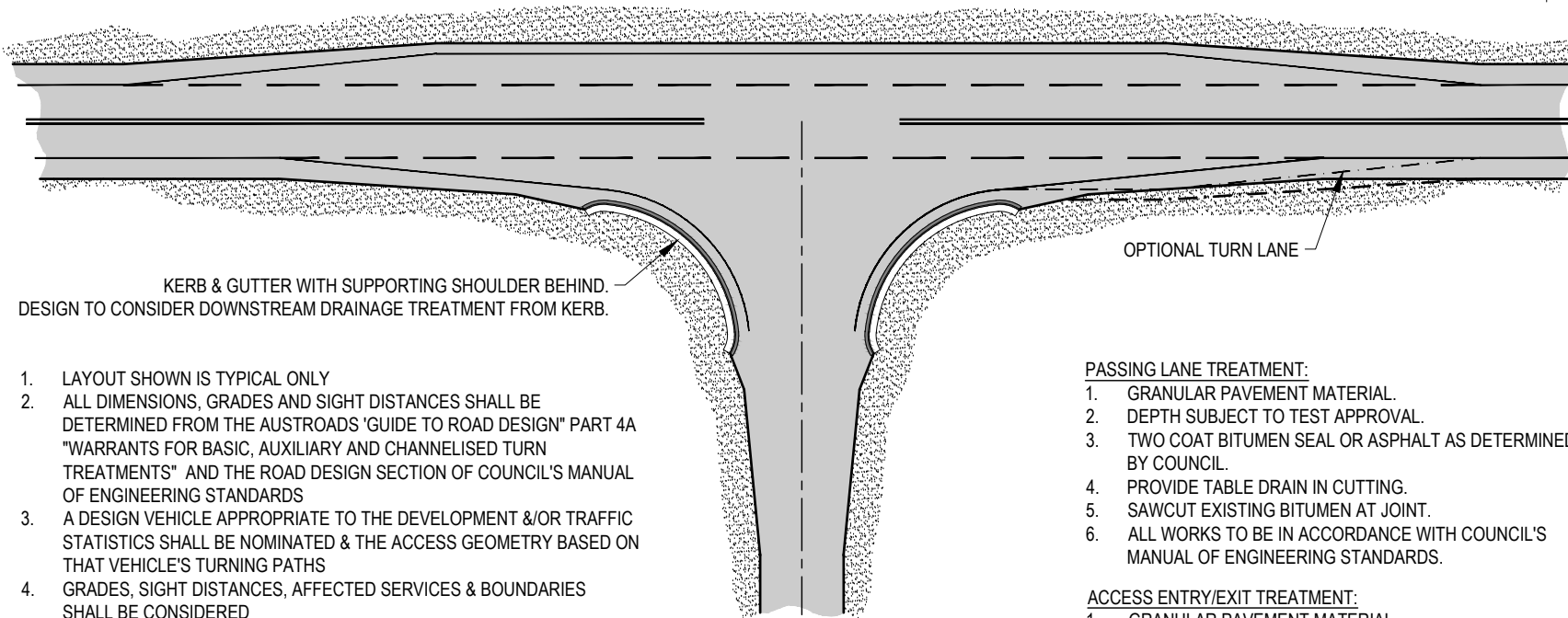
REFLECTIVE MATERIAL

THE BACKGROUND SHALL CONSIST OF CLASS 1 MATERIAL, LAMINATED TO THE EDGE OF BLADE.

LETTERING

LETTERS & NUMERALS FOR STREET NAMES SHALL BE SERIES 'D', AS SPECIFIED IN AS1744, WHERE THE TEXT PRODUCES A SIGN GREATER THAN 1200mm IN LENGTH, THE LETTERING MAY BE MADE PROPORTIONALLY NARROWER BUT NOT NARROWER THAN SERIES 'C'.





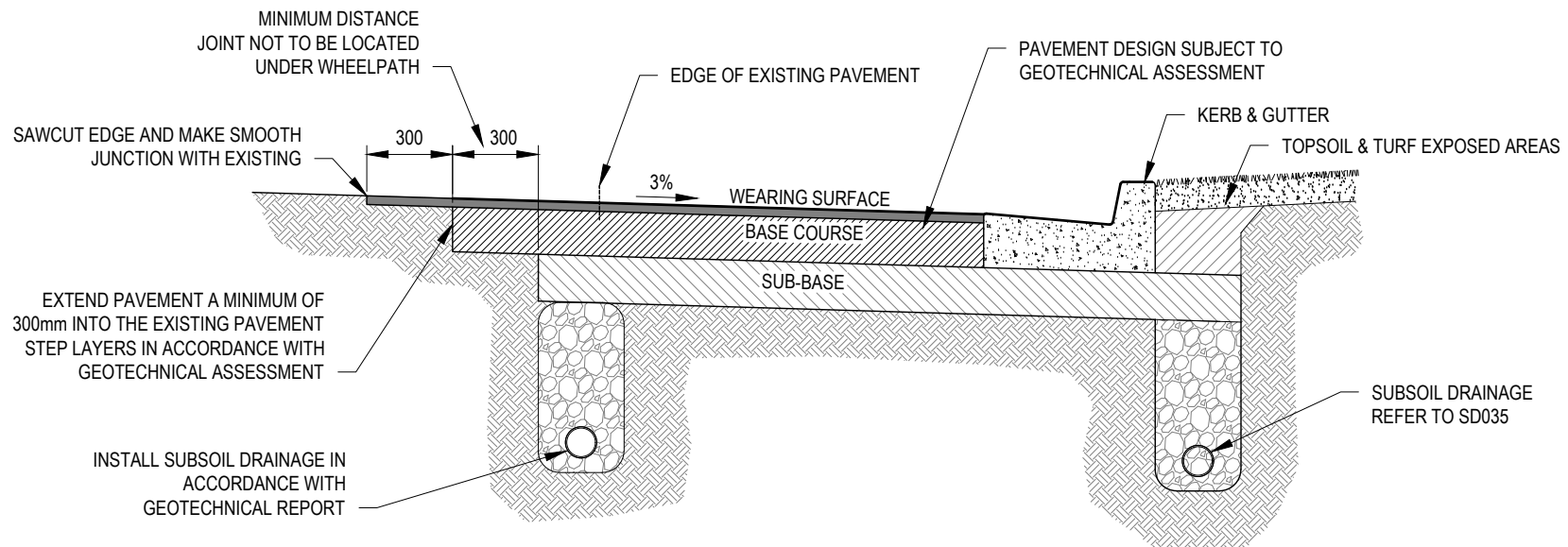
1. LAYOUT SHOWN IS TYPICAL ONLY
2. ALL DIMENSIONS, GRADES AND SIGHT DISTANCES SHALL BE DETERMINED FROM THE AUSTRROADS 'GUIDE TO ROAD DESIGN' PART 4A "WARRANTS FOR BASIC, AUXILIARY AND CHANNELISED TURN TREATMENTS" AND THE ROAD DESIGN SECTION OF COUNCIL'S MANUAL OF ENGINEERING STANDARDS
3. A DESIGN VEHICLE APPROPRIATE TO THE DEVELOPMENT &/OR TRAFFIC STATISTICS SHALL BE NOMINATED & THE ACCESS GEOMETRY BASED ON THAT VEHICLE'S TURNING PATHS
4. GRADES, SIGHT DISTANCES, AFFECTED SERVICES & BOUNDARIES SHALL BE CONSIDERED
5. LINEMARKING & SIGNAGE SUBJECT TO LOCAL TRAFFIC COMMITTEE ASSESSMENT

PASSING LANE TREATMENT:

1. GRANULAR PAVEMENT MATERIAL.
2. DEPTH SUBJECT TO TEST APPROVAL.
3. TWO COAT BITUMEN SEAL OR ASPHALT AS DETERMINED BY COUNCIL.
4. PROVIDE TABLE DRAIN IN CUTTING.
5. SAWCUT EXISTING BITUMEN AT JOINT.
6. ALL WORKS TO BE IN ACCORDANCE WITH COUNCIL'S MANUAL OF ENGINEERING STANDARDS.

ACCESS ENTRY/EXIT TREATMENT:

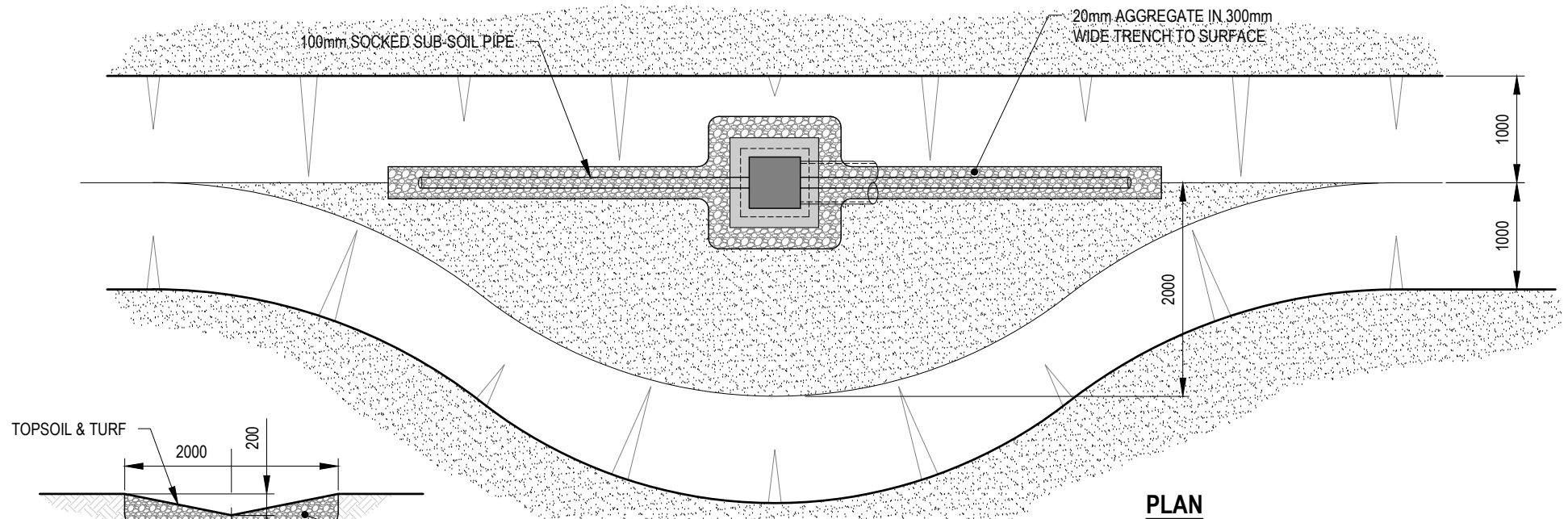
1. GRANULAR PAVEMENT MATERIAL
2. COMPACTED DEPTH MINIMUM 200mm
3. TWO COAT BITUMEN FLUSH SEAL
4. WHERE PIPE CROSSING IS REQUIRED SEE SD013-1 FOR HEADWALL DETAILS



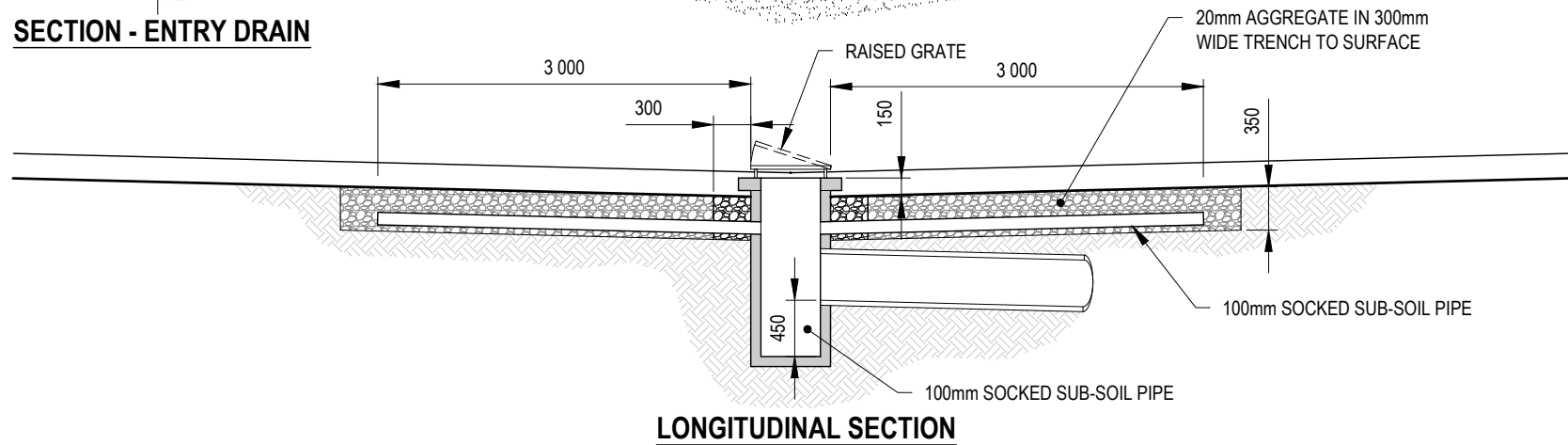
TYPICAL SECTION

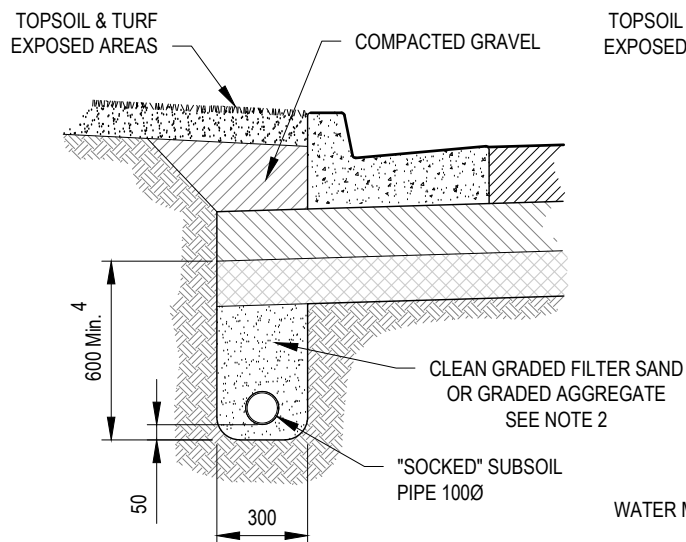
NOTE:

1. ALL DIMENSIONS IN MILLIMETRES
2. PAVEMENT JOINS NOT TO BE PLACED UNDER WHEELPATHS.

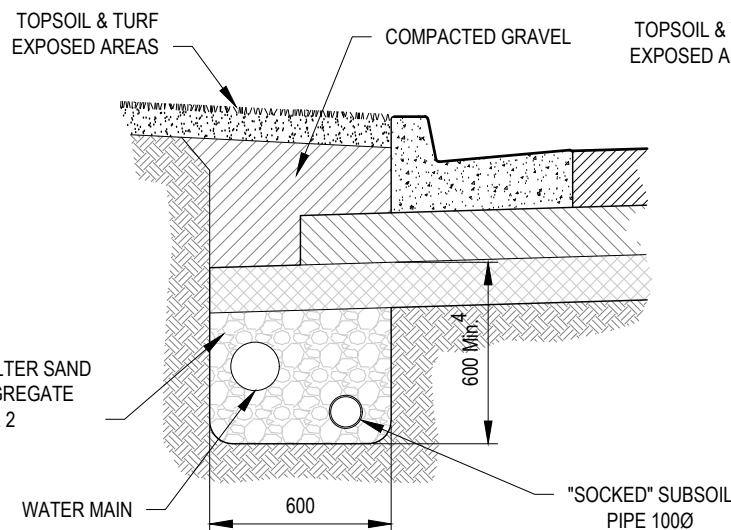


SECTION - ENTRY DRAIN

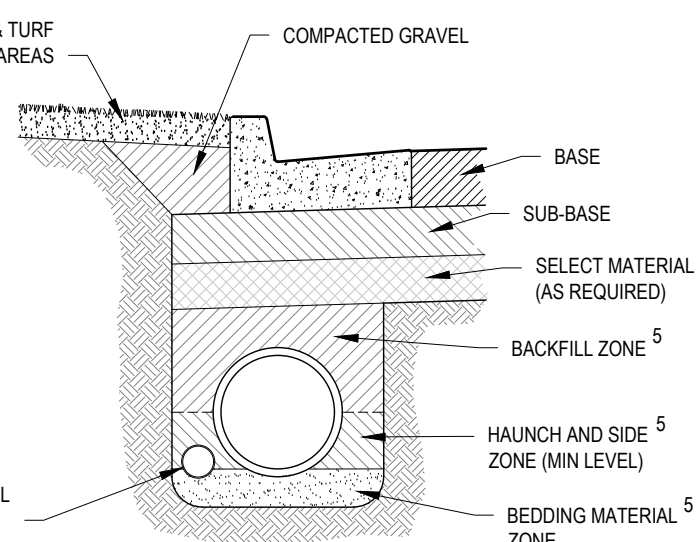




TYPICAL INSTALLATION



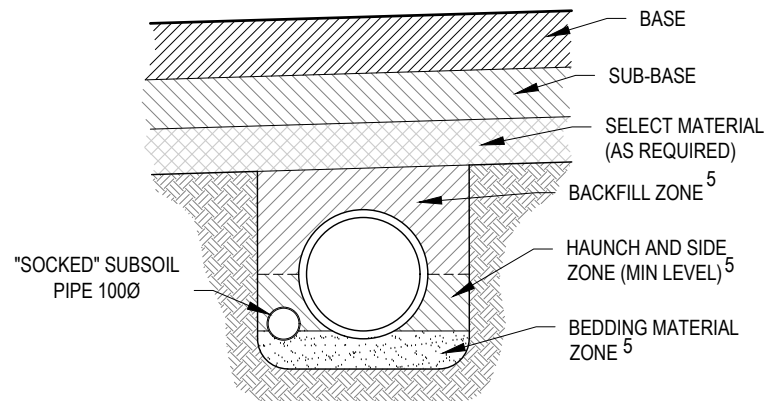
**SHARED TRENCH
(WITH WATER MAIN)**



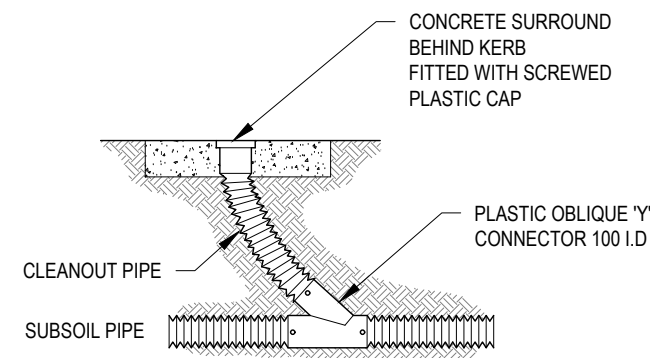
**STORMWATER TRENCH
(ALL STORMWATER PIPES)**

NOTE:

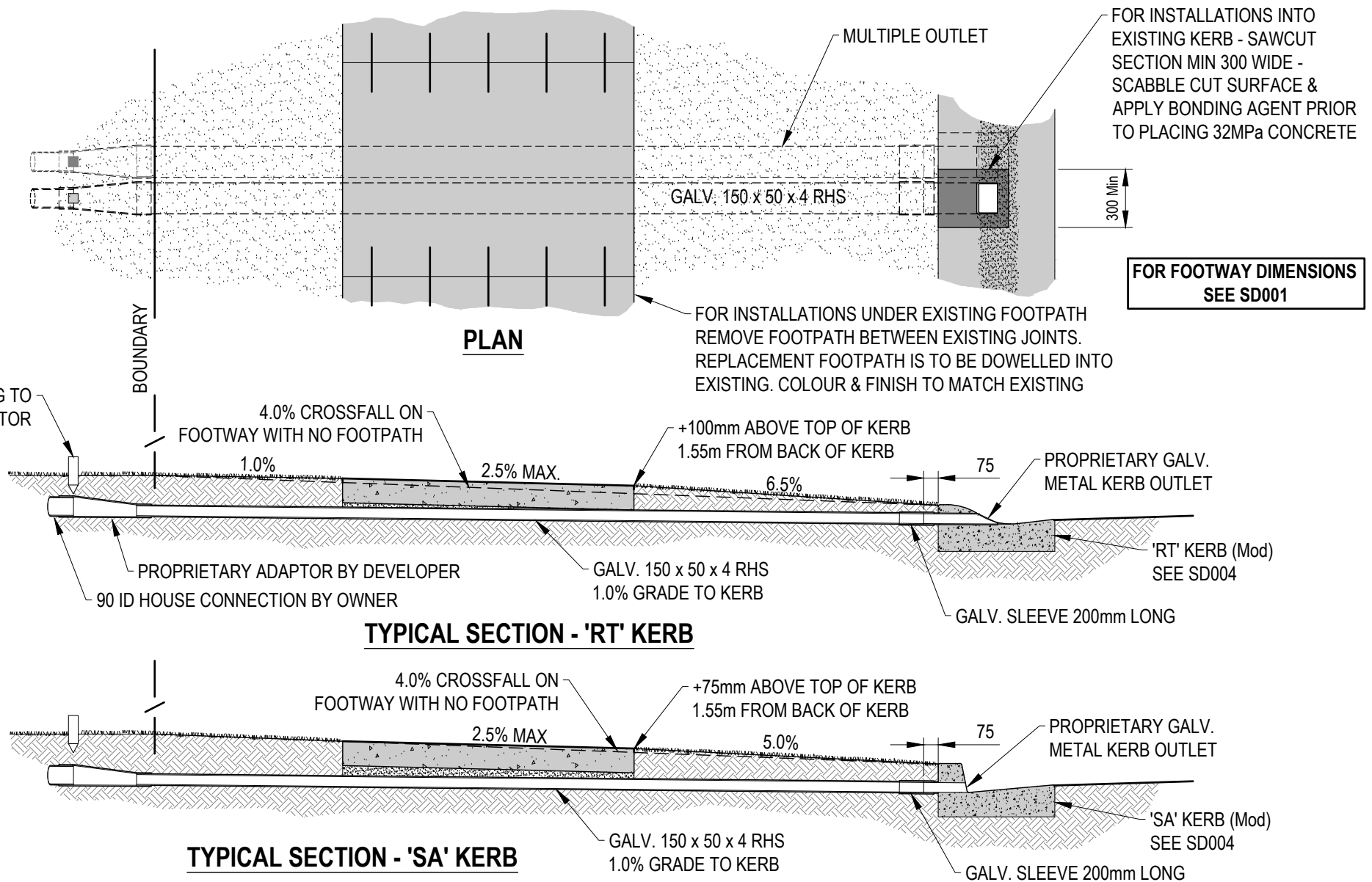
1. TYPE, LOCATION AND EXTENT OF ADDITIONAL SUBSOIL DRAINAGE SHALL BE IN ACCORDANCE WITH A GEOTECHNICAL CONSULTANT'S ASSESSMENT.
2. A NOMINAL SIZE AGGREGATE (10mm MAXIMUM) MAY BE SUBSTITUTED FOR THE FILTER SAND
3. FLUSH POINTS SHALL BE PROVIDED AT UPSTREAM DEAD ENDS & CRESTS & AT MAXIMUM OF 60m CTRS.
4. DEPTH MAY BE VARIED IN A ROCK SUBGRADE.
5. SEE THE CONSTRUCTION SECTION OF THE MANUAL OF ENGINEERING STANDARDS FOR TRENCH MATERIAL SPECIFICATION. EACH ZONE MAY BE ONE HOMOGENEOUS APPROVED MATERIAL.

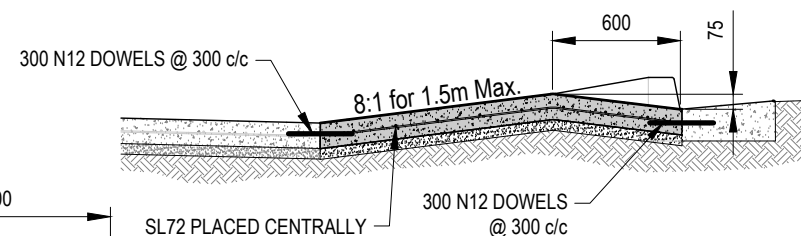
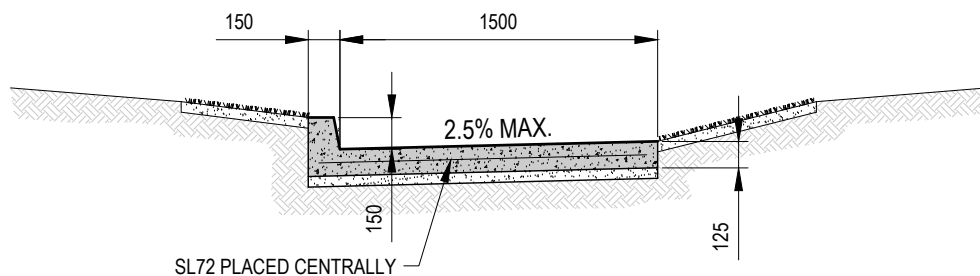


**STORMWATER TRENCH UNDER ROAD
(ALL STORMWATER PIPES)**



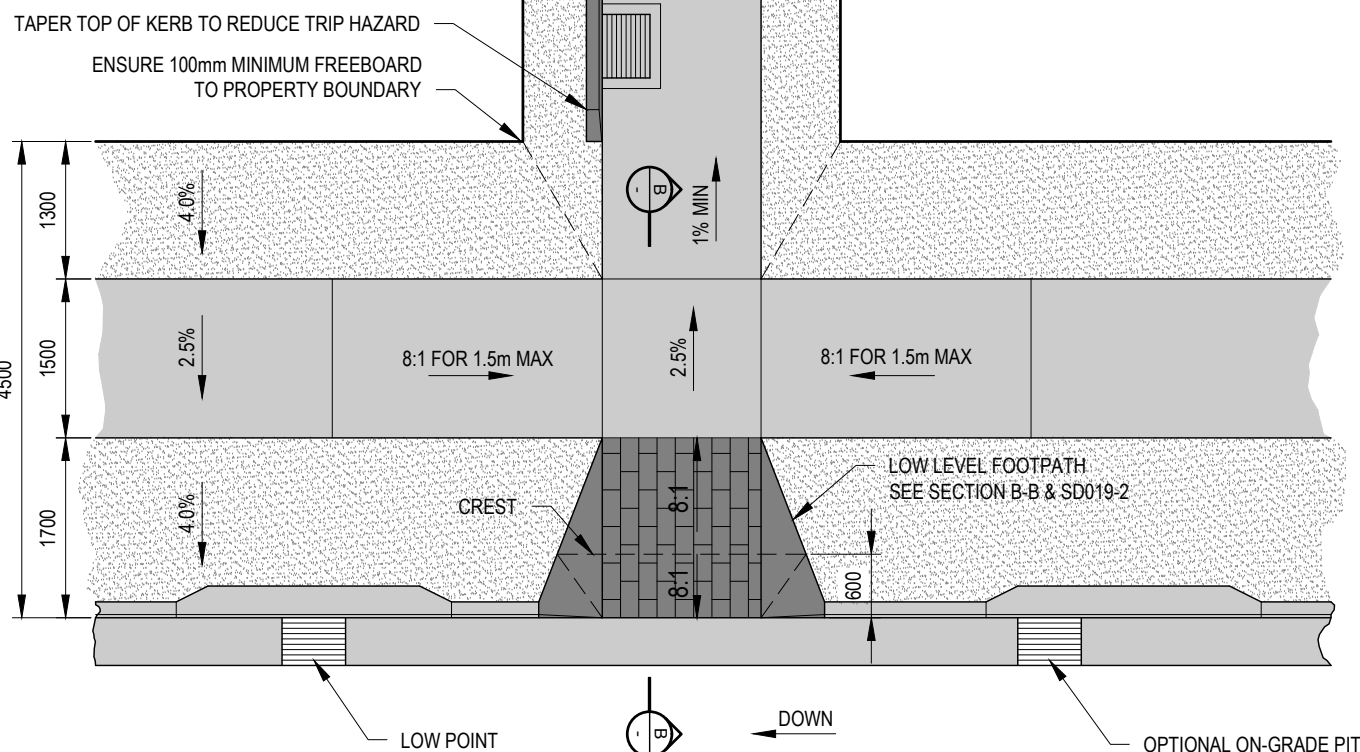
FLUSH POINT





SECTION A-A

SECTION B-B



NOTE:

1. DETAILS SHOWN ARE APPLICABLE AT UPSTREAM ENTRIES TO FLOW PATHS ONLY.
2. SHAPE AND GRADES OF FOOTPATH AND PRAM RAMP TO BE IN ACCORDANCE WITH SD019-2.
3. REFER TO SD10 FOR JOINT REQUIREMENTS IN CONCRETE PAVING.
4. FLOW PATH AND RAMP AREAS TO BE FULLY CONCRETED.

FOOTWAY FLOWPATH

maitland city council
infrastructure & works

po box 220, maitland nsw 2320
email: mcc@maitland.nsw.gov.au

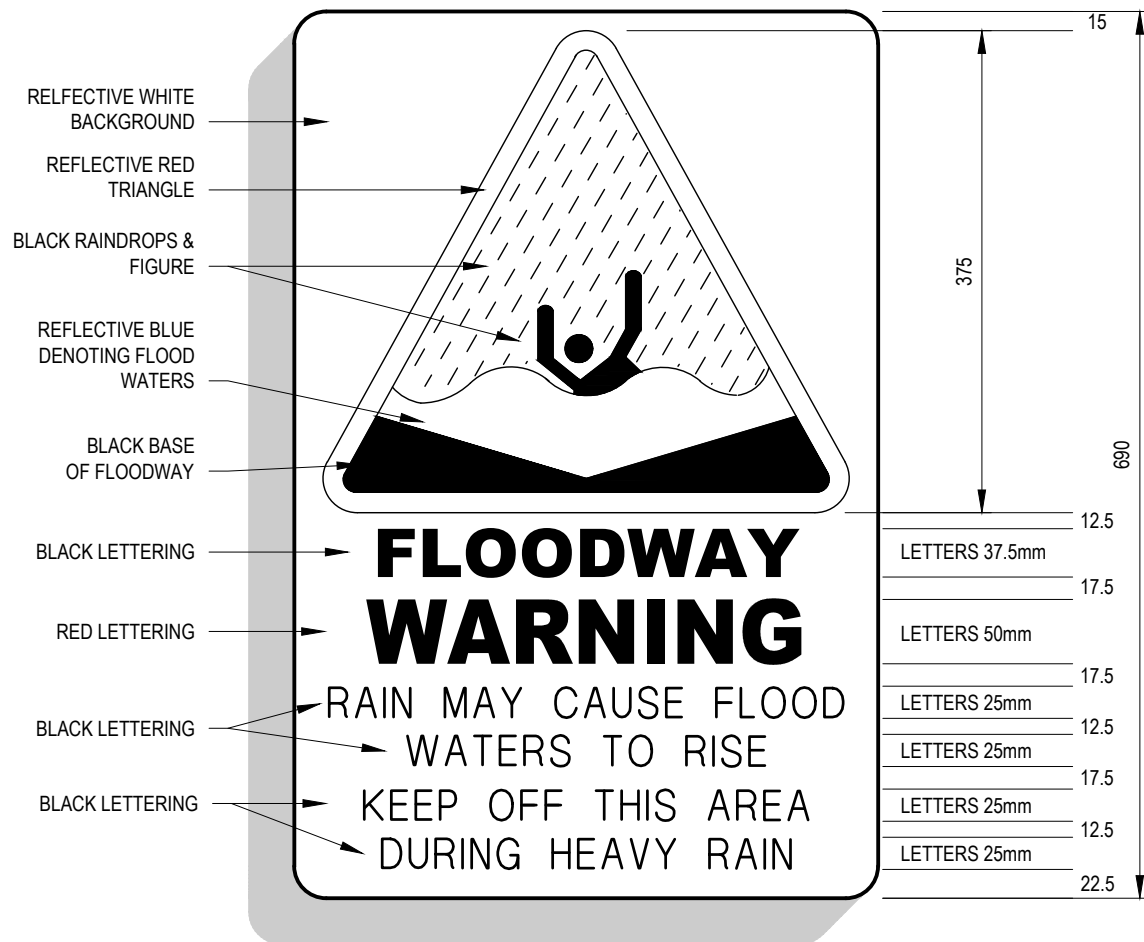
MANUAL OF ENGINEERING STANDARDS - STANDARD DRAWINGS

Rev: 08/04/2019

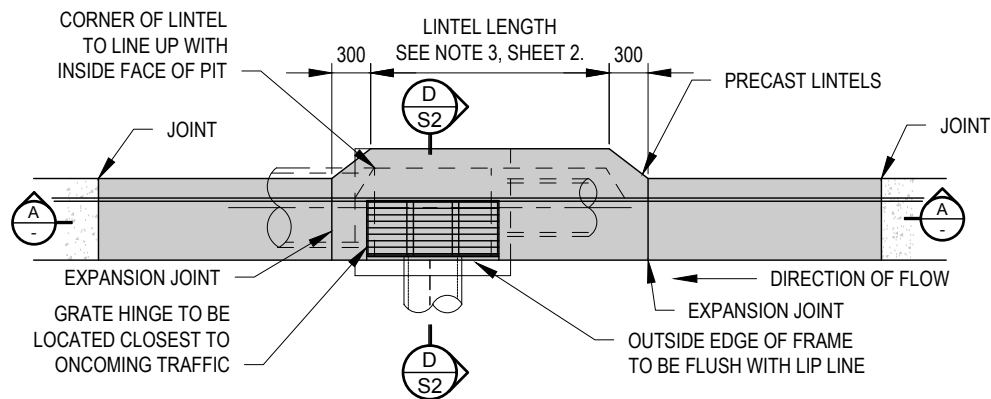
SD037

SHEET 01 of 01

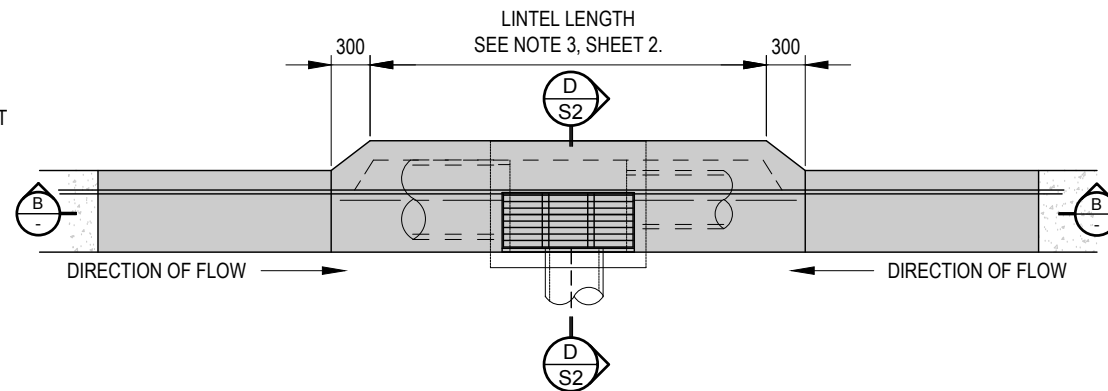




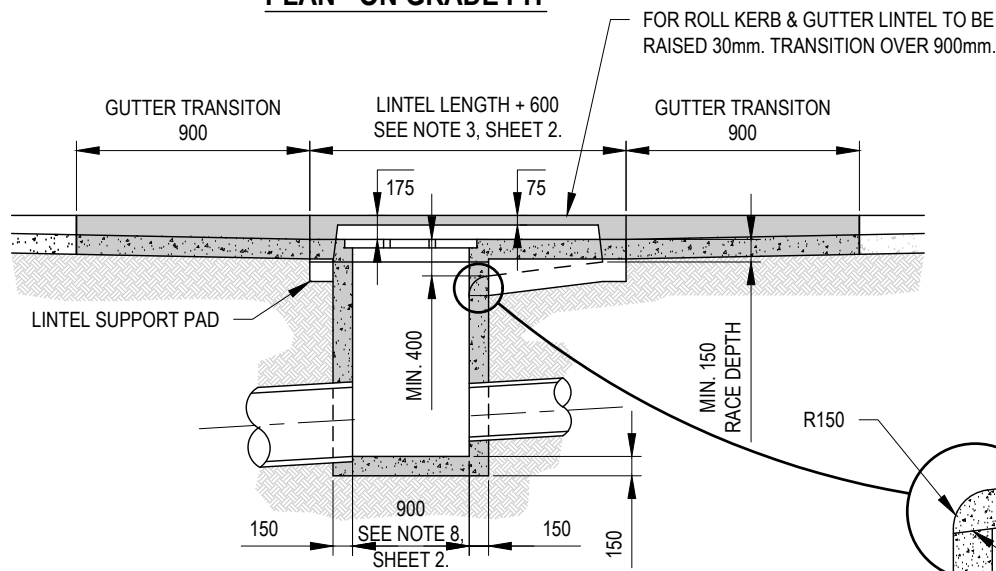
NOTE: ALL LETTERING TO BE "E" SERIES



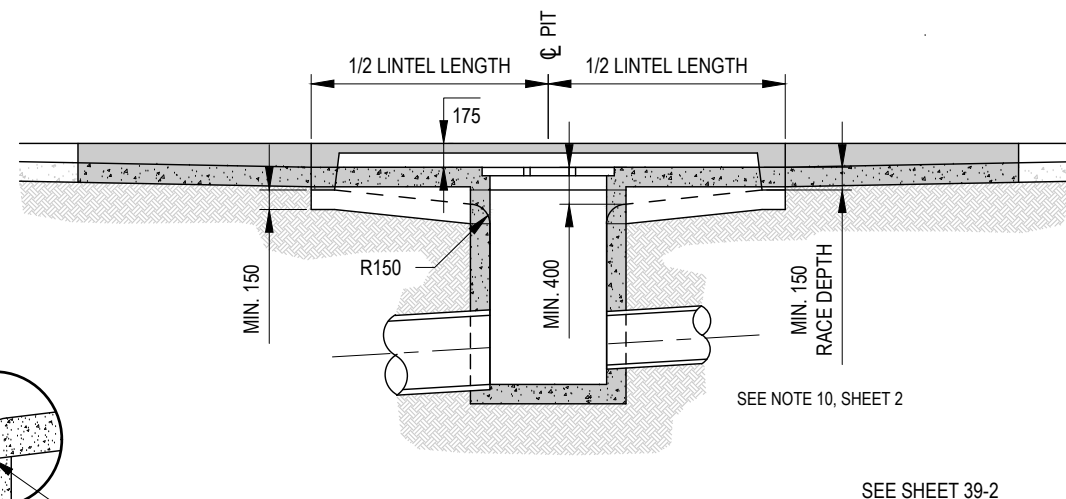
PLAN - ON GRADE PIT



PLAN - SAG PIT



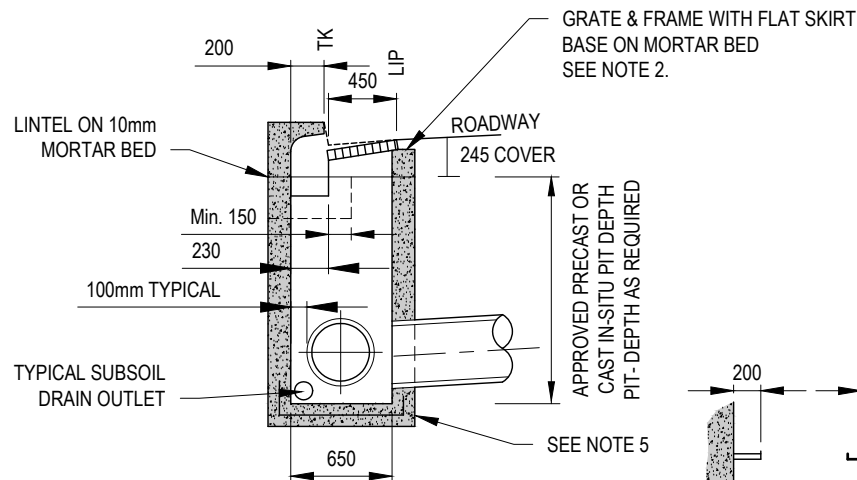
SECTION A-A



SECTION B-B

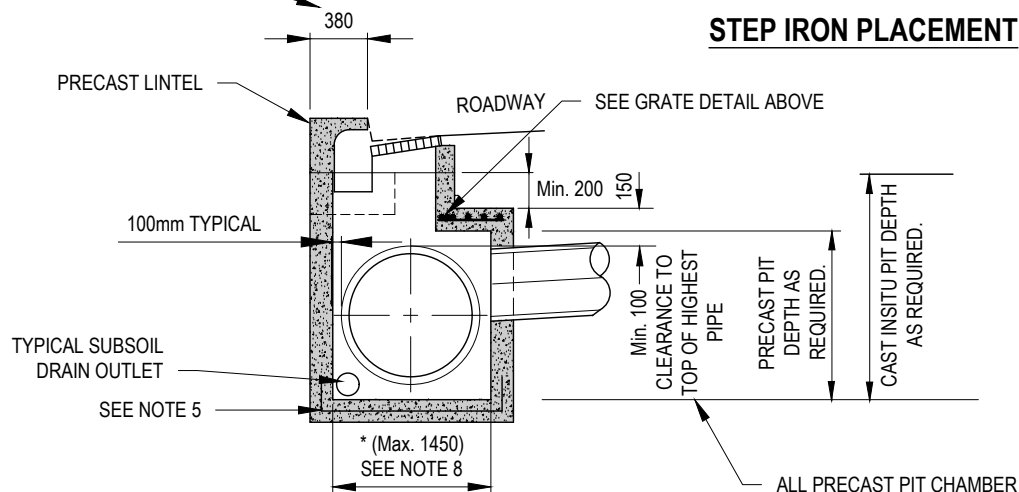
SEE SHEET 39-2
FOR SECTION D-D





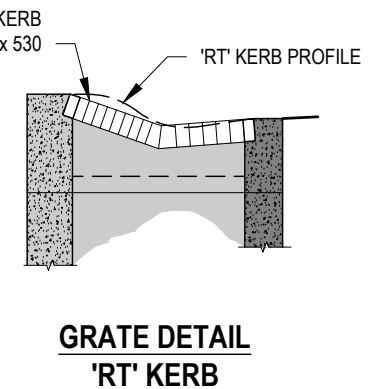
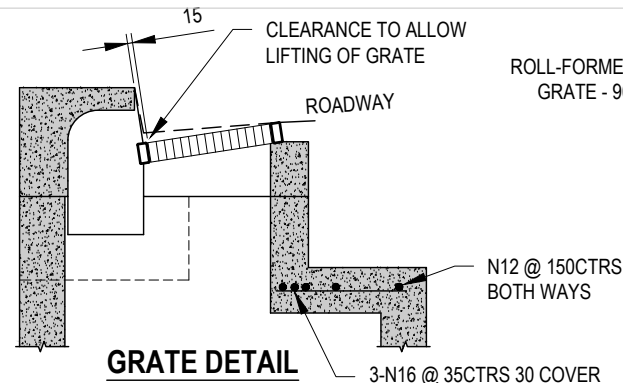
SECTION D-D (Min 650mm WIDTH)

MAY VARY SLIGHTLY
BETWEEN MANUFACTURERS



SECTION D-D (Max 1450mm WIDTH)

STEP IRON PLACEMENT



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. GRATES TO BE;
- CLASS 'B' FOR OFF ROAD AREAS
- CLASS 'C' - MEDIUM DUTY FOR LIGHT TRAFFIC AREAS
- CLASS 'D' FOR ROADS & COMMERCIAL AREAS
3. GRATES ARE TO BE HOT DIP GALVANISED 80-85 MICRONS THICK. ALL GRATES TO BE PROVIDED WITH HINGE PINS.
4. ALL LINTELS TO BE APPROVED PRECAST TYPE. DIMENSIONS SHOWN ON PLAN TO DENOTE CLEAR OPENINGS, MIN SIZE 1.2m. DIMENSIONS MAY VARY BETWEEN MANUFACTURERS.
5. PROVIDE STEP IRONS FOR PITS DEEPER THAN 1.2m.
6. MINIMUM THICKNESS OF WALLS AND BASE TO BE 150mm.
7. ALL PITS TO HAVE A MINIMUM OF SL82 MESH IN BASE AND N12 "L" STARTER BARS (450 LEGS) @ 400 CTRS.
8. PITS BETWEEN 1.5m & 2.5m DEEP TO HAVE SL82 MESH CENTRALLY PLACED IN WALLS FOR FULL DEPTH WITH N12 "L" CORNER BARS (450 LEGS) @ 400 CTRS.
9. PITS DEEPER THAN 2.5m OR LONGER THAN 900 OR 1450 WIDE SHALL BE DESIGNED BY A QUALIFIED ENGINEER.
10. PITS POURED IN MULTIPLE HEIGHT SECTIONS SHALL INCLUDE SL82 MESH OR 400N12 STARTER BARS @ 300 c/c.
11. COMPRESSIVE STRENGTH (FC) FOR CAST INSITU CONCRETE SHALL BE A MINIMUM 32 MPa @ 28 DAYS.
12. NO RENDERING PERMITTED IN STRUCTURAL COMPONENTS.
13. THIS STANDARD REFERS TO PITS CONSTRUCTED ADJACENT TO FLEXIBLE PAVEMENTS. TOTAL ISOLATION OF PITS IS REQUIRED ADJACENT TO RIGID PAVEMENTS.
14. ALL PITS TO BE ADEQUATELY STREAMLINED AND BENCHED.
15. FOR PITS LOCATED AT KERB RETURNS REFER TO SD009

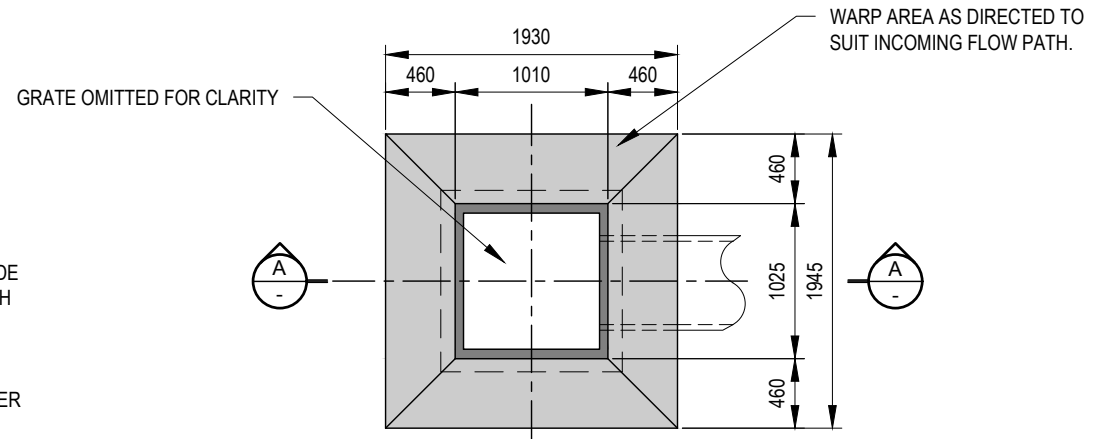
STEP IRON NOTE:

1. STEP IRONS TO COMPLY TO AS1657.
2. STEP IRONS TO BE HOT DIPPED GALVANISED OR PLASTIC.
3. STEPS TO BE FIXED INTO THE PIT WALL WITH AN EPOXY RESIN COMPOUND.

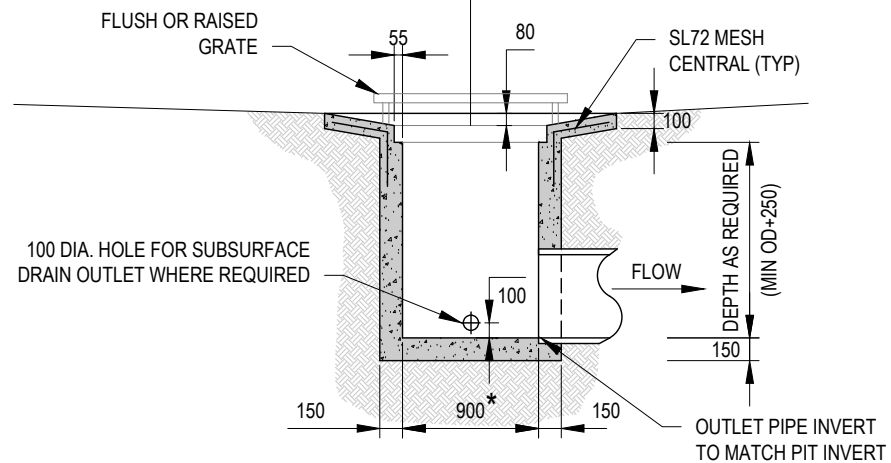
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. FOR DETAILS OF GULLY GRATING AND FRAME SEE WEDLOCK GRATE CODE PC9090B OR APPROVED EQUIVALENT. ALL GRATES TO BE PROVIDED WITH LOCKING BOLTS. HINGES TO BE LOCATED ON UPSTREAM SIDE.
3. PROVIDE STEP IRONS FOR PITS DEEPER THAN 1.2m REFER TO SD039.
4. MINIMUM THICKNESS OF WALLS AND BASE TO BE 150mm.
5. ALL PITS TO HAVE A MINIMUM OF SL82 MESH IN BASE AND N12 "L" STARTER BARS (450 LEGS) @ 400 c/c.
6. PITS BETWEEN 1.5m & 2.5m DEEP TO HAVE SL82 MESH CENTRALLY PLACED IN WALLS FOR FULL DEPTH WITH N12 "L" CORNER BARS (450 LEGS) @ 400 c/c.
7. PITS DEEPER THAN 2.5m OR LONGER THAN 900 OR 1450 WIDE SHALL BE DESIGNED BY A QUALIFIED ENGINEER.
8. PITS POURED IN MULTIPLE HEIGHT SECTIONS SHALL INCLUDE SL82 MESH OR 400N12 STARTER BARS @ 300 c/c.
9. COMPRESSIVE STRENGTH (FC) FOR CAST INSITU CONCRETE SHALL BE A MINIMUM 25 MPa @ 28 DAYS.
10. NO RENDERING PERMITTED IN STRUCTURAL COMPONENTS.
11. ALL PITS TO BE ADEQUATELY STREAMLINED AND BENCHED.
12. PROVIDE MIN 450mm PINNED TURF SURROUND.
13. SHAPE ADJACENT AREAS TO ASSIST WATER COLLECTION.

*	PIPE DIAM RANGE
900	600mm TO 750mm INCL
1200	825mm TO 900mm INCL



PLAN



SECTION A-A

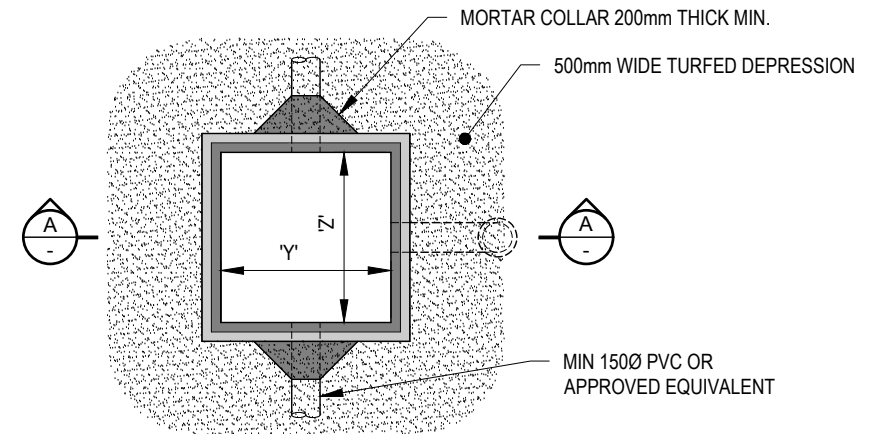


MINIMUM PIT DIMENSIONS

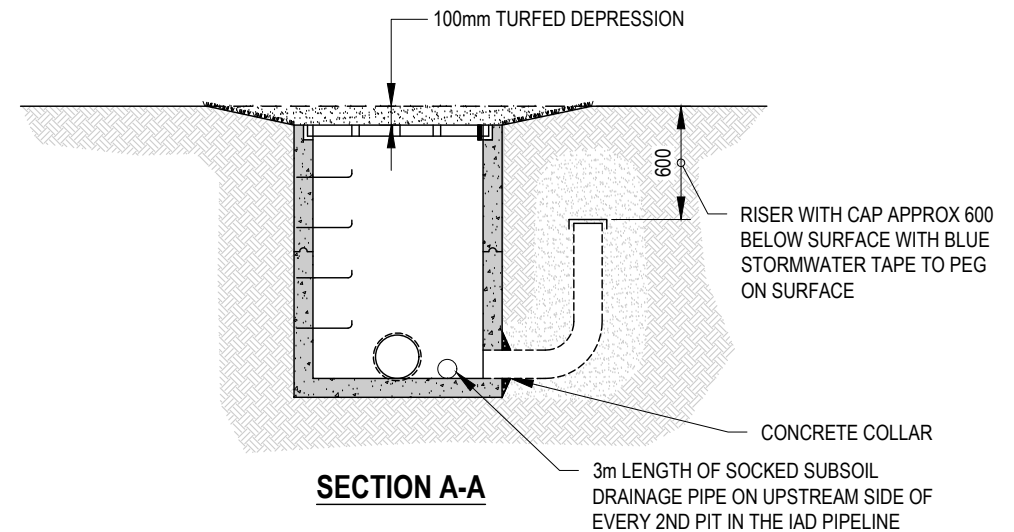
PIT DEPTH	<900	900 - 1200	>1200
'Y'	450	600	600
'Z'	450	600	900

NOTE:

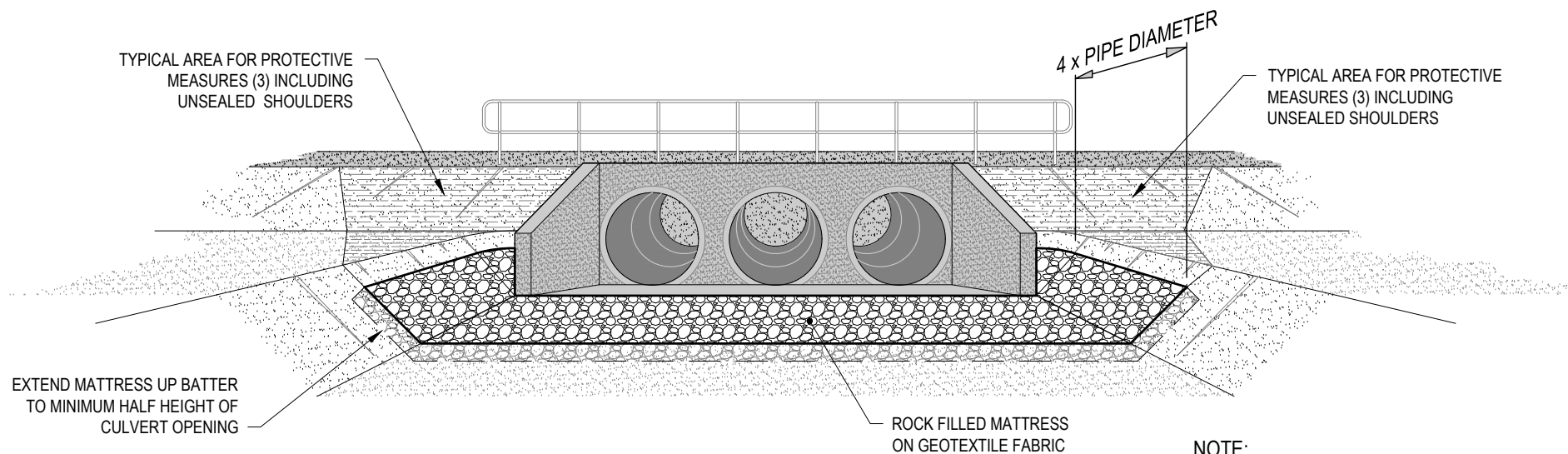
1. INTER-ALLOTMENT DRAINAGE PITS SHALL BE PROVIDED TO THE LOW CORNER OF EACH LOT UNLESS OTHERWISE PROVIDED.
2. PITS WILL ALSO BE PROVIDED AT CHANGES OF PIPE SIZE, CHANGES IN GRADE, CHANGED IN PIPE TYPE OR CLASS AND CHANGES IN DIRECTION OF 45° OR GREATER. SUCH PITS ARE TO BE A MINIMUM INTERNAL SIZE OF 450 x 450 APPROVED PRECAST OR CAST INSITU.
3. PITS SHALL BE COVERED BY AN APPROVED GRATE TO PROVIDE AN ADEQUATE SURFACE WATER INLET. ALL GRATES ARE TO BE PROVIDED WITH EITHER "J" BOLTS OR PINS TO PREVENT REMOVAL. PITS SURROUNDS WILL BE TURFED AND PEGGED OR NETTED TO A MINIMUM WIDTH OF 500mm.
4. PIT INLET GRATES SHALL BE DEPRESSED 100mm BELOW SURROUNDING GROUND LEVEL TO ASSIST SURFACE WATER COLLECTION.
5. PROVIDE STEP IRONS FOR PITS DEEPER THAN 1.2m. REFER TO SD039. SUCH PITS ARE TO HAVE A MINIMUM INTERNAL SIZE OF 900 x 600mm.
6. CONNECTION FOR ROOF WATER FOR SINGLE RESIDENTIAL DWELLINGS SHALL BE PROVIDED VIA A 150mm DIA. STUB INTO THE SIDE OF THE PIT.
7. PIPE CONNECTION TO PIT TO BE SEALED WITH MINIMUM 100mm MORTAR COLLAR FOR SEAL AND SUPPORT.



PLAN

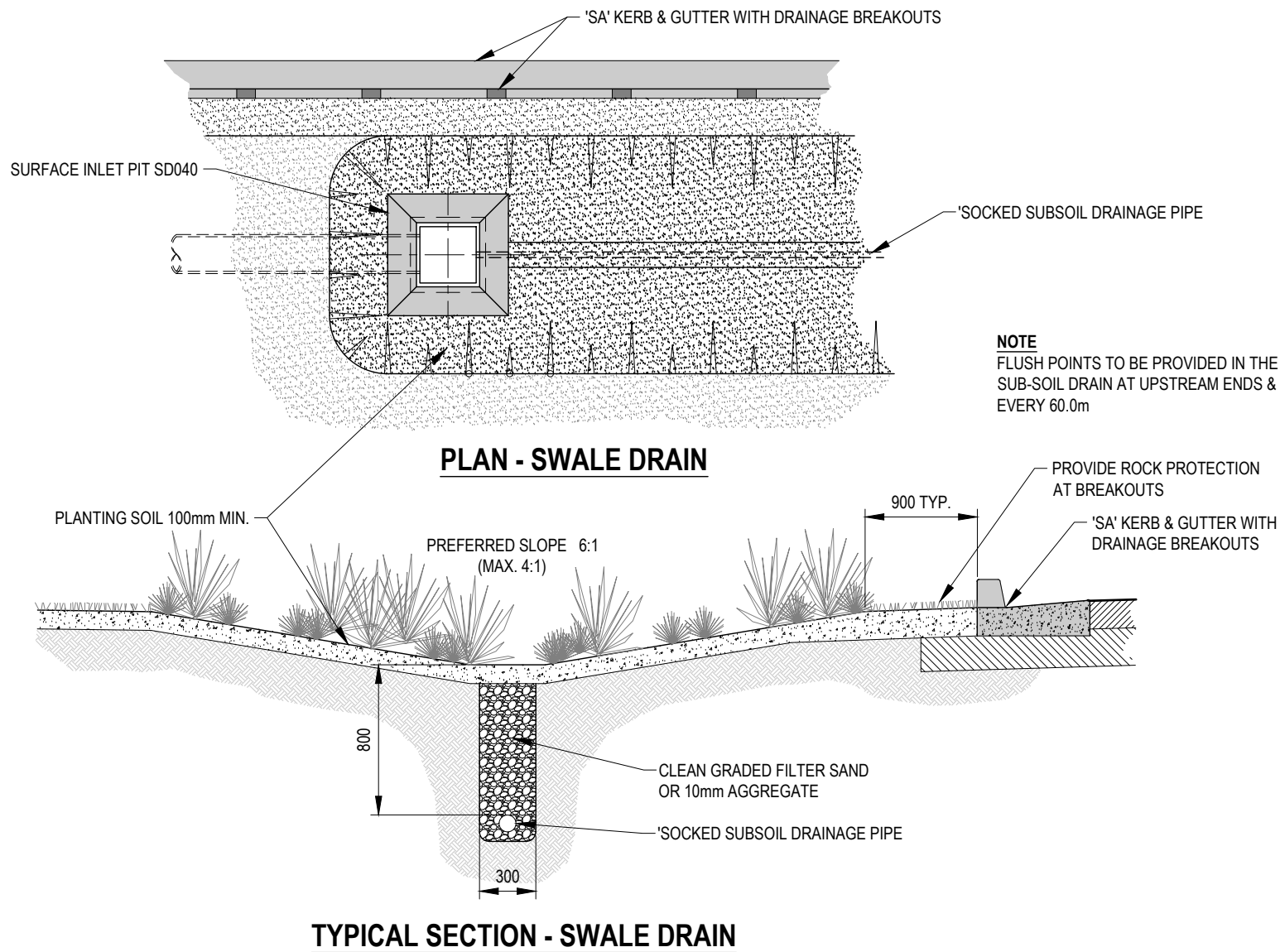


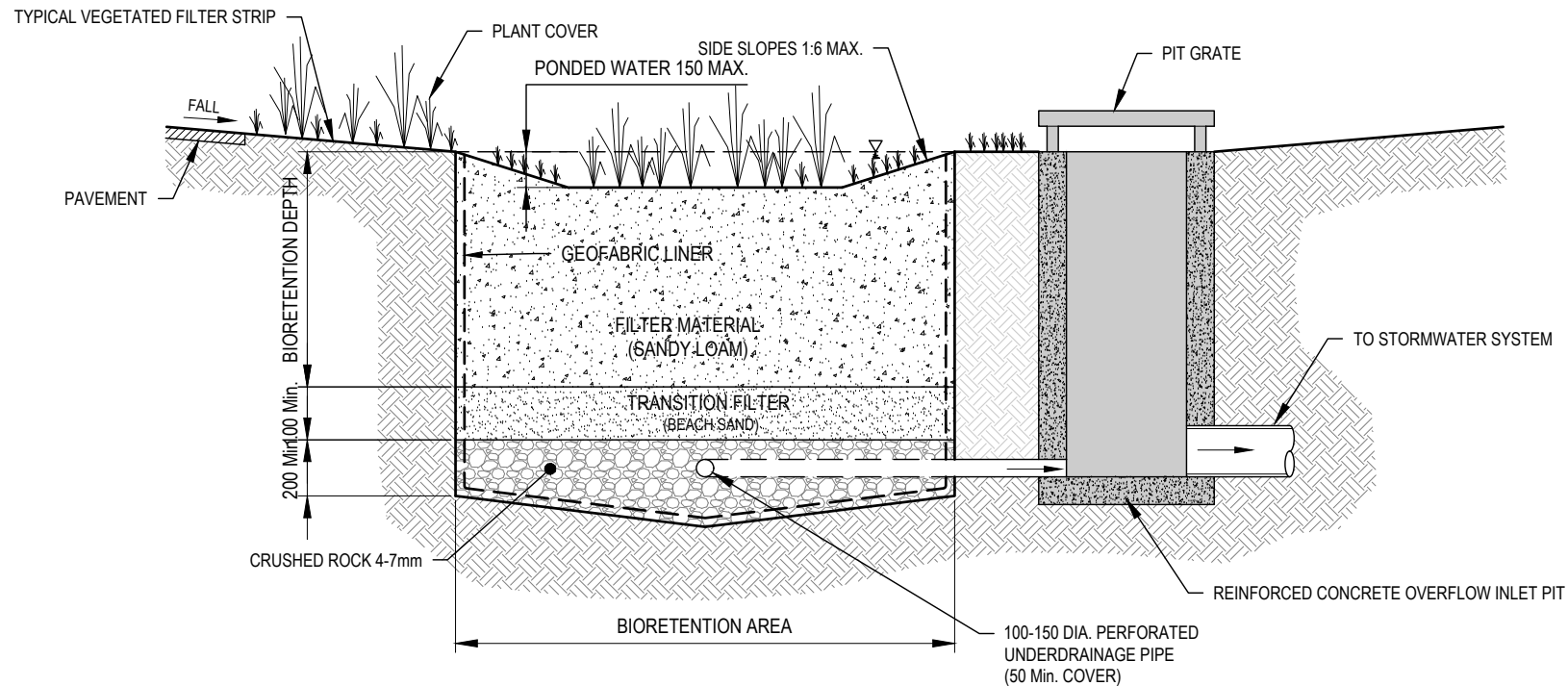
SECTION A-A



NOTE:

1. SAFETY FENCING SHALL BE PROVIDED ABOVE HEADWALL SUBJECT TO PROXIMITY OF PEDESTRIANS.
2. ENERGY DISSIPATERS SHALL BE INCLUDED IN THE DESIGN AS REQUIRED
3. WHERE THERE IS A POSSIBILITY OF OVERFLOW OF THE ROAD, SCOUR PROTECTION MEASURES ARE TO BE IMPLEMENTED ON SHOULDERS AND BATTERS

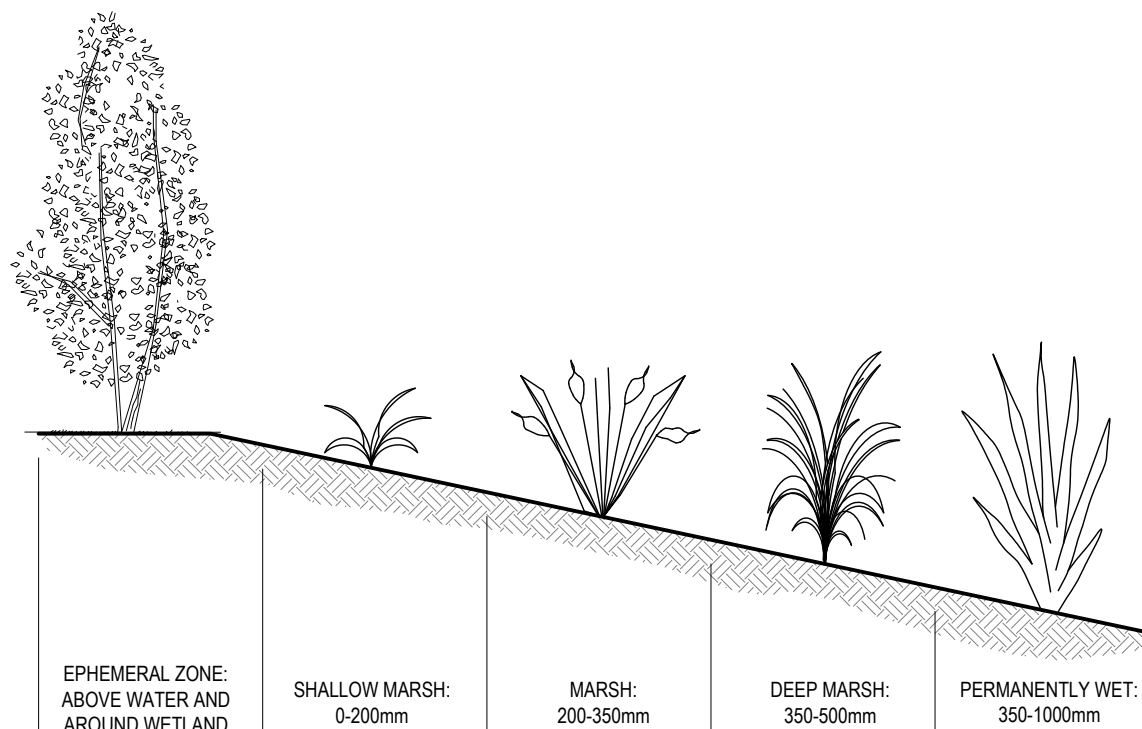




NOTE:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE
2. THE BIORETENTION SYSTEM SHALL BE DESIGNED BY A SUITABLY QUALIFIED ENVIRONMENTAL ENGINEER TAKING INTO ACCOUNT THE FOLLOWING:
 - TREATABLE VOLUME
 - TREATABLE FLOW RATE
 - MAXIMUM PONDED DEPTH (150mm)
 - MAXIMUM SIDE SLOPES (1:6)
 - FILTER MEDIA HYDRAULIC PERMEABILITY
 - PLANT SPECIES

- SURFACE AREA AND DIMENSIONS OF SYSTEM
 - FILTER AREA AND DEPTH
 - UNDERDRAINAGE PIPE SIZE
 - TRANSITION SAND LAYER
 - BACK FLUSH FOR UNDERDRAINAGE PIPES
 - HIGH FLOW BYPASS
 - LOW PERMEABILITY LINER (IF REQUIRED)
3. THE BIORETENTION SYSTEM SHALL NOT BE USED FOR SEDIMENT CONTROL DURING CONSTRUCTION.
 4. PITS AND GRATES IN ACCORDANCE WITH COUNCIL STANDARDS.



NOTE:

1. ANY TREES SURROUNDING WETLAND SHOULD BE DISTANCED TO ALLOW ACCESS BY MAINTENANCE PLAN IN AND AROUND WETLAND.
2. ALL WEATHER ACCESS IS REQUIRED TO WETLAND.

EPHEMERAL ZONE (ABOVE WATER LEVEL AND AROUND WETLAND):

- Eucalyptus camaldulensis Red River Gum
- Tristaniopsis laurina Water Gum
- Callistemon salignus Willow Bottlebrush
- Banksia integrifolia Coast Banksia
- Casuarina glauca Swamp Oak
- Syzygium paniculatum Magenta Lilly Pilly
- Melaleuca quinquenervia Broad-leaved Paperbark
- Melaleuca styphelioides Black Tea Tree

SHALLOW MARSH (0 - 200mm):

- Baumea articulata Jointed Twig-rush
- Bolboschoenus caldwellii Club-rush
- Bolboschoenus fluviatilis Stream Club-sedge
- Eleocharis acuta Spike-rush
- Juncus usitatus Common-rush
- Schoenoplectus validus River Club-rush

MARSH (200 - 350mm):

- Lepironia articulata
- Eleocharis acuta Spike-rush
- Carex inversa Knob Sedge

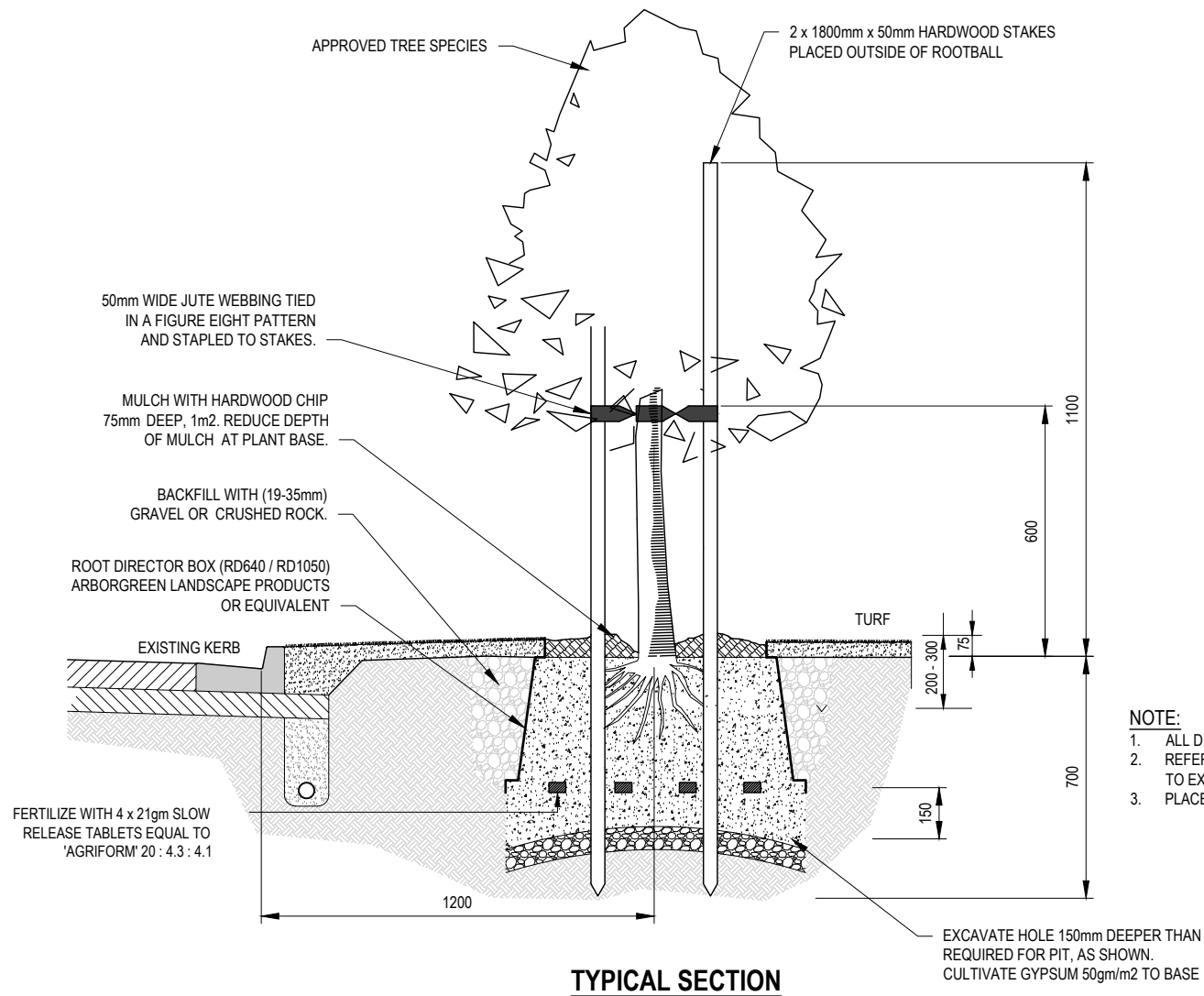
DEEP MARSH (350 - 500mm):

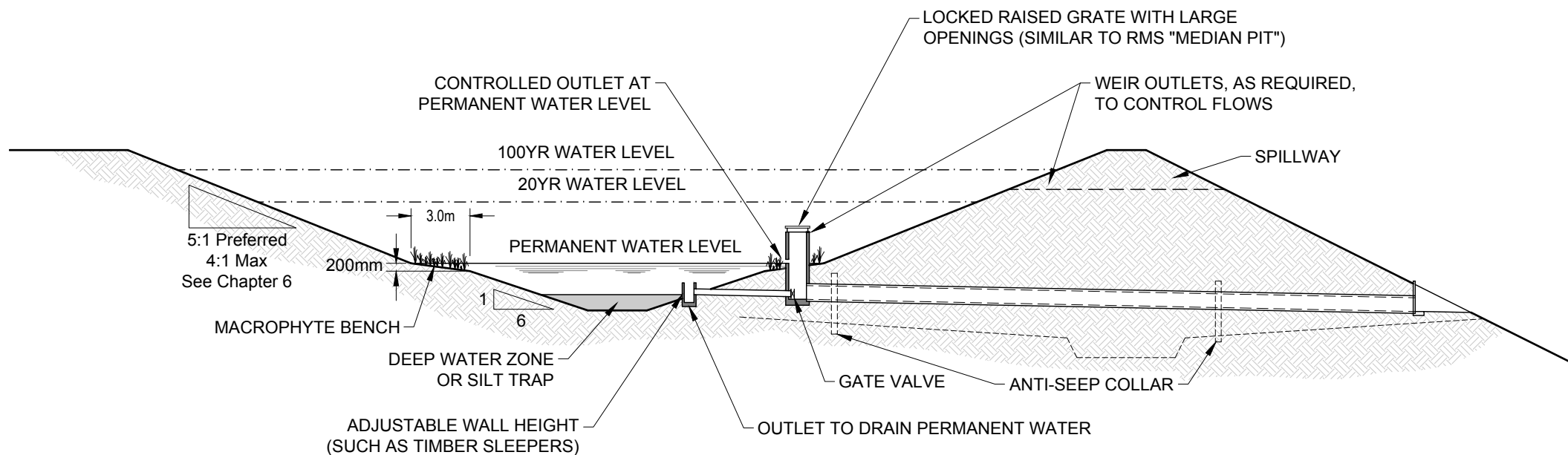
- Baumea articulata Jointed Twig-rush
- Bolboschoenus caldwellii Club-rush
- Eleocharis acuta Spike-rush
- Juncus usitatus Common-rush
- Schoenoplectus validus River Club-rush
- Triglochin procerum Water Ribbons
- Vallisneria gigantea Ribbonweed

PERMANENTLY WET (350 - 1000mm):

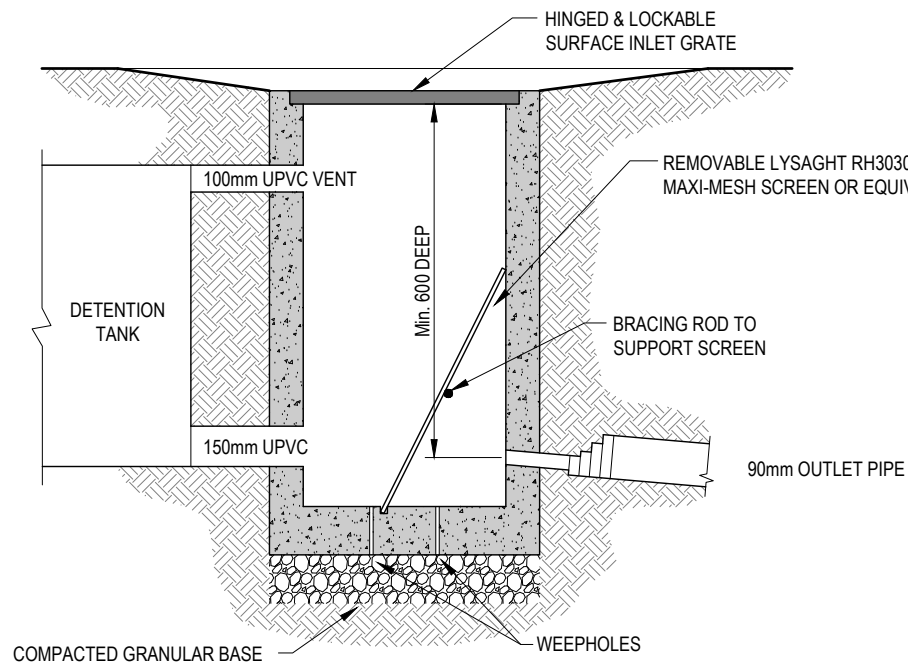
- Bolboschoenus caldwellii Club-rush
- Ceratophyllum demersum Hornwort
- Ranunculus inundatus Buttercup
- Triglochin procerum Water Ribbons
- Vallisneria gigantea Ribbonweed



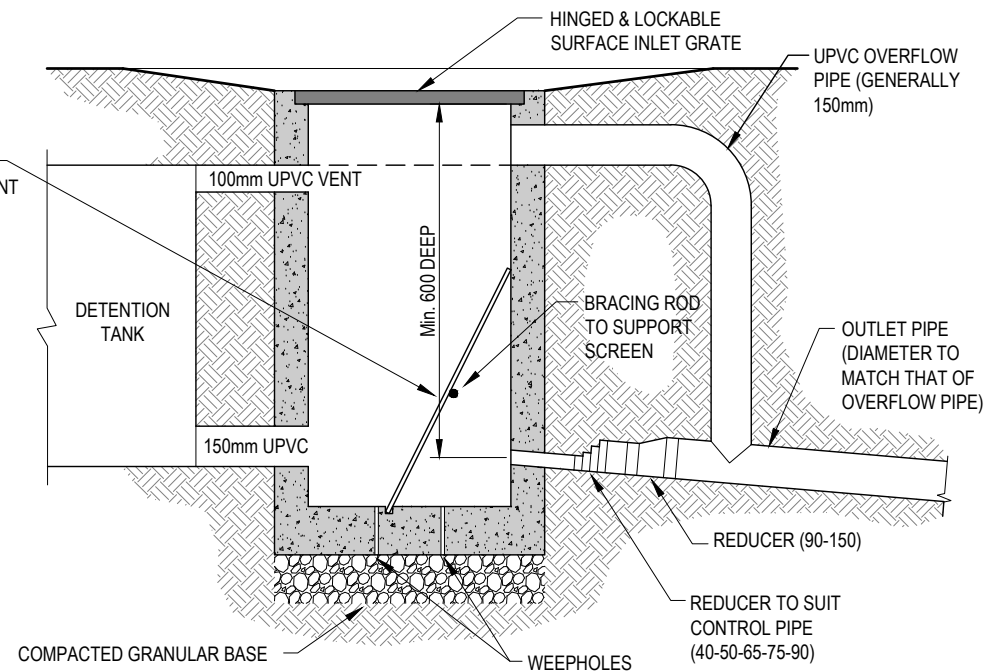




TYPICAL ARRANGEMENT



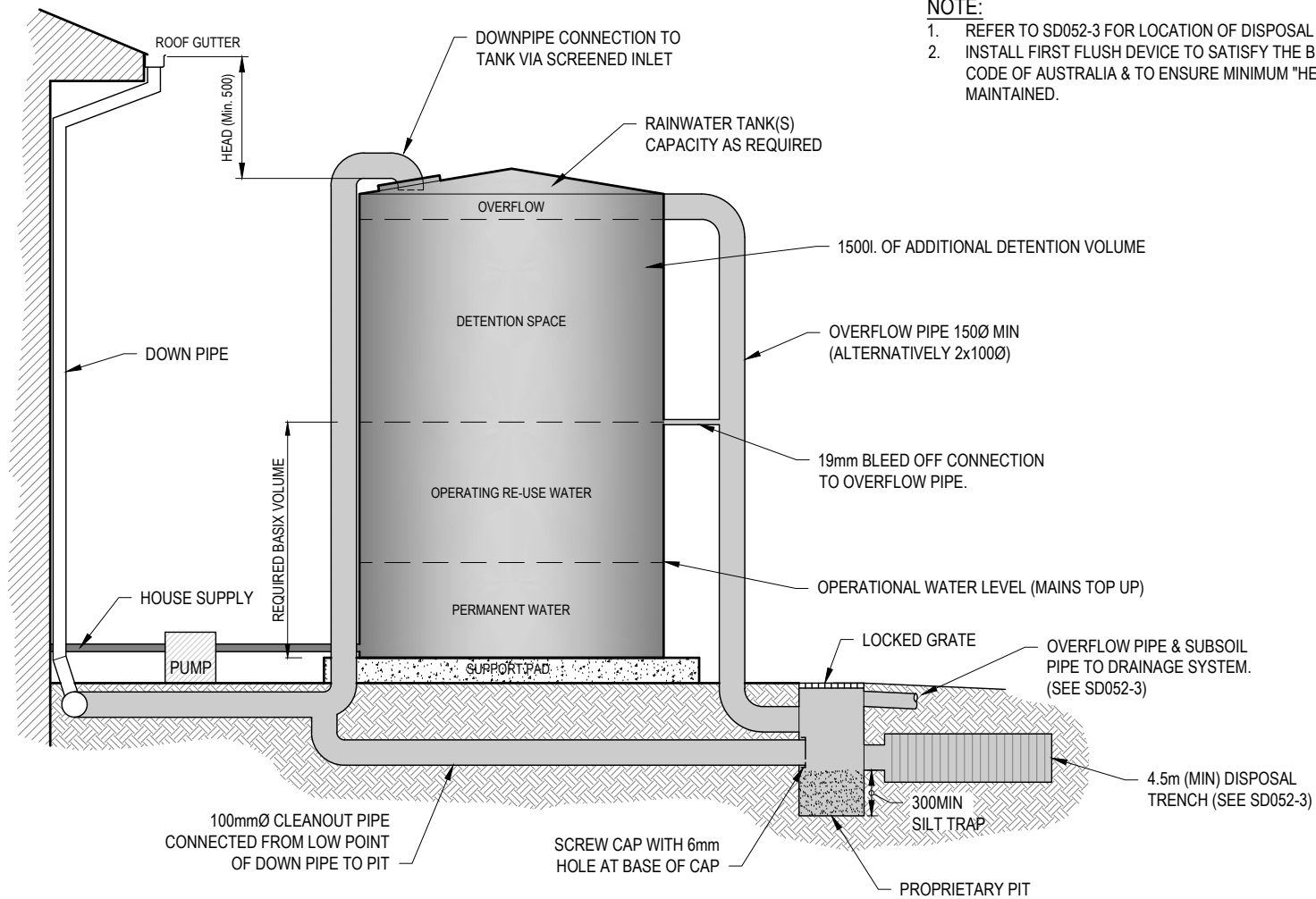
WITHOUT OVERFLOW PIPE
(WHERE SURFACE OVERFLOW AVAILABLE)

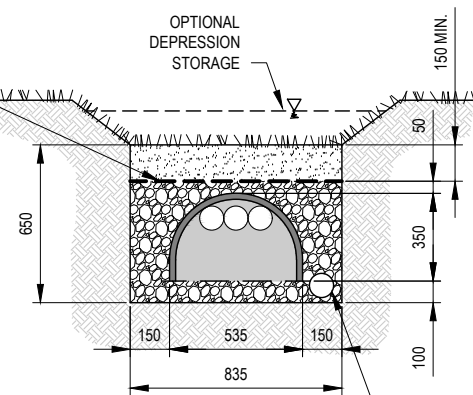
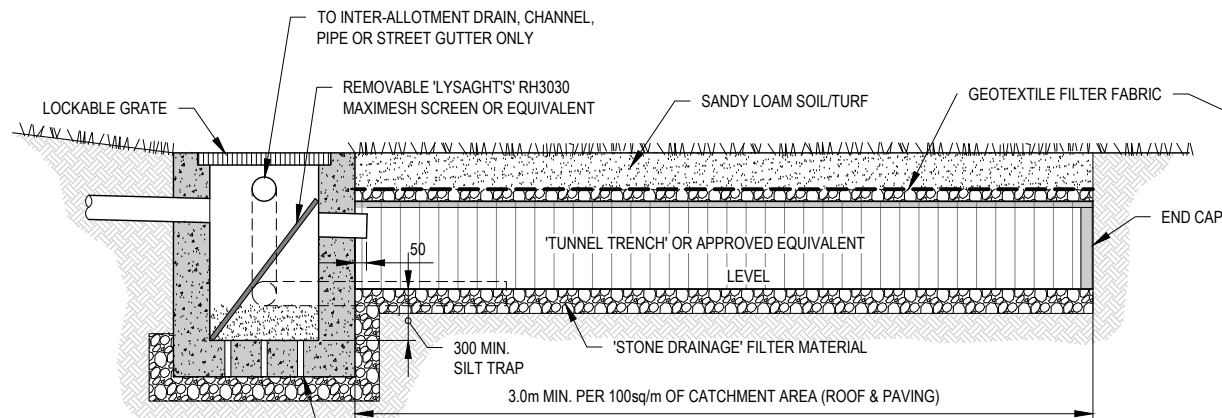


WITH OVERFLOW PIPE

NOTE:

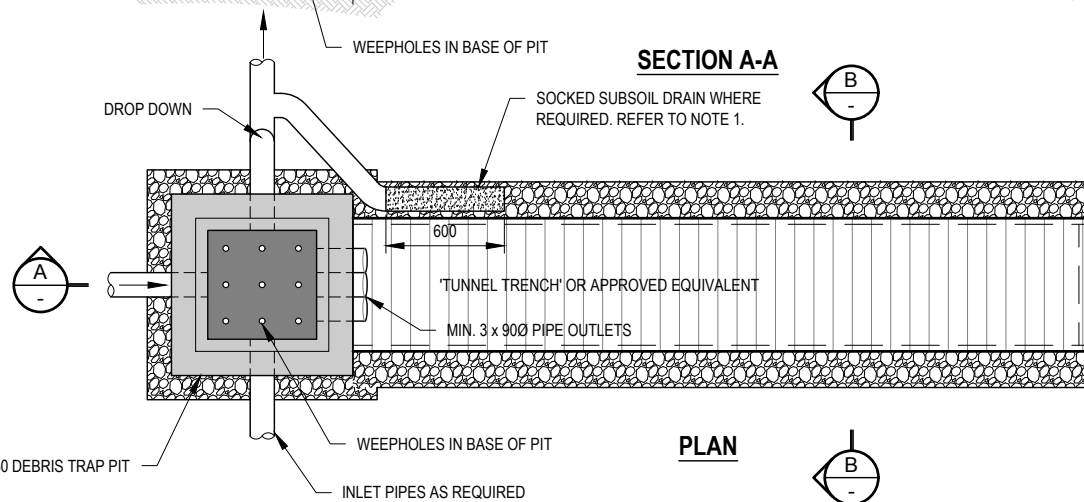
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. STORMWATER PIPES TO BE SEWER GRADE ACROSS PUBLIC FOOTWAY.
3. CONCRETE COMPRESSIVE STRENGTH 32MPa.
SIDE WALLS OF ALL PITS DEEPER THAN 1500 ARE TO BE REINFORCED WITH ONE LAYER OF SL82 MESH RETURNED 300 INTO BASE. WHERE REQUIRED INCREASE CONCRETE STRENGTH TO 32MPa.
4. DEPTH OF PIT NOT TO EXCEED 2000mm.
5. PROVIDE STEP IRONS FOR PITS DEEPER THAN 1200mm REFER TO SD039.
6. ALL EXPOSED EDGES TO BE ROUNDED WITH 20mm RADIUS





SECTION B-B

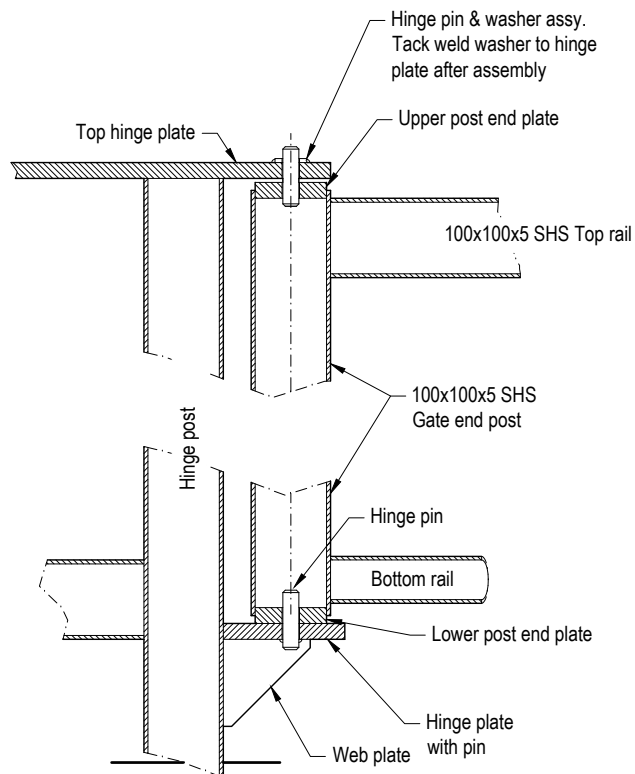
SOCKED SUBSOIL DRAIN WHERE REQUIRED REFER TO NOTE 1



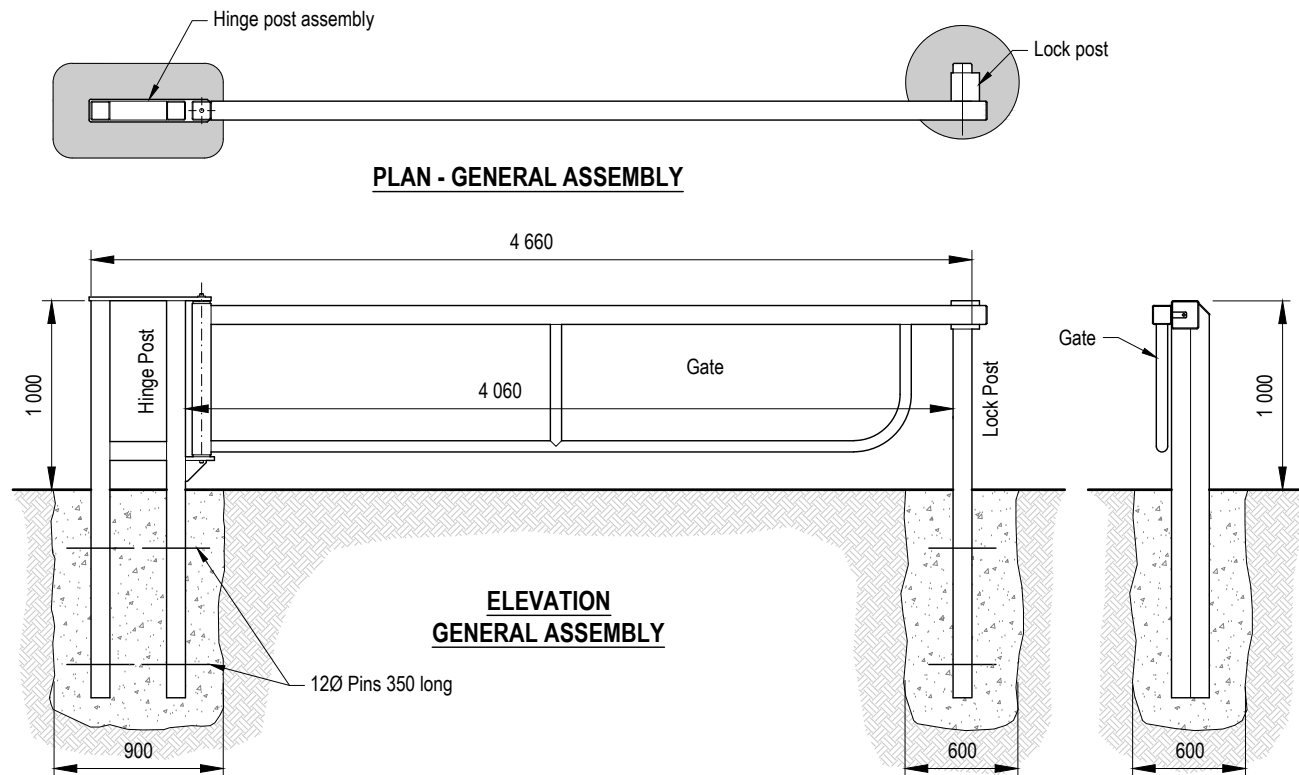
PLAN

NOTE:

1. IN CLEAN SAND CONDITIONS, TRENCHING SHALL BE A MIN OF 1.0m CLEAR OF STRUCTURAL FOUNDATIONS AND PROPERTY BOUNDARIES
2. IN CLAY CONDITIONS, TRENCHING SHALL BE A MIN. OF 3.0m CLEAR OF STRUCTURAL FOUNDATIONS WITH A SOCKED SUBSOIL DRAIN INSTALLED
3. REFER TO AUSTRALIAN RUNOFF QUALITY SECTION 11.
4. THE TRENCHING SHALL BE PLACED LEVEL, WHERE POSSIBLE & ALONG THE CONTOUR OF THE LAND. DEPTH MAY BE VARIED TO SUIT.
5. THE TRENCHING SHALL BE PLACED DOWNHILL OF BUILDINGS AND TO ACHIEVE MAXIMUM AREA, SLOPING AWAY FROM THE TRENCH, FOR DISPERSAL OF WATER.
6. THE DISPERSAL AREA SHOULD BE CHOSEN TO AVOID OVERFLOW TOWARD A BUILDING OR ONTO ADJOINING PROPERTIES.



HINGE ASSEMBLY DETAIL



LOCK POST

NOTE

1. All dimensions are in millimetres
2. All welds to be 6mm continuous fillet
3. Gate & posts to be hot dipped galvanised after fabrication
4. All field welds to be cold galvanised
5. All concrete to be 20MPa

