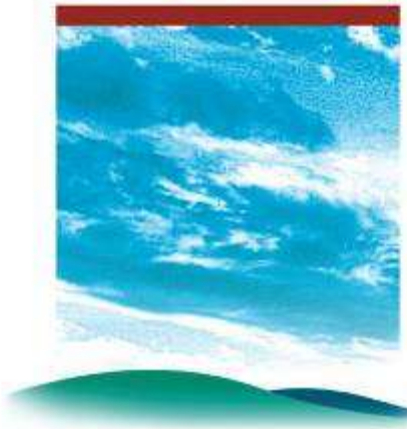


Shire of

Gunnedah

Land of Opportunity

V2.0

August 2013

Engineering Guidelines

For

Subdivisions & Developments

Version	Changes	Date
Draft Version 1.0	Revision of old Guidelines	August 2012
Draft Version 2.0	Remove trees from Footpath allocation	March 2013

Table of Contents

PART 1

General

Requirements

1 GENERAL REQUIREMENTS

1.1 Introduction

The Engineering Design Guidelines for Subdivision and Development have been compiled to outline Council's general procedures and practices in respect of the engineering design requirements for subdivision and development of land within the Council area.

The following guidelines have been prepared in order to facilitate the expeditious processing of engineering plan submissions, issue of Construction Certificates and release of Subdivision Certificates. Applicants should be aware that each development is required to be treated on its merits and that approval is dependent on the overall impact of the development on the area and not solely in compliance with minimum engineering standards.

Council welcomes the submission of innovative design solutions and staff are available for initial consultation to discuss and assess the prospects for approval.

All applicants are advised to ensure that all conditions of the Development Consent are addressed within the detailed engineering plans.

All references to an engineer should be interpreted as a person acceptable for Corporate Membership of The Institution of Engineers, Australia or a person with equivalent qualifications and experience.

All references to "Engineering Design Guidelines" or Design Guidelines should be interpreted as referring to "Engineering Design Guidelines for Subdivisions and Developments". All reference to a "Registered Surveyor" should be interpreted as a person registered under the Surveying and Spatial Information Act, 2002.

Part 1 of the Guidelines outlines Council's general engineering requirements. The detailed engineering design requirements are given in Parts 2 to 6.

Part 2 Guidelines for Design of Roads

Part 3 Guidelines for Design of Drainage

Part 4 Guidelines for Design of Water Reticulation

Part 5 Guidelines for Design of Wastewater Reticulation

Part 6 Guidelines for Landscaping

1.2 General

It is important to recognise that where a developer proposes, or is required to carry out civil engineering works in connection with a subdivision or development, the civil engineering works will generally become the responsibility of Council for ongoing asset management.

Before the developer commences the civil engineering works, a satisfactory engineering plan of the proposals should be submitted to and approved by Council.

When approval to a subdivision or other development includes conditions of construction which are embodied in the approved plans and specifications, the onus is primarily on the applicant to whom the approval is given to ensure that the work is completed in accordance with plans and specifications.

A contractor carrying out subdivision works is responsible to the developer, not Council.

The developer should nominate to Council, the person or firm, with whom correspondence relating to the technical aspects of the development should be exchanged.

Council will hold the developer (applicant), to whom the development approval was issued, solely responsible for constructing the required development works to Council's satisfaction and maintaining them during any specified period.

The developer should nominate to Council for approval prior to commencement of construction, the name of the contractor who is to carry out the work associated with the development. Details of experience and technical expertise in similar works and the financial capabilities of the contractor to carry out the works are also required by the Council.

The Council will not require the details above for contractors previously approved.

1.3 Changes to these Design Guidelines

From time to time Council will make changes to these Design Guidelines. A current copy of the Guidelines will be available at www.gunnedah.nsw.gov.au. It is the responsibility of the Developer to ensure that all aspects of submitted drawings comply with the most current set of design guidelines as at the date the final designs have been submitted for assessment.

1.4 Submission of Engineering Drawings and Specifications

All documentation supporting a Construction Certificate application must be submitted in electronic format with a hardcopy covering letter and completed Construction Certificate Application Form at a Council Customer Service Counter.

The documentation supporting a Construction Certificate application must be complete in its entirety and satisfy all requirements of the consent, Council's Engineering Design Guidelines for Subdivisions and Developments and Council's Development Control Plan.

The covering letter shall detail the contents supplied in the electronic media and the number of Lots included in the application. The fee payable at this point shall only be "Construction Certificate for Subdivision (per Lot)" fee in accordance with the Fees and Charges Annexure of Council's current Operational Management Plan.

1.4.1 ENGINEERING DRAWINGS

The following general requirements apply in the preparation of engineering drawings for developments and subdivisions, including all associated works:

Engineering drawings are to be submitted, with a covering letter, by the applicant as detailed below. One (1) set of approved plans will be returned to the applicant.

One (1) A1 size set shall be accompanied by the relevant stormwater, sewer and water strategy assessed as part of the Application for Construction Certificate for examination by Council and the additional three (3) A1 size sets forwarded upon approval.

Specific requirements to be included on drawings are detailed in each section of the Guidelines with checklists to ensure the necessary information contained at the rear of each section

All drawings should be signed by the respective Consultant/Engineer engaged by the Developer.

1.4.2 PERSONS QUALIFIED

Council requires that design plans be prepared to Council's standards by a person, either holding qualifications acceptable for Corporate Membership of the Institution of Engineers, Australia, and/or who has proven experience in the preparation of plans and specifications for land development.

Council relies upon the professional skill and experience of the person responsible for the preparation of the plans and specifications for the land development. Council requires that the person taking responsibility for the proper design and specification for the land development (or each of them when there is more than one) provide a certificate in the form attached to these guidelines as **ANNEXURE A** certifying that all prudent actions have been taken to ensure that the design meets or exceeds current engineering standards appropriate to the development and the site.

1.4.3 CONSTRUCTION SPECIFICATION

Preparation of the construction specification is the responsibility of the Applicant, and the specification may include reference to requirements contained within Council's Engineering Design Guidelines, together with the appropriate standard specifications selected from other sources.

One (1) copy of the Construction Specification is to be submitted with the initial set of engineering drawings, which will be approved by Council.

1.4.4 APPROVAL OF ENGINEERING DRAWINGS AND SPECIFICATION

It is the entire responsibility of the person(s) or company submitting the documents, to ensure that the designs and specification comply with Council's Engineering Guidelines for Subdivision Developments, Relevant Australian Standards Relevant Local and State and Federal Government Legislation, Local Government Plans.

The Council's issue of the Construction Certificate is conditional on the above basis and does not relieve the developer from rectifying any errors or omissions which become evident during construction.

Developers should be aware that the review of plans and specifications by Council does not extend to verifying site investigations or engineering calculations and design. Professional responsibility for this work rests with developer and the person preparing the designs and specifications. Council relies upon this work being undertaken by an appropriately skilled and experienced person which must be certified in the manner described in Annexure A before a construction certificate will be issued.

1.5 Completion of Required Works for Release of Subdivision Certificate

1.5.1 NOTIFICATION OF COMPLETION

When the developer (or his consultant) is of the opinion that Completion of Works has been reached, the developer should, notify Council in writing and request a final inspection.

Within fourteen (14) days of the receipt of the request, the Council's Representative(s) shall inspect the works and provide a written advice of the results of the final inspection. The developer or the nominated representative must be present for the inspection and assist the Council's Representatives in checking levels, opening manholes etc, as required.

The Subdivision/Occupation Certificate will not be signed and released by Council until it is satisfied that the following works are completed:

1.5.1.1 DEVELOPMENTS INCLUDING ASPHALT SEALED ROADS

- Water supply, sewer reticulation, kerb and gutter, stormwater drainage and the road construction up to and including the sub-base pavement;
- Work as Executed Plans for the work constructed to that point;
- A performance bond for the remainder of the work to be completed; and
- A commitment from the Developer to update Work as Executed plans after completion of sealing works.

1.5.1.2 DEVELOPMENTS NOT INCLUDING ASPHALT SEALED ROADS

- Water supply, sewer reticulation, kerb and gutter, stormwater drainage and the road construction including sealing; and
- Work as Executed Plans for all work constructed.

1.5.2 PERFORMANCE BONDS

A Performance Bond may be lodged by the developer for specified outstanding works, subject to agreement to the extent of those works by Council. The Performance Bond must be lodged prior to the release of the Subdivision Certificate and it shall be the value of the outstanding works, plus 30%.

The Council will fix a reasonable time for the completion of works from the date of release of the Subdivision Certificate. If works are incomplete in the time allowed, the Council may grant an extension of time to complete, or Council may complete works at the developer's cost using the bond. Any unexpended balance will be refunded to the developer.

1.5.3 MAINTENANCE BOND

Prior to the issue of a Subdivision Certificate Council will require the lodgement of a Maintenance Bond which is held to cover the cost of any maintenance or defects identified during the maintenance period in relation to the subdivision or development works that are intended to be under Council ownership. The maintenance period commences from the date of issue of the Subdivision Certificate or Occupation Certificate, unless a performance bond for outstanding work is entered into, in which case the maintenance period shall commence from the date of completion of the outstanding works. The maintenance period is 12 months, however where infrastructure intended to be public assets is dedicated to Council but staged release of Lots is proposed as part of the Subdivision Certificate process, then the maintenance period will be extended for the period of time that it takes the developer to release at least half of the Lots constructed for each Construction Certificate. The amount of the Bond is calculated as 5% of the total contract price for completion of the work, with a minimum amount of three hundred dollars ($300).

The bond shall be released in stages as follows:

- Fifty percent (50%) of the bond held (or 50% of the remaining bond should a portion of the bond money have been utilised to repair defects – see Section 1.5.3.1) shall be released after a period of six months or, in the case of staged Lot release as part of the Subdivision Certificate process, when at least half of the Lots created for each Construction Certificate have been released;
- The balance of the bond remaining shall be released after a further 6 months.

1.5.3.1 MAINTENANCE OF WORKS

At any time during the Maintenance Period, the relevant Director may direct the developer to rectify any omission or defect in the works which exist at final inspection or becomes apparent prior to the expiration of the Maintenance Period. If defects or omissions are not rectified to the satisfaction of the Director, Council shall be at liberty to rectify same and apply the maintenance bond for payment of the cost thereof.

The nature of some defects, e.g. water main breaks, sewer main connections etc., may necessitate Council's immediate action to repair. The maintenance bond will be used for the costs unless the developer elects to pay Council separately.

The Performance Bond, as referred to in Section 1.5.2 above, will be released by Council following satisfactory inspection of the outstanding works covered by the bond.

1.6 Works-As-Executed (W.A.E.) Plans

Following the completion of engineering works in a subdivision or development, "Works-As-Executed" plans are required to be prepared by a registered surveyor/professional engineer and forwarded to the Council prior to the release of the final plan of subdivision or occupational certificate. In the case of Sewer and Water works, WAE plans are to show the location and depth of junctions/water connections.

The Works-As-Executed plans must be certified by the Registered Surveyor or the Engineer responsible for the preparation of the Works-As-Executed plans:

The following certificate is to be appended to each page of the plans and signed by the supervising surveyor or engineer.

'I hereby certify that engineering works shown on this plan are Works-As-Executed and have been constructed in accordance with the plans and specifications approved by the Council.'

Name: _____

Signature: _____

Capacity: _____

Date: _____

Council relies upon the professional skill and experience of the person responsible for the supervision of the works and ensuring the works are undertaken in accordance with the approved plans and specifications together with these guidelines and any other appropriate standards.

Developers should be aware that Council inspections of the site are not a substitute for proper works supervision and Council relies upon the skill, experience and diligence of the person accepting professional responsibility for this work to ensure it is constructed in a proper manner.

General requirements regardless of the format Works as Executed drawings are submitted include;

- All sheets in an approved set of plans must be submitted;
- Marked as Revision 'W' (Remark: Work As Executed) regardless of whether work has been changed on that sheet or not;
- Where infrastructure refers to a future stage or previously constructed stage - this must be clearly noted;
- The Lot layout on the WAE plans must conform to what is to be released by Council;
- The location of conduits, subsoil lines, stub mains and interlot drainage lines, etc;
- Plans should substantially be in black & white/greyscale;
- Changes such as:
  - any departure from the approved plans; and
  - any additional work that has been undertaken; should be easily distinguishable and shown in red.
- Where Council requires the resubmission of plans due to errors - all sheets must be resubmitted;
- Sheets requiring a change should be marked as Revision 'W#' (# - number of WAE resubmit); and
- Initially and for each resubmission one hard copy (1) A1 size set of the plans shall be provided together with an electronic copy in one of the following formats.

PDF

- Sheets must be submitted in Full Scale (A1);
- One PDF containing all sheets (in order);
- PDF should be an electronic rendition of the submitted hard copy.

AUTOCAD DWG

- Council can accept up to and including the latest DWG file version;
- Council must be advised where the DWG has been created in a non-Autodesk product, like Microstation or 12D;
- Drawing must be on MGA (Zone 56) co-ordinates, with AHD datum
- Drawing must only contain:
  - Lot Layout;
  - Infrastructure Locations;
  - Labelling (if appropriate);
  - Each Asset Type (Water, Sewer, Stormwater, Roads etc) must be on their own layer - this can be further expanded if desired (i.e. Roads-Kerb, Stormwater-Open Channel etc); and
  - Items changed at WAE must be put on an easily distinguishable WAE layer for each Asset Type.

- Surfaces used in the compilation of the original design together with the final design surface.
- Each asset must be represented by a single feature (Nodes/Pits can be a block, pipes must be single line [line types can be used where appropriate]).
    - Where pipes connect they must share a common vertex (and where appropriate share that vertex with a node/pit).

1.7 Penalties

Penalties will apply for Developers/Consultants in the following instances:

- In the case of Subdivision Construction Certificate plans that are submitted to Council which contain misleading information or false certification in respect compliance with the requirements of these Guidelines; and
- Works as Executed drawings are submitted to Council which, at any time after submission are found to not accurately reflect the actual work completed.

The penalties that apply will be according to relevant State and Federal Law.

1.8 Miscellaneous

1.8.1 INSURANCE

Contractors/consultants engaged in the preparation of plans and administration of construction works associated with approved developments must hold current Public Liability Insurance and Professional Indemnity Insurance.

The value of indemnity in each case will be determined by Council's Planning and Environmental Department.

Council will annually check that the necessary insurance remains current.

1.8.2 ALLOTMENT FILLING

Any proposed allotment filling on residential or commercial subdivisions or developments shall be shown on the drawings, including the location, quantity required and source material.

Topsoil (as defined in AS3798-2007) required to be removed during the works and re-instated following completion is not required to be included in lot filling declarations, provided this fill is less than 150mm thick.

All allotment filling shall be designed, constructed and tested in accordance with Australian Standard 3798 – Guidelines for Earthworks for Residential and Commercial Developments.

ANNEXURE A – Certification

I …… [*Print Name*] of …….. [Print *address*] hereby certify as follows:

1. I am a person qualified in accordance with Clause 1.4.2 of the Gunnedah Shire Council Engineering Design Guidelines for Subdivision Developments.

2. I am aware and accept that Gunnedah Shire Council is relying upon my professional skill and experience in designing/supervising the construction of the following works;

    a.

    b.

3. I am aware that the Gunnedah Shire Council reviews and inspections of the designs and the works are limited to regulatory purposes and the Council relies upon my professional skill and experience and my certifications for the purpose of confirming that the works have been designed and completed in a competent manner in accordance with the Gunnedah Shire Council Engineering Design Guidelines for Subdivision and Developments together with all prudent standards and investigations which would be expected to be applied or undertaken by a professional engineer.

4. I hereby expressly authorise Gunnedah Shire Council to rely upon this certification to be satisfied of the standard of design and confirm that no further verification or enquiry should be made by Gunnedah Shire Council in relation to verifying the quality of construction in relation to those works.

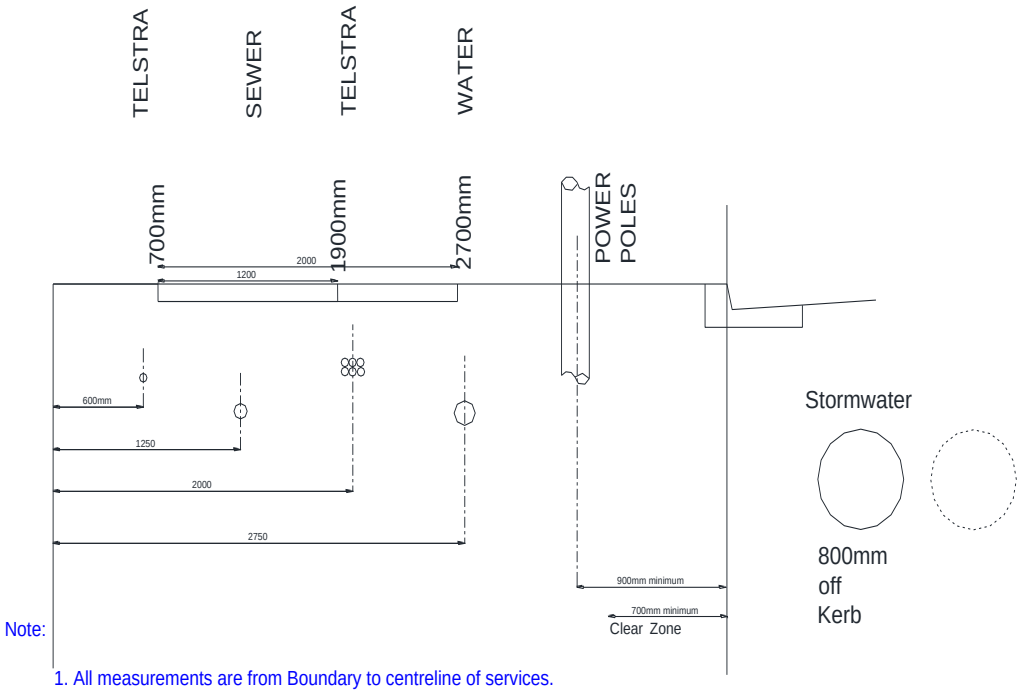
5. I confirm my understanding and accept that the purpose of this certification is firstly to confirm that the works have been designed in a prudent and professional manner and secondly to confirm for the purposes of professional liability that I understand that Council is relying upon my professional skill, experience and diligence to be satisfied that the works have been designed to the standards required by the Engineering Design Guidelines for Subdivisions and Developments together with all other prudent standards and investigations which would be expected to be applied or undertaken by a professional engineer and as such I confirm that I have an enforceable duty to the Council to ensure the work has been completed in the manner relied upon by the Council.

Name: _____

Signature: _____

Capacity: _____

Date: _____



Note:

1. All measurements are from Boundary to centreline of services.
2. Telstra trunk mains , where possible, to be located in opposite footpath to sewer and water.
3. Maximum Telstra inspection pit size to be 950 overall where located on same side as sewer.
4. Small diameter pipes for Telstra & electricity cable arrangement between two bodies
5. Where manholes % pits are required special arrangement to be made.
6. In footways where permanent levels have been established, all mains are to be laid at sufficient depth to permit driveways to be constructed into any property fronting such footways.
7. Cases not covered by standard to be determines by mutual agreement between authorities interested
8. All dimensions in mm.
9. All frangible objects to be a minimum of 700mm from edge of kerb

Gunnedah Land of Opportunity	GUNNEDAH SHIRE COUNCIL	Approved WK	ISSUE B	DATE 12/03/13
	FOOTPATHS 4.5 m Allocations	FILE NAME Footpath 1.dwg	SHEET NUMBER 1 OF 1 SHEETS	
		ARCHIVE FILE	PLAN No. 2513	

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PART 2

DESIGN

GUIDELINES

FOR

ROADS

2 DESIGN GUIDELINES FOR ROADS

2.1 Introduction and Objectives

This section of the Guidelines outlines the minimum requirements for the design of roads in the Gunnedah Shire Council area.

The primary design objective is to facilitate the expansion of the Gunnedah Shire Council road network whilst ensuring the following:

- Provision of a safe environment for all road users;
- Development of a network that balances the existing and anticipated future demands of Council; and
- Design of pavements that meet minimum serviceability standards for the design lifetime with minimal maintenance needs.

The design of roads shall be based on best practise engineering standards and shall meet or exceed the requirements of these Guidelines as well as relevant sections of Standards and publications referenced herein.

The other parts of the Engineering Guidelines for Subdivisions and Developments are as follows:

Part 1 General Requirements

Part 3 Guidelines for Design of Stormwater Drainage

Part 4 Guidelines for Design of Water Reticulation

Part 5 Guidelines for Design of Sewerage Reticulation

Part 6 Guidelines for Landscaping

References

Part 2 of the Guidelines should be read and utilised in combination with the following publications as referenced throughout:

- Austroads Road Design Guide, Parts 1-7
- Austroads Guide to Pavement Technology, Parts 1-9
- RMS Supplements to Austroads and Aust. Standards
- AAPA National Asphalt Specification
- AS1141 – Methods of Testing Aggregates
- AS1158 – Australian Standard for Public Lighting
- AS1289 – Method of Testing Soils for Engineering Purposes
- AS1379 – Specification and Manufacture of Concrete
- AS1428 – Design for Access and Mobility
- AS1742 – Manual for Traffic Control Devices
- AS2008 – Residual Bitumen For Road Pavements
- AS2150 – Hot-Mix Asphalt – A Guide to Good Practice
- AS2758 – Aggregates and Rocks for Engineering Purposes
- AS3845 – Road Safety Barrier Systems.
- NSW Streets Opening Conference – Guide to Codes and Practises for Streets Opening

2.2 Definitions

All references to the Director should be interpreted as referring to the Director – Infrastructure Services or their nominated representative.

All references to an Engineer should be interpreted as a person eligible for Membership of the Institution of Engineers, Australia. The Design Engineer is referred to as the person or persons responsible for the preparation of the design drawings and documentation on behalf of the Developer.

All testing to Australian Standards is to be conducted by a NATA accredited testing authority.

All references to Australian Standards or Austroads are to be read in conjunction with the relevant RMS Supplements.

A built-up area is considered to be roadside development comprising property accesses at spacing's averaging less than 100m over distances of at least 500m.[1]

A rural area is considered to be a roadside development with an average lot size greater than 1,000m^2.

2.3 Information to be provided with the Application for a Construction Certificate

The following information shall be submitted in support of an application for a Construction Certificate, and is considered the minimum list of requirements.

2.3.1 DESIGN DRAWINGS

Design drawings shall be submitted to Council for approval. Information to be included in the design drawings is detailed in **APPENDIX A** – Information to be shown on Drawings.

2.3.2 DESIGN CHECKLISTS

Each of the supporting items or documents listed in the checklists in **APPENDIX B** – Checklists shall be completed and submitted with the Drawings. Should any of the items required in any checklist be outstanding or not to a standard acceptable to Council, the Drawings and checklists shall be returned to the developer for amendment. Council shall only commence review of the design drawings once it is satisfied that all the requirements of the checklists have been met.

2.4 Road Types, Classifications and Design Elements

2.4.1 GENERAL

Roads are generally composed of combinations of some or all of the following key elements;

- Travel lanes;
- Parking lanes;
- Footway reserves;
- Stormwater drainage infrastructure;
- Structural pavement;
- Wearing surface;
- Linemarking and Signage;
- Safety Barrier;
- Street lighting;
- Electricity Distribution; and

[1] *Taken from definitions in AS1742.3*

- Provision of Services.

The inclusion or exclusion of any or all of these elements as well the specific requirements for each for a particular road within a subdivision or development shall be determined by Council and will be based on the size, type, location and nature of the subdivision or development, the requirements of local planning instruments such as the Local Environment Plan (LEP), Development Control Plans (DCP), Development Servicing Plans (DSP) and any other policies, specifications and guidelines as required.

For the majority of roads being designed within the GSC area the various combinations of design elements will fall within one of the Road Design Standard (RDS) categories as per Table A – Road Design Standards. Council will assign an RDS to each road within a subdivision or development as a condition of development consent.

Where a standard RDS as per Table A is not appropriate for roads within a particular subdivision or development, Council will determine the requirements for each design element for the roads as a condition of development consent.

Design Element	RDS 1	RDS 2	RDS 3	RDS 4	RDS 5
Kerb and Gutter	✓	✓	×	×	×
Formed Footpath	✓	✓	×	×	×
Piped Underground Stormwater Drainage	✓	✓	×	×	×
Surface Drainage	×	×	✓	✓	✓
Asphalt Wearing Surface	✓	×	×	×	×
Sprayed Bitumen Wearing Surface	×	✓	✓	✓	×
Unsealed Gravel Wearing Surface	×	×	×	×	✓
Street Lighting	✓	✓	✓	×	×
Above Ground Electricity Distribution	×	×	×	✓	✓
Below Ground Electricity Distribution	✓	✓	✓	×	×

Part 2 - Table A – Road Design Standard (RDS) matrix

2.4.2 ROAD CLASSIFICATIONS AND FORMATION WIDTHS

Roads are typically categorised according to the function of the road within the entire road network, as well as the nature and volume of traffic expected to utilise the road and is related to the number of lots serviced by each road. Typical design parameters for each classification of road are contained in the road hierarchy shown in Table B – Road Classifications and Formation Widths.

Table B is not to be considered as an inflexible development standard, and Council will consider variations from the parameters detailed in the table where it can be clearly established such variation enhances the amenity of the locality whilst retaining an appropriate traffic hierarchy and providing adequate service and utility corridors and allocations.

Each of the roads detailed in Table B – Road Formation Widths and Classifications can be defined as follows;

- **Arterial**; The highest order roads with the primary function of providing principal links between urban centres, either between conurbations or within a conurbation, or between urban centres and rural regions. Arterial roads shall be developed, or have the capacity to be developed into multi-lane facilities with access control being a desirable feature to enhance traffic flow.

- **Sub-Arterial;** Roads with the main function of connecting arterial roads to centres within a rural area and supplementing the arterial roads in providing for traffic movements from one part of an urban area to another.
- **Distributor (bus routes);**
- **Collector;** Roads that are intended to carry traffic between the arterial and sub-arterial roads and local and access streets. Collector roads are not expected to carry high traffic volumes, and are not used for longer distance travel, except at the beginning or end of the journey. Collector roads help to distribute traffic at the neighbourhood level and may provide access to abutting properties. Ideally they should discourage through traffic by not providing continuous through routes between higher order roads.
- **Local and Access;** These are the lowest order roads in tributary road system and consist of local streets and access streets which provide access to residential properties. Their main functions are to provide both property access and residential amenity (resident safety and amenity are dominant design elements). Typically, an access street has only one entry/exit point (such as a cul-de-sac), whilst a local road has more than one entry/exit point.

Generally, arterial and sub-arterial roads form the basis for the major road system, whilst the collectors and the local accesses form the basis for the internal road system within the subdivision or development. Local and access roads should not interact directly with an arterial or sub-arterial road.

Subdivision and development proposals are to show the proposed hierarchy on the design drawings as well as in the Traffic Impact Study. When preparing the proposed road hierarchy plan for the subdivision or development, consideration shall be given to the function of the road within the entire network, the expected traffic volume and the connection with the adjacent road network.

The road category to be adopted and the formation widths to be used for design purposes will be approved by Council following a detailed analysis of the proposed site, the design traffic and the nature and function of the subdivision or development. The adopted road category and width shall apply to the entire length of the road, and progressive widening or narrowing of a road through intersections or development stages will not be permitted.

When calculating the proposed category or function of a road, designers must consider the ultimate number of lots serviced by the road when all potential stages of development and subdivision are complete. Consultation with Council regarding the ultimate function of the road may be necessary.

It is the designers' responsibility to ensure that road reserve widths are sufficient to accommodate all road and ancillary services and utilities that are required to be located within the reserve and the road reserve may need to be wider than the minimum width detailed in Table B. Consultation with relevant service authorities such as telecommunications and electricity distribution authorities to determine their requirements for the subdivision may be necessary.

Hierarchy	Road Category	Travel lane (m)	Parking lane (m)	Between kerbs (where applicable) (m)	Footpath service (m)	Median strip (m)	Total reserve (m)*
1	Arterial	3.5	3.0	20	5	5	35
2	Sub-arterial	3.5	3.0	20	5	0	30
3	Distributor (Bus routes)	3.5	3.0	13	4.5	0	22
4	Collector	3.5	3.0	13	3.5	0	20
5	Local						
	• *servicing less than 16 dwellings*	3	2.5	11	4.5	0	20
	• *cul de sac servicing between 10 & 16 dwellings*	3	2.5	9	4.5	0	18
	• *cul de sac servicing less than 10 dwellings*	3	0	6	4.5	0	15
	Rural Residential (R5)						
	• less than 100 AADT	3	1.5	9	8		25
	• 100-500 AADT	3	1.5	9	8		25
	• 500-1000 AADT	3.5	-	9	8		25
	• 1000-2000 AADT	3.5	1	9	8		25
	• > 2000 AADT	3.5	1	9	8		25
	Industrial	3.5	4	15	5	0	25

Part 2 - Table B – Road Classifications and Formation Widths

2.5 Design Parameters

2.5.1 GENERAL

The design of roads shall include the following as a minimum:

- Consideration of the function of the road including the nature and volume of traffic;
- Geometric design, including analysis of existing and proposed levels, gradients and alignments;
- Formation and carriageway cross section and kerb return design;
- Intersection analysis and design;
- Earthworks requirements;
- Pavement design;
- The provision of existing and proposed services, structures and ancillary facilities;
- The provision of vehicle access to each lot;
- Construction management; and
- Any other relevant details.

Sections 2.10 and 2.11 of this document relate to Intersection Design and Pavement Design respectively.

2.5.2 ROAD RESERVES

2.5.2.1 ROAD RESERVE WIDTH

The nominal width of road reserves shall be in accordance with Table B - Road Classifications and Formation Widths.

Road reserve widths must be sufficient to accommodate the road formation, required services and utilities with approved clearances, pedestrian and bicycle access where required, parking, stormwater drainage and bus routes where development is significant.

Should the development design incorporate water sensitive urban design principles the road reserve may need to be wider than that specified in Table B.

2.5.2.2 ROAD RESERVE BOUNDARIES

Road reserve boundaries may be curved, but where they are to be fenced as chords, these should be not less than 10 metres. Where a number of such chords occur adjacent to each other they shall, wherever practical, be equal in length.

2.5.2.3 CARRIAGEWAY WIDTH

The nominal carriageway widths are shown in Table B – Road Classifications and Formation Widths.

2.5.2.4 FOOTWAY (VERGE) WIDTH

The Footway Reserve is that part of a public road exclusive of the carriageway, and is to be of width prescribed in Table B - Road Classifications and Formation Widths for each road classification.

The nominal footway width in built-up areas is 4.5m to ensure that all required services and utilities are allocated within their allotted corridor location and width. However, this footpath width may be varied where it can be demonstrated that all required services and utilities for the subdivision are provided for within the road reserve with appropriate corridor location and widths, subject to the following minimum conditions;

1. The minimum footway reserve width shall be 2.5m to satisfy the clear zone for non-frangible objects described in Note 2; associated with Part 2 Table G.
2. Street lighting must be provided on at least one footway reserve;
3. Street trees are to be provided for at the frontage of each lot as per Section 6 Landscaping

The width of the footway in rural areas is dependent on the nature and size of stormwater drainage infrastructure.

Notwithstanding the requirements of Table B, Council may require the inclusion of paved footpaths, cyclepaths or shared footpaths at any location within a subdivision if warranted by existing or predicted pedestrian and/or bicycle traffic movements.

Notwithstanding the requirements of Table B, the footway reserve of any commercial subdivision or development shall be paved from the kerb to the property boundary.

Paved footpaths shall be designed as per Standard Drawing No. 11448– Concrete Footpath and Cyclepath Jointing Details. Perambulator ramps as per Australian Standard 1428.1 shall be provided at all kerb and gutter crossings where paved footpaths are constructed.

The service and utility allocation corridors in footways for built-up and rural areas are shown in Standard Drawings 13465B and 13558C respectively.

The corridor allocations for services and utilities are detailed in Section 2.9.5.1 – Location of Utilities.

2.5.2.5 FOOTWAY CROSS-FALLS

In commercial areas where the footway reserve is to be totally paved from the kerb to the adjacent property boundary, the cross-fall is to be nominally 2% towards the carriageway edge.

In areas where the footway reserve is unpaved or partially paved, cross-fall from kerb to the adjacent property boundary is to be nominally between 2% and 3% towards the carriageway edge.

Areas where cross-fall is required to be outside these limits is to be approved by Council's Infrastructure staff.

2.5.2.6 ACCESS ROADS (SHAREWAYS)

An Access Road or Shareway is defined as a public road of width greater than three metres but not greater than six metres, and is to be used primarily for access to the rear of premises. Design parameters for Access Ways shall be in accordance with Table B - Road Classifications and Formation Widths.

The nominal width of Access Roads shall be six metres. Access Roads of less than six metres width shall have one way vehicle movement only, and provisions for vehicle parking/passing must be provided.

Access Roads dedicated to the public as access from or between roads, or as access to public gardens, recreation space or national parks and the like shall be designed in accordance with the design principles outlined in this document.

2.5.2.7 PATHWAYS

A Pathway is defined as a public road of width three metres or less, generally designed for the use of pedestrians and/or cyclists as an access from or between roads.

Pathways dedicated to the public or as access to public garden and recreation space shall be cleared and formed, with a concrete path as per Section 2.5.2.4 provided centrally in the reserve.

Generally the maximum permissible grade for pathways shall be 15%. Where grades are excessive, pathways shall be designed in accordance with *Australian Standard AS 1428 Design for Access and Mobility.* The maximum permissible grade to be used in pathways providing access to public gardens and reserves shall be 8%.

The hydraulic capacity of formed pathways must be considered where pathways are to be utilised as overland flow paths.

2.5.3 DESIGN TRAFFIC

The Design Traffic for use in road geometry and pavement thickness calculations shall be determined by analysis of existing traffic movements, through traffic, and an estimate of traffic generated by existing and future development.

For road geometry, road classification and intersection design the principles outlined in the *Austroads Guide To Traffic Management Parts 1-12* shall be used to estimate the quantity, nature, and distribution of traffic generated by the development.

Additionally, for pavement thickness design calculations the principles outlined in the *Austroads Guide to the Pavement Technology, Part 2 – Pavement Structural Design, Section 7 – Design Traffic* with reference to relevant *RMS Supplements to Austroads* shall be used to calculate the traffic loading on the pavement.

In all cases the Design Traffic shall be that predicted at the end of the design life of the pavement as per Section 2.11.2 of these Guidelines.

The estimation of design traffic shall refer to the Traffic Impact Study, completed at the development application stage that quantifies the level of impact the proposed subdivision or development will have on the local traffic environment.

Proprietary software programs may be used to quantify the level of impact on traffic distribution, however the software must be a recognised industry standard and a comprehensive list of set-up parameters used to obtain results from the software is to be submitted along with the detailed design documentation.

For the purposes of determining the existing traffic volumes of roads that may impact on the proposed development, Council shall make available to the developer, where available, existing traffic count data and any other such information relevant to the development.

For pavement design calculations, consideration shall be given to the impact of construction traffic on the newly constructed pavement. It may be necessary to increase the overall pavement depth to ensure the pavement is of sufficient strength to cater for traffic loads during construction of housing, commercial buildings etc. A staged construction design approach may be adopted to manage the impact of construction traffic.

2.5.4 DESIGN SPEED

The Design Speed to be adopted for the design of new roads shall be the greater of the selected 85th percentile desired speed[2] for the section of road being designed and the prevailing speed limit.

2.5.5 DESIGN VEHICLES

Design vehicles to be used for Vehicle Turning Movement and Intersection Design calculations shall be as follows:

Road Classification *(as per Section 2.4.2)*	**Design Vehicle**
Arterial	Design Prime Mover and Semi-Trailer (19m)
Sub-Arterial	
Industrial	
Collector/Distributor	Design Single Unit Truck/Bus (12.5m)
Local/Access	Service Vehicle (8.8m)

Part 2 - Table C – Design Vehicles for Roads

2.6 Geometric Design

2.6.1 GENERAL

The principle geometric design consideration for roads is to provide the following:

- Smooth, safe, trafficable horizontal and vertical alignments;
- Adequate sight distance with consideration being given to the road classification requirements;
- A safe and efficient speed environment;
- Safe vehicular and pedestrian access to each allotment; and
- Provision for utilities and stormwater drainage.

The geometric design of roads is to be based on the principles of the *Austroads Guide to Road Design – Part 3: Geometric Design*, with reference to *RMS Supplements to Austroads* and all publications referenced therein.

Designers of roads shall clearly demonstrate consideration of the following elements as a minimum:

- Access provisions and sight distance from/to each lot;
- Sight stopping distances from all locations;
- The speed environment created by the alignment;
- Provision for stormwater drainage;
- Provision for services and utilities; and
- Hydraulic analysis if the road formation is to be utilised as an overland flow path.

2.6.2 SCOPE OF DESIGN

Road horizontal and vertical alignment designs are required to be extended a minimum of 100m beyond the extent of the development where there is a possibility of the road being extended by future development stages. Where new roads intersect with existing roads the intersection shall be designed in accordance with Section 2.10 – Intersections.

[2] A method for determining the desired speed for a road is contained in the *Austroads Guide to Road Design – Part 3: Geometric Design*

2.6.3 SIGHT DISTANCE

Designers must consider sight stopping distances in the geometric design, and these shall be determined as per the procedure in the *Austroads Guide to Road Design – Part 3: Geometric Design – Section 5 – Stopping Distance* with reference to relevant *RMS Supplement to Austroads*.

Landscaping plans shall be prepared with consideration given to sight distance requirements, as shall any proposal for "Estate Entrance Structures". Design drawings submitted for approval shall show all existing and proposed features in sufficient detail to demonstrate that appropriate sight distances are achieved.

2.6.4 HORIZONTAL ALIGNMENT AND CURVES

The minimum radius of horizontal curves shall be:

Minimum Deflection Angle	Minimum Radius (m)
75°	20
60°	33
40°	65
30°	75
20°	100

Part 2 - Table D –Minimum Radius of Horizontal Curves for Roads

Where the deflection angle is 90° and travel speed is not an issue, the minimum radius of horizontal curves is to be related to the turning requirements of the applicable Design Vehicle as detailed in Table C – Design Vehicles for Roads

For design speeds up to 60 km/hour, the use of transition curves is not considered necessary.

2.6.5 VERTICAL ALIGNMENT

Longitudinal Gradients shall be designed to comply with the following absolute limits;

Gradient Type	Value
Maximum permissible grade on an arterial road	8.0%
Minimum permissible grade on an arterial road	1.0%
Maximum permissible grade on all other road categories	16.0%
Maximum distance maximum grade is to be adopted in any one location	150m
Minimum permissible grade on all other road categories	1.0%
Maximum permissible grade adjacent to street intersections, locations of poor visibility, horizontal curves of 15m or less and at cul-de-sacs	10.0%
Maximum grade of turning circles in cul-de-sacs	5.0%

Part 2 - Table E – Absolute Limits for Longitudinal Gradients on Roads

Drainage requirements on steep grades will typically involve the incorporation of special structures and extensive piping of easements. Developers may find it more economical to avoid the use of steep grades to negate the need for the use of such structures.

Gutters or table drains are to have a minimum grade of 1% and consideration shall be given to increasing the minimum grade where changes of direction or drainage concentration occur.

Where the grade of table drains incorporated into the road formation design exceeds 6%, a concrete lined drain shall be required in accordance with Standard Drawing No. 2361.

2.6.6 VERTICAL CURVES

Vertical curves shall be provided at all changes in grade and consideration shall be given to the combination of vertical curves with any horizontal curves.

2.6.7 SUPER-ELEVATION

Super-elevation of curves is generally not considered necessary in built-up areas, however if required in rural areas or roads with high design speeds the design of such curves shall be carried out in accordance with the *Austroads Guide to Road Design – Part 3: Geometric Design, Section 7.7 - Superelevation*.

The maximum super-elevation of a curve in a built-up area shall be 4.0%. The maximum super-elevation of a curve in a rural area shall be 7.0%.

2.6.8 PAVEMENT CROSS-FALL

The nominal cross-fall on all pavements shall be 3.0%.

The maximum cross-fall will generally occur on super-elevated curves and road intersections, and this must be clearly indicated on design drawings.

The relative change in cross-fall of kerb line and centreline is not to exceed 0.5 %.

2.6.9 ONE-WAY CROSS-FALL

One-way cross-falls will only be considered where a two-way cross-fall cannot be reasonably achieved due to the topography of the site. The nominal cross-fall for one-way cross-falls shall be 3%. Where the design of the road includes the provision of kerb and gutter as per Table A - Road Design Standards; type SF kerb shall be installed on the high side of one-way cross-falls.

Consideration shall be given to the hydraulic capacity of the carriageway cross-section in drainage calculations for one-way cross-falls.

2.6.10 CROWN OFF-SETS

In areas of difficult terrain where it is not desirable to have the crown on the centre of the road, the crown may be relocated towards the higher side of the road, provided that the new location is a minimum distance of 3.5m from the edge of the nearest kerb face and 1.0m outside the outer wheel path of the inner traffic lane.

2.6.11 CUL-DE-SACS

The radius of a cul-de-sac bowl shall not be less than 10.0 metres. The provision of stormwater drainage in cul-de-sacs, including the provision of easements or drainage reserves at cul-de-sac heads, shall be given careful consideration.

2.6.12 SPLIT-LEVEL CARRIAGEWAYS

If the topography of a development or subdivision necessitates split level construction of a road, the road reserve shall be sufficiently widened from that detailed in Table B to include the minimum formation width as well as the provision of a median island.

Medians shall consist of a permanently retained batter not steeper than 1 to 4 (1 horizontally and 4 vertically) and constructed of structural concrete, stone pitch or proprietary keystone blocks. All retaining walls are to be designed by an appropriately qualified structural engineer. The cross-fall of each carriageway is to be one way towards the outer carriageway edge.

Type SF kerb shall be provided along all median edges to prevent mounting by vehicles.

Consideration shall be given to the warrant for a safety barrier along a median of a split-level carriageway in accordance with Section 2.9.1 of these Guidelines.

Lengths of split level carriageway exceeding 100m will not be permitted nor may split level carriageways traverse through intersections.

2.6.13 INTERSECTIONS AND ROUNDABOUTS

For the geometric design parameters for intersections and roundabouts refer to Section 2.10 Intersections and Roundabouts.

2.7 Formation Design

2.7.1 PAVEMENT DESIGN

For the design parameters of pavements refer to Section 2.11 – Pavement Design.

2.7.2 KERB AND GUTTER

Where required in Table A - Road Design Standards (RDS) or otherwise; kerb and gutter shall be designed to address drainage requirements and to adequately and safely provide both vehicular and pedestrian access to each allotment

Where it is considered impractical to construct an isolated section of kerb and gutter and road pavement, Council may require the developer to pay a contribution in lieu of construction, based on the estimated full cost of the works calculated by Council.

Kerb and gutter shall be of the type SA for all arterial, sub-arterial and collector roads as detailed in Table B - Road Classifications and Formation Widths, and type RT for local and access roads. All commercial and industrial areas (B1-B7 and IN1-IN3 as shown in Table B) shall have type SA kerb.

Notwithstanding the requirements of Table B – Road Classifications and Formation Widths; where a road carriageway is to be utilised as an overland flow path for stormwater drainage, the kerb and gutter shall be of type SA in accordance with GSC Standard Drawing No.2361.

2.7.3 VEHICULAR CROSSINGS AND ACCESSES

Each allotment shall include provision for vehicular crossings from the carriageway in accordance with Table F – Vehicle Crossings. The responsibility for construction of vehicular crossings in roads with kerb and gutter may be assigned to new property owners. In such instances, appropriate measures must be taken to protect the integrity of the kerb and gutter during both subdivision and housing construction.

Access Description	Allotment Type	
	Residential	Commercial/ Industrial
Maximum number of crossings per street frontage	2	2
Maximum width of crossings	4.5m	6.0m
Minimum distance from crossing to corner allotment boundary	6m	6m
Minimum kerb separation distance between crossings	2m	2m
Minimum kerb separation distance between crossings and common property boundary	0.5m	0.5m

Part 2 - Table F – Vehicle Crossings

Roads shall be located and designed so that vehicular access can be readily obtained to every allotment of a development, and shall be designed such that the B99 Vehicle as detailed in *Australian Standard 2890.1 – Parking Facilities; Off Street Car Parking* can satisfactorily enter or exit the allotment. Consideration shall be given to access for emergency vehicles and towed vehicles such as caravans, trailers and horse floats for roads in rural areas.

Vehicle accesses shall be designed to cross the footway reserve perpendicular to the longitudinal road alignment.

For roads where type SA kerb is used, concrete laybacks designed in accordance with Standard Drawing 2361 – Vehicular Crossings shall be provided for all vehicle crossovers. Laybacks shall

be designed such that the height at the back of the layback is at a minimum equal to the height of the adjacent kerb and gutter to ensure the drainage characteristics of the kerb and gutter are not compromised. The use of driveway risers shall not be permitted.

Vehicular crossings that cross table drains shall include one of the following;

a) A piped culvert, unless the location of the access is at an obvious high point. The minimum width of culverts shall be 4.5 metres. All culverts shall have a sloping type headwall at each end of the piped culvert.

b) A concrete lined drain. Details of the proposed vehicular crossing are to be provided with design drawings – Rural Vehicular Access Details for all residential allotments and in accordance with Standard Drawing No: 2362;

c) A gravel lined drain. Details of the proposed vehicular crossing are to be provided with design drawings – Rural Vehicular Access Details for all non-residential lots;

d) Culverts across table drains shall be designed with the following hydraulic capacity;

- 1 in 5 year ARI capacity before property culvert overtops;
- No water shall encroach on the edge of shoulder on sealed roads, or the edge of gravel for unsealed roads.

The minimum size for piped culverts is to be 375mm diameter and pipes shall be laid such that the invert of the pipe matches the invert of the adjacent table drain

Vehicle crossings that cross major system overland flow paths shall not be permitted to have a piped culvert and shall have a concrete lined drain as per b) above.

Where the wearing surface of the road adjacent to the vehicle crossing is a bitumen seal or is designed to be constructed with a bitumen seal, vehicle crossings that cross table drains shall also be bitumen sealed from the edge of the pavement seal to the property boundary. The bitumen seal shall extend the full width of the crossing, including the batters adjacent to headwalls.

Gated accesses in rural areas or areas where the posted speed limit for the road is greater than 80km/h shall have the gate recessed into the property such that no part of the design vehicle (including provision for trailers, floats or caravans) protrudes into the road formation whilst stationary.

The design of vehicle crossings in rural or high speed developments shall have regard to the geometric, spacing and sight distance requirements of Section 2.10 of this document as well as Austroads Guide to Road Design – Part 4; Intersections and Crossings, General and relevant RMS Supplements.

2.7.4 STAGED ROAD CONSTRUCTION

Where roads are constructed in stages of a subdivision, a permanent barricade conforming to *AS1742.3 – Manual for Traffic Control Devices* with reference to *RMS Supplement to Australian Standard AS1742.3shall* be constructed at the end of the road to warn motorists of the termination of the road and to prevent their passage beyond.

A temporary bitumen sealed cul-de-sac designed in accordance with 2.11 shall be designed and constructed at the end of staged road developments.

Barricades and temporary pavements are to be removed only upon completion of construction of the adjoining stage.

2.7.5 LOCAL AREA TRAFFIC MANAGEMENT

Where Local Area Traffic Management (LATM) devices are required as a condition of development consent, these devices shall be designed and installed in accordance with *The Austroads Guide to Traffic Management – Part 8; Local Area Traffic Management*, and *Australian Standard 1742.13 - Local Area Traffic Management including relevant RMS supplements*. The type and location of any LATM devices shall be clearly shown on the design drawings.

2.8 Earthworks

2.8.1 VEGETATION REMOVAL

Road reserves in urban areas shall be cleared of all vegetation for the full width and 0.5 metres past the lot boundaries. Where it is proposed to remove any trees with a trunk diameter greater than 150mm as measured 600mm from natural surface, the location of such trees shall be shown on the design drawings and Council shall be consulted to determine the environmental significance of the trees.

2.8.2 BATTERS

Cut and fill batters in road reserves shall not be steeper than one (1) in vertical to three (3) horizontal in cuttings and one (1) vertical to four (4) horizontal in embankment. In urban areas, cut and fill batters may be formed to extend 0.5m past the road reserve boundary. If the maximum grade in a cut and fill batter cannot be accommodated within these boundaries, the road reserve shall be widened accordingly. Cut and fill batters in rural areas shall lie wholly within the road reserve, and if necessary the road reserve shall be widened to accommodate the batters.

All formed batters shall be vegetated with topsoil and appropriate grass species. The developer shall provide details of the proposed grass species to be used.

Batters in cuttings shall have concrete or other proprietary lining type catch-drains at the top of the batter incorporated into the stormwater drainage design. The type and location of all batter catch-drains shall be clearly shown on the design drawings.

Where any cutting or filling in a road reserve may undermine or compromise the structural integrity of an existing structure either in the road reserve or on the adjacent land, a structural retaining wall shall be required to retain either the existing structure or the batter.

2.8.3 ROAD EMBANKMENTS

Where road embankments exceed two metres in height as measured vertically from the top of the batter to the toe; the requirement for safety barrier fencing shall be determined in accordance with Section 2.9.1 of these guidelines.

Notwithstanding this, safety barrier fencing shall not be used on road boundaries adjacent to residential allotments in built-up areas.

2.9 Ancillary Facilities

2.9.1 SAFETY BARRIER FENCING

The requirement for the use of safety barrier fencing shall be as per the principles outlined in the Austroads Guide to Road Design, Part 6 – Roadside Design, Safety and Barriers with reference to relevant RMS Supplement to Austroads.

Barrier fencing shall be designed and installed as per Australian Standard AS3845 – Road Safety Barrier Systems with reference to relevant RMS Supplement to Austroads.

2.9.2 STREET BLADES

Street blades are to be designed, manufactured and erected in accordance with Australian Standard 1742.5 - Manual of uniform traffic control devices - Part 5: Street Name and Community Facility Name Signs.

All street blades shall be reflectorized as per Clause 2.7 of AS1742.5 with reference to relevant RMS Supplement to Austroads.

The installation of community facilities signs shall not be permitted without the prior approval of the Director.

2.9.3 SIGNPOSTING, LINEMARKING AND GUIDE POSTS

The design, location and installation of signs, line markings and guide posts shall be in accordance with *Australian Standard AS1742 – Manual of Uniform Traffic Control Devices Part 2 – Traffic Control Devices for General Use* with reference to relevant RMS Supplement to Austroads and

Standard Drawing no: 2524. The location of signs, line markings and guide posts shall be shown on a dedicated design plan.

2.9.4 STREET LIGHTING

Where required in Table A - Road Design Standard (RDS) or otherwise; street lighting shall be provided on roads and designed in accordance with the Australian Standard for Public Lighting AS 1158.

Street lights shall be designed to maximise energy efficiency. Street lights shall generally be of the following type:

- 42 Watt Eco Friendly Luminaire for all local and collector roads; and
- 250 Watt High Pressure Sodium for all arterial and sub-arterial roads and intersections.

Where practical, street lights should be located adjacent to the property boundary in a staggered or alternating pattern on either side of the road reserve, and designed such that the light is directed towards the centre of the road reserve whilst ensuring that pedestrian facilities such as formed footpaths benefit from the light. The interaction of the street light with street trees should be given careful consideration.

The design of the subdivision or development shall include consideration of the requirements for the provision of street lighting at intersections, pedestrian crossings and other areas of high pedestrian or vehicular traffic.

2.9.5 PROVISION OF UTILITIES

2.9.5.1 LOCATION OF UTILITIES

The provision of utilities within the road reserve shall be as per Standard Drawing 2513 – Footpath Allocations and Section 2.5.5.6. Utilities shall not be installed beneath the floor or batters of table drains or other drainage structures.

The minimum corridor widths and footpath allocations for utilities and services are as per Table G – Utility and Service Corridors and Offsets.

Utility or Service	Minimum Corridor Width (mm)	Corridor Offset From (mm)	Corridor Offset To (mm)
Street Lighting	300	3700 from Property Boundary	4000 from Property Boundary
Electricity Distribution	900 *Note 2*	300mm from property boundary	1200mm from property boundary
Telecommunications	600 *Note 1*	300mm from property boundary	900mm from property boundary
Telecommunications trunk lines and NBN Co. Infrastructure	600	1700mm from property boundary	2300mm from property boundary
Sewer	600	950mm from property boundary	1550mm from Property boundary
Street Tree	1200 *Note 3*	Centre of street tree to be minimum 2100mm from edge of travel lane *Note 2*	3400mm from Property boundary
Water	600	Centre of water main corridor to be 2750mm from Property Boundary	
Concrete footpath	1500-2700	700mm from property boundary	

Part 2 Table G – Utility and Service Corridors and Offsets

- Note 1: The corridor width for electricity, telecommunications and natural gas is based on the use of shared trenching as per the provisions of the *NSW Streets Opening Conference Guide to Codes and Practises for Streets Opening.* Approval for shared trenching should be sought from the relevant utility providers prior to submission of the design drawings.
- Note 2: The clear zone for non-frangible objects in the road reserve shall be nominal 2500mm from the outside edge of the adjacent travel lane. Resulting in tree line being 1500mm from face of kerb.
- Note 3: The separation distance of any utilities, services or other infrastructure from a street tree shall be no less than 600mm as measured from the centre of the tree.

2.9.5.2 UTILITIES ROAD CROSSINGS

All trenches and conduits under roads shall be installed at a grade of not less than 0.5% and shall be clearly marked on design drawings.

Utility crossings under roads shall be completed prior to construction of the pavement base course layer. Where utilities are to be installed after construction of the pavement is complete, these shall be underbored with minimal disturbance to the pavement.

Where the diameter of the utility conduit is greater than 250mm, open trenching shall be permitted. Re-instatement of the pavement in open trenches shall be as per 2.11 of these Guidelines. The provision of utilities in shared trenches shall not be permitted unless the prior approval of the relevant utilities authority is obtained.

All road crossings shall be designed perpendicular to the centreline of the road.

2.9.5.3 ELECTRICITY DISTRIBUTION UTILITIES

All electrical power shall be distributed as per the requirements of Table A - Road Design Standard (RDS). Consultation with the appropriate electricity distribution authority regarding the provision of electricity distribution shall be required.

2.9.5.4 ELECTRICITY ROAD CROSSINGS AND TRANSMISSION EASEMENTS

Where proposed roads intersect with existing or proposed electricity transmission easements, consultation with the appropriate electricity distribution authority regarding acceptable minimum ground clearances to the distribution infrastructure within the easement shall be necessary.

If a subdivision is created over an electricity easement, Country Energy may require the provision of vehicular access along the easement.

2.10 Intersections

2.10.1 GENERAL

The design of intersections shall consider the following criteria:

- The efficient movement of traffic through the intersection and distribution of this traffic throughout the development or subdivision;
- The relationship between the intersection type and the horizontal and vertical alignments of the intersecting roads;
- Analysis and treatment of conflict points created by traffic movements through the intersection;
- The safety of motorists, pedestrians and cyclists negotiating the intersection;
- Provision for pedestrian movements;
- The speed environment created by the intersection; and
- The amenity and location of the intersection.

The type of proposed intersections should be selected in accordance with the *Austroads Guide To Traffic Management, Part 6 – Intersections, Interchanges and Crossings* and designed according

to the *Austroads Road Design Guide with reference to appropriate RMS supplements*, in particular the following parts*;*

- Part 4; Intersections and Crossings – General;
- Part 4a; Unsignalised and Signalised Intersections;
- Part 4b; Roundabouts; and
- Part 4c; Interchanges.

Intersections shall generally comprise of T-junctions or staggered T-junctions. Where T-junctions are considered impractical, four-way intersections or cross-intersections may be proposed, however these shall be controlled by suitable traffic management devices or other methods, based on warrant.

Where staggered 'T'-junctions are proposed, the distance between the centrelines of the minor roads shall be located a minimum distance of 2 x SSD (Sight Stopping Distance) apart for the adopted Design Speed calculated using a 1.5 second reaction time.

Roads shall not be designed to intersect at an angle less than 70º.

All proposed junctions with classified roads shall have a design reaction time of 2.5 seconds when calculating intersection stopping distances.

Landscaping plans, including any proposed "Estate Entrance Structures", shall be prepared for intersections with consideration given to sight distance requirements, and all landscaping and vegetation shall be designed to require minimum ongoing maintenance.

Design plans shall show all existing and proposed intersection features in sufficient detail to demonstrate that appropriate sight distances are achieved.

2.10.2 DESIGN TRAFFIC

The quantity, nature and distribution of traffic shall be determined as per the requirements of Section 2.6.2 – Design Traffic.

2.10.3 WARRANTS FOR INTERSECTION TREATMENT TYPE

Warrants for the selection and use of intersection treatment types shall be determined using the procedure outlined in *Austroads Road Design Guide, Part 4a, Section 4.8 - Warrants for BA, AU and CH Turn Treatments with reference to appropriate RMS supplements* where one or more of the following design criteria are met:

- All arterial and sub-arterial roads;
- The design speed exceeds 80km/h for built-up areas or is equal to or greater than 100km/hour in rural developments;
- The design traffic for either the minor or major road exceeds 1000 AADT; and
- A four-way intersection or cross-intersection is proposed.

For existing intersections, the level of service achieved by the intersection for the design traffic generated by the development or subdivision shall be clearly demonstrated as per the method described in the *Austroads Guide To Traffic Management with reference to appropriate RMS supplements*.

For new intersections, the intended level of service provided by the proposed intersection treatment type selected shall be clearly demonstrated as per method described in the *Austroads Guide To Traffic Management with reference to appropriate RMS supplements.*

When considering levels of services provided by intersections, the designers must consider the traffic generated following the ultimate growth of the development or subdivision.

2.10.4 VEHICLE TURNING MOVEMENTS

Notwithstanding the requirements of the *Austroads Road Design Guide Part 4*, vehicle turning movements at intersections are to be designed using the *Austroads Vehicle Turning Templates*.

Sufficient carriageway width shall be provided such that the swept path of a Design Vehicle (as per Table C) making a turning movement is contained wholly within the travelled lane. The design vehicle must be able to make a turning movement in a single forward motion without the need to use vehicle accesses, driveways or lanes in the opposite direction of travel.

2.10.5 ROUNDABOUTS

Where a roundabout is either proposed or required to be constructed as an intersection treatment type, it shall be designed in accordance with the Austroads Guide to Road Design, Part 4B – Intersections and Crossings – Roundabouts *with reference to appropriate RMS supplements*.

Where the centre median island of a proposed roundabout is to be landscaped, the type of landscaping proposed shall be shown on the design drawings and included in the landscaping plan, and shall be designed to require minimum maintenance. Any proposed roundabout landscaping shall not interfere with the design sight distances of the roundabout.

2.10.6 SIGNALISED INTERSECTIONS

Where a signalised intersection is either proposed or required to be constructed as an intersection treatment type, it shall be designed in accordance with the Austroads Guide to Road Design, Part 4A – Intersections and Crossings – Unsignalised and Signalised Intersections.

2.11 Pavement Design

2.11.1 GENERAL

This Section outlines the minimum requirements for the design of road and carpark pavements.

2.11.2 PAVEMENT DESIGN LIFE

Pavement designs are to be undertaken based on a minimum design life of:

Type of Pavement	Minimum Design Life
Flexible pavements, either unbound granular or containing one or more modified layers	20 years
Segmental block pavements (pavers)	20 years
Rigid pavements (concrete)	40 years

Part 2 -Table H – Pavement Design Life

2.11.3 PAVEMENT DESIGN PROCEDURE

Pavement design criteria is to include but not be limited to the following:

Element	Applicable Section
Projected traffic loadings	2.11.4
Subgrade evaluation	2.11.5
Environmental Factors	2.11.6
Materials	2.12
Construction methods	Specification

Part 2 - Table I – Pavement Design Criteria

A pavement design report shall be prepared by a Certified/Chartered Engineer, and shall include the following as a minimum;

1. Evaluation and reporting of the subgrade material;
2. Subsoil drainage conditions;
3. Design Parameters used in accordance with these Guidelines;
4. The calculated nominal layer thicknesses;
5. Details of the materials to be used in the pavement construction;
6. Wearing surface type and properties. NOTE: Council prefers the final bitumous seal to be rubberised on appropriate wearing surfaces.

2.11.4 DESIGN TRAFFIC

The Design Traffic for use in pavement design calculations shall be determined as per Section 2.5.3 – Design Traffic.

2.11.5 SUBGRADE EVALUATION

Subgrade strength characteristics used in the pavement depth design shall be determined by sampling, testing and reporting in accordance with *AS1289 - Method of Testing Soils for Engineering Purposes.*

Sampling shall be random in accordance with *AS1289.1.4.1*. Additional sampling may be required in the bowls of cul-de-sacs, at intersections and at all locations where existing subgrade conditions change suddenly as directed by the Director.

Subgrade material testing and reporting shall consist of the following:

- California Bearing Ratio (CBR);
- In-situ Dynamic Cone Penetromter (DCP) and
- Linear Shrinkage of sampled material.
- Final compaction to exceed Q: 102%

2.11.6 ENVIRONMENTAL FACTORS

The following environmental factors shall be considered during the pavement design process:

- The identification and treatment of ground water;
- Natural drainage including sub-soil drainage;
- The presence of acid sulphate soils;
- The presence of erosion prone soils such as silt, buried landfill and waste dumps;
- The impacts of appropriate preventative or remedial treatments as necessary.

2.11.7 PAVEMENT DEPTH DESIGN

The nominal pavement design shall be determined using the empirical procedure outlined in the *Austroads Guide to Pavement Technology - Part 2: Pavement Structural Design, Section 8.3.*

Pavements with an asphalt wearing surface as per Table A – Road Design Standards (RDS) may have the asphalt thickness included in the overall pavement depth, but shall not have the asphalt thickness included in the depth of base-course material.

2.12 Materials Selection

2.12.1 PAVEMENT GRANULAR MATERIALS

Details of the materials source and properties proposed for use in the pavement shall be submitted as part of the pavement design report. The following information is required as a minimum:

Property
Material Source
Material Type
Representative CBR Value
Particle Size Distribution
Atterburg Limits

Part 2 - Table J – Pavement Materials

Materials proposed to be used in the pavement shall have the following minimum properties:

Pavement Layer	Property	Required Value
Sub-Base Course	CBR	Minimum 30%
	Plasticity Index (PI)	Maximum 12
Base Course	CBR	Minimum 80%
	Plasticity Index (PI)	Maximum 6
All layers	Particle Size Distribution	Material is to be classed as "well-graded granular material"

Part 2 - Table K – Pavement Materials Limits

2.12.2 WEARING SURFACE

2.12.2.1 ROADS WITH ASPHALT WEARING SURFACE

Where a road is to have an asphalt wearing surface as per Table A – Road Design Standards (RDS), it shall consist of a minimum nominal 30mm layer of AC10 dense graded asphalt.

Asphalt mix designs prepared in accordance with the *AAPA National Asphalt Specification*, including NATA certified test reports of previous applications shall be submitted as part of the pavement design report.

Pavements that are designed with an asphalt wearing surface shall have a cutback bitumen prime seal applied prior to application of the asphalt. The prime seal shall consist of the following:

Element	Type Required	Conformance Standard
Binder	As per pavement design report	AS2157
Aggregate	Nominal 7mm	AS2758.2

Part 2 - Table L – Prime Seal Design

The prime seal is to extend full width between kerbs and the bitumen shall be applied to the kerb/pavement interface as well as the lip of kerb. Care should be taken to ensure no bitumen is applied to the face of kerb or channel.

A seal design consisting of the proposed aggregate and binder sources and properties and the application rates for both shall be provided to Council prior to works commencing.

Application of asphalt wearing courses shall only be permitted where it can be clearly demonstrated that all volatile compounds from the prime seal have evaporated.

2.12.2.2 ROADS WITH BITUMEN SEAL

Where a road is to have a sprayed bitumen seal wearing surface as per Table A – Road Design Standards (RDS), the seal shall conform to the following:

Element	Type Required	Conformance Standard
Type Of Seal	Two-Coat Bitumen Seal	N/A
Binder	Cutback Bitumen either C170 or C320 with a final seal using a Polymer Modified Binder class S35E	AS1357
Aggregate - 1st Application	Nominal 20mm	AS2758.2
Aggregate – 2nd Application	Nominal 14mm	AS2758.2

Part 2 - Table M – Bitumen Seal Design

A seal design consisting of the proposed aggregate and binder sources and the application rates for both including the design parameters used to determine these rates shall be provided to Council. The seal design shall also detail the method of application of the seal, including any proposals to undertake both applications on the same day. Council promotes the use of a rubberised bitumen binder for the final seal.

Bitumen sealing shall extend the full width of the carriageway, including shoulders and parking areas.

2.12.2.3 ROADS WITH UNSEALED GRAVEL PAVEMENT

Where a road is to have an unsealed gravel wearing surface as per Table A – Road Design Standards (RDS), the wearing surface shall have the following desirable characteristics:

- Skid resistance;
- Smooth riding characteristics;
- Well-graded with a maximum size of 26mm;
- Cohesive properties;
- Resistance to ravelling and scouring;
- Wet and dry stability;
- Low permeability; and
- Load spreading ability

The wearing course material used for unsealed roads shall also conform to the following:

Sieve Size (mm)	% passing for all maximum sizes
55	100
37.5	95 – 100
26.5	90 – 100
19	80 – 100
2.36	35 – 65
0.425	15 – 50
0.075	10 – 40
Plasticity	Maximum 12

Part 2 - Table N – Gravel Wearing Surface Design

Details of the proposed material to be used in the construction of the wearing surface of unsealed roads shall be provided to Council or approval prior to works commencing.

2.12.2.4 INTERSECTIONS AND ROUNDABOUTS

Consideration shall be given to the selection of the wearing surface for intersections and roundabouts, particularly for high stress environments where the design traffic includes a high percentage of heavy vehicles.

As a minimum, all roundabouts shall be surfaced with a minimum nominal 40mm thick layer of AC14 dense graded asphalt containing a polymer-modified binder. The wearing course for roundabouts shall extend to the commencement of the central splitter islands at each approach. The wearing course for intersections shall extend 30m into each intersection approach.

Mix designs for roundabouts shall be prepared and submitted in accordance with Section 2.12.2 of these guidelines.

2.12.3 PAVEMENT CROSS-SECTION

2.12.3.1 ROADS WITH KERB AND GUTTER

The pavement sub-grade and sub-base layers shall be designed to a minimum 500mm behind the invert of kerb.

2.12.3.2 ROADS WITHOUT KERB AND GUTTER

All pavement layers shall be designed for the full width of the carriageway, including parking lanes and shoulders.

Where pavements are constructed on formed batters, the pavement layers shall extend the full width of the batter.

2.12.3.3 SUB-SOIL DRAINAGE

Where in-situ natural drainage conditions warrant consideration of the use of sub-soil drainage, the design of such shall be in accordance with the *Austroads Guide to Pavement Technology – Part 10; Subsurface Drainage.* The type and location of all sub-surface drainage systems shall be clearly shown on the design drawings.

2.13 APPENDIX A – Information to be shown on Drawings – Road Design

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
1	**General**			
1a	Cover Sheet with Locality Plan and List of Drawings			
1b	Plans prepared in A1 format, drawn at an appropriate scale to provide sufficient detail			
1c	Drawing Scale is shown on drawings as a bar scale			
1d	Scale of Detail Drawings is shown as appropriate			
1e	Schedule of Symbols			
1f	Benchmark within 100 metres of development site is shown			
1g	North Point shown			
2	**Road Layout Plans**			
2a	Existing Services and structures are shown			
2b	Lot boundaries and numbers shown			
2c	Road Hierarchy for each road is shown			
2d	Road centreline chainages, radii, tangent points and deflection angles shown			
2e	All turning movements have been checked for swept path compliance.			
2f	Critical vehicle turning movements are shown on separate plans, including turning at intersections and cul-de-sacs			
2g	Road reserve widths indicated			
2h	Road formation widths indicated			
2i	Road carriageway widths indicated			
2j	Proposed utilities locations and offsets are shown and tabulated (typical section only)			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
2k	Utilities crossings shown			
2l	Vehicular access crossings are clearly shown, are at appropriate locations and details are clearly documented.			
2m	Kerb or table drain profiles are clearly nominated			
2n	Radii on kerb returns and kerb lines shown			
2o	Internal intersections to the development are shown in sufficient detail to support proposed design, including proposed kerb radii			
2p	External intersections to the development are shown in sufficient detail to support proposed design, including proposed kerb radii			
2q	Proposed Street Names are nominated			
2r	Footpaths are located on plan at correct offset and dimensions and details are indicated (typical section only)			
2s	Shared paths are clearly shown and dimensions and details are indicated (typical section only)			
2t	Location of signage, safety barriers and line marking is shown			
2u	Topographic contours and intervals are clearly shown			
3	**Road Longitudinal Sections**			
3a	Longitudinal sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
3b	Centreline long section shows the following at no more than 20 metre intervals and at all intermediate changes of grade;			
3c	Chainages			
3d	RL of existing surface			
3e	Design RL of new road			
3f	Design grades			
3g	Length of vertical curves			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
3h	Kerb return long section shows the following at no more than 20 metre intervals and at all intermediate changes of grade;			
3i	Chainages			
3j	Design RL of kerb invert			
3k	Design grades			
3l	Length and radii of vertical curves			
4	**Road Cross-Sections**			
4a	Cross-sections are drawn at scale of 1:100 natural			
4b	Cross sections show the following at no more than 20 metre intervals and at all intermediate changes of grade or profile;			
4c	Chainages			
4d	RL of existing surface			
4e	Design RL of new road			
4f	Drainage infrastructure, with invert levels			
4g	Location of footpaths and Utilities			
4h	Batter Cut/Fil Gradients			
4i	Pavement cross-falls including any super-elevated curves			
4j	Pavement details including layer thicknesses and material types (typical section only)			
4k	Wearing surface details (typical section only)			
4l	Details of Sub-Soil Drainage (if required)			
5	**Miscellaneous**			

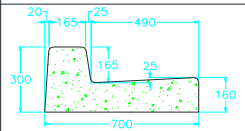
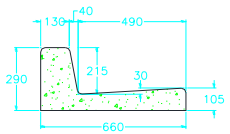
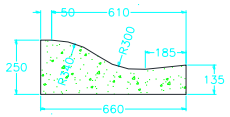
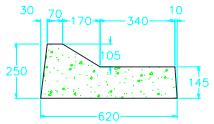
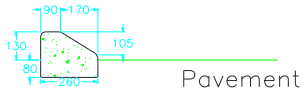
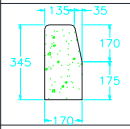
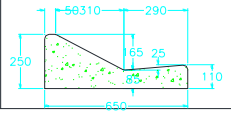
Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
5a	Location and details of any Estate Entry Structures			
5b	Location and details of and Local Area Traffic Management devices			
5c	Location of vegetation to be removed or retained			
5d	Location and details of any batter catch-drains			
5e	Landscaping details for roundabouts			
5f	Details of the type of vegetation to be used on batters			
5g	Details of any retaining structures to be used in batters or split-level carriageways.			

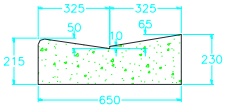
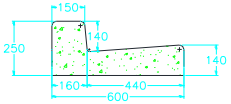
2.14 APPENDIX B – Checklists - Road Design

Item No.	Description	Reference	Developer Confirmation	GSC Confirmation	Comments
1	Have all engineering design condition of the development consent been met, and required documentation submitted				
2	Traffic Study including start-up parameters	2.5.3			
3	Details of Estate Entrance Features	2.6.3			
4	Pavement Design Report	2.11.3			
5	Subgrade Evaluation Report	2.11.5			
6	Details of source and properties of pavement materials	2.12.1			
7	Asphalt Mix Designs	2.12.2.1			
8	Asphalt Mix Designs for Roundabouts	2.12.2.4			
9	Prime Seal Design	2.12.2.1			
10	Bitumen Seal Design	2.12.2.2			
11	Details of material to be used in unsealed gravel pavement	2.12.2.3			

2.15 DRAWINGS - Road Design

Standard Kerb and Gutter Shapes	**2395**
Street Nameplate Details	**2524**
Subsoil Drains refer Austroads Part 5 for detail	
Vehicular Crossings – Residential	**2361**
Vehicular Crossings –Rural Dish Drain Treatment	**2361**

TYPE	TYPICAL USE	VOLUME m3/m	PROFILE AND DIMENSIONS
	Barrier kerb and gutter adjacent to a footway	0.130	
	200 Barrier kerb and gutter adjacent to a footway	0.089	
	Urban, allows verge /footway parking	0.112	
	Raised medians and traffic islands	0.105	
	Raised medians and traffic islands	0.098	
	Barrier kerb only	0.056	
	Alternative Urban allows verge/footway parking	0.093	

TYPE	TYPICAL USE	VOLUME m3/m	PROFILE AND DIMENSIONS
	Urban layback adjacent to a footway	0.127	
	150 Barrier kerb and gutter adjacent to a footway		

NOTES
All exposed edges are to be rounded to 20mm radius.
All dimensions are in millimetres

ISSUE	DATE	REASON FOR ISSUE	SIGNED	APPROV	REPRODUCED FROM COUNCIL KERB AND GUTTER MACHINE MOULDS DRAWN: W. COOPER	DATUM BENCHMARK	SCALES A1 1:10 A3 1:20	Gunnedah Land of Opportunity	GUNNEDAH SHIRE COUNCIL GUNNEDAH SHIRE COUNCIL STANDARD KERB AND GUTTER SHAPES	JOB NUMBER FILE NAME ARCHIVE FILE	ISSUE A SHEET NUMBER 1 OF 3 SHEETS PLAN No. 2395	DATE 29/10/01

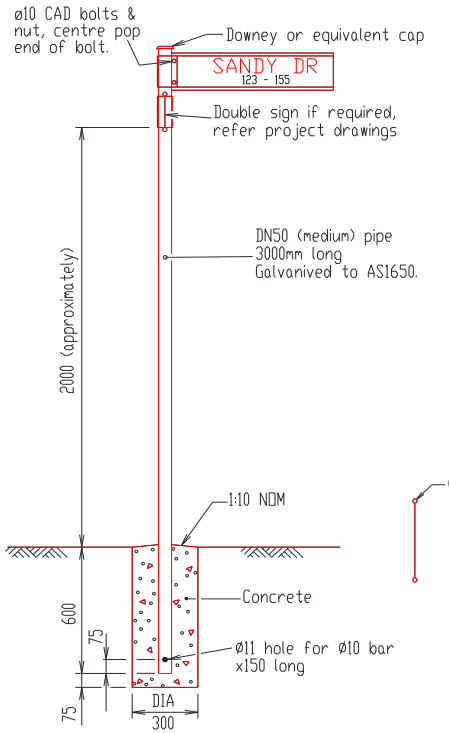
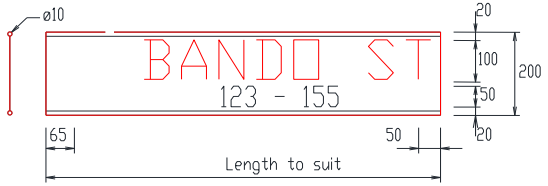


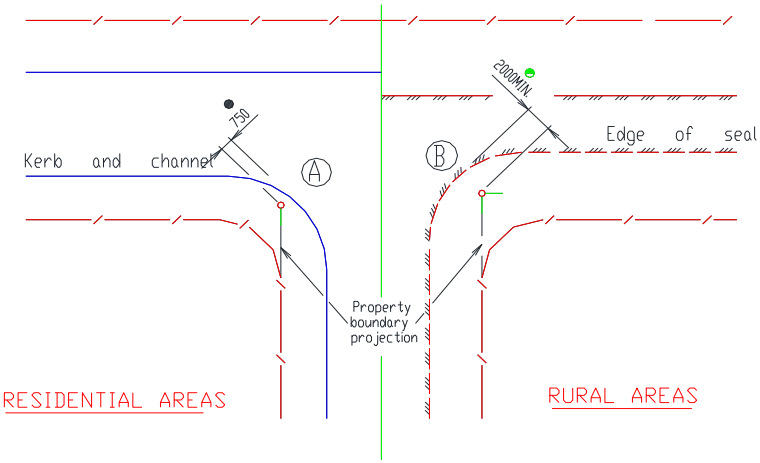
Table of Abbreviations	
Avenue	AV
Court	CT
Crescent	CR
Drive	DR
Close	CL
Lane	LA
Parade	PDE
Road	RD
Street	ST
Terrace	TCE

Other abbreviations to be approved by Superintendent.



LEGEND

- Sign post is to be located 750mm behind nominal kerb line.
- Sign post is to be located 2000mm MIN. - 4000mm MAX. from edge of seal, or as directed by the Superintendent.



SIGN LOCATIONS

NOTES:

1. Street names must be gazetted and approved by Council.
2. Name plates: 200mm wide and 3mm thick extruded aluminium or polypropylene section.
3. Bracket: Standard 200mm wide and 3mm thick alumimium extruded bracket (including 2 x ø6 CAD bolts & nuts). CAD bolts and nuts to AS 1897.
4. Letters & Numbers : Class 1 black on Class 2 white reflectorised background (both sides) to AS 1743.2
   Letters: 100mm high, Series B, medium spacing. (spacing may be varied to suit length of street name when approved by Superintendent.)
   Numbers: 50mm high, Series C, narrow spacing.
   All text to AS1744.
5. All signs are to be approved by the Director prior to erection.
6. Signs to be positioned on the side of street/road that provides best visibility.
7. Concrete N20 in accordance with AS 1379 and AS 3600.
8. Bars Ø10, Grade 250 to AS 1302.
9. All dimensions in millimetres.

ISSUE	DATE	REASON FOR ISSUE	SIGNED	APPROV	SURVEYED:		DATUM	SCALES
					DESIGNED:		HEIGHT	Not To Scale
					DRAWN:	SD	CO-ORDS	
					CHECKED:		BENCHMARK	
					ACCEPTED:			

Gunnedah Land of Opportunity

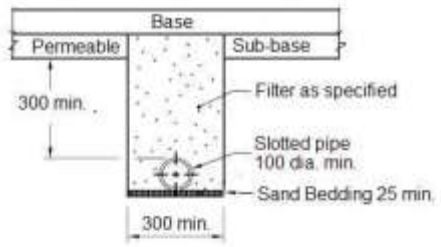
GUNNEDAH SHIRE COUNCIL

STREET NAME SIGN

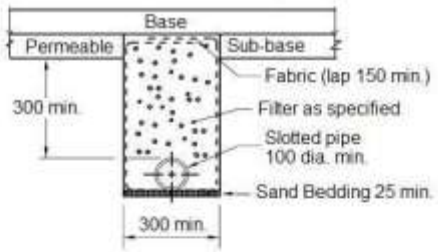
JOB NUMBER | ISSUE A | DATE 9/1/13

FILE NAME 2524 - Signs.dwg | SHEET NUMBER | OF | SHEETS

ARCHIVE FILE | PLAN No. 2524



PAVEMENT DRAIN TYPE 1



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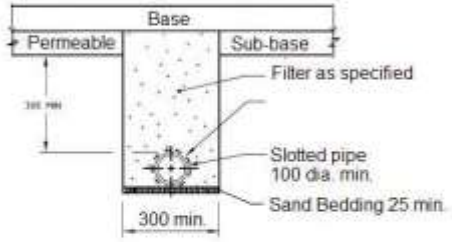

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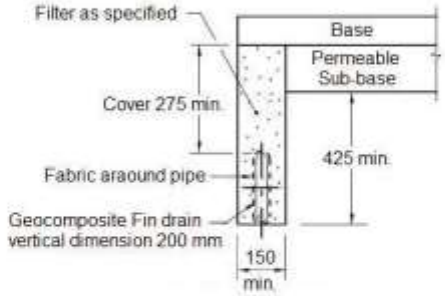
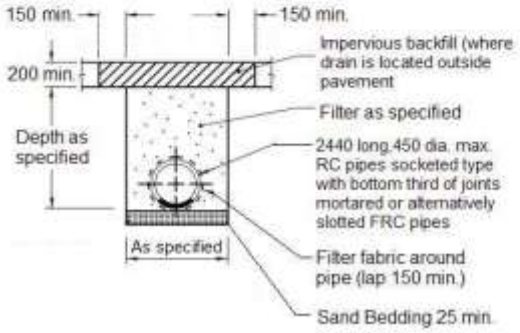
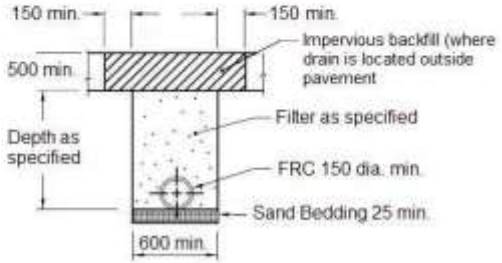


PAVEMENT DRAIN TYPE 4



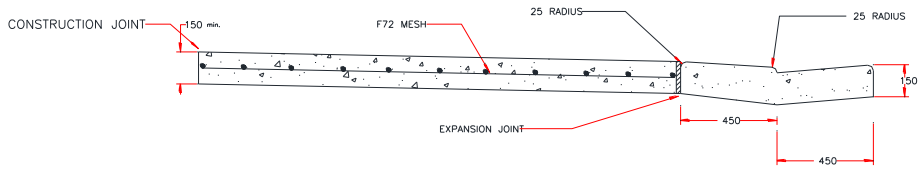
COMBINED PAVEMENT AND
STORM WATER DRAIN



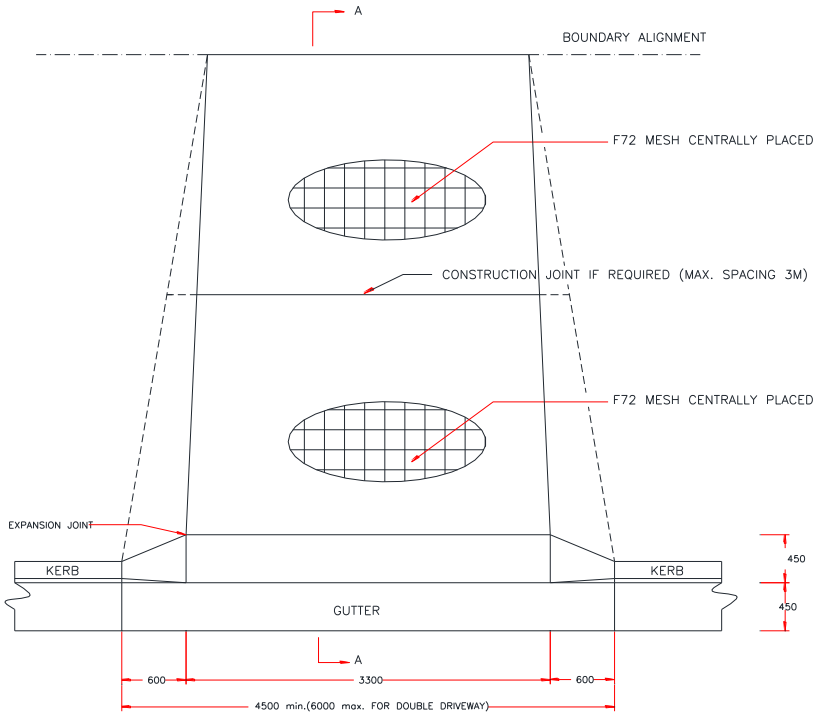
FORMATION DRAIN

Subsurface Drainage (refer Austroads Part 5: Drainage Design)

MAX 3% - MIN 2% CROSSFALL
OVER FOOTWAY



SECTION A–A



PLAN : VEHICLE CROSSING AND REINFORCED DRIVEWAY SLAB

PROCEDURAL REQUIREMENTS FOR CONCRETE WORKS ON FOOTWAYS :

1. APPLICATION TO COUNCIL REQUESTING PERMISSION TO CONSTRUCT DRIVEWAY - PLAN LAYOUT TO BE GIVEN TO APPLICANT

2. COUNCIL ENGINEER TO INSPECT SITE - DETERMINE AND PROVIDE PEG LEVELS (HEIGHT OF TOP OF CONCRETE) AT BOUNDARY LINE (IDEALLY TO MAINTAIN 2% FALL TO KERB TOP)

3. APPLICANT TO PROVIDE "ESTIMATE COST" (INDICATIVE FIGURES - $100/m2 FOR CONCRETE & $500 FOR LAYBACK - ACTUAL COST WILL VARY ACCORDING TO SITE)

4. APPLICANT TO PAY BOND OF 50% OF ESTIMATED COST (DETERMINED AS ABOVE) TO COUNCIL

5. ADEQUATE SIGNS, LIGHTS AND BARRIERS ARE TO BE ERECTED AND MAINTAINED BY THE CONTRACTOR UNTIL FINAL COMPLETION

6. CONTRACTOR TO NOTIFY COUNCIL AT LEAST 2 (TWO) WORKING DAYS PRIOR TO CONCRETE BEING POURED IN ORDER FOR COUNCIL ENGINEER TO INSPECT BOXING AND REINFORCEMENT PLACEMENT

7. CONTRACTOR TO REMOVE SPOIL AND TRIM ADJACENT FOOTPATH IMMEDIATELY CONCRETE WORKS ARE COMPLETED

8. CONTRACTOR IS TO ADVISE COUNCIL THAT WORK HAS BEEN COMPLETED

9. COUNCIL ENGINEER IS TO INSPECT SITE TO DETERMINE WORK HAS BEEN SATISFACTORILY COMPLETED

10. UPON COUNCIL APPROVAL OF COMPLETED WORKS, APPLICANT'S BOND TO BE RETURNED BY MAIL

NOTE 1. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING SERVICES

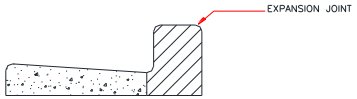
NOTE 2. CONCRETE IS TO BE A MINIMUM OF150mm THICK, CLASS 20 MPa

NOTE 3. IF PAVERS ARE TO BE USED, A 100mm THICK CONCRETE BASE (MINIMUM) IS REQUIRED

NOTE 4. FOR INDUSTRIAL DRIVEWAYS, 200mm THICK CONCRETE SLAB AND TWO LAYERS OF MESH (SPACED 50mm FROM TOP AND BOTTOM RESPECTIVELY) ARE REQUIRED

NOTE 5. CONCRETE IS TO BE BROOM FINISHED

NOTE 6. WHERE PROPOSED CONCRETE ADJOINS EXISTING CONCRETE, THE CONTRACTOR SHALL ENSURE EXISTING CONCRETE HAS A ROUGHENED SURFACE TO PROMOTE BONDING



CONCRETE SHOWN
IS TO BE REMOVED AND REPLACED
AS PER VEHICULAR CROSSING DETAIL

ISSUE	DATE	REASON FOR ISSUE	SIGNED	APPROV
C	13/08	Drawing standard and cost change	SD	
B	12/12	Cost increase	AB	

DRAWN: S. NAUGHTON
CHECKED: W. COOPER
ACCEPTED: T. PAGE

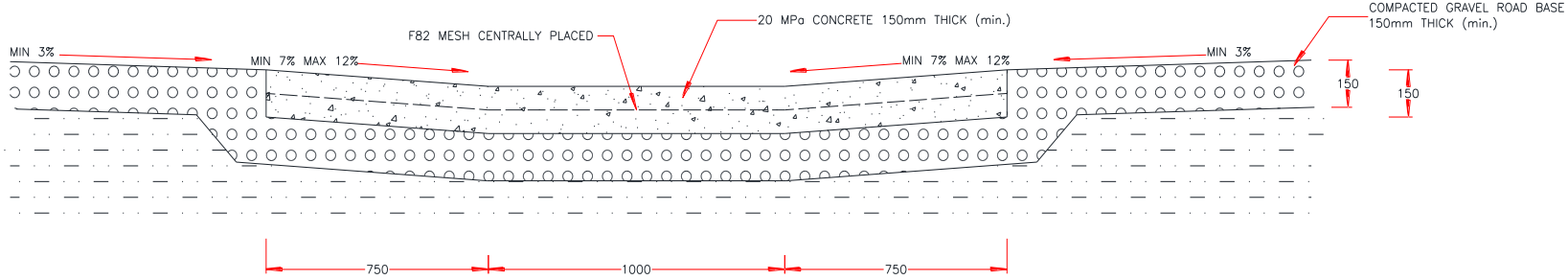
DATUM
BENCHMARK
SCALES NOT TO SCALE

Gunnedah
Land of Opportunity

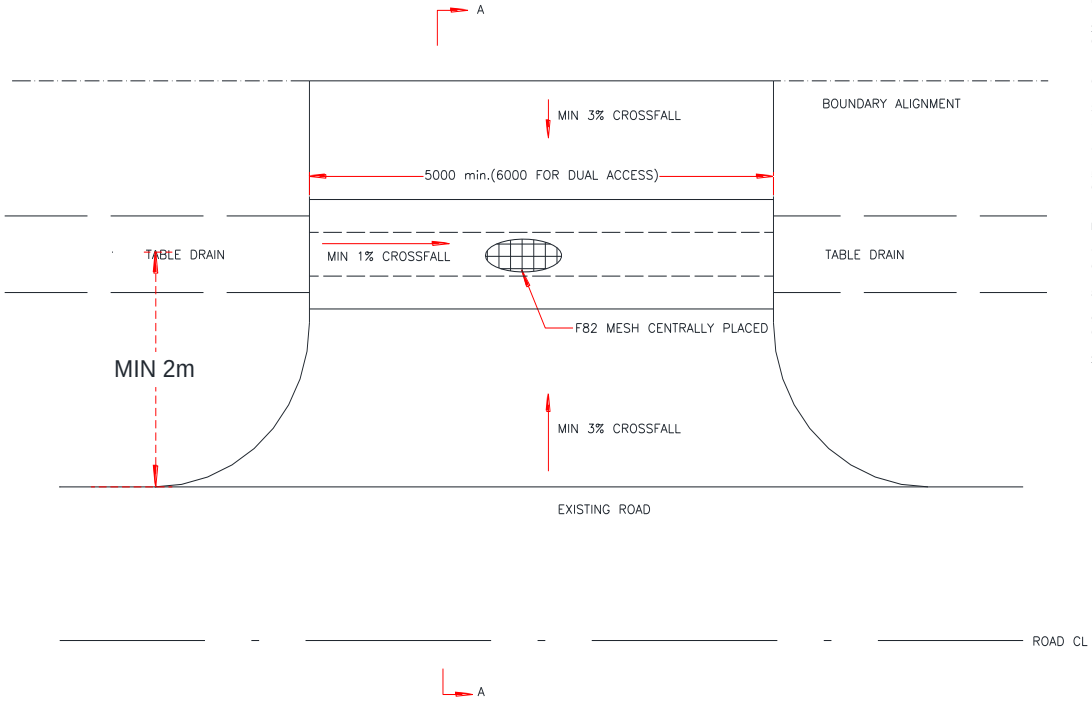
GUNNEDAH SHIRE COUNCIL
STANDARD DRAWING
CONCRETE WORKS OVER FOOTPATH
CONSTRUCTION OF DRIVEWAY

FILE NAME Driveway_StdDraw.DWG
ARCHIVE FILE Driveway_StdDraw.EXE

ISSUE C
DATE 13/08/12
SHEET NUMBER 1 OF 2 SHEETS
PLAN No. 2361



SECTION A–A



PLAN : VEHICLE CROSSING FOR RURAL RESIDENTIAL ACCESS

PROCEDURAL REQUIREMENTS FOR CONSTRUCTION OF RURAL RESIDENTIAL ACCESS :

1. APPLICATION TO COUNCIL REQUESTING PERMISSION TO CONSTRUCT ACCESS - PLAN LAYOUT TO BE GIVEN TO APPLICANT
2. COUNCIL ENGINEER TO INSPECT SITE - DETERMINE AND PROVIDE PEG LEVELS (HEIGHT OF TOP OF CONCRETE)
3. APPLICANT TO TO PROVIDE "ESTIMATE COST" (INDICATIVE FIGURES - $160/m2 FOR CONCRETE - ACTUAL COST WILL VARY ACCORDING TO SITE)
4. APPLICANT TO PAY BOND OF 50% OF ESTIMATED COST (DETERMINED AS ABOVE) TO COUNCIL
5. ADEQUATE SIGNS, LIGHTS AND BARRIERS ARE TO BE ERECTED AND MAINTAINED BY THE CONTRACTOR UNTIL FINAL COMPLETION
6. CONTRACTOR TO NOTIFY COUNCIL AT LEAST 2 (TWO) WORKING DAYS PRIOR TO CONCRETE BEING POURED IN ORDER FOR COUNCIL ENGINEER TO INSPECT BOXING AND REINFORCEMENT PLACEMENT
7. CONTRACTOR TO REMOVE SPOIL AND TRIM ADJACENT TABLEDRAIN & ROAD RESERVE IMMEDIATELY CONCRETE WORKS ARE COMPLETED
8. CONTRACTOR IS TO ADVISE COUNCIL THAT WORK HAS BEEN COMPLETED
9. COUNCIL ENGINEER IS TO INSPECT SITE TO DETERMINE WORK HAS BEEN SATISFACTORILY COMPLETED
10. UPON COUNCIL APPROVAL OF COMPLETED WORKS, APPLICANT'S BOND TO BE RETURNED BY MAIL

NOTE 1. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING SERVICES

NOTE 2. CONCRETE IS TO BE A MINIMUM OF150mm THICK, CLASS 20 MPa

NOTE 3. CONCRETE IS TO BE BROOM FINISHED

NOTE 4. CONCRETE TO BE PLACED ON COMPACTED GRAVEL BASE 150mm THICK (min)

NOTE 5. 150mm GRAVEL BASE TO EXTEND FROM ROAD TO CROSSING, AND THEN FROM CROSSING TO BOUNDARY

NOTE 6. REINFORCEMENT IS TO BE F82 STEEL MESH, PLACED CENTRALLY.

NOTE 7. WHERE AN EXISTING WATER MAIN IS PLACED IN THE FOOTWAY, A CONSTRUCTION JOINT IS TO BE PLACED 500mm EITHER SIDE OF MAIN.

ISSUE	DATE	REASON FOR ISSUE	SIGNED	APPROV
C	13/08	Drawing standard and cost change	SD	
B	13/12	Cost increase	AB	

DRAWN: S. NAUGHTON
CHECKED: W. COOPER
ACCEPTED: M. JONES

DATUM
BENCHMARK
SCALES NOT TO SCALE

Gunnedah
Land of Opportunity

GUNNEDAH SHIRE COUNCIL
STANDARD DRAWING
RURAL RESIDENTIAL ACCESS CONSTRUCTION
BETWEEN BOUNDARY AND EDGE OF ROAD

FILE NAME Driveway_StdDraw.DWG
ARCHIVE FILE Driveway_StdDraw.EXE

ISSUE C
DATE 13/08/12
SHEET NUMBER 2 OF 2 SHEETS
PLAN No. 2361

PART 3

DESIGN

GUIDELINES

FOR

STORMWATER

DRAINAGE

3 GUIDELINES FOR STORMWATER DRAINAGE DESIGN

3.1 Introduction and Objectives

This document outlines Gunnedah Shire Council's minimum requirements for stormwater drainage design in developments or subdivisions.

The principle objective is to promote development within the Gunnedah Shire Council area whilst ensuring the following:

- The safe and efficient collection and control of all stormwater generated within the subdivision of development;
- The safe and efficient collection and control of all stormwater entering subdivision or development from the water shed about the subdivision or development;
- Provision of an effective outlet for all collected stormwater from the subdivision or development to a natural watercourse
- Achieving these objectives without detrimentally affecting the general environment, surface and subsurface water quality, groundwater infiltration characteristics and watercourses both upstream and downstream of the subdivision or development.
- Design and construction of a stormwater network that is both feasible to construct and economical to maintain in the long term; and
- Design and construction of a stormwater network that does not place an unnecessary burden on Council's maintenance and operations resources ;

The design of stormwater drainage systems shall be based on best practise engineering standards and shall meet or exceed the requirements of these Guidelines as well as relevant sections of any publications referenced herein.

This document is in no way a comprehensive design manual and is intended to be read in conjunction with and as a supplement to documents and publications referenced herein, in particular the *2001 Edition of Australian Rainfall and Runoff*.

The other parts of the Engineering Guidelines for Subdivisions and Developments are as follows:

Part 1 General Requirements

Part 2 Guidelines for Design of Roads

Part 4 Guidelines for Design of Water Reticulation

Part 5 Guidelines for Design of Sewerage Reticulation

Part 6 Guidelines for Landscaping

3.2 References

This Part should be read and utilised in combination with the following publications as referenced throughout:

Australian Rainfall and Runoff, 2001 Edition;

- CSIRO Publication; 'Urban Stormwater Best Practice Environmental Management Guidelines';
- Australian Standard AS3500.3 – Stormwater Drainage.

3.3 Definitions

All references to the Director should be interpreted as referring to the Regional Services Director or their nominated representative.

All references to the Design Engineer should be interpreted as a person eligible for corporate membership of the Institution of Engineers, Australia. The Design Engineer is referred to as the person or persons responsible for the preparation of design drawings and documentation on behalf of the Developer.

For the purposes of stormwater drainage design; a built-up area is considered to be a development or subdivision with an average lot size equal to or less than 1,000m^2.

For the purposes of stormwater drainage design, a rural area is considered to be a development or subdivision with an average lot size of greater than 1,000m^2.

3.4 Information to be provided with the Application for Construction Certificate

The following information shall be submitted in support of an application for a Construction Certificate submitted by a developer, and is considered the minimum list of requirements.

3.5 Design Drawings

Design drawings shall be submitted to Council for approval. Information to be included in the design drawings is detailed in **APPENDIX A** – Information to be shown on Drawings.

3.5.1 DESIGN CHECKLISTS

Each of the supporting items or documents listed in the checklists in **APPENDIX B** – Checklists shall be completed and submitted with the Drawings. Should any of the items required in any checklist be outstanding or not to a standard acceptable to Council, the Drawings and checklists shall be returned to the developer for amendment. Council shall only commence review of the design drawings once it is satisfied that all the requirements of the checklists have been met.

3.5.2 STORMWATER SERVICING STRATEGY

The stormwater strategy submitted with the application for development consent shall include the following as a minimum:

- Type of minor system proposed (overland/piped underground);
- Location of major system overland flow paths;
- Location of any trunk drainage systems;
- Catchment and sub-catchment boundaries, areas and land use types;
- Analysis of topography, including natural drainage paths and watercourses;
- Consideration of flows from upstream developments and catchments, and consideration of the impact of the development on downstream developments and catchments;
- Location and type of any drainage retention or detention structures; and
- Location and type of any water quality devices.

Council must be immediately informed of any variations to the Stormwater Servicing Strategy that are identified during the detailed design phase.

To assist in preparation of the Stormwater Servicing Strategy and the detailed drainage design, Council will make available to the Design Engineer all data, information and modelling results relevant to the development being designed. It is the developer's responsibility to consult with Council to obtain this information, and they shall be required to provide evidence to demonstrate that such consultation has occurred.

3.6 Stormwater Drainage Systems - General Design Criteria

Drainage design shall give consideration to the entire drainage catchment, not just the area included in the subdivision or development. Design Engineers shall base the calculated peak flow on the ultimate full potential development of the entire drainage catchment containing both the

development site and upstream area for normal flow situations as well as the overland flooding caused by pipe blockages, general flooding and high water levels.

Prior to commencing the detailed design, the Design Engineer must determine the ultimate zoning of the upstream catchment area contributing to the drainage system within the subdivision or development, and consultation with Council's planning and engineering staff is encouraged.

Staged upgrading of drainage systems shall not be permitted.

3.6.1 MINOR/MAJOR SYSTEM DESIGN APPROACH

The Design Engineer shall adopt the 'Minor/Major System' approach as outlined in Section 1.5 in *Book 8 of Australian Rainfall and Runoff* for the design of all drainage systems.

3.6.2 DESIGN ELEMENTS

Stormwater drainage infrastructure is generally composed of combinations of some or all of the following design elements:

- Piped inter-allotment drainage;
- Underground minor system consisting of a network of pits and pipes, with kerb and gutter on roadways;
- Overland minor system comprising of table drains, swales and channels
- Underground piped major system;
- Overland major system consisting of open drains and channels;
- Trunk drainage system;
- Drainage retention or detention structures; or
- Water quality devices.

The majority of developments within the GSC area will involve the design of stormwater drainage that falls within one of the Drainage Design Standard (DDS) categories as per Table A – Drainage Design Standards, and Council will assign a DDS to each subdivision or development as a condition of development consent.

Design Element	DDS 1	DDS 2	DDS 3
Kerb and Gutter	✓	✓	×
Piped Underground Minor System	✓	✓	×
Overland Minor System (Table Drains)	×	×	✓
Piped Underground Major System	✓	×	×
Overland Major System including roadways	×	✓	✓
Trunk Drainage system;	**As required**	**As required**	**As required**
Drainage retention or detention structures	**As required**	**As required**	**As required**
Water Quality devices	**As required**	**As required**	**As required**

Part 3 - Table A – Drainage Design Standard (DDS) matrix

Where a standard DDS as per Table A is not appropriate for drainage within a particular subdivision or development, Council will determine the requirements for each design element for the drainage as a condition of development consent.

3.6.3 PIPED MINOR DRAINAGE SYSTEMS WITH KERB AND GUTTER

Where the minor system is to be underground, this typically consists of a pit, pipe and kerb and gutter network with sufficient capacity to capture flows from nominated storm events designed to an Average Recurrence Interval (ARI) as determined in Section 3.7.2 and convey them to a natural watercourse. These pipelines prevent stormwater damage to properties and also limit the frequency and quantity of surface water to a level that is acceptable to the community. Pipelines may not always follow the natural drainage paths and are usually aligned along property boundaries and the roadway kerb and gutters.

3.6.4 OVERLAND MINOR DRAINAGE SYSTEMS

Where the minor system is to be overland, this typically consists of open table drains designed parallel to roadways to convey flows generated by Average Recurrence Intervals as prescribed in Section 3.7.2 to a natural watercourse. Where table drains intersect with roadways, under-road culverts shall be designed to connect table drains.

3.6.4.1 MAJOR DRAINAGE SYSTEMS

The major system caters for the runoff from storms of higher intensity than for which the minor drainage system has been designed and typically consists of overland flow paths designed to convey flows when the capacity of the minor system is exceeded. The major drainage system shall be designed to convey flow resulting from 100 year ARI storm events to a natural watercourse. These flows shall follow a designated overland flow path, which typically shall be:

- A road if the catchment area is sufficiently small;
- A defined drainage reserve or open channel generally following natural drainage contours where it is impractical or unsafe for a road to carry the excess flows; and
- A piped underground system where it is impractical or unsafe for the major flows to follow overland flowpaths.

3.6.5 METHODOLOGY FOR DETERMINING PRE-DEVELOPED (NATURAL) FLOWS

Peak Flow Estimation

Peak flow estimation for each pre-developed area shall be determined using the Probabilistic Rational Method described in section 1.4.1 of Book 4 AR&R.

1. Times of Concentration for each pre-developed catchment shall be determined from the formula:

   $$tc = 0.76\ A^{0.38}$$

   Where: tc is the time of concentration (hours)
   A is catchment area (km^2)

2. Rainfall intensity: for the critical time of concentration and required ARI is read from IFD data for the appropriate location as defined by the Bureau of Meteorology.
3. Runoff Coefficient: read the runoff coefficient C_{10} for an ARI of 10 years from Table E.

For ARI's other than 10 year an appropriate frequency factor FFy is read for Table XI x2 x3 x4 for the appropriate town as defined below.
The below 500m elevation FFy values are to be used for all catchments as the default. The above 500m elevation FFy values are only to be used for catchments where the primary discharge location for the entire catchment is above 500m.

Note that the values used are different to the values in Table F.

The run off co-efficient Cy for the adopted ARI is determined by the formula:

$$Cy = C_{10} \times FFy$$

Gunnedah

	Pre Developed Frequency Factors	C Factor		C Factor
Gunnedah	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.25827		0.25827
FFy				
FF1	0.38	0.10	0.52	0.13
FF2	0.54	0.14	0.64	0.17
FF5	0.78	0.20	0.82	0.21
FF10	1	0.26	1	0.26
FF20	1.26	0.33	1.21	0.31
FF50	1.71	0.44	1.52	0.39
FF100	2.14	0.55	1.78	0.46

Curlewis

	Pre Developed Frequency Factors	C Factor		C Factor
Curlewis	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.30400		0.30400
FFy				
FF1	0.38	0.12	0.52	0.16
FF2	0.54	0.16	0.64	0.19
FF5	0.78	0.24	0.82	0.25
FF10	1	0.30	1	0.30
FF20	1.26	0.38	1.21	0.37
FF50	1.71	0.52	1.52	0.46
FF100	2.14	0.65	1.78	0.54

Mullaley

	Pre Developed Frequency Factors	C Factor		C Factor
Mullaley	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.32667		0.32667
Ffy				
FF1	0.38	0.12	0.52	0.17
FF2	0.54	0.18	0.64	0.21
FF5	0.78	0.25	0.82	0.27
FF10	1	0.33	1	0.33
FF20	1.26	0.41	1.21	0.40

FF50	1.71	0.56	1.52	0.50
FF100	2.14	0.70	1.78	0.58

Tambar Springs

	Pre Developed Frequency Factors	C Factor		C Factor
Tambar Springs	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.32267		0.32267
Ffy				
FF1	0.38	0.12	0.52	0.17
FF2	0.54	0.17	0.64	0.21
FF5	0.78	0.25	0.82	0.26
FF10	1	0.32	1	0.32
FF20	1.26	0.41	1.21	0.39
FF50	1.71	0.55	1.52	0.49
FF100	2.14	0.69	1.78	0.57

Carroll

	Pre Developed Frequency Factors	C Factor		C Factor
Carroll	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.28400		0.28400
Ffy				
FF1	0.38	0.11	0.52	0.15
FF2	0.54	0.15	0.64	0.18
FF5	0.78	0.22	0.82	0.23
FF10	1	0.28	1	0.28
FF20	1.26	0.36	1.21	0.34
FF50	1.71	0.49	1.52	0.43
FF100	2.14	0.61	1.78	0.51

Kelvin

	Pre Developed Frequency Factors	C Factor		C Factor
Kelvin	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.30267		0.30267
Ffy				
FF1	0.38	0.12	0.52	0.16
FF2	0.54	0.16	0.64	0.19

FF5	0.78	0.24	0.82	0.25
FF10	1	0.30	1	0.30
FF20	1.26	0.38	1.21	0.37
FF50	1.71	0.52	1.52	0.46
FF100	2.14	0.65	1.78	0.54

Breeza

	Pre Developed Frequency Factors	C Factor		C Factor
Breeza	Elevation Below 500m	C10xFFy	Elevation Above 500m	C10xFFy
C10		0.29067		0.29067
Ffy				
FF1	0.38	0.11	0.52	0.15
FF2	0.54	0.16	0.64	0.19
FF5	0.78	0.23	0.82	0.24
FF10	1	0.29	1	0.29
FF20	1.26	0.37	1.21	0.35
FF50	1.71	0.50	1.52	0.44
FF100	2.14	0.62	1.78	0.52

3.7 Procedure for Design of Minor Drainage Systems

Piped Minor Systems		Overland Minor Drainage Systems	
Procedure	**Section**	**Procedure**	**Section**
Hydrological Design			
Determination of Design Average Recurrence Intervals	3.7.2	Determination of Design Average Recurrence Intervals	3.7.2
Preliminary Layout of Proposed Drainage	3.7.3.1	Preliminary Layout of Proposed Drainage	3.8.3.2
Calculation of Minor System Flow Rates	3.7.4	Calculation of Minor System Flow Rates	3.7.4
Hydraulic Design			
Hydraulic Design of Minor Systems	3.9	Hydraulic Design of Minor Systems	3.10

Part 3 - Table B – Design Procedure for Minor Systems

3.7.1 HYDROLOGY

Drainage design shall include a drainage catchment plan showing the total catchment area and sub areas that form the basis of the design, together with drainage calculation sheets or summaries of computer modelling.

Partial areas shall be taken into account when determining peak flow sites. Particularly in instances where the catchment contains sub areas, such as reserves, that may have a relatively large time of concentration in conjunction with a small co-efficient of runoff. In some instances a partial area design discharge may result in runoff that is less (or the same) than a discharge that has been calculated at some upstream point. A check of the partial area flows shall be required to determine the peak flow. The peak flow to be adopted for design purposes shall be the largest flow from either full or partial area calculations.

Although the parameters and techniques for Flow Estimation in urban catchments, as set out in these Guidelines, generally refer to the Rational Method, it may, depending on catchment characteristics, be more appropriate to use a Unit Hydrograph or Nonlinear Run-Off Routing Model. The advantages and disadvantages of Unit Hydrographs are explained in detail in Australian Rainfall and Runoff. It is the responsibility of the Design Engineer to determine the most appropriate methodology for each application. Various drainage tools, proprietary software and construction methods are available to the Design Engineer to achieve an appropriate design. Regardless of the technique or method used, detailed documentation shall be required to be submitted for approval.

Where computer software is used for hydrological modelling, it shall be 'a recognised industry standard' software program. A comprehensive list of set-up parameters used to obtain results from the software is to be submitted along with the detailed design documentation and a copy of the electronic model.

For catchment area greater than 50 hectares, two recognised runoff estimation methods shall be used to enable comparison or runoff estimates.

3.7.2 DETERMINATION OF DESIGN AVERAGE RECURRENCE INTERVALS

For all drainage systems the following average recurrence intervals (ARI) shall be adopted:

3.7.2.1 MINOR SYSTEM RECURRENCE INTERVALS

Land Use	Design ARI
All residential areas	5 years
Rural areas	5 years
Commercial	10 years
Industrial	10 years

Part 3 - Table C – Recurrence Intervals for Minor Systems

3.7.2.2 MAJOR SYSTEM RECURRENCE INTERVAL

The Design Engineer is to ensure that peak 100 year ARI flows have a safe and effective flow path to a natural watercourse or to an established trunk drainage system when the capacity of the minor system is exceeded. Overland flow paths must be clearly shown on the detailed design drawings.

3.7.2.3 TRUNK DRAINAGE RECURRENCE INTERVAL

For underground minor drainage systems, a trunk drain is considered to be a drain that would require a 1200mm diameter pipe or greater to convey the 5 year ARI from the entire catchment under consideration.

For overland minor drainage systems, a trunk drain is considered to be an open channel with a clear waterway area of 4.5m^2, designed in accordance with Section 3.14 of these Guidelines.

3.7.3 PRELIMINARY LAYOUT OF PROPOSED DRAINAGE

3.7.3.1 PIPED MINOR DRAINAGE SYSTEMS

An assessment of the topography will determine the location of proposed drainage paths. Once the location of a proposed network is defined, trial pit locations should be specified. Generally, pits should be spaced so that by-pass flows are minimised. The width of flow in gutters should not exceed 2.5 metres and pits should be spaced no more than 75 metres apart. Pits at road

intersections should be located so as to limit flow around kerb returns to a maximum of 20 litres/second.

An approximate procedure for locating pits is detailed in *Technical Note 2 in Australian Rainfall and Runoff*. Refer to Section 3.9 for details of pit inlet design and location.

Catchment areas to each pit shall be determined from contour information and proposed property boundaries. A site inspection should always be made to verify the contour information and assess the likelihood of any flow path deviations which may occur as a consequence of existing or proposed developments. Changes to flow paths can occur as a result of the construction of fences, retaining walls, buildings etc. after the construction phase of the subdivision. The impact of these changes must be considered at the design stage.

Sub-area discharges can be calculated using the procedures detailed in Section 3.7.4.6 of these Guidelines. Major system flow paths should be defined at this stage, and analysed according to the procedures detailed in Section 3.8 of these Guidelines.

3.7.3.2 OVERLAND MINOR DRAINAGE SYSTEMS

Typically, the overland minor system drainage consists of table drains designed in conjunction with the road network. The layout of roads and table drains should generally follow natural drainage paths.

Catchment areas to each table drain shall be determined from contour information and proposed property boundaries. A site inspection should always be made to verify the contour information and assess the likelihood of any flow path deviations which may occur as a consequence of existing or proposed developments. Changes to flow paths can occur as a result of the construction of fences, retaining walls, buildings etc. after the construction phase of the subdivision. The impact of these changes must be considered at the design stage.

Sub-area discharges can be calculated using the procedures detailed in Section 3.7.4.6 of these Guidelines. Major system flow paths should be defined at this stage, and analysed according to the procedures detailed in Section 3.8 of these Guidelines.

3.7.4 CALCULATION OF MINOR SYSTEM FLOW RATES

3.7.4.1 DESIGN RAINFALL INTENSITIES

Rainfall intensities adopted for design are those issued by the Bureau of Meteorology for the location of the development. The Design Engineer is to adopt the rainfall intensities for the zone in which the proposed development lies.

This data is to be used for all IFD calculations.

3.7.4.2 TIMES OF CONCENTRATION

The Time of Concentration (T_c) shall be calculated using the following formulas based on the type of catchment being analysed. Where proposed developments consist of a combination of urban and rural sub-catchments, it will be necessary to determine the T_c for each sub-catchment separately.

3.7.4.3 BUILT-UP AREAS

Times of concentration for each sub-catchment in a built-up area shall be determined using the Kinematic Wave Equation, as detailed in *Technical Note 3 of Book 8 of Australian Rainfall and Runoff*;

$$t = 6.94\ (L \times n^*)^{0.6} / I^{0.4} S^{0.3}$$

where

t is the overland flow time (minutes);

L is the flow path length (metres);

n* is a surface roughness or retardance co-efficient;

I is the rain intensity (mm/hour);

S is the slope (m/m).

The Kinematic Wave Equation is very sensitive to slope and the Retardance Co-efficient (n*); and these should be estimated carefully. Recommended Retardance Co-efficients are listed below;

Land Use	Retardance Co-efficient
Road/Paved Areas Only	0.01
Normal Residential	0.08
Medium Density Residential	0.06
Industrial/Commercial	0.04
Parkland	0.15
Open Space (Natural Bushland)	0.3

Part 3 - Table D – Retardance Co-efficients

Note:

Minimum T_c; 6 minutes

Maximum Tc; 20 minutes

Where Tc is in excess of 14 minutes, it will be necessary to validate the use of such a Tc in the calculations.

3.7.4.4 RURAL AREAS

Times of concentration for each rural sub-catchment shall be determined using the Bransby-Williams formula described in *Section 1.3.2 of Book 4 of Australian Rainfall and Runoff.*

$$t_c = 58L / (A^{0.1} \times S_e^{0.2})$$

where

t_c is the time of concentration (minutes);

L is the mainstream length measured to the catchment divide (km);

A is the catchment area (km^2);

S_e is the equal area slope of the main stream projected to the catchment divide (m/km).

3.7.4.5 RUN-OFF CO-EFFICIENTS

Run-off coefficients "C" shall be determined in accordance with *Section 1.5.5 (iii) of Book 8 of Australian Rainfall and Runoff*. The following equations apply for each zone in GSC:

$$C_y = F_y \times C_{I0}$$

where: $$C_{I0} = 0.9 \times f + {}^{10}C_1 \times (1-f)$$

and; $$^{10}C_1 = 0.1 + (0.7 - 0.1) \times (^{10}I_1 - 25)/(70 - 25)$$

These parameters are defined below:

C_y: Run-off Co-efficient for recurrence interval "y" (years)

C_{I0}: 10 year ARI Run-off Coefficient

F_y: Frequency Factor -see Table E

f: Fraction Impervious -see Table F

Rainfall Intensity of a 10 year ARI, 1 hour duration storm for each zone, as per Table D – Rainfall Intensity for calculation of C_{10}

Location/Zone	Rainfall Intensity; $^{10}I_1$ (mm/hour)	Pervious Area Runoff Co-efficient; $^{10}C_1$
Gunnedah	40.4	0.30533
Curlewis	40.3	0.30400
Carroll	45.3	0.36999
Mullaley	42.0	0.32667
Tambar Springs	41.7	0.32267
Kelvin	40.2	0.30267
Breeza	39.3	0.29067

Part 3 - Table E - Pervious Area Runoff Co-efficient $^{10}C_1$

Where an analysis is to proceed which requires the estimation of Initial and Continuing Loss Rates, these shall be set to zero. That is, there should be no initial and no continuing loss incorporated in any analysis.

Past experience suggests that major flooding in the Gunnedah Region occurs when the catchment is already saturated and the Loss Rates are negligible.

Recurrence Interval	F_y
1	0.80
2	0.85
5	0.95
10	1.00
20	1.05
50	1.15
100	*1.20*

Part 3 - Table F - Frequency Factors for Run-off Co-efficients

Land Use	f
Residential Lot in Built-Up Area	0.75
Residential Lot in Built-Up Area including half road	0.80
Residential Lot in Rural Area	0.60
Residential Lot in Rural Area including half road	0.65
Half Width Road Reserve	0.80
Commercial Areas	0.95
Industrial Areas	0.90
Public Recreation Areas	0.40
Open Space (Natural Bushland)	0.35

Part 3 - Table G - Fraction Impervious for Run-off Co-efficients

3.7.4.6 SUB-AREA DISCHARGE

The discharge for each sub-catchment may be calculated using the Rational Method formula:

Q = C x I x A / 0.36 (litres/second)

"Hydrological Design Sheet 1" (refer **APPENDIX C**) sets out the preferred format for these calculations. *Technical Note 6 of Book 8 of Australian Rainfall and Runoff* details a worked example for these calculations. The following points should be noted:

- The rainfall intensity adopted (column 8) is for the total flow time;
- A "C" value (column 9) and sub area (column 10) is calculated for each land use type; and
- The discharge for the sub-catchment (column 13) is calculated by summing the CA's (column 12) and multiplying by (I/ 0.36).

"Hydrological Design Sheet 2" (refer **APPENDIX C**) can then be used to calculate the flows along each reach of the pipe system.

Hydraulic Design Sheets in MS Excel format with visible formulas and calculations shall be submitted with the design documentation.

3.7.4.7 PARTIAL AREA FLOWS

In built-up areas, it is probable that a greater flow rate may be obtained by applying the Rational Method to a lower part of the catchment with a Time of Concentration less than the full area travel time. These partial areas effects commonly occur when 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.

In areas where this may be 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.

3.8 Hydrological Assessment of Major System Flows

All drainage designs shall incorporate an assessment of major system flows and the design of a major drainage system. The major drainage system shall collect major storm runoff from a catchment, in excess of the capacity of the minor drainage system, and convey this runoff to a natural watercourse without nuisance, danger or damage. The major drainage system shall be designed and constructed such that its function ensures a reasonable level of pedestrian and vehicular traffic safety and accessibility limits flooding of private and public property and minimises pollutant inflows to receiving waters.

The roads and pathways will generally form the flow path by which the major system flows are routed, either to the trunk drainage system or to a natural watercourse with sufficient hydraulic capacity to receive the flows.

The Rational Method may be used to estimate major system flows for critical points in the drainage system. Minimum requirements of the major drainage system are as follows:

1. Design of major drainage systems shall be based on the peak 100 year ARI storm with some consideration given to the impact of a rarer storm event. The peak storm shall be determined by routing storms of varying duration until peak flows (Q_{100}) are identified. Two recognised flow estimation methods (runoff routing computer models) in addition to the Rational Method shall be used for comparative purposes for urban catchments or sub-catchments greater than 50 Ha;
2. Hydraulic Grade Line (HGL) analysis shall be used for the design of major system flows, floodways, low flow pipes and retarding/detention basins. The results of the HGL analysis shall be shown on the longitudinal sections of the design drawings;

3. The width of major floodways shall be governed by the greater of the hydraulic requirements or the width for suitable maintenance (including mowing of grassed trapezoidal drains);
4. Depth of overland flows shall be governed by freeboard to properties or upper limits of surface flow depth/velocity criteria for public safety; and
5. Where major system flows are to be conveyed in open channels, these shall be designed in accordance with Section 3.11 of this document.

The design of major drainage systems shall consider the use of gross pollutant traps and sediment interception ponds, particularly immediately downstream of urban areas.

The Design Engineer shall demonstrate that consideration has been given to any trapped low points in the design where the overland flowpath may divert surcharge into properties. This is especially important when designing “downhill" cul-de-sac and kerb returns adjacent to a sag vertical curve.

If the roadway capacity is inadequate, an estimate shall be made of the capacity of the minor system under major flow conditions. Pit capacities should be calculated using the appropriate blocking factors, and pipe capacities estimated with trial diameters and head levels no greater than 150mm below the surface levels/invert of kerb (applicable up to the design ARI for the respective pipeline reach).

Technical Note 6 of Book 8 of Australian Rainfall & Runoff details a procedure for checking major system flows. The preferred format for major systems is tabulated as per "Hydrological Design Sheet 3" (**APPENDIX C** and shall be submitted in MS Excel format along with the design documentation).

The location of major system flowpaths shall be shown on the Drawings and shall be accompanied by all necessary design documentation.

3.9 Hydraulic Design – Piped Minor Drainage Systems

3.9.1 DESIGN OF PIT INLETS

3.9.1.1 PIT LOCATIONS

The following criteria govern the location of pits in roadways for the design average recurrence interval:

a) Inlet Pits are to be spaced so that flow width should not exceed 2.5m (may not be applicable in the upper reaches of the catchment) for the 5 year ARI Storm;
b) Gutter flows should at no point overtop the kerb;
c) Velocity x depth should not exceed 0.4 (5 year ARI);
d) Bypass from any pit on grade is not to exceed 15% of the total flow at the pit (Full capture Desirable);
e) Maximum spacing between pits should not exceed 75m;
f) Where flows in the gutter are equal to or greater than 20 litres per second and/or equal to or greater than 1m in width adjacent to the upstream kerb return tangent point, it will be necessary to intercept these flows with a Kerb Inlet Pit; and
g) The location of gully pits on curves is to be avoided and they are not to be placed in line with the normal passage of pedestrians.

Technical Note 4 of Book 8 of Australian Rainfall and Runoff details a method for calculating gutter and road flows.

3.9.1.2 INLET DESIGN

Once the sub-catchment flows are known, pit inlets should be designed in accordance with the charts contained on the following pages. All new inlet pits shall be constructed using welded steel “Weldlok” type or equivalent grates with appropriate skirts.

On grade, percentage capture by grates is mainly dependant on lintel size and the slope of the gutter. Pit manufacturers specifications provide an indication of the percentage capture of pits on grade.

Sag pits shall be designed based on a depth of ponding, up to the top of the kerb. Ponding depths can be calculated using design charts as per manufacturers guidelines. Minimum internal lintel size in a sag should be 2.4m.

Alternatively, inlet capacities can be calculated from first principles using formulas as detailed in *Section 1.5.4(iii), Book 8 of Australian Rainfall and Runoff.* If using these formulae, appropriate blocking factors shall be applied.

Calculations for the design of pit inlets are to be tabulated on "Hydrological Design Sheet 1" (Columns 16 to 20) and submitted to Council in MS Excel format along with the design documentation.

3.9.2 DRAINAGE PIT DESIGN

3.9.2.1 GENERAL

- Standard pits in accordance with Drawings 2340 or approved equivalent precast pits shall be provided in drainage lines at all changes in grade, level or direction and at all pipe junctions;
- The minimum clearance from the top of the manhole to the design water level in the pit should be 150mm;
- Pipe junctions where the deflection angle of the major flow is 90º should be avoided;
- The vertical drop across pits shall be designed on the following basis;
    - Where there is no change in direction or pipe diameter; 50mm invert to invert;
    - Where there is no change in pipe diameter but direction change; 70mm invert to invert;
- Changes in diameter should be graded obvert to obvert;
- Where the depth of the pit exceeds 1.2 metres, standard galvanised or other approved step-irons are to be provided at a spacing of 300mm to provide access for inspection and cleaning; and
- Every endeavour is to be made to maintain flow velocities through pits and excessive drops will not be permitted.

3.9.2.2 INLET PITS

Inlet pits are to be in accordance with Council's Standard Drawing No 2340.

3.9.2.3 ANGLE PITS AND JUNCTION PITS

Angle and junction pits are to be in accordance with Council's Standard Drawing No's 2340a and 2340b respectively.

3.9.2.4 FOOTPATH AND FIELD SURFACE INLET PITS

Where footpath or field surface inlet pits are required, they are to be in accordance with IPWEA Guidelines.

3.9.2.5 SURCHARGE SURFACE INLET PIT

At the upstream end of drainage pipelines in public reserves, gullies, etc. and in subdivisions involving staged construction an inlet pit with Weldlok or similar surcharge surface inlet pit cover is to be provided in accordance with IPWEA guidelines.

3.9.2.6 INLET EFFICIENCY

An allowance of 150mm is to be adopted below the highest point of the pit inlet/kerb invert, to effectively allow such inlets to act efficiently.

3.9.2.7 PIT LOSS FACTORS

Pit loss factors (k) should be calculated using the following formula in accordance with *Section 1.5.7(iv) of Book 8 of Australian Rainfall &Runoff.*

$$h_L = Cu.V_o^2 / 2g$$

where;

- h_L is the loss (m);
- C_u is a dimensionless energy loss coefficient;
- V_o is the velocity of flow in the outlet or downstream pipe (m/s);
- g is the acceleration due to gravity (m/s^2)

3.9.3 PIPELINE DESIGN

3.9.3.1 GENERAL

The Hydraulic Grade Line (HGL) method shall be used for pipeline design. *Technical Note 9 of Book 8 of Australian Rainfall and Runoff* details the recommended procedures for Hydraulic Grade Line calculations. The "Hydraulic Design Sheet" (see **APPENDIX C**) shall be used for calculating the HGL and shall be submitted in MS Excel format along with the design drawings.

The initial pipe sizing shall be performed on a reach by reach basis and final HGL checking of the system should then be performed from the system outlet working upstream. The water level results of the HGL analysis shall be plotted on the pipeline longitudinal sections in the design drawings.

The following points details the minimum requirements for pipeline design;

a) All pipelines constructed shall be rubber ring jointed type;

b) Pipelines in roadways should have a minimum diameter of 375mm in urban areas and 450mm in rural areas;

c) Generally, pipelines should cross roads at right angles to the road centreline;

d) Pipelines should have adequate inspection manholes spaced no greater than 75m for each drainage pipeline. Where the pipeline diameter exceeds 1200mm, this distance may be increased to 100 metres;

e) For single cell pipe systems, a downstream pipe of smaller diameter than the upstream pipe will not be permitted;

f) The minimum grade of all pipelines shall be 1.0% to encourage self-cleaning under low flow velocities. Flow velocities should be limited to a minimum of 0.6 m/s for self-cleaning purposes;

g) The inlet and outlet drains to pipelines should be carefully designed so as to avoid either scouring or silting velocities during storm flows, and adequate scour protection is to be provided at the outlet of all stormwater lines. Details of proposed scour protection to pipe outlets shall be shown on the design drawings;

h) All pipe inlets and outlets shall be designed with appropriate inlet/outlet structures;

i) Curved pipelines will not be permitted where the diameter of the pipeline is less than 900mm. Where curved pipelines are permitted, they are to be constructed using rubber ring jointed reinforced concrete pipes and installed strictly in accordance with the Manufacturer's recommended radii.

3.9.3.2 RECOMMENDED PIPE FRICTION CO-EFFICIENTS

Table H below details the recommended pipe friction co-efficients to be used in HGL calculations;

Pipe Material	Mannings "n"	Colebrook-White "k"
Steel Re-inforced Concrete Pipe (SRCP)	0.012	0.6
Fibre Re-inforced Concrete Pipe (FRCP)	0.011	0.3
UPVC Pipe (UPVC)	0.01	0.015

Part 3 - Table H – Pipe Friction Co-efficients

3.9.3.3 TAILWATER LEVELS

The tailwater to be adopted will depend on the outflow conditions. Where determination of a tailwater level is in doubt the design engineer shall consult with Council prior to proceeding with the design to confirm the value, generally;

- For free outfalls, the pipe obvert may be adopted;
- For discharge into receiving waters, tailwater equivalent to the design ARI flood level may be adopted;
- For discharge into existing systems where the hydraulic grade levels are unknown, a tailwater 150mm below the natural surface/invert of kerb may be adopted; and
- For discharge into a point designed to surcharge, a tailwater level equivalent to the height of the surcharge may be adopted.

3.9.3.4 HEADWALLS AND OUTLET STRUCTURES

Concrete headwalls shall be designed for all culverts and pipe outlets and shall be designed in accordance with RMS Specifications.

3.9.3.5 CONCRETE BULKHEADS

Concrete bulkheads shall be required for all drainage pipelines with grades exceeding 6%, at intervals not exceeding 15 metres. Bulkheads are to be in accordance with Council's Drawing No. 2340D.

3.9.3.6 SUB-SOIL DRAINAGE

Sub-soil drains may be required in certain locations, particularly as intercepting drains behind kerb and for drainage of the flexible pavement, and these shall be designed as per the requirements of the *Austroads Guide to Pavement Technology – Part 10; Sub-Soil Drainage*. Sub-soil drainage lines should be graded to suitable outlets such as stormwater pits.

3.9.3.7 CULVERT DESIGN

Road culverts should be designed in accordance with culvert hydraulics theory. That is, the culvert capacity is determined by the flow conditions, depending on whether inlet control or outlet control governs.

Recommended design procedures are contained in *Section 3 of the Concrete Pipe Association of Australia's publication: "Hydraulics of Precast Concrete Conduits Hydraulic Design Manual".* The preferred format for culvert design calculations is provided in **APPENDIX C** and shall be submitted in MS Excel format along with the design documentation.

3.10 Hydraulic Design – Overland Minor Drainage Systems

Design of table drains shall be in accordance with *Section 1.6.4 of Book 8 of Australian Rainfall & Runoff,* having regard to vehicle crossover and access requirements in Part 2 of these Guidelines.

The profile of table drains located between the roadway and property accesses shall be designed such that a B99 Vehicle as detailed in *Australian Standard 2890.1 – Parking Facilities; Off Street Car Parking* can satisfactorily enter and exit allotments as per Section 28.3 of these Guidelines.

Notwithstanding this, table drains in overland minor systems shall have a minimum floor width of 2.0m and batter slopes not exceeding 1 in 5 to allow for maintenance and mowing, provided the HGL of the drain is below the bottom of all pavement layers in the adjacent pavement..

The floors and lowest 0.5m of batter walls of table drains shall appropriately stabilised to prevent scouring and erosion of the drain (in both the short and long term) and the remainder of the batter walls shall be topsoiled and seeded with appropriate grass species. Details of the proposed grass species to be used shall be included in the design drawings.

Where table drains or open channels intersect with roadways, culverts shall be designed to convey flows under the roadway. Culverts shall be designed in accordance with Section 3.9.3.7 of these Guidelines.

3.11 Hydraulic Design – Major System Flows

The capacity of roadways to convey the major system flows shall be calculated using the procedure outlined in *Technical Note 4 of Book 8 of Australian Rainfall & Runoff.*

The hydraulic design of major system open channels shall be in accordance with *Section 1.6.4 of Book 8 of Australian Rainfall & Runoff*.

3.12 Drainage Corridor Tenure

Where inter-allotment stormwater drainage, piped or otherwise, is designed to discharge onto land other than an existing drainage easement, drainage reserve, public road or other legal point of discharge or public place as approved by the Director, it shall be the responsibility of the developer to obtain a drainage easement through such land, sufficient in dimension to convey the drainage to an easement, natural watercourse or public place, and to transfer easement rights thereover to each upstream beneficiary of the inter-allotment drainage line. Gunnedah Shire Council is not to be named as a beneficiary of easements for the purposes of inter-allotment drainage.

Where minor system stormwater drainage, piped or otherwise, is designed to discharge onto land other than an existing drainage easement, drainage reserve, public road or other legal point of discharge, it shall be the responsibility of the developer to obtain a drainage easement through such land, sufficient in dimension to convey the drainage to an easement, natural watercourse or public place, and to transfer easement rights thereover to Council.

Where major system stormwater drainage, piped or otherwise, is designed to discharge onto land other than a roadway, an existing drainage reserve or other public place, the land shall be dedicated as a drainage reserve, sufficient in dimension to convey the drainage to a natural watercourse or other public place, and to transfer ownership thereover to Council.

Where it is intended to create drainage easements or drainage reserves in a subdivision or development, a notation shall appear on the engineering drawings and subdivision plan creating the easement or easements pursuant to Section 88B of the Conveyancing Act, 1919 as amended.

Where a drainage easement lies within a development which does not involve the opening of a new road, the developer shall transfer to Council any drainage easement provided in the subdivision and execute a transfer and grant of easement in favour of Council pursuant to Section 88B of the Conveyancing Act, 1919 as amended.

Where stormwater is designed to discharge into a public park, an open grassed channel shall be provided to meet the minor/major design requirements of these Guidelines.

The Subdivision certificate will not be released until the above requirements have been complied with, and all fees and contributions have been paid.

3.12.1 WIDTH OF EASEMENTS

Type of Drainage	Easement Width
Inter-allotment Drainage	3.0 metres (may be shared with sewer)
Piped Drainage	(1.5 x Depth of Trench) metres
	Minimum Easement Width – 3.0 metres
Open Channels	Top width of 1 in 100 year ARI flow plus freeboard equal 25% of maximum flow.

Part 3 - Table I – Easement Widths

3.13 Inter-Allotment Drainage Systems

Inter-allotment drainage is considered necessary in urban development's where roof water and surface water cannot be discharged directly to the street gutter. Inter-allotment drainage systems are intended to collect both roof water and surface water.

Inter-allotment drainage lines shall be designed with an ARI of 10 years over the entire lot area, with a fraction impervious area as per Table G – Fraction Impervious for Run-Off Co-Efficients, and in accordance with the *Building Code of Australia or Australian Standard AS3500,* whichever is applicable.

The minimum size pipe is to be 225mm diameter. The design is to include manholes at intervals of not more than 75 metres. Consideration will be given to the installation of a 150mm diameter pipe where only one (1) lot is to be served.

Inter-allotment drainage lines are to be located within an easement 3.0 metres wide, granted in favour of the properties served by that line, and should be located in the higher rather than the lower property.

Under no circumstances should minor or major system drainage, piped or otherwise, discharge into an inter-allotment drainage line. Similarly, only stormwaters that are captured from roofs and the surfaces of private properties are to be captured and discharged into inter-allotment drainage lines. Stormwater from roads, parks, reserves or other public places shall not be discharged into inter-allotment drainage lines.

Each lot served by an inter-allotment drainage line shall be provided with at least one grated inlet structure to permit the inlet of surface water. At the most suitable point in each lot, the inlet structure is to be brought to surface level with an exposed lid. From the wall of the pit a 150mm junction is to be left for the connection of roof water. The connection by the plumber of roof water to this point is to be supervised by Council's Building Inspector.

Inter-allotment drainage pits are to be in accordance with IPWEA guidelines.

3.14 Trunk Drainage Systems

The design engineer shall demonstrate that the requirement for trunk drainage within a proposed development has been considered. The design engineer shall consider the relationship of the proposed development with other developments within the catchment when considering trunk drainage requirements.

All trunk drainage systems are to be designed to a peak 100 year ARI storm, with a freeboard allowance of 25% of peak flows on top of calculated top water levels. Retardation or detention structures shall not be utilised in trunk drainage systems. Trunk drainage systems shall be designed as open channels as per Section 3.15. Modification of these values will depend on individual cases, e.g. freeboard may be increased or reduced where waterway area is such that the sensitivity of the floodway to changes in the flow parameters is indicative of a corresponding large or small change in flow depth and velocity.

An example of the recommended procedure for trunk drainage design is contained in *"Technical Note 10" of Book 8 of Australian Rainfall & Runoff.*

3.14.1 CALCULATIONS

Flows through a trunk drainage network shall be calculated using an appropriate runoff-routing model as detailed in *Section 1.6 of Book 8 of Australian Rainfall & Runoff.* Details of the model to be used are to be submitted to Council with the design documentation.

Where computer software is used for hydrological modelling, it shall be 'a recognised industry standard' software program. A comprehensive list of set-up parameters used to obtain results from the software is to be submitted along with the detailed design documentation and a copy of all electronic data/models used.

3.14.2 HYDRAULIC DESIGN

Open channels shall be designed using backwater calculations in the format as per **APPENDIX C.** A freeboard allowing flows up to 25% greater the peak 100 year ARI top water level is to be incorporated into the channel design. The product of Velocity x Depth should not exceed 1.0.

Recommended Manning's Roughness Co-Efficients "n" for Open Channels are given in Table K:

Surface Type	Recommended Value
Concrete Lining	0.013
Grass	0.035
Earth (Clear)	0.02

Part 3 - Table J – Mannings Values for Open Channels

3.15 Open Channel Design

3.15.1 GENERAL

Open channels include major system flowpaths and trunk drainage lines, and shall be designed in accordance with *Section 1.6.4 of Book 8 of Australian Rainfall & Runoff* and the following.

3.15.1.1 LOW-FLOW PIPES AND LINED INVERTS

Open channel drainage systems shall incorporate low-flow pipelines of a minimum size of 375mm diameter, sized using a flow of 3 litres/sec/hectare for residential land uses and 10 litres/sec/hectare for industrial land uses.

Alternatively, lined low-flow inverts shall accommodate flow equivalent to those of the low-flow pipelines, and shall be designed with a 1m wide, 150mm deep concrete dish drain in accordance with Standard Drawing 2361.

3.15.1.2 FLOW VELOCITIES

Maximum flow velocities in grass-lined channels shall be 2 m/s for a minimum 100 year ARI flow unless. Designs shall be based on sub-critical flow with a Froude Number no greater than 0.8.

3.15.1.3 SCOUR PROTECTIONS

Scour protection shall be designed at all inlet/outlet points of open channels, and at any point in the channel where there is a significant change in flow conditions or there is the potential for scouring. Details of proposed scour protections.

Adjacent piped systems should connect to the low flow piped system as a continuation of the side lines pipe diameter. The connection point should be a surcharge pit capable of surcharging the side lines total discharge. No surcharge points should occur in the channel batters higher than the 100 year ARI Top Water Level.

3.15.1.4 STABILISING

The floors of all open channels including the walls of batters 0.5m above floor level shall be designed with turf of an appropriate species. The remainder of internal and external batters of

open channels shall be provided with topsoil and seeded with appropriate grass species, or shall be designed with a geotextile material with a minimum life expectancy of two (2) years.

The details and specification for fixing of geotextile are to be submitted with the design documentation.

3.15.1.5 BATTER SLOPES AND LONGITUDINAL GRADES

Batter slopes of grassed open channels shall be a minimum of 1 in 5. The minimum crossfalls in channels should be 2% with a depressed channel invert as per Standard Drawing 2361 – Rural Dish Crossing the minimum longitudinal grade of open channels shall be 1.0% and the maximum longitudinal grade shall be such that the maximum flow velocity is not exceeded.

3.15.1.6 ROAD CROSSINGS

Where open channels are required to cross roads, they shall do so via culverts sized to match the flow conditions. Culverts shall be designed in accordance with culvert hydraulics theory. That is, the culvert capacity is determined by the flow conditions, depending on whether inlet control or outlet control governs.

Recommended design procedures are contained in *Section 3 of the Concrete Pipe Association of Australia's publication: "Hydraulics of Precast Concrete Conduits Hydraulic Design Manual".* The preferred format for culvert design calculations is provided in **APPENDIX C** and shall be submitted in MS Excel format along with the design documentation.

3.15.1.7 CURVATURE

The centerline curves of open channels shall have a radius not less than twice the minimum width at the top of 100 years flow with a minimum of 30 metres.

3.16 Stormwater Detention or Retention in Subdivisions and Developments

3.16.1 DEFINITIONS

- *Stormwater Detention* is defined as the process of temporarily holding and/or controlled release of stormwater through the use of a hydraulic storage system;
- *Stormwater Retention is defined as the reduction in flow volume by long-term storage or discharge to an alternative outlet such as evaporation or infiltration;*

In subdivisions or developments larger than single allotments, stormwater detention or retention typically involves the construction of detention/retention basins to retard flows and control outfall.

In smaller developments, stormwater retention or detention typically involves the design of on-site detention structures and systems.

3.16.2 GENERAL DESIGN REQUIREMENTS AND CONSIDERATIONS

Stormwater detention or retention is to be considered where post-developed flows discharging from the development exceed the pre-developed flows, or where the capacity of the existing downstream stormwater drainage system will be exceeded by the addition of any flows from the proposed development.

Stormwater detention or retention is only to be considered as a preferred design option where it can be demonstrated that there are no other practical solutions to capture and control stormwater flows, or where there is a demonstrated environmental benefit with their use. The Design Engineer shall provide details of all other design strategies explored prior to the selection of stormwater detention or retention as the preferred design option.

Where it is intended to utilise stormwater retention/detention structures, details of such shall be included in the Stormwater Servicing Strategy, including details of the requirements for a suitable stormwater retention/detention system and details that demonstrate that the system can be integrated into the development and the surrounding environment. Where retention structures are proposed, the Servicing Strategy shall include a water usage plan, details of any top-up water supplies, and capacity modelling data.

Detailed design and documentation of retention/detention systems are to be prepared by the Design Engineer. A detailed hydrological and hydraulic analysis is required for all detention/retention systems and shall be submitted in MS Excel Format along with the detailed design documentation.

Where computer software is used for hydrological modelling, it shall be 'a recognised industry standard' software program. A comprehensive list of set-up parameters used to obtain results from the software is to be submitted along with the detailed design documentation and any other electronic data/models used.

Land that has been identified for stormwater retention/detention basins to be maintained by Council, whether existing or proposed, must be shown on a Plan of Subdivision as a Drainage Reserve and vested to the Council as operational land.

In circumstances where detention basins are not to be maintained by Council and are located within land that is common property, a covenant as per Section 88B of the Conveyancing Act 1919 (as amended) shall be placed on each benefiting allotment to ensure the performance of the structure is not compromised by any act, or failure to act, by the body corporate.

Detention basins should be designed to drain completely and shall be constructed so that the area can be used for passive recreation or active recreation or other uses such as carparks as determined by Council.

Retention/detention basin areas shall not be used in calculations for public open space requirements.

When a retention/detention basin is required for any development, the basin and any overland flow paths shall be constructed as part of stage one works. Where it can be demonstrated to Council that a retention/detention basin is not required as part of the first stage works; plans, computations, and relevant approvals must be provided to confirm the alternate method of outfall and/or storage capacity provisions.

3.16.3 STORMWATER RETENTION/DETENTION IN LARGE SUBDIVISIONS AND DEVELOPMENTS

3.16.3.1 OBJECTIVES

The objectives to be achieved through the design of stormwater retention/detention are as follows:

- To protect property and infrastructure from flooding occurring from a nominated rainfall event by the provision of retention/detention basins;
- To limit, as much as possible, the number of retention/detention basins servicing an area to reduce Council's future maintenance expenditure;
- To protect Council's existing stormwater drainage assets from exceeding their design capacity and overloading as a result of new developments which increase the amount of stormwater runoff being generated from a particular property.
- To protect the public from risk of injury or death;
- To standardise the type and operation of structures, basins and outfalls associated with retention/detention; and
- To design aesthetically pleasing drainage structures having regard to the area that they will be located in.

3.16.3.2 RISK ANALYSIS

A risk assessment report is to be prepared by the Design Engineer for all retention/detention systems to assess the likelihood and consequence of structural failure of the system. The risk assessment should be undertaken in accordance with the principles detailed in *Australian Standard AS4360-2004.*

The Design Engineer shall be responsible for deciding on the action required in response to the risk assessment report and its recommendations, however consultation with Council is encouraged

if recommendations are complicated, require community involvement, or have significant ongoing maintenance issues. All major detention/retention basins which may be considered to cause risk of life if failure occurs shall be submitted to the Dam Safety Committee (DSC) prior to the lodgement of the DA by the Design Engineer and the resulting notifications from the DSC shall be included with the Development Application.

A copy of the risk assessment report, with recommendations and associated works, shall be provided to Council with the detailed design documentation.

3.16.3.3 LOCATION

Retention/detention basins shall not be located in areas zoned Flood Liable Land.

Retention/detention basins shall not be located "on-stream" in the flow path of natural drainage courses or designated overland flow paths. Basins shall not be placed over natural water bodies and shall not create ponding.

The location of retention/detention basins shall have regard to:

- The physical dimensions required for storage volume including the flattest possible batters, access to the basin bed, and maintenance of batters and edges;
- Pre-developed catchments;
- Existing developed catchments;
- Existing drainage including piped, swale drains, or flow paths;
- Existing and proposed drainage easements;
- Ground water depth and seasonal fluctuations;
- Subsoil characteristics;
- Location and point of discharge;
- Soil type and seepage rate;
- Land uses and zoning;
- Effect of overland flows external to the catchment;
- Potential risk or affect on people, fauna and flora;
- Amenity of the area;
- Benefiting landholder issues;
- Provision of a suitable discharge method by gravity only:
- Maintenance issues and all weather access;
- Water quality;
- The location of overland flows into the basin and the treatment(s) to minimise erosion;
- Inlet velocity and the need to install energy dissipation structures; and
- Flood level information or historical flood data.

Approval of the proposed location of any retention/detentions structures will only be subject to Council being satisfied that each of the above criteria has been satisfactorily addressed.

3.16.3.4 DESIGN CRITERIA

All retention/detention structures are to be designed utilising;

- Hydrographs produced by an acceptable method of unit graph theory or mathematical modelling; and
- Flood routing through the structure.

Retention/detention structures shall be designed to maintain the existing undeveloped discharges for the range of storm durations and frequencies from 1 year ARI events up to and including 100 year ARI events.

The methods described in Section 3.7.4 of these guidelines may be used to calculate peak flows.

Retention/detention structures with downstream established areas and no clear and safe overland flow paths shall be designed for the peak 100 year ARI storm with consideration given to a rarer storm event.

The peak storm duration with retention/detention structures is likely to be longer than without them. A graph showing the range of peak flood levels in the structure and peak discharges from the structure are to be provided for all storm events examined. Consideration must be given to areas downstream to ensure that changes in timing of peak flows at the confluence of downstream reaches is not adversely impacted by construction of the structure.

A sensitivity analysis must be undertaken for a range variables (catchment roughness, link lags etc) to determine how sensitive the design is to minor changes in these variables.

Rainwater tanks either installed or intended to be installed as part of the development shall not be used in retention/detention basin design calculations. The volume of storage in pits and pipes in the minor system is also to be ignored.

3.16.3.5 FREEBOARD

Minimum freeboard shall be 500mm for earth structures and 300mm for concrete structures. Council will require a minimum freeboard to top basin water level (following a 1 in 100 year ARI peak storm, no outfall condition) equal to the lowest kerb inlet level in the catchment area. This is subject to the following:

- The top water level in the structure resulting from the minor storm event shall be no higher than the invert of the lowest inlet pipe to the basin; and
- The overland flow path for a major storm shall be designed such that the minor system contribution to flow is ignored, i.e. inlet pipe is blocked.

3.16.3.6 OVERFLOW SYSTEMS

Spillway design must be of sufficient capacity to safely convey a minimum 100 year ARI peak flow without failure of the embankment. Spillway structures are to be designed as a concrete lip with erosion protection measures. Scour protection of the spillway embankment is to be provided in accordance with the predicted velocities.

Spillway calculations shall include a blocking factor of the outlet structure of 50%.

All overflows are to be directed away from buildings, adjoining properties and associated infrastructure. The depth of overland flow shall be designed so that it is no higher than 300mm below the lowest floor level of any dwelling impacted by the overflow.

Overflow flow paths must be shown as major system flow paths on the detailed design drawings.

3.16.3.7 RETENTION/DETENTION STRUCTURE DEPTH

The depth of excavations for retention/detention structures shall be limited such that loss or infiltration to the demonstrated water table level will not occur.

The maximum depth of retention/detention systems shall be such that they are not required to meet the requirements described by ANCOLD.

Retention/detention structures may require an impervious lining or other treatment to prevent the ingress of groundwater. Groundwater may not be able to be extracted and used.

Any structure that penetrates the demonstrated groundwater zone such as footings and drainage shall be appropriately treated to prevent possible damage caused by contact with ground water.

The depth of all retention/detention structures for which the public have access to will be determined having regard to the safety of persons who may fall into or enter the structure during times of operation.

3.16.3.8 BATTER SLOPES IN EARTHEN BASINS

Maximum batters for retention/detention basins shall be 1 in 6 for both cut and fill situations.

Minimum crossfall for floors is to be 1.0% graded to the outlet point of the structure.

3.16.3.9 GEOTECHNICAL PROPERTIES

Due consideration must be given to the geotechnical aspects of retention/detention structure design, and a full Geotechnical report prepared by a suitably qualified and experienced Geotechnical Engineer is to be submitted with the detailed design documentation.

3.16.3.10 INLET STRUCTURES

Any inlet pipe to a basin shall be fitted with a headwall and an approved structure that will allow debris escape whilst impeding the entry of persons.

All inlet headwalls shall be fitted with an approved post and rail barrier to prevent falls and to identify the location of headwalls and wingwalls.

3.16.3.11 OUTLET STRUCTURES

Culvert outlets from retention/detention structures are to be rubber ring jointed with no lifting holes. Cut-off walls and seepage collars are to be provided as necessary. Pipe and culvert bedding are to be specified to minimise permeability.

Outlet structures must take into account upstream catchment land uses in consideration of potential blocking. Outlets must be designed with debris and scour control devices and energy dissipation structures.

3.16.3.12 ACCESS REQUIREMENTS

All weather access is to be provided to the retention/detention basin and any associated structures to enable maintenance to be carried out. The access should be provided in such a manner that there is no need to reverse a maintenance vehicle at any time. The access should be provided so that maintenance of any portion of the basin and its associated works can be safely carried out. A 3.0 metre width reserve shall be required around the perimeter of all retention/detention basins.

3.16.3.13 FENCING AND SECURITY

Retention basins shall generally be fenced off and made safe against casual entrance. Where batter slopes of detention basins are steeper than the current standard for publicly accessible areas, they shall also be fenced to prevent casual entrance.

3.16.3.14 LANDSCAPING

The floors of all retention/detentions structures and walls of batters 0.5m above floor level shall be appropriately stabilised to prevent erosion and scoring of the drain (in both the short and long term). The remainder of internal and external batters of retardation/detention structures shall be provided with topsoil and seeded with appropriate grass species.

Fully detailed landscape plans for all retention/detention basins shall be submitted as part of the landscaping plan required in Part 6 – Landscaping of these Guidelines.

3.16.3.15 SIGNAGE

Approved signage shall be provided at all retention/detention basins indicating the depth of water and slope of batters. Signs are to be erected such that two signs and depth indicators are visible from any one point at any time.

3.16.3.16 MAINTENANCE

Access covers and grates are to be designed so as to enable access for maintenance and cleaning. Any large pipe inlets into the basin shall be grated in a satisfactory manner to prevent

entry to the stormwater drain. The grates shall be designed so that they can easily be maintained and so that they will not cause blockages during storm events.

Pits, pipes, screens etc that require regular cleaning and maintenance shall be readily accessible with all openings of suitable geometry to allow for cleaning and removal of debris and silt accumulations.

3.16.4 ON-SITE DETENTION SYSTEMS IN SMALL DEVELOPMENTS

3.16.4.1 OBJECTIVES

The objectives of small on-site detention (OSD) systems are as follows:

- The capacity of existing drainage infrastructure shall not be exceeded as a result of developments which increase the volume and rate of stormwater runoff beyond the capacities originally designed for;
- The likely cumulative impact of similar developments shall not adversely impact on the capacity of the existing drainage system;
- That OSD systems are able to be effectively maintained by landowners and provide a cost-effective method of meeting the other requirements of this section;
- Provide a simplified method for designers, builders and owners to determine Council's requirements for on-site detention in relation to volume of detention and permissible rate of discharge to Council's drainage system; and
- That OSD system's meet necessary OH&S guidelines.

3.16.4.2 GENERAL

On-site detention systems may be required in the following types of development:

- Any development on an existing lot where post-developed flows exceed existing flows;
- Any development where the capacity of the drainage network downstream of the development will be exceeded by post-developed flows from the development;
- Any development where generated stormwater flows could adversely impact on private property irrespective of the capacity of the downstream drainage network; and
- Any areas identified by Council as drainage problem areas.

Where an OSD system is required for a development, the entire development area is to be considered in OSD calculations. No stormwater runoff is to by-pass the OSD system. Rainwater tanks shall not be included in detention volume calculations.

3.16.4.3 DESIGN CRITERIA

OSD systems shall be designed to maintain the existing undeveloped discharges for all storm durations and frequencies in the range from the 5 year ARI up to and including the 100 year ARI events.

The methods described in Section 3.7.4 of these guidelines may be used to calculate peak flows.

The design documentation must clearly describe the proposed storage system and location. The developer shall provide computations in MS Excel Format that demonstrate the volume of detention required and the permissible rate of discharge.

3.16.4.4 OVERFLOW

A suitable overflow system must be provided to cater for storm events greater than the design storm and to cater for a blockage in the system. All overflows are to be directed away from buildings, adjoining properties and associated infrastructure and must drain to the legal point of discharge. The overflow system shall be designed to cater for all storms up to and including a 100 year ARI storm event.

The depth of overland flow shall be designed so that it is no higher than 300mm below the lowest floor level of any dwelling impacted by the overflow.

3.16.4.5 DISCHARGE CONTROL POINT

Orifice plates shall be designed to be corrosion resistant stainless steel. The outlet is to be protected by a screening device to avoid blocking.

3.16.4.6 SIGNAGE

Each OSD system is to be marked by a plate in a prominent position which identifies the OSD system and that it is an offence to reduce the volume of the structure or interfere with the orifice plate that controls the outflow.

3.16.4.7 UNDERGROUND (OSD) AND ACCESS REQUIREMENTS

All underground storage tanks shall have suitable access for maintenance and comply with the Occupational Health and Safety Act 2000 and Confined Spaces requirements.

All underground storage tanks shall comply with the Public Health Act 1991.

Access to underground storage tanks must be secured with a grate or cover and fastened to prevent unauthorised access. Access points are not to be concreted, paved, built over or otherwise obstructed.

Access openings must be a minimum:

- 600 mm by 600 mm for storages up to 600 mm deep; or
- 900 mm by 900 mm for storages greater than 600 mm deep.

The floor of underground storages must be graded so that the storage empties and water does not pool in the tank.

Underground storage tanks may face corrosion and acidic attack. The storage tank type must be resistant to the environment in which it is placed. This applies to both above and below ground installation.

Underground storage tanks must not be installed over or within 1.0m of a water main, sewer main, on-site wastewater system or on-site wastewater disposal field.

Underground storage tanks should not be installed within 1.0m of the drip line of trees. A root barrier shall be installed if underground storage tanks are located adjacent to trees.

Where OSD facilities are located under driveways and parking areas, consideration must be given to the finished surface levels and vehicular access requirements.

OSD storage shall not be installed into the groundwater zone unless detailed computations are provided and approved by council.

3.16.4.8 ABOVE GROUND OSD SYSTEMS:

Above ground OSD may comprise of one or a combination of the following:

- Driveways and carpark areas;
- Tanks of varying configurations;
- Excavated earthen storages; or
- Grassed or landscaped areas.

3.16.4.9 PAVED SURFACES

- Water ponding depth is to be limited to a depth of 150 mm in areas where vehicles are parked and 180 mm in areas where vehicles are not parked;
- The storage area shall be totally impermeable;

- Where the surface may be used for traffic or pedestrian movements, flows from minor events up to the peak 5 year ARI event are to be stored underground.

3.16.4.10 LANDSCAPED AREAS

- OSD systems shall not extend across lot boundaries;
- OSD shall meet the following requirements:
    - Water depth shall be no deeper than 1200 mm;
    - Water depth greater than 500 mm shall be fenced with child-proof fencing;
    - A maximum batter slope of 1 in 6 or alternatively a terraced slope system so that the maximum terraced depth is no greater than 300 mm; and
    - Council may consider alternative designs to the above requirements, however public safety shall be addressed and child-proof fencing may be required.
- The floor of the OSD area is to be permeable to allow infiltration and should not pond water;
- The bunded wall of the OSD area must be impervious; and
- Where vegetated, the storage capacity shall be increased by 20% to allow for vegetation growth.

3.16.4.11 MAINTENANCE OF ON-SITE DETENTION SYSTEMS

Where an OSD system is required the landowner shall be required to maintain these to the satisfaction of Council. A plan of required maintenance procedures and practices for OSD systems shall be supplied with the design documentation.

3.17 APPENDIX A – Information to be shown on drawings – Stormwater Drainage

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
1	**General**			
1a	Cover Sheet with Locality Plan and List of Drawings			
1b	Plans prepared in A1 format at a scale of 1:500			
1c	Drawing Scale is shown on drawings as a bar scale			
1d	Scale of Detail Drawings is shown as appropriate			
1e	Schedule of Symbols			
1f	Benchmark within 100 metres of development site is shown			
1g	North Point shown			
1h	Site topography is shown via contour lines			
2	**Drainage Layout Plans**			
2a	Catchment area plan including sub-catchments and areas is submitted			
2b	Existing services and drainage structures are shown			
2c	Lot boundaries and numbers shown			
2d	Pipeline or table drains are numbered			
2e	Pipeline or table drain centreline chainages are shown			
2f	Pipeline diameters or table drain cross-sections are shown			
2g	Kerb or table drain profiles are clearly nominated			
2h	Location of pits shown			
2i	Type and size of pits clearly indicated			
2j	Location and dimensions of any proposed easements or drainage reserves is shown			
2k	Location of major system overland flow path shown			
2l	Natural drainage paths are shown			
2m	Location of natural watercourse to be drained to is identified			
2n	Location of any retention, detention or water quality devices is shown			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
3	**Drainage Longitudinal Sections**			
3a	Longitudinal sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
3b	Longitudinal section shows the following;			
3c	Chainages			
3d	RL of existing surface at each inlet structure, outlet structure, pit and/or change of grade			
3e	Design RL of all inlet and outlet structures; pit, pipe and table drain inverts, pit inlets and all changes of grade			
3f	Design grades including length of each gradient			
3g	Pipe diameters and classes and/or table drain capacities is shown.			
3h	Hydraulic Grade Line Analysis results as per AR&R			
3i	Location of existing and proposed services and utilities			
4	**Drainage Cross-Sections**			
4a	Cross-sections are drawn at scale of 1:100 natural			
4b	Cross sections show the following at no more than 20 metre intervals and at all intermediate changes of grade or profile;			
4c	Chainages			
4d	RL of existing surface			
4e	Design RL of table drain invert and top of batters			
4f	Batter slopes of table drains are shown			
4g	Section profiles of all open channels is shown			
4h	Batter slopes, depth and typical section of any retention/detention structures is shown			
4i	Details of low-flow pipes and/or lined inverts is shown			
4k	Details of Sub-Soil Drainage (if required)			
4l	Sections of pits including details of access covers and access provisions is shown			
5	**Miscellaneous**			
5a	Location and details of any Water Quality devices is shown			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
5b	Location and details of any batter catch-drains			
5c 5d	Details of the type of vegetation to be used on batters Scour protection to all outlet structures is shown			
5e	DSC recommendations sought and included.			

3.18 APPENDIX B – Checklists - Stormwater Drainage

Item No.	Description	Reference	Developer Confirmation	GSC Confirmation	Comments
1	Stormwater Servicing Strategy	3.5.2			
2	Hydrological Modelling, including details of start-up parameters used in computer modelling	3.7.1			
3	Hydrological Design Sheets used for sub-area discharge calculations	3.7.4			
4	Hydraulic Design Sheet used for calculating Major System flows	3.8			
5	Hydraulic Design Sheet used for pipeline design and HGL analysis	3.9.3			
6	Culvert Design Calculations	3.9.3.7			
7	Details of modelling or calculations used for Trunk Drainage System Design	3.14			
8	Details of geofabric used for slope stabilisation	3.15.1.4			
9	Hydrological/hydraulic assessment and design of retention/detention structures	3.16.3			
10	Risk Analysis for retention/detention structures	3.16.3.2			
11	Geotechnical Report for proposed retention/detention structures	3.16.3.9			
12	Landscape plan for retention/detention structures	3.16.3.14			
13	Details of proposed OSD systems	3.16.4			
14	Hydrological/hydraulic assessment and design of OSD systems	3.16.4.3			
15	Maintenance Plan for OSD systems	3.16.4.11			

APPENDIX C – Hydrological Design Sheet – Stormwater Drainage

Hydrological Design Sheet 2										
Project ID:								Prepared By:		
Reference:								Date:		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Pipe	Full - Area				Partial - Area				Adopted Flow-Rate (Litres/sec) Greater of [5] & [9])	Remarks
	Time (T_c) (mins)	Intensity (I) (mm/hour)	∑C*A (ha)	Q=CIA/0.36 [(3)x(4)/0.36] (litres/sec)	Time (T_c) (mins)	Intensity (I) (mm/hour)	∑C*A (ha)	Q=CIA/0.36 [(7)x(8)/0.36] (litres/sec)		

Hydrological Design Sheet 3

Project ID:		Prepared By:	
Reference:		Date:	

(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)		(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
		Flow Times																	
Location	Land Use Type	Flow Length (m)	Slope (S) (m/m)	n*	$L^{0.4}$	Time (T) (mins)	Total Time (min)	Intensity (I) (mm/hour)	Runoff Co-efficient (C)	Area (A) (ha)	Area (A) (km²)	CA (ha) [(9)x(10)]	∑ CA (ha)	Q=CIA/0.36 [(8)x(12)/0.36]	Cumulative Pit Capacities (l/sec)	Downstream Pipe Capacity (l/sec)	Road Flow rate; [13] lesser of [14] & [15] (l/sec)	Road Capacity Check	Remarks

Hydraulic Design Sheet

Project ID:		Prepared By:	
Reference:		Date:	

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
																Upstream Invert Levels (m AHD)				Downstream Inverts (m AHD)			
Pipe	Length (L) (m)	Design Flow Rate (Q) (l/sec)	Trial Pipe Diameter (m)	Full Pipe Velocity (V) (m/sec)	$V^2/2g$ (m)	U/S Surface Level (m AHD)	U/S Pit Water Level Limit* (m)	Pit Pressure Change Co-efficient k_u or k_w	$k_u \cdot V^2/2g$ (m) [6] x [9]	HGL at U/S Pit (m) [8] - [10]	HGL Slope S_f (m/m)	Pipe Friction Loss $S_f \cdot L$ [12] x [2]	HGL at D/S Pit (m) [11] - [13]	D/S Pit Surface Level (m AHD)	D/S Pit Water Level Limit* (m)	Hydraulic [11] - [4]	Cover [7] - Cover	U/S Pipe [23] - drop	Adopted Lowest of [17], [18] & [19]	Hydraulic [14] - [4]	Cover [7] - Cover	Adopted Lowest of [21] & [22]	Remarks

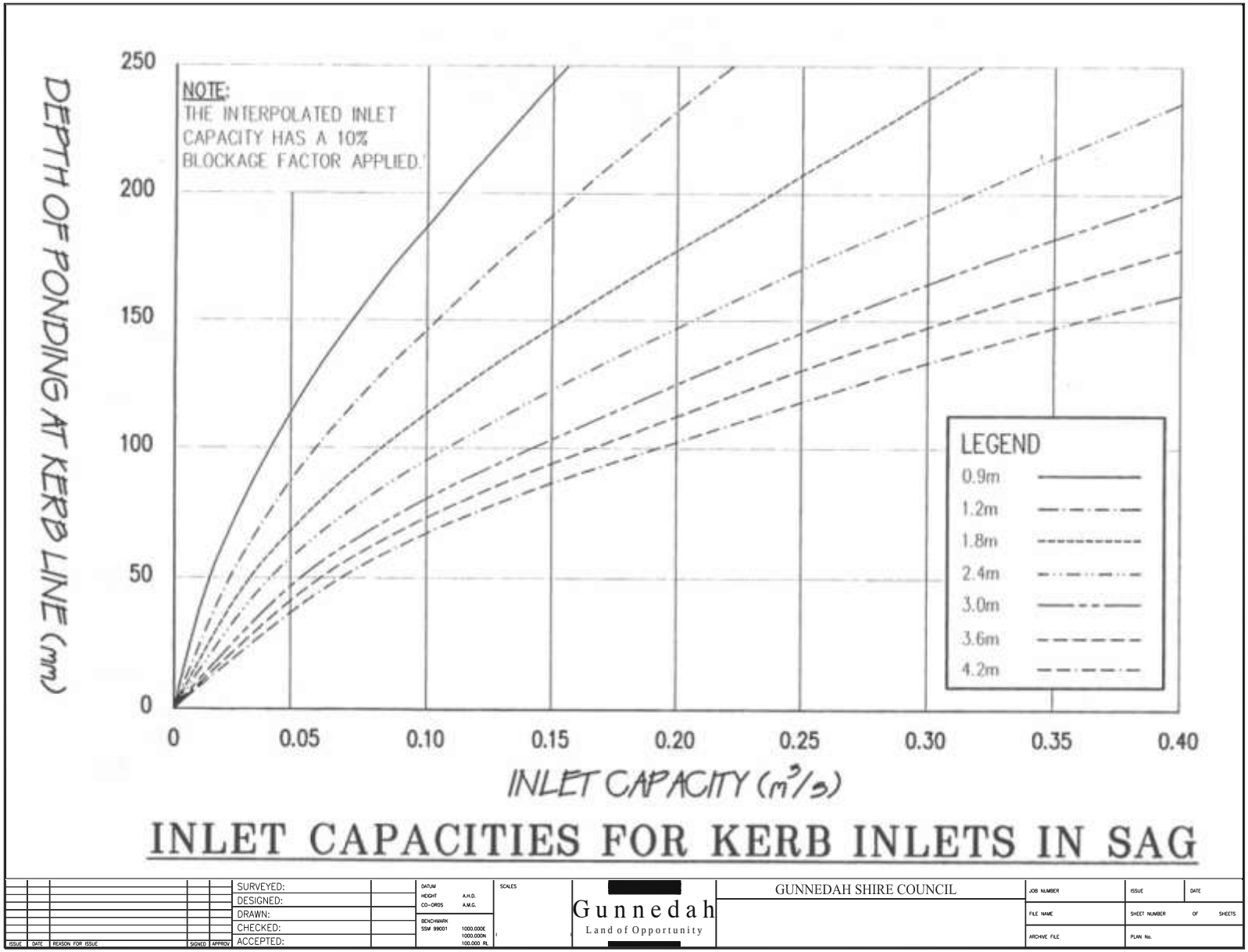
Hydraulic Checking Sheet

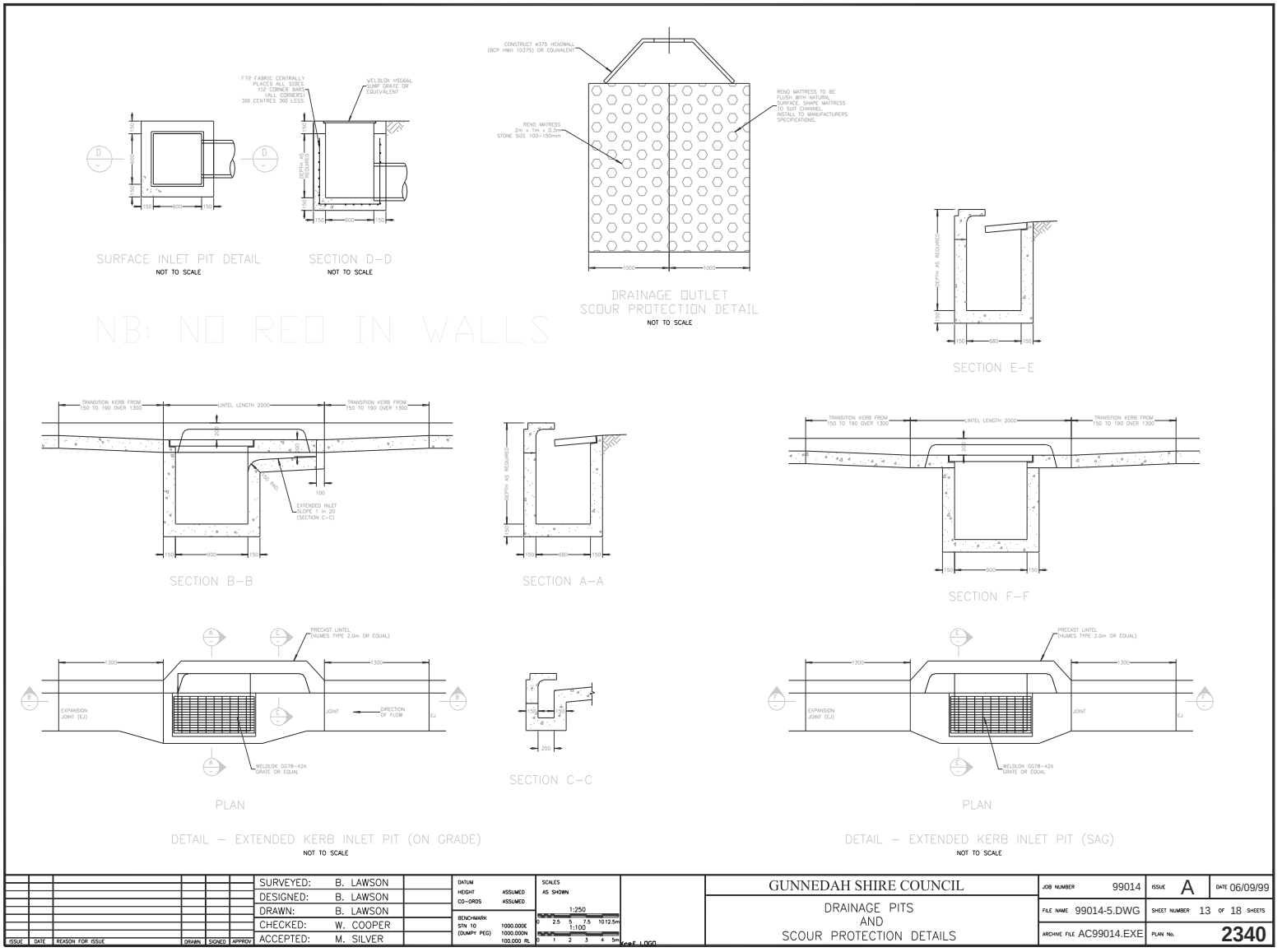
Project ID:								Prepared By:					
Reference:								Date:					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Pipe	Length (L) (m)	Design Flow Rate (Q) (l/sec)	Pipe Diameter (m)	Full Pipe Velocity (V) (m/sec)	$V^2/2g$ (m)	D/S HGL Level (m AHD)	Pipe Friction Loss $S_f . L$ (m)	HGL just below U/S Pit (m) [7] + [8]	Obvert Level at Upper End of Pipe (m)	Pit Pressure Change Co-efficient k_u or k_w	$k . V^2/2g$ (m) [11] x [6]	Adopted U/S Pit HGL (or water) Level* (m)	U/S Surface Level (m AHD)

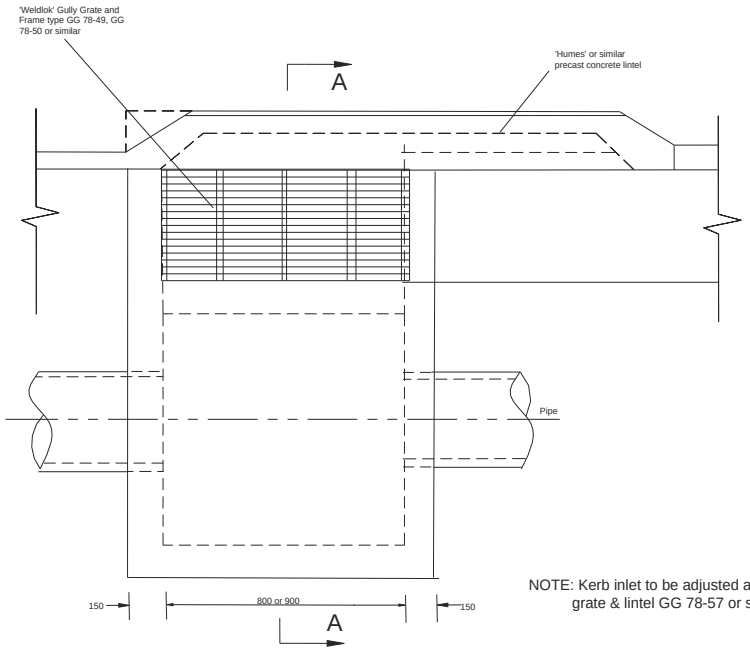
3.19 DRAWINGS – Stormwater Drainage

Inlet Capacity Chart - Kerb Inlet in Sag

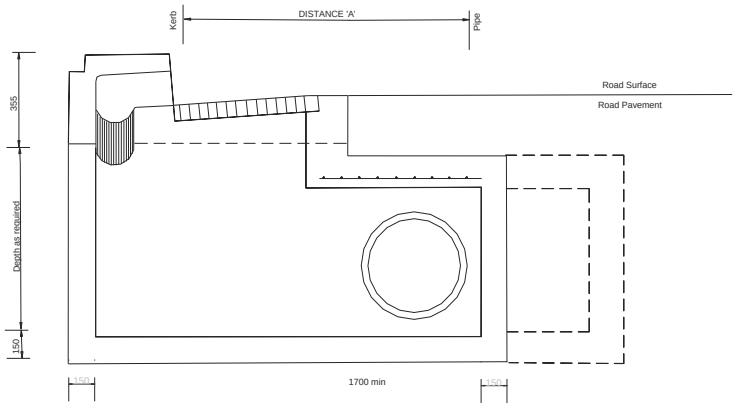
Kerb Inlet Pit Standard	**2340**
Kerb Inlet Pit – Pipe under Carriageway	**2340C**
Angle Pit	**2340a**
Junction Pit	**2340b**
Concrete Bulkheads	**2340D**
Excavation, Bedding and Backfilling of Stormwater Pipes	**D-0030**


DEPTH OF PONDING AT KERB LINE (mm)
250
200
150
100
50
0
NOTE:
THE INTERPOLATED INLET CAPACITY HAS A 10% BLOCKAGE FACTOR APPLIED.
LEGEND
0.9m
1.2m
1.8m
2.4m
3.0m
3.6m
4.2m
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
INLET CAPACITY (m³/s)
INLET CAPACITIES FOR KERB INLETS IN SAG
SURVEYED:
DESIGNED:
DRAWN:
CHECKED:
ACCEPTED:
ISSUE
DATE
REASON FOR ISSUE
SIGNED
APPROV
DATUM
HEIGHT A.H.D.
CO-ORDS A.M.G.
BENCHMARK
SSM 99001 1000.000E 1000.000N 100.000 RL
SCALES
Gunnedah
Land of Opportunity
GUNNEDAH SHIRE COUNCIL
JOB NUMBER
ISSUE
DATE
FILE NAME
SHEET NUMBER
OF
SHEETS
ARCHIVE FILE
PLAN No.


SURFACE INLET PIT DETAIL
NOT TO SCALE
SECTION D–D
NOT TO SCALE
DRAINAGE OUTLET
SCOUR PROTECTION DETAIL
NOT TO SCALE
NB: NO REO IN WALLS
SECTION E–E
SECTION B–B
SECTION A–A
SECTION F–F
SECTION C–C
PLAN
DETAIL – EXTENDED KERB INLET PIT (ON GRADE)
NOT TO SCALE
PLAN
DETAIL – EXTENDED KERB INLET PIT (SAG)
NOT TO SCALE
SURVEYED: B. LAWSON
DESIGNED: B. LAWSON
DRAWN: B. LAWSON
CHECKED: W. COOPER
ACCEPTED: M. SILVER
GUNNEDAH SHIRE COUNCIL
DRAINAGE PITS
AND
SCOUR PROTECTION DETAILS
JOB NUMBER 99014
ISSUE A
DATE 06/09/99
FILE NAME 99014-5.DWG
SHEET NUMBER 13 OF 18 SHEETS
ARCHIVE FILE AC99014.EXE
PLAN No. 2340



PLAN



SECTION A-A

NOTE: Kerb inlet to be adjusted as required to suit 'Wedlok' grate & lintel GG 78-57 or similar

PIPE OFFSETS FROM KERB			
PIPE ø	DISTANCE 'A'	PIPE ø	DISTANCE 'A'
375	1100	750	1250
450	1100	825	1250
525	1100	900	1250
600	1100	1050	1450
675	1250	1200	1450

Note: For pipes greater than 600mmø extend box width in increments of 150mm to suit pipe sizes

GENERAL NOTES
Concrete 20MPa
Step irons to be provided at 300c/c in pits deeper than 1200mm

ISSUE	DATE	REASON FOR ISSUE	SIGNED	APPROV

SURVEYED:
DESIGNED:
DRAWN:
CHECKED:
ACCEPTED:

DATUM
HEIGHT A.H.D.
CO-ORDS A.M.G.
BENCHMARK
SSM 99001 1000.000E 1000.000N 100.000 RL

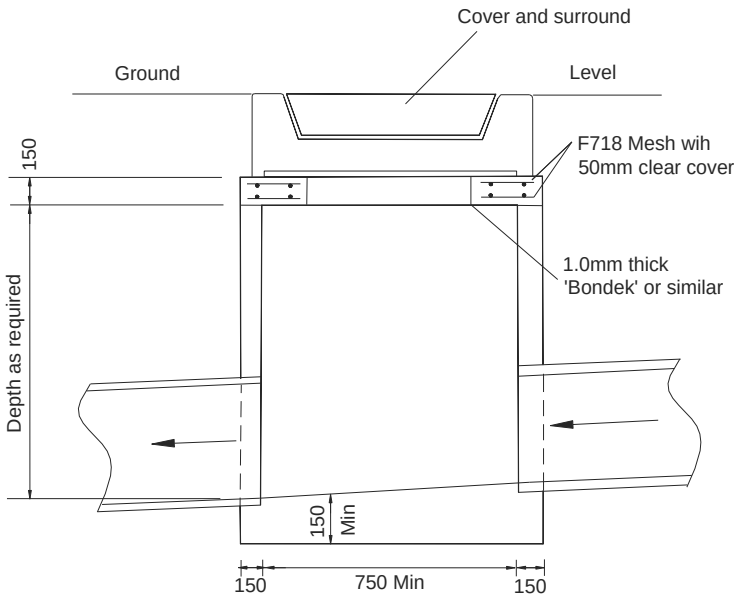
SCALES

Gunnedah
Land of Opportunity

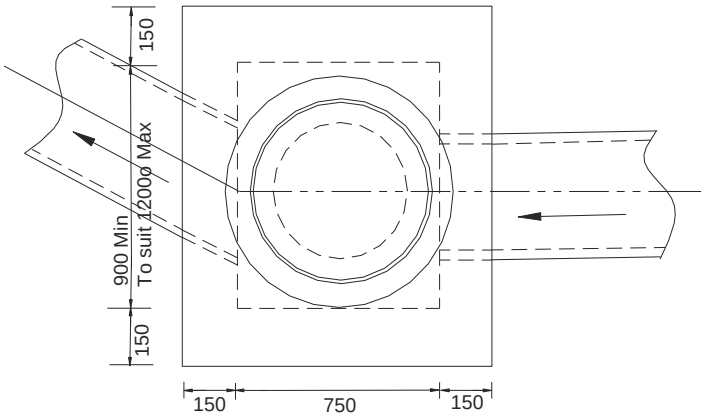
GUNNEDAH SHIRE COUNCIL

Kerb Inlet Pit - Pipe under Carriageway

JOB NUMBER	ISSUE	DATE
FILE NAME	SHEET NUMBER	OF SHEETS
ARCHIVE FILE	PLAN No. 2340C	



SECTIONAL ELEVATION

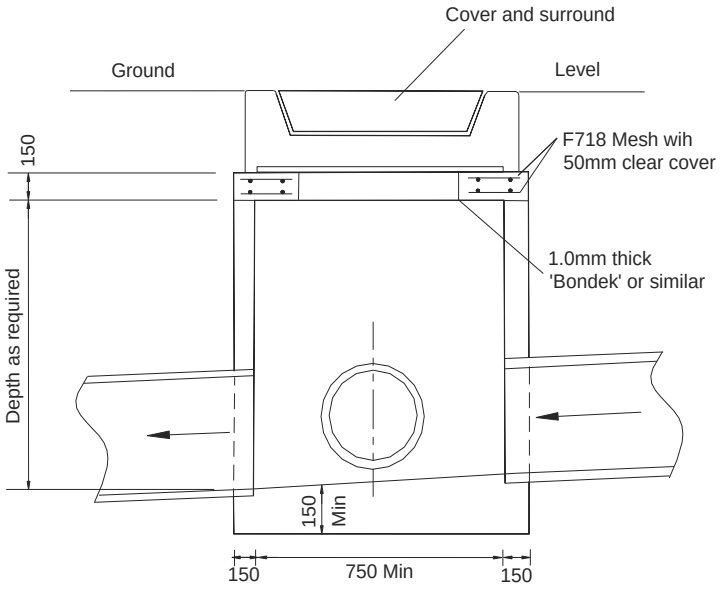


PLAN

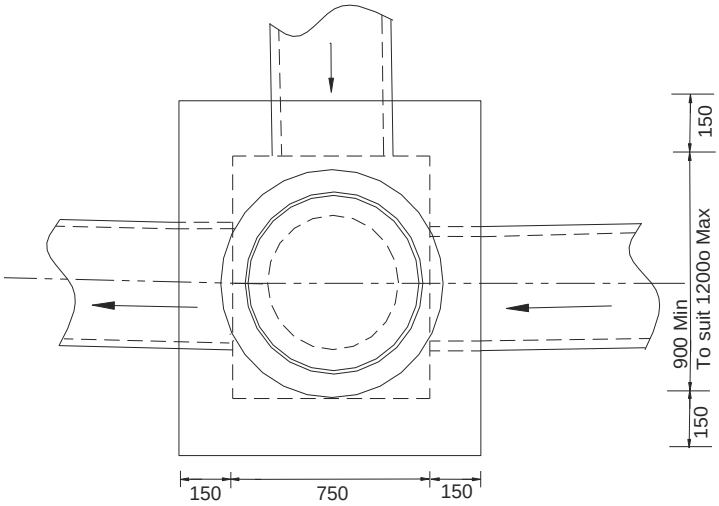
GENERAL NOTES:

Step irons to be provided at 300c/c in pits deeper than 1200MPa
Concrete 20MPa

Gunnedah Land of Opportunity	GUNNEDAH SHIRE COUNCIL	JOB NUMBER	ISSUE	DATE
	ANGLE PIT	FILE NAME	SHEET NUMBER	OF SHEETS
		ARCHIVE FILE	PLAN No. 2340a	



SECTIONAL ELEVATION

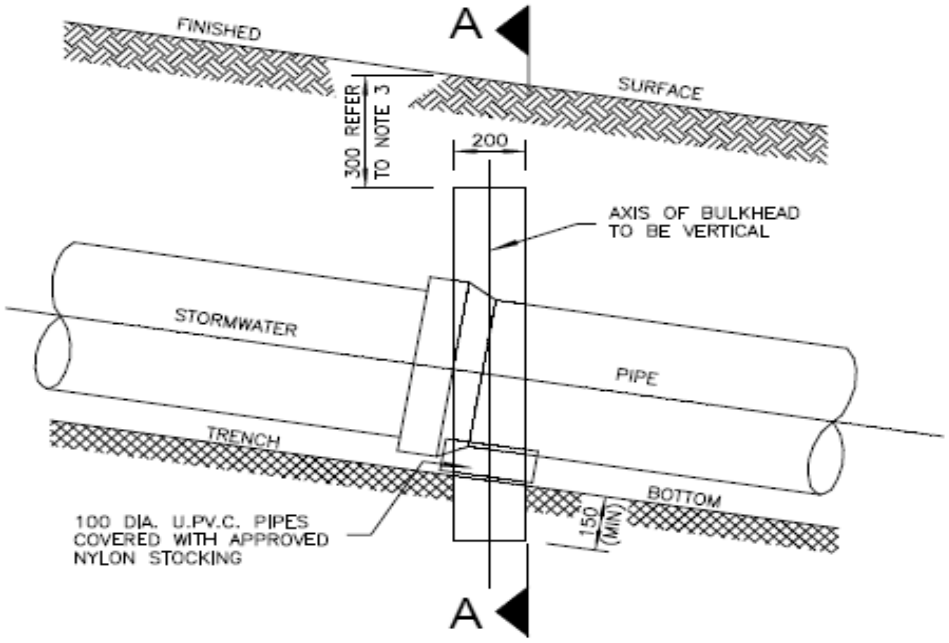


PLAN

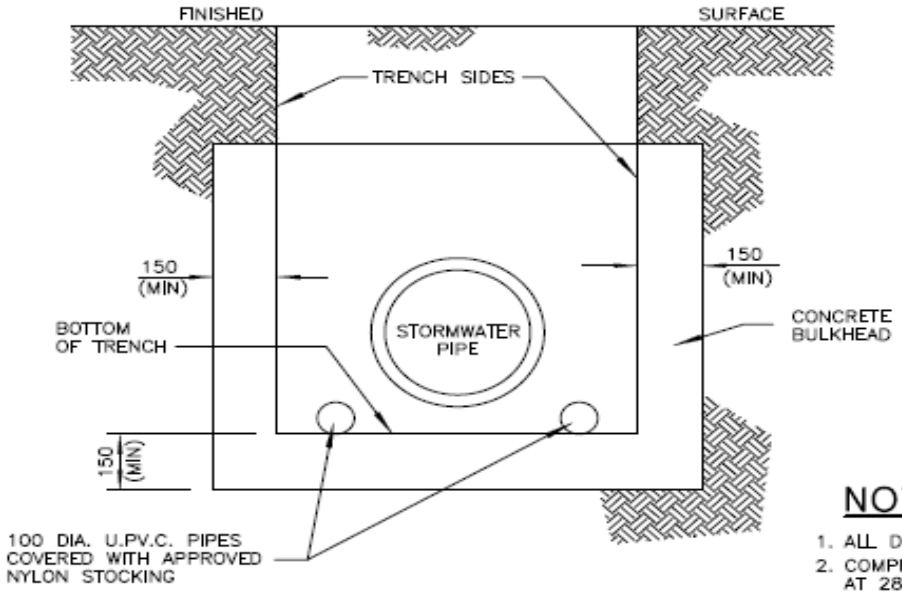
GENERAL NOTES:

Step irons to be provided at 300c/c in pits deeper than 1200MPa
Concrete 20MPa

Gunnedah Land of Opportunity	GUNNEDAH SHIRE COUNCIL	JOB NUMBER	ISSUE	DATE
	JUNCTION PIT	FILE NAME	SHEET NUMBER OF SHEETS	
		ARCHIVE FILE	PLAN No. 2340b	



ELEVATION

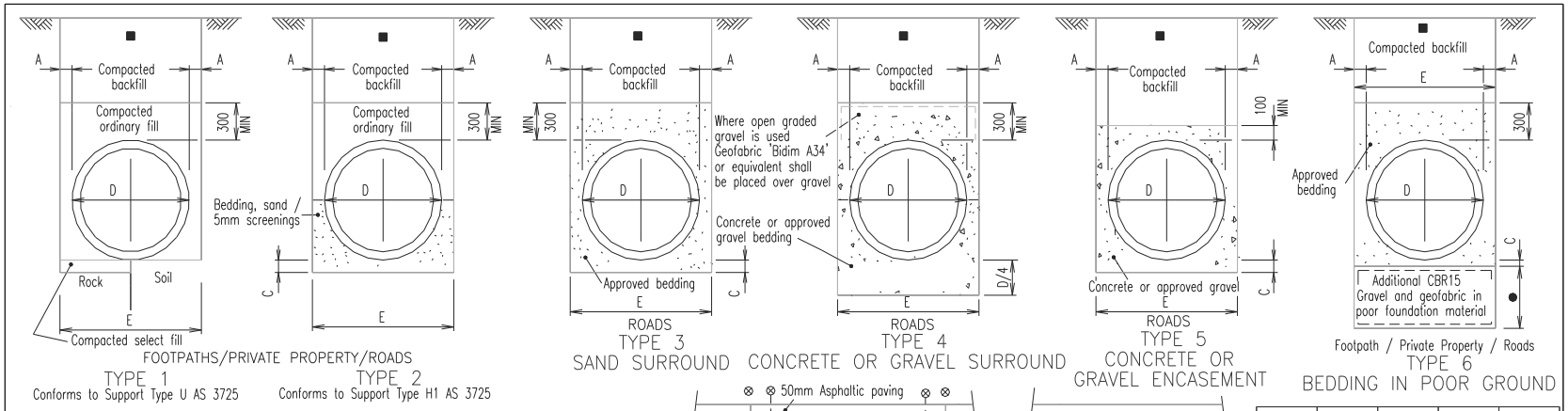


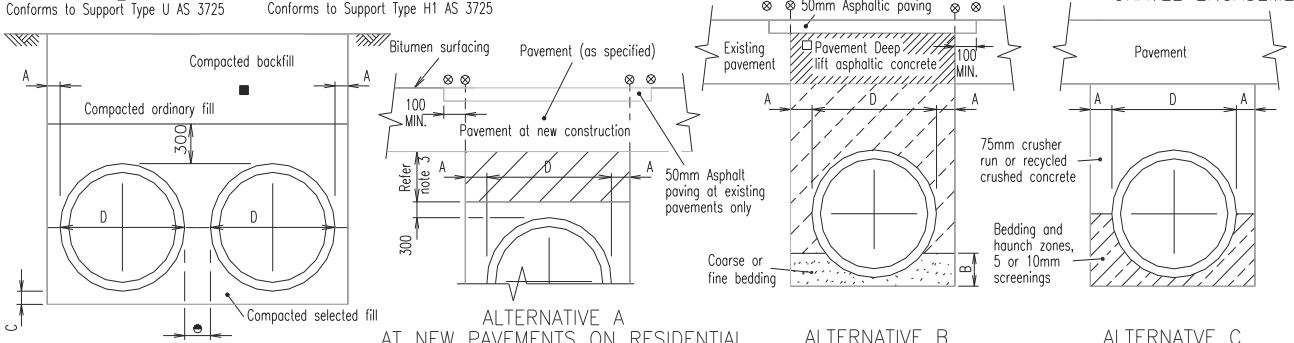
SECTION A-A

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. COMPRESSIVE STRENGTH OF CONCRETE AT 28 DAYS TO BE 25MPa.
3. WHERE THE PIPELINE IS UNDER A ROAD PAVEMENT, THE TOP OF BULKHEAD SHALL EXTEND TO SUBGRADE UNLESS OTHERWISE DIRECTED BY COUNCIL'S ENGINEER.

Gunnedah Land of Opportunity	GUNNEDAH SHIRE COUNCIL	JOB NUMBER	ISSUE	DATE
	CONCRETE BULKHEADS	FILE NAME	SHEET NUMBER OF SHEETS	
		ARCHIVE FILE	PLAN No. 2340D	





NOMINAL Ø culvert D(mm)	MINIMUM width A (mm)	HAUNCH depth B	Bedding depth C	Allowable width,E(m)	
				DES	MAX
300	300	36	100	1.0	1.1
375	300	45	100	1.1	1.2
450	300	53	100	1.1	1.3
525	300	61	100	1.2	1.5
600	300	69	100	1.3	1.6
750	300	85	100	1.5	1.8
900	300	103	100	1.6	1.9
1050	300	120	100	1.8	2.1
1200	300	135	100	2.0	2.2
1350	300	150	100	2.1	2.4
1500	300	169	100	2.3	2.7
1650	330	184	150	2.6	2.9
1800	360	200	150	2.8	3.1
1950	390	222	150	3.1	3.3
2100	420	239	150	3.4	3.5
2400	480	270	150	3.9	4.2
2700	540	303	150	4.3	4.6
3000	600	335	150	4.9	5.0

Bedding & Haunch material (Gravel, loam, sand or mixture) grading

AS Sieve Size	% Passing by mass	
	Type 1 – Pipes ≤ ø1200	Type 2 – Pipes > ø1350
19.0	100	98 – 100
9.5	–	35 – 50
4.75	–	5 – 10
2.36	40 – 100	0 – 2
0.425	15 – 70	0 – 1
0.075	3 – 30	0 – 1

Conforms to Support Type H1

LEGEND

- □ Pavement. Refer project documentation for detail
- ⊗ Saw cut at existing pavement
- ◓ Pipes : 300 when NOMINAL D < 600
  600 when NOMINAL D 600 – 1800
  900 when NOMINAL D > 1800
  Dimensions can be reduced to 150 MIN for non mechanical compaction of backfill
- ■ Refer Alternative A, B and C for backfill requirements at existing and new pavements.
- ● Depth to be approved by the Superintendent
- Gravel (MIN CBR15) backfill
- No fines concrete backfill (8 parts 10mm NOM size aggregate to 1 part cement).

NOTES:

1. Selected backfill in all cases shall be carried through to the wings and continued 300 thick for the length and height of wings.
2. Bedding compaction (Compacted selected fill / sand bedding)
   Cohesive material – 95% standard compaction
   Non-cohesive material – density index of 70 MIN, refer AS 1289.E5.1
   Sand – compact by flooding and use of vibrators.
3. Backfill compaction
   Compacted gravel (300mm) layer under road pavement 95% standard compaction.
   Compacted ordinary fill / CBR15 Gravel 90% standard compaction – below 300mm zone.
   Compacted backfill – at footpaths / private property 90% standard compaction.
   MAX. densities determined by standard compaction tests to AS 1289.5.1.1.
4. Refer project drawings for types and/or alternatives to be adopted.
5. Type U & Type H1 to conform to AS 3725.
6. Dimension A can be reduced to 150 MIN for non mechanical compaction of backfill
7. Pipes are to be designed to their correct strength class under all construction loads, dead loads and in-service loads.
8. All dimensions in millimetres.

REVISIONS		DATE
C	Note 7 added	6/1/00
B	Bedding modification Type 2, 4, 7 and Alternative B	16/1/97
A	ORIGINAL ISSUE	8/12/95

INSTITUTE OF PUBLIC WORKS ENGINEERING AUSTRALIA
QUEENSLAND DIVISION INC.

EXCAVATION, BEDDING AND BACKFILLING OF STORMWATER DRAINAGE PIPES

DRAINAGE
Standard Drawing
D–0030
A | B | C

JWP – CADENZA 113327-D-0030

PART 4

GUIDELINES

FOR

WATER

RETICULATION

DESIGN

4 GUIDELINES FOR WATER RETICULATION DESIGN

4.1 Introduction

This document outlines Gunnedah Shire Council's recommended practice for design and construction of water reticulation.

It is in no way a comprehensive "Design Manual" and it is intended to be read in conjunction with documents referenced in Section 4.3.

The other parts of the Engineering Guidelines for Subdivisions and Developments are as follows:

Part 1 General Requirements

Part 2 Guidelines for Design of Roads

Part 3 Guidelines for Design of Drainage

Part 5 Guidelines for Design of Sewerage Reticulation

Part 6 Guidelines for Landscaping

4.2 Definitions

Any reference to Director in this section will be taken as a reference to the Director – Infrastructure Services, or nominated representative.

Distribution and Trunk mains are those pipelines which transfer water to reservoirs, link reservoirs or areas of demand, or distribute water to or through areas of development. These pipelines are of strategic importance to the operation of the reticulation system irrespective of size. Individual service connections will not be permitted to these pipelines.

4.3 References

This section of the Guidelines should be read and utilised in combination with the following publications as referenced throughout;

- AWA Water Supply Code of Australia WSA 03-2002
- AS2280 Ductile Iron Pipes and Fittings - 2004
- AS4087 Metallic Flanges for Waterwork Purposes - 2004
- AS1432 Copper Pipes for Plumbing, Gas fitting and Drainage Applications - 2004
- NSW Code of Practise for Plumbing and Drainage 3rd Edition 2006
- Building Code of Australia 2008 Volume 1
- AS/NZS 3500:1 Plumbing and Drainage

4.4 Classification of Areas for Water Supply

For each town and village within Gunnedah Shire Council area provided with reticulated water Council has adopted areas that are defined as water reticulation areas. Broadly these areas are those where

- Treated water is/must be supplied at full mains pressure;
- Fire fighting is to be supplied via the reticulation through the provision of hydrants.

Outside of those areas if treated water is to be supplied by Council, those areas will be classified as trickle flow areas. Broadly these areas are those where

- Treated water is/must be supplied at a maximum flow rate to each connection of 0.06 l/sec
- Fire fighting is provided by on site storage at each property and not the reticulation.

4.5 General Requirements Regardless Of Area

4.5.1 DESIGN

Any development application that involves changes to the existing, new, or extension of existing water infrastructure must be accompanied by documentation that complies with the requirements detailed in the following sections including plans and calculations at the time of submission.

4.5.2 SERVICING STRATEGY

All design elements submitted must comply with the Servicing Strategy approved by Council as part of the conditions of development consent issued for the subject development, as appropriate.

Changes to the approved Servicing Strategy must be approved by the Director prior to the submission of plans and associated documentation.

4.5.3 FUTURE DEMANDS

Water supply components are to be sized to cater for proposed future development. Council's current reticulation analyses will be used as a guide in assessing size requirements.

In certain cases where Developers are requested by Council to construct infrastructure that caters for future demand as well as their own development, Council will reimburse the difference in cost between constructing the larger components and the size required to supply the development. For further details in relation to development within reticulation areas please refer to Council's policy:- Water and Sewer Reimbursement of Developers for Construction of Water and Sewer Infrastructure Within Reticulation Areas and for development elsewhere refer to Council's policy:- Water Sewer Reimbursement of Developers for Construction of Water and Sewer Infrastructure Outside Reticulation Areas.

4.5.4 PLANS AND CALCULATIONS

The Checklist – Water Reticulation Design in **APPENDIX A** shall be completed and submitted with the Drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to Council, the Drawings shall be returned to the developer for amendment. Council shall only commence review of the design drawings once it is satisfied that all the requirements of the checklist have been met.

Design drawings and calculations shall be submitted to Council for approval. Information to be included in the design drawings is detailed in **APPENDIX B** – Information to be shown on Water Reticulation Drawings. The completed checklist will be submitted with the Drawings.

4.5.5 STRUCTURES

Detailed engineering drawings are required for any structures such as reservoirs, pumping stations and PRV pits proposed for construction in conjunction with water supply works.

4.5.6 LOCATIONS AND COVER

Water mains are to be located on the footpath in accordance with the footpath allocations referred to in Part 1 of these Guidelines and shall extend to the extremity of the development.

Cover to pipelines will be in accordance with the manufacturer's instructions; however minimum cover required is 500mm in footpaths and driveways and 600mm under road carriageways. The depths may need to be increased on larger diameter mains to accommodate larger fittings.

The Director may give approval for infrastructure to be located in areas other than road reserves provided an easement is created. The developer should transfer to Council any water easements provided in the subdivision and execute a transfer and grant of easement in favour of Council pursuant to Section 88B of the Conveyancing Act 1919, as amended. The minimum width of water easement should be 3.0m.

The Director may require water mains to be located on both sides of the road in commercial/industrial areas, in areas likely to have high or medium density housing, at the boundaries between pressure zones and on highly trafficked roads.

The position of all mains, control valves, hydrants and other associated structures dimensioned to at least 2 adjacent property boundaries must be shown on Works as Executed drawings to allow location at some future date. WAE plans must be provided prior to the release of linen plans. Water mains are to be provided for the full extent of the development to facilitate the systematic and orderly expansion of Council's infrastructure

4.5.7 MAINS IN CUL-DE-SACS

Where the cul-de-sac incorporates a pathway to an adjacent street or ends in a park, the water main is to extend through the pathway or park so that a dead-end is not created in the main.

Where a pathway or park is not provided, the main is to be returned at the end of the cul-de-sac to form a loop main which should conform to the following criteria:

1. The loop is to be totally on the footpath, apart from the one road crossing required to reconnect with the main;
2. The loop is to incorporate a minimum of 3 separate service tapping's, each separated by at least one block frontage;
3. A hydrant is to be provided within the loop approximately equidistant from loop back point and at the reconnection junction of the main; and
4. The loop is to cross the road perpendicular and at the start of the neck at the Cul-de-sac.

4.5.8 HYDRANT, FLUSHING POINT AND STOP VALVE CHAMBERS

Around each valve, hydrant and flushing point, a chamber of the type shown in and specified on Standard Drawing No. WAT 1301, WAT 1302 will be provided.

Unless otherwise specified, each valve chamber should be covered by a cast iron surface box cast into a concrete block as shown on Standard Drawing Nos. WAT1306 and WAT1304 however other covers will be considered. Concrete blocks shall be used in roadways.

4.5.9 EXISTING STOP VALVES AND HYDRANTS

Where the subdivision is utilising existing water mains, the level of hydrant and stop valve surface boxes should be adjusted to suit new surface levels.

4.5.10 DETECTOR TAPE

A metal detectable tape complying with Australian Standard AS2648 shall be laid with water mains constructed from material other than Ductile Iron Cement Lined in accordance with the manufacturer's specifications. At a minimum such tape shall be continuous and electrically bonded to metallic components including services and standpipes.

4.5.11 TAPPING BANDS

Approved tapping bands are to be used for all service connections. Tapping bands including hard stop design will be required when using non DICL pipe material. Thin brass type tapping bands without rubber backing will not be permitted. Readytap connectors or equivalent are acceptable.

4.5.12 WATER METER INSTALLATION

Council requires that all lots, including areas set aside for recreation, be provided with a water meter in a location as detailed in Standard Drawing No. 6492. Developer to pay applicable fees and charges prior to subdivision release.

Council will supply and install water meters once the applicable fees and charges have been paid and upon registration of the subdivision and following receipt of a request for water meter connection from the property owner.

4.5.13 SHARED TRENCHING

4.5.13.1 FOOTPATHS

Shared trenching can be of benefit to control the location of services relative to each other and to reduce the cost of design and construction.

Where there is agreement between the Water Agency and other utility service Owners, shared trenching may be used for water mains (usually up to DN 150), telecommunication cables/conduits, electricity cables/conduits, and reticulation gas mains.

Where shared trenching is proposed, a detailed design shall be submitted for approval by the Water Agency and shall include:

(a) relative location of services (horizontal and vertical) in the trench;

(b) clearances from other services;

(c) pipe support and trenchfill material specifications;

(d) embedment and trenchfill compactions;

(e) trench markings;

(f) services location with respect to property boundaries; and

(g) any limitations on future maintenance.

Where shared trenching is adopted, identification marking shall be used, as required by the Water Agency and other utility service Owners, particularly if clearances between services are reduced from standard requirements. The vertical alignment of water main / conduit levels in industrial / commercial zoned areas shall be staggered to allow for the future installation of property services and fire services (Refer to Figure 4.1).

Where approved by the Water Agency, shared trenching may also be used for property service connections.

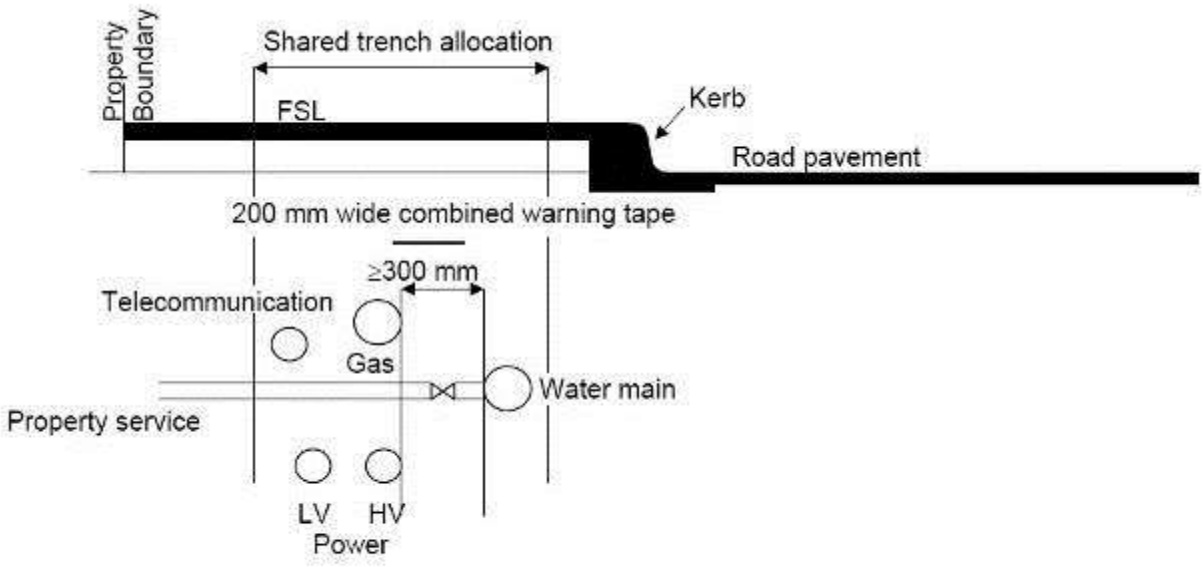


FIGURE 4.1 TYPICAL SHARED TRENCHING ARRANGEMENT

4.5.13.2 ROAD CROSSINGS

All road crossings are to be provided at right angles to the road centreline at the point of crossing.

Shared trenches will be permitted between utilities provided the minimum separation between utilities, not in conduits, is 300 mm both in the horizontal or vertical direction.

Shared trenches will be permitted between utilities provided the minimum separation between the outside of the conduits containing the utilities is 100mm in the horizontal or vertical direction with water utilities on top.

Fill between the conduits shall be as detailed in Standard Drawing No. WAT1202 & WAT1203.INSERT

4.5.14 PIPE/FITTINGS CONNECTION

4.5.14.1 POLYETHYLENE

In the case of Polyethylene all pipes and fittings are to be joined by electro fusion techniques in accordance with the manufacturer's requirements. Those carrying out the pipe joins are to be appropriately qualified, capable of demonstrating their experience with this technique and have the right equipment to affect the welds. Council will also consider butt welding of the pipes by persons with the appropriate qualifications, equipment and experience.

Service connections will be via polypropylene tapping bands with one mechanical connection allowed to allow connection of the service to the copper standpipe.

4.5.14.2 ALL OTHER MATERIALS

Connection of pipes will be in accordance with the manufacturer's instructions.

4.5.15 PRESSURE REDUCING VALVES

Where Pressure Reducing Valves (PRV's) are required they shall be of a type and design approved by the Director.

Pits to house PRV's will be constructed from concrete, or other suitable material, and be of a size that allows a clear work area of at least 600 mm in all directions around the PRV. A drain shall be located in the bottom of the pit which drains to adjacent water course or drainage structure. Dismantling joints will be provided on the upstream and downstream side of the valve and the pit will have lockable removable covers.

4.5.16 OPENING OF VALVES

The developer is required to establish that all valves and service connections are fully open, following construction as appropriate.

4.5.17 THRUST BLOCKS

Valves, flexible jointed bends, tees, dead ends, and other points in the pipeline where there are unbalanced forces should be adequately restrained to withstand the forces resulting from the internal pressure when the pipeline is in use by packing between the fitting and the side of the trench with concrete as detailed in Standard Drawing No. WAT1206.

Stop valves on mains of 150mm diameter or greater are to be fixed to the thrust block.

The Developer shall be responsible for any failure of the pipeline that may be due to inadequate restraint in accordance with Standard Drawing No. WAT1206.

4.6 Water Reticulation Areas

4.6.1 MINIMUM REQUIREMENTS

Council requires that all allotments, including areas set aside for recreation, be provided with a reticulated water supply sufficient for both domestic and fire fighting purposes.

4.6.2 WATER DEMAND

The design water demands should be calculated in accordance with New South Wales Public Works Department Standards.

4.6.3 SYSTEM COMPONENTS

The water supply system components should be designed generally in accordance with New South Wales Public Works Department standards and Council requirements as detailed in these guidelines.

4.6.4 SERVICE RESERVOIRS

Minimum capacity is one days supply at future peak day demand.

4.6.5 STATIC HEAD

Recommended minimum static head required at the meter location for each lot, when the service reservoir is one third depleted, refer to Part 4 Table A.

Location	Recommended Minimum Static Head (Metres)
Gunnedah	20
Curlewis	20
Mullaley	20
Tambar Springs	20

Part 4 Table A – Recommended Minimum static head requirements

The main is to be capable of delivering peak instantaneous demand to each lot, while maintaining a minimum head of 20m throughout the system with the service reservoir assumed to be two thirds depleted.

4.6.6 PIPE SIZE

Minimum acceptable pipe size is 100mm diameter for residential areas and 150mm diameter for commercial and industrial areas. 100mm pipes may be considered in some isolated industrial areas.

100mm dead end mains are to be limited to 150m in length and should serve no more than 40 residential dwellings.

100mm mains over 2,000m long are not permitted.

Water mains ≥ 200mm NB in size are to be constructed of ductile iron cement lined (DICL) with minimum class PN35.

4.6.7 MAINS AND FITTINGS

4.6.7.1 MATERIALS

All mains must be constructed from material which is compatible with Ductile Iron fittings.

Council may direct that any water mains should be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with AS 2280. This will usually only apply to those designated as trunk or distribution mains which service adjacent development.

All cast or ductile iron fittings should be cement or epoxy lined and conform to AS 2280. Stop valves and scour valves are to be clockwise closing (CC) and resilient seated, with stop valves to have a minimum pressure rating of PN16.

For flanged pipe the pipe barrel is to be manufactured to AS/NZS2280 flanged class.

Flanged fittings should be cement or epoxy lined and conform to AS4087 and AS2280 with a minimum pressure rating of PN16 or PN35 depending on the application.

Where it is proposed to use pipe material other than PN35 Ductile Iron the Developer will be required to show that the material proposed conforms as follows:

- Pipe is suitable to meet pressure requirements at the proposed location;
- Has the minimum required pressure rating of PN16, SDR 11;
- Is compatible with Ductile Iron fittings;
- Fatigue and/or cyclical load testing indicates the material will meet a minimum 50 year design life;
- Will not be adversely effected, in terms of shape and strength by construction loading;
- Installation method to manufacturers instruction for minimum 50 year design life; and
- Complies with a relevant Australian Standard.

4.6.7.2 HYDRANTS AND VALVES

Fire hydrants are to be provided at a maximum of 75 metre spacing's in residential areas, at maximum spacing's of 250 metres in rural residential areas and at all dead-ends. TABLE

A hydrant or air valve is to be provided at all high points and a hydrant or scour valve at all low points.

A hydrant is to be located immediately upstream of stop valves located at junctions.

Air valves are to be installed with an air isolation valve to allow maintenance of the air valve without shutting down the main.

Scour valves are to be discharged to a stormwater drainage pit or an adjacent water course or stormwater facility when drainage pits are not available.

Stop valves are required at all pipeline intersections and branches so that each section of line can be isolated separately, by closing a maximum of three (3) valves.

Where kerb and gutter is constructed adjacent to the main the locations of stop valves and hydrants should be delineated by formed kerb impressions. Lettering should be 75mm high and 15mm wide and placed on top of kerb.

Where no kerb and gutter is available the locations of stop valves and hydrants should be delineated by galvanized steel marker posts and indicator plates erected on the footpath, at the property line, perpendicular to the location of the valve or hydrant. Standard Drawing No. WAL1300 provides details regarding posts and indicators.

Raised Pavement Markers "reflective" blue in colour shall be fixed to the centreline of the road perpendicular to the location of hydrants.

All maincocks, hydrants, stop valves, scour valves and air valves are to be located on the footpath, unless approved otherwise.

Hydrants are not to be located in table drains.

Hydrants and Valve covers are to open in the direction of the main.

4.6.7.3 KERB IMPRESSIONS

Lettering for respective infrastructure to be as follows;

SV – Stopvalves, scour valves

H – Hydrants

W – Water mains, water service

In addition the following kerb impressions should also be made to indicate the location of relative infrastructure.

S – Sewer main

G – Gas

T – Telecommunications

4.6.7.4 TRENCH STOPS/DRAINAGE

Trench Stops or concrete bulkheads are required for grades of 10 % or steeper. Spacing requirements are detailed in Part 4 Table B. SEE WAL1210

Grade (%)	Horizontal Spacing (m)
10	10x Depth to Invert
15	6x Depth to Invert
20	5x Depth to Invert
25	4x Depth to Invert
33	3x Depth to Invert
50	2x Depth to Invert

Part 4 Table B - Trench Stops Spacing

Adequate trench drainage is required to prevent trench scouring and subsidence due to high permeability of the bedding and trench fill.

4.6.8 SERVICE CONNECTIONS

4.6.8.1 MATERIALS

Water services should be of single service hard drawn copper pipe type A, manufactured in accordance with AS1432 or polyethylene pipe min. Pn 12.5.

Copper services are to be a minimum of 20mm nominal diameter with 1.4mm wall thickness.

Fittings at joints, branches and bends are to be brass or copper capillary fittings or of a type approved by the Director. Ballvalves and elbows are to be of brass and of a type approved by the Director. Flared fittings will be acceptable.

4.6.8.2 LOCATION

Water services are to be laid at right angles to the road centreline and parallel to the radius on curves and in cul-de-sac ends.

The services are to have a minimum cover of 500mm under carriageways and 300mm in footpath reserves.

The service is to terminate inside each lot in accordance with Standard Drawing No. 6492. The minimum distance between two (2) adjacent tapping bands should be 600mm.

All maincocks are to be located in the footpath.

In Industrial/Commercial areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe shall be 100mm. PN 9, uPVC pipe is required as a conduit.

In residential areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe shall be 50mm. PN9, uPVC pipe is required as a conduit.

Conduits may be laid for future proposed services, however the service is not to be connected to the water main.

Fire service to be contained within lot served.

4.6.8.3 NOMINAL SIZE OF WATER SERVICE

The minimum size of a water service in residential areas is 20 mm.

The minimum size of a water service in industrial commercial areas is 25 mm.

For areas set aside for recreation, a 32mm service with a 20mm meter is to be provided.

However fire fighting requirements and other considerations may warrant a larger service size. The Developer is responsible for nominating the correct size water service.

The size of water services serving multiple units will vary as detailed in Part 4 Table C below as given in the *NSW Code of Practice for Plumbing and Drainage 3rd Edition 2006.*

Class of Building	No of dwellings	Water Service Size (mm)	Total Length (m)
Class 1 Single	1	20	30
Dwelling House	1	25	130
Class 1&2	1	20	100
Excluding Single	2	25	100
Dwelling House	3-5	32	100
	6-10	40	100
	11-16	50	100

Part 4 - Table C – Size of Water Service

Notes: Classes are defined in Part A3 of the Building Code of Australia 2008 Volume One

Limitations of Method:

1. *Total length as measured from the water main to the last branch offtake is not to exceed the total length as stated above.*
2. *Height of the highest fixture above the water main is not to exceed 4m, where the minimum mains pressure is 15m (150 Kpa).*

Where the project is outside these limitations, other methods shall be used.

4.7 Trickle Flow Areas or Rural/Residential Areas

In trickle flow areas or rural/residential areas Council will NOT allow the use of water mains less than 100mm in diameter. The following conditions are relevant depending on the diameter of the main.

4.7.1 MINIMUM REQUIREMENTS

Council requires that all proposed residential allotments be provided with a reticulated water supply sufficient for domestic supply and in accordance with the appropriate water demand.

4.7.2 WATER DEMAND

The design water demands should be calculated in accordance with AWA Water Code of Australia except that the demand for each residential allotment is a maximum of 0.06 Litres/sec

Services must be connected to individual property service reservoir of min.10Kl as per AS3500.

Flow reduction devices shall be fitted to each service to limit flow to 0.06 Litres/sec.

4.7.3 SYSTEM COMPONENTS

The water supply system components should be designed generally in accordance with AWA Water Code of Australia and Council's requirements as stated in these guidelines.

4.7.4 SERVICE RESERVOIRS AT PROPERTIES

Minimum capacity is one days supply at future peak day demand or 10Kl, whichever is greater.

4.7.5 HEAD

The main is to be capable of delivering 0.06 Litre/sec demand to each lot, while maintaining a positive head throughout the system with the service reservoir assumed to be two thirds depleted.

4.7.6 PIPE SIZE

Mains are to be sized to meet the required demand of this and/or proposed future developments Future Demands

Minimum nominal internal diameter of all pipes shall be 100 mm

Council's current reticulation analyses will be used as a guide in assessing size requirements.

4.7.7 PIPELINES 100MM IN DIAMETER OR GREATER

4.7.7.1 MAINS AND FITTINGS - MATERIALS

All mains of diameter 100mm or greater must be constructed from material which is compatible with Ductile Iron fittings.

Council may direct that water mains shall be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with *AS2280.* This will usually only apply to those designated as distribution mains which service adjacent development.

All cast or ductile iron fittings should be cement or epoxy lined and conform to *AS 2544 and AS 2280 respectively.* Stop valves and scour valves are to be anti-clockwise closing (ACC) and resilient seated.

Where it is proposed to use pipe material other than Ductile Iron the Developer will be required to show that the material proposed conforms as follows:

- Is compatible with Ductile Iron fittings;
- Fatigue and/or cyclical load testing indicates the material will met a 50 year design life;
- Will not be adversely effected, in terms of shape and strength by construction loading; and
- Complies with a relevant Australian Standard.

All creek, causeway or river crossings should be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with *AS 2280*.

4.7.7.2 FLUSHING POINTS, HYDRANTS AND VALVES

Flushing points are to be provided at dead-ends. Air valves, complete with isolation valves, are to be provided at all high points in the main.

A hydrant or air valve is to be provided at all high points and a hydrant or scour valve at all low points.

Air valves are to be installed with an air isolation valve to allow maintenance of the air valve without shutting down the main.

Scour valves are to discharged to an adjacent water course or drainage structure.

Stop valves are required at all pipeline intersections and branches so that each section of line can be isolated separately, by closing a maximum of three (3) valves.

Stop valves and flushing points should be delineated by the installation of galvanized steel marker posts and indicator plates erected on the footpath, at the property line, perpendicular to the location of the valve or hydrant. Standard Drawing No. WAL1300 provides details regarding posts and indicators.

All maincocks, flushing points, stop valves, scour valves and air valves are to be located on the footpath, unless approved otherwise.

4.7.7.3 SERVICE CONNECTIONS – MATERIALS

Water services should be of single service hard drawn copper pipe, manufactured in accordance with AS1432 or polyethylene pipe minimum pressure Pn 12.5.

Copper services are to be a minimum of 20mm nominal diameter with 1.4mm wall thickness.

Fittings at joints, branches and bends are to be brass or copper capillary fittings. Ballvalves and elbows are to be of brass and of a type approved by the Director. Flared fittings will be acceptable.

4.7.7.4 SERVICE CONNECTIONS – LOCATIONS

Water services are to be laid at right angles to the road centreline and parallel to the radius on curves and in cul-de-sac ends.

The services are to have a minimum cover of 500mm under carriageways and 300mm in footpath reserves.

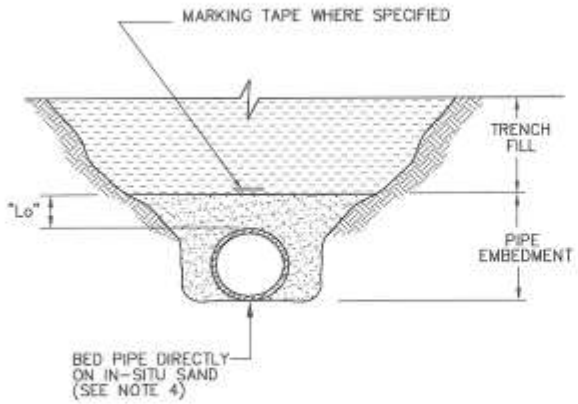
The service is to terminate inside each lot in accordance with Standard Drawing No. 6492. The minimum distance between two (2) adjacent tapping bands should be 600mm.

All maincocks are to be located in the footpath.

In residential areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe shall be 50mm. PN 9, uPVC pipe is required as a conduit.

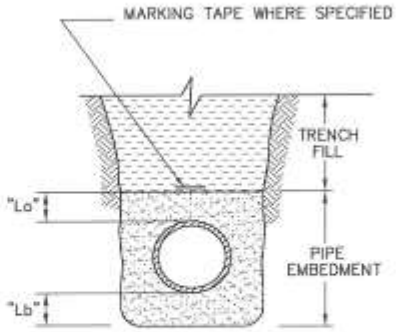
DRAWINGS - for Water Reticulation

Water Main Trench Details	**WAT1202 & WAT1203**
Service Connections & Surface Box Concrete Blocks	**6492 & WAT1106, 1107, 1109**
Hydrant & Stop Valve Surface Box Details	**WAT1300, 1301, 1302, 1304 and 1306**
Water Main Concrete Thrust Blocks	**WAT1206, 1207, 1210**



TYPE 'A' SUPPORT

TRENCH IN SAND STRATA



TYPE 'B' SUPPORT

TRENCH STRATA OTHER THAN SAND

PIPE SIZE (DN)	BEDDING & OVERLAY DEPTH			
	'Lb' (min)		'Lo'	
	DI STEEL	PVC GRP PE	DI STEEL	PVC GRP PE
100 – ≤450	100	150	150	200
>450 – ≤900	150	150	150	300
>900	150	150	200	300

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH WAT–1201.
3. EMBEDMENT, TRENCH FILL & COMPACTION TO MEET REQUIREMENTS OF WSA–03 PART 3.
4. WHERE TRENCH FLOOR CONSISTS OF MATERIALS MARKED WITH * ON WAT–1200 OBTAIN GEOTECHNICAL ADVICE.

EMBEDMENT TYPES TO BE SPECIFIED IN DESIGN DRAWINGS

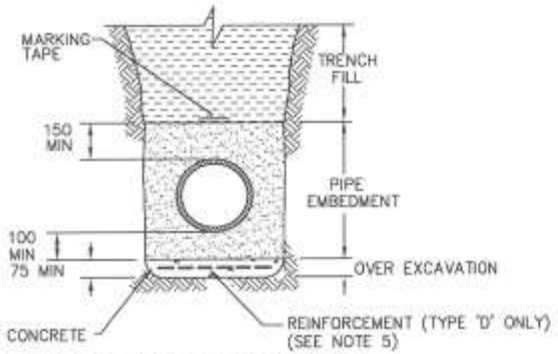
WATER SERVICES ASSOCIATION of Australia

WATER SUPPLY CODE OF AUSTRALIA

STANDARD EMBEDMENT ALL PIPE TYPES

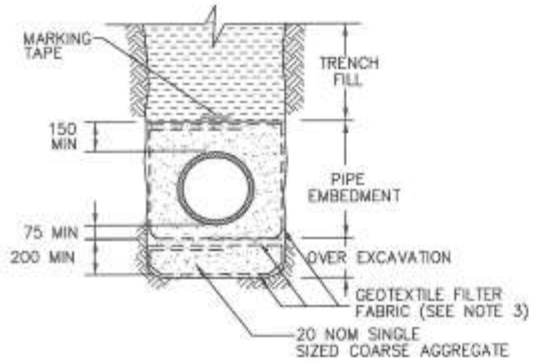
NOT TO SCALE

WAT–1202



TYPE 'C' & 'D' SUPPORT

CONCRETE OVERBREAK
NON-REINFORCED (TYPE 'C')
REINFORCED (TYPE 'D')
ALL PIPE TYPES



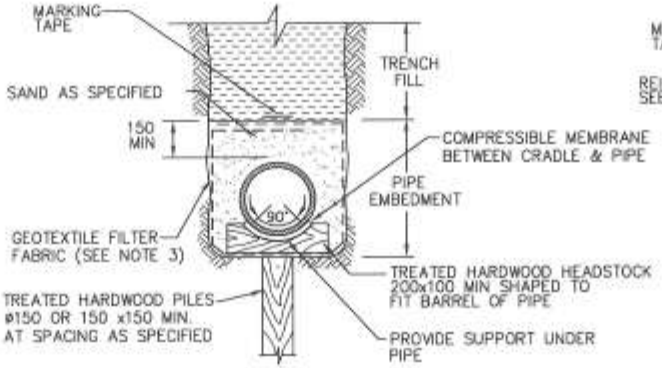
TYPE 'E' SUPPORT

GEOTEXTILE PILLOW
ALL PIPE TYPES

POOR FOUNDATION

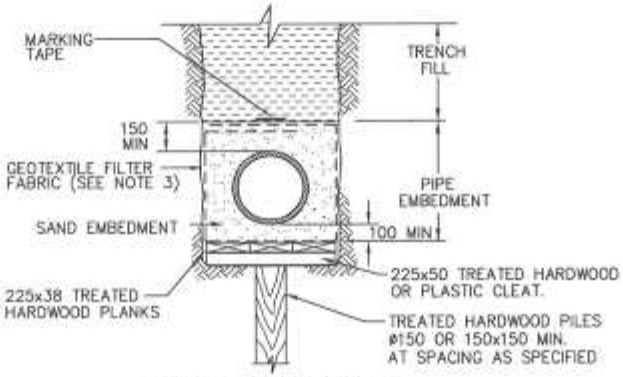
REQUIRING OVER-EXCAVATION
(TYPES C, D & E)

EMBEDMENT TYPES TO BE SPECIFIED IN DESIGN DRAWINGS



TYPE 'F' SUPPORT

ALL PIPE TYPES (DI PREFERRED)

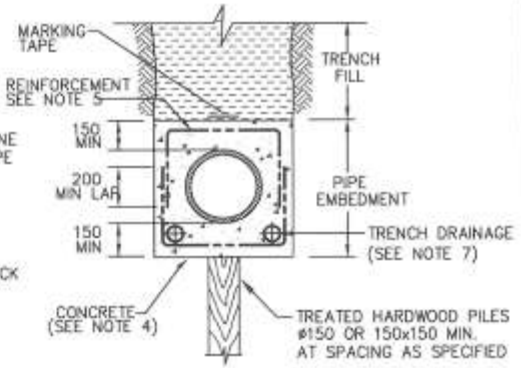


TYPE 'G' SUPPORT

STEEL FBPE LINED AND COATED PIPEWORK

INADEQUATE FOUNDATION REQUIRING PILES

(TYPES F & G)



TYPE 'H' SUPPORT

ALL PIPE TYPES

INADEQUATE SIDE SUPPORT & FOUNDATION

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. USE THESE SUPPORT TYPES ONLY WHERE SPECIFIED BY THE DESIGNER.
3. LAY GEOTEXTILE FILTER FABRIC LAID AGAINST THE TRENCH FLOOR AND WALL SUCH THAT IT FULLY ENCASES OVER EXCAVATION. PROVIDE MIN 250 LAP AT ALL FILTER FABRIC JOINTS.
4. UNREINFORCED CONCRETE TO BE CLASS N20, AND REINFORCED CONCRETE N25. FOR AGGRESSIVE CONDITIONS USE SPECIAL GRADES OF CONCRETE.
5. MINIMUM STEEL REINFORCEMENT OF 0.4% OF CONCRETE CROSS SECTION PLACED CENTRALLY AND WITH MINIMUM COVER OF 65 TO EXTERNAL FACE. SUPPLY REINFORCEMENT FOR THE APPLICABLE LOADING IN DESIGN DRAWINGS.
6. PILE INSTALLATION ARRANGEMENT (PER SUPPORT)
   ≤DN 300 SINGLE PILE
   >DN 300 TWIN PILE
7. SEE WAT-1210 IF CONTINUOUS TRENCH DRAINAGE IS REQUIRED.

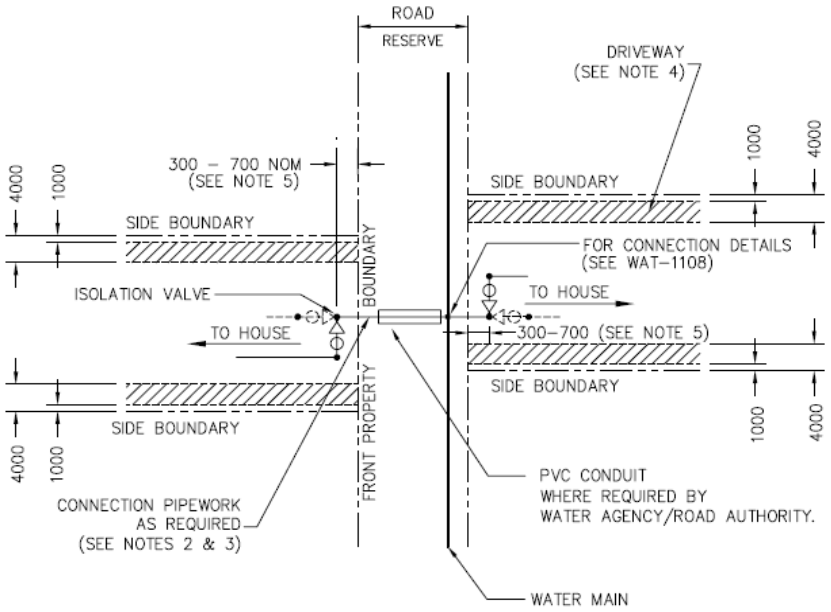
WATER SERVICES ASSOCIATION of Australia

WATER SUPPLY CODE OF AUSTRALIA

SPECIAL EMBEDMENTS
INADEQUATE AND POOR FOUNDATION

NOT TO SCALE

WAT-1203



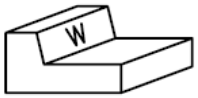
LEGEND:

- ISOLATION VALVE & METER
- DRIVEWAY AREA (NOT TO BE USED FOR METER) (SEE NOTE 4)
- PROPERTY BOUNDARIES

SINGLE SERVICE LOCATION DETAIL

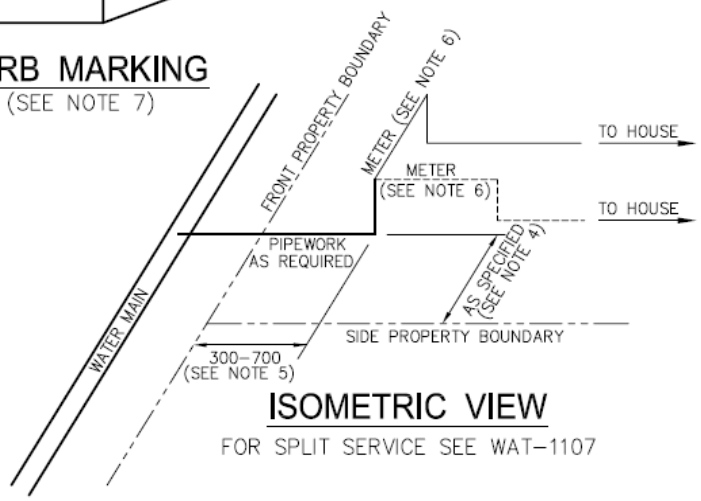
(SEE NOTE 9)

FOR MAIN CONNECTION ARRANGEMENTS AND METER ARRANGEMENT DETAILS SEE WAT–1108 & WAT–1109



KERB MARKING

(SEE NOTE 7)



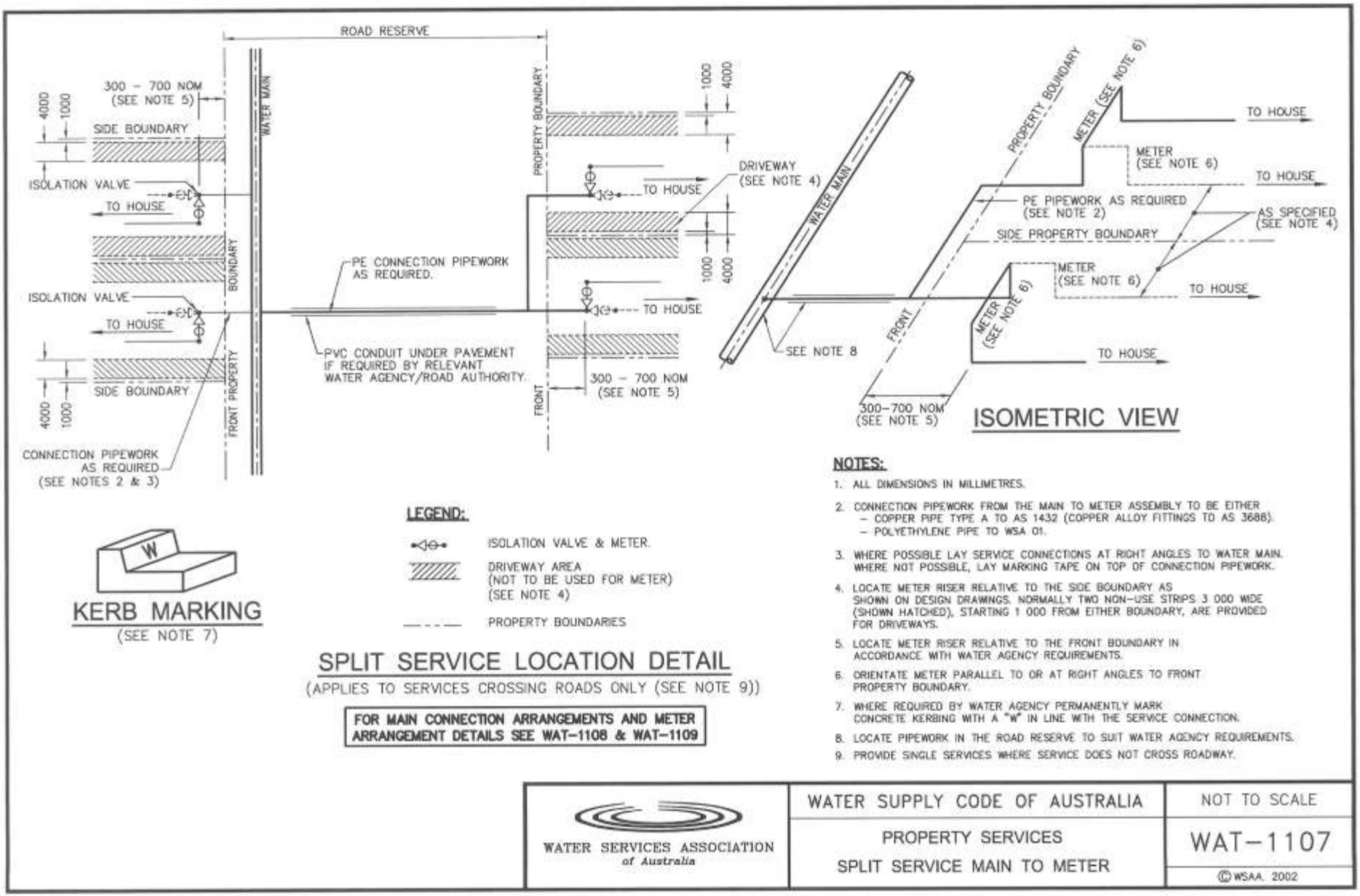
ISOMETRIC VIEW

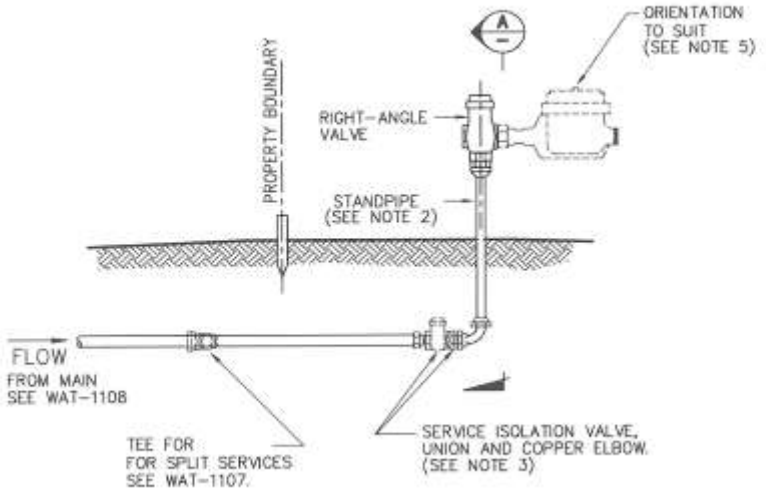
FOR SPLIT SERVICE SEE WAT–1107

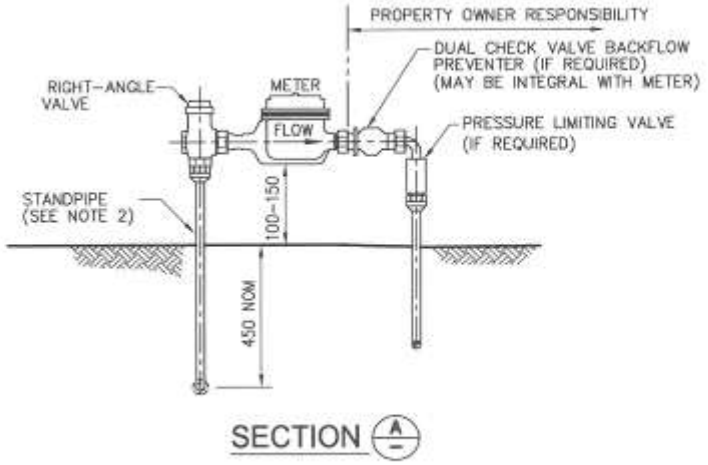
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. CONNECTION PIPEWORK FROM THE MAIN TO METER ASSEMBLY TO BE EITHER
   – COPPER PIPE TYPE A TO AS 1432 (COPPER ALLOY FITTINGS TO AS 3688).
   – POLYETHYLENE PIPE TO WSA 01.
3. WHERE POSSIBLE LAY SERVICE CONNECTIONS AT RIGHT ANGLES TO WATER MAIN. WHERE NOT POSSIBLE, LAY MARKING TAPE ON TOP OF CONNECTION PIPEWORK.
4. LOCATE METER RISER RELATIVE TO THE SIDE BOUNDARY AS SHOWN ON DESIGN DRAWINGS. NORMALLY TWO NON–USE STRIPS 3 000 WIDE (SHOWN HATCHED), STARTING 1 000 FROM EITHER BOUNDARY, ARE PROVIDED FOR DRIVEWAYS.
5. LOCATE METER RISER RELATIVE TO FRONT BOUNDARY IN ACCORDANCE WITH WATER AGENCY REQUIREMENTS.
6. ORIENTATE METER PARALLEL TO OR AT RIGHT ANGLES TO FRONT PROPERTY BOUNDARY.
7. WHERE REQUIRED BY WATER AGENCY PERMANENTLY MARK CONCRETE KERBING WITH A "W" IN LINE WITH THE SERVICE CONNECTION.
8. LOCATE PIPEWORK IN THE ROAD RESERVE TO SUIT WATER AGENCY REQUIREMENTS.
9. SPLIT SERVICES MAY BE PROVIDED WHERE SERVICE CROSSES THE ROAD.

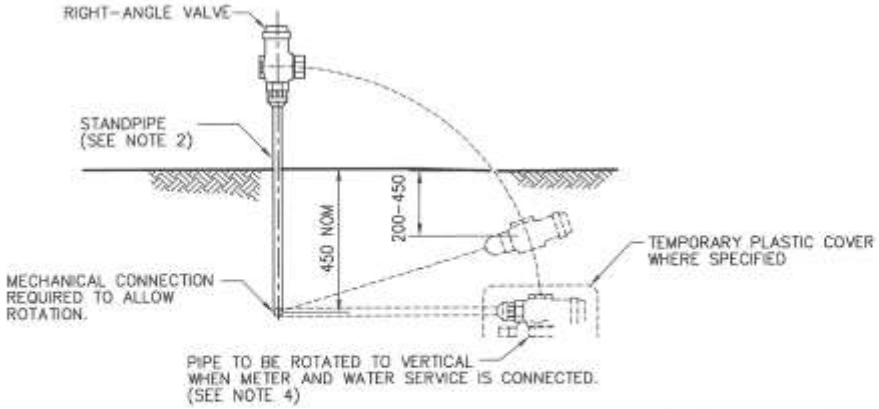
WATER SERVICES ASSOCIATION of Australia	WATER SUPPLY CODE OF AUSTRALIA PROPERTY SERVICES SINGLE SERVICE MAIN TO METER	NOT TO SCALE WAT–1106


ROAD RESERVE
300 – 700 NOM
(SEE NOTE 5)
4000
1000
SIDE BOUNDARY
ISOLATION VALVE
TO HOUSE
WATER MAIN
PROPERTY BOUNDARY
DRIVEWAY
(SEE NOTE 4)
PE CONNECTION PIPEWORK
AS REQUIRED.
PVC CONDUIT UNDER PAVEMENT
IF REQUIRED BY RELEVANT
WATER AGENCY/ROAD AUTHORITY.
FRONT PROPERTY BOUNDARY
CONNECTION PIPEWORK
AS REQUIRED
(SEE NOTES 2 & 3)
FRONT
SEE NOTE 8
METER (SEE NOTE 6)
PE PIPEWORK AS REQUIRED
(SEE NOTE 2)
SIDE PROPERTY BOUNDARY
AS SPECIFIED
(SEE NOTE 4)
ISOMETRIC VIEW
KERB MARKING
(SEE NOTE 7)
LEGEND:
ISOLATION VALVE & METER.
DRIVEWAY AREA
(NOT TO BE USED FOR METER)
(SEE NOTE 4)
PROPERTY BOUNDARIES
SPLIT SERVICE LOCATION DETAIL
(APPLIES TO SERVICES CROSSING ROADS ONLY (SEE NOTE 9))
FOR MAIN CONNECTION ARRANGEMENTS AND METER
ARRANGEMENT DETAILS SEE WAT–1108 & WAT–1109
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. CONNECTION PIPEWORK FROM THE MAIN TO METER ASSEMBLY TO BE EITHER
– COPPER PIPE TYPE A TO AS 1432 (COPPER ALLOY FITTINGS TO AS 3688).
– POLYETHYLENE PIPE TO WSA 01.
3. WHERE POSSIBLE LAY SERVICE CONNECTIONS AT RIGHT ANGLES TO WATER MAIN.
WHERE NOT POSSIBLE, LAY MARKING TAPE ON TOP OF CONNECTION PIPEWORK.
4. LOCATE METER RISER RELATIVE TO THE SIDE BOUNDARY AS
SHOWN ON DESIGN DRAWINGS. NORMALLY TWO NON–USE STRIPS 3 000 WIDE
(SHOWN HATCHED), STARTING 1 000 FROM EITHER BOUNDARY, ARE PROVIDED
FOR DRIVEWAYS.
5. LOCATE METER RISER RELATIVE TO THE FRONT BOUNDARY IN
ACCORDANCE WITH WATER AGENCY REQUIREMENTS.
6. ORIENTATE METER PARALLEL TO OR AT RIGHT ANGLES TO FRONT
PROPERTY BOUNDARY.
7. WHERE REQUIRED BY WATER AGENCY PERMANENTLY MARK
CONCRETE KERBING WITH A "W" IN LINE WITH THE SERVICE CONNECTION.
8. LOCATE PIPEWORK IN THE ROAD RESERVE TO SUIT WATER AGENCY REQUIREMENTS.
9. PROVIDE SINGLE SERVICES WHERE SERVICE DOES NOT CROSS ROADWAY.
WATER SERVICES ASSOCIATION
of Australia
WATER SUPPLY CODE OF AUSTRALIA
PROPERTY SERVICES
SPLIT SERVICE MAIN TO METER
NOT TO SCALE
WAT–1107
© WSAA 2002





TYPICAL ABOVE GROUND METER ASSEMBLY ARRANGEMENT



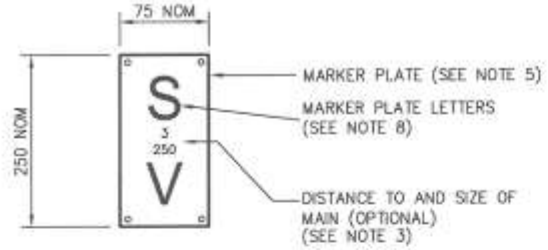
LAY OVER ARRANGEMENT FOR PRE LAID SERVICES

(SEE NOTE 4.)

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. MATERIAL FOR COPPER STANDPIPE TO BE TYPE A COPPER PIPE TO AS 1432. (COPPER ALLOY FITTINGS TO AS 3688).
3. PROVIDE IN-LINE VALVES AT BASE OF COPPER RISER WHERE SPECIFIED BY WATER AGENCY.
4. PLUG OR BAG THE RIGHT-ANGLE TERMINATION VALVE FOR THE SERVICE CONNECTION TO SEAL THE PIPE BEFORE THE RISER IS BURIED. PROVIDE MARKING TAPE WHERE SPECIFIED BY THE WATER AGENCY.
5. ORIENTATE METER PARALLEL TO OR AT RIGHT-ANGLES TO THE FRONT BOUNDARY.

WATER SERVICES ASSOCIATION of Australia	WATER SUPPLY CODE OF AUSTRALIA PROPERTY SERVICES ABOVE GROUND METER ASSEMBLY ARRANGEMENT	NOT TO SCALE WAT-1109 © WSAA. 2002



TYPICAL PLATE ARRANGEMENT

MAY BE FIXED TO POST, KERB OR BUILDING

VALVES

S V	STOP (ISOLATING)
Sc V	SCOUR
A V	AIR RELEASE

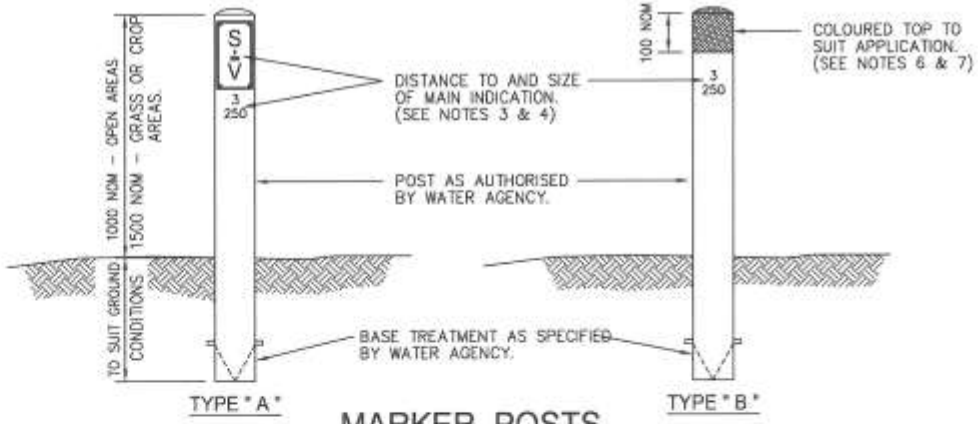
HYDRANTS

H	HYDRANT

OPTIONAL IDENTIFIERS

H P	HYDRANT IN PATHWAY OR NATURE STRIP
H R	HYDRANT IN ROADWAY

MARKER PLATES



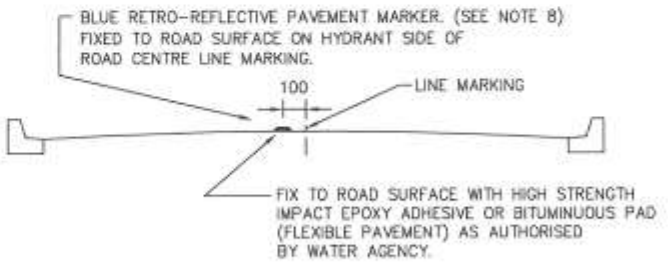
MARKER POSTS

STANDARD MARKER LETTERS
80 HIGH x 80 WIDE x 15 STROKE WIDTH
TO BE ENGRAVED INTO THE KERB.

ENGRAVED LETTERING TO BE PAINTED GOLDEN YELLOW (Y14) TO AS 2700

MARKER PLATES MAY BE USED AS AN ALTERNATIVE & FIXED USING MASONARY NAILS OR EPOXY ADHESIVE. (SEE NOTE 4)

KERB MARKING

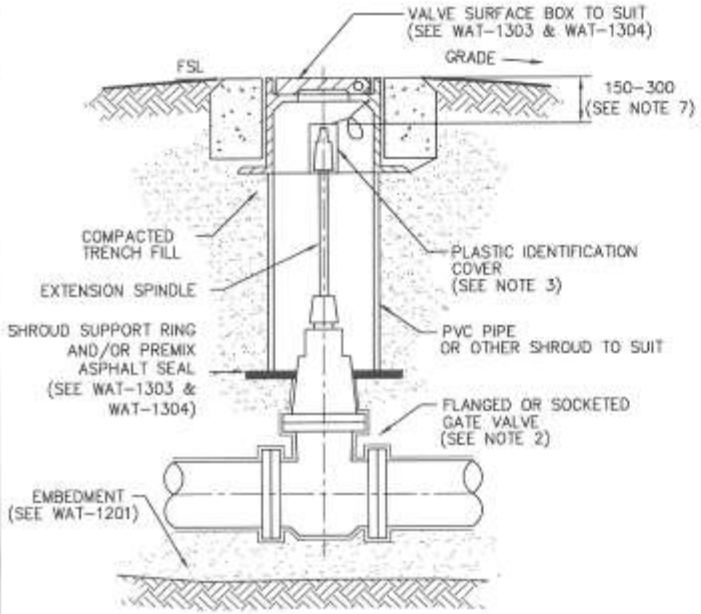


HYDRANT RETRO-REFLECTIVE PAVEMENT MARKER

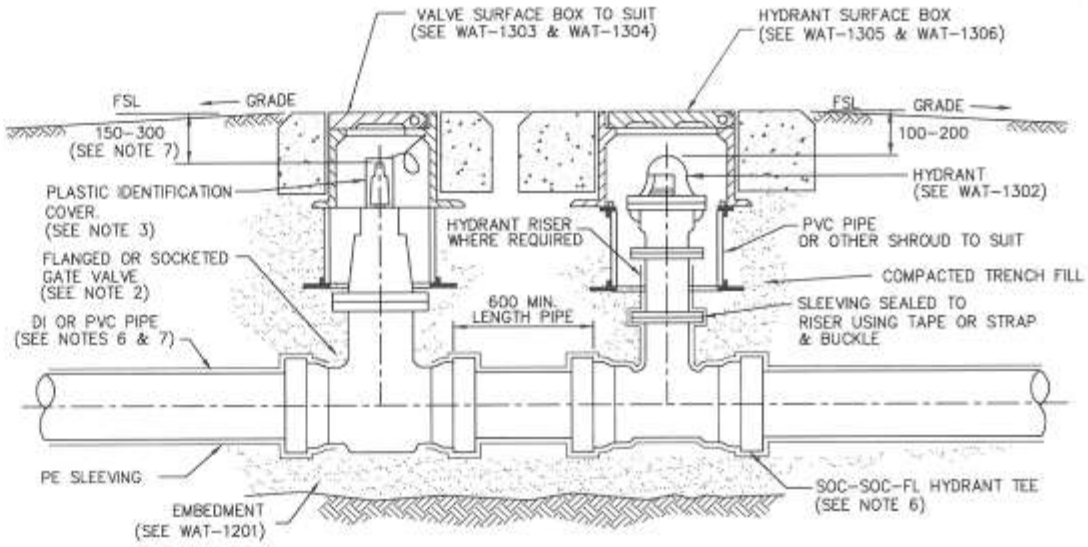
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. TYPE, LOCATION AND ORIENTATION OF MARKERS TO BE IN ACCORDANCE WITH RELEVANT WATER AGENCY REQUIREMENTS.
3. DISTANCE TO AND SIZE OF MAIN/FITTING TO BE MARKED ON POST OR MARKER PLATE.
   - NUMBERS TO BE 12 (MIN) HIGH.
   - NUMBERS TO BE PAINTED OR PUNCHED TO CREATE A PERMANENT IDENTIFICATION.
   - TOP NUMBER TO BE DISTANCE TO MAIN (m).
   - BOTTOM NUMBER TO BE DN OF MAIN (mm).
4. LOCATE MARKERS AT RIGHT ANGLES TO THE MAIN WITH MARKINGS FACING TOWARDS THE VALVE OR HYDRANT.
5. METALLIC MARKER PLATES TO BE REFLECTIVE WHITE WITH NON-REFLECTIVE LETTERING. LETTERING COLOUR TO BE HOMEBUSH RED (R22), LILAC (P23) OR OTHER COLOURS TO AS 2700 AS APPROPRIATE TO USAGE. MARKER PLATE LETTERS TO BE 80 HIGH x 40 WIDE x 10 STROKE WIDTH.
6. COLOURED MARKER TOPS ON TYPE "B" POSTS TO BE:
   - WATER (GENERAL) – BLUEBELL (B41).
   - HYDRANTS – HOMEBUSH RED (R22).
7. INSTALL TYPE "A" AND TYPE "B" MARKER POSTS AS SPECIFIED BY WATER AGENCY.
8. RAISED PAVEMENT RETROREFLECTIVE MARKERS TO COMPLY WITH AS 1906.3

WATER SERVICES ASSOCIATION of Australia	WATER SUPPLY CODE OF AUSTRALIA	NOT TO SCALE
	VALVE AND HYDRANT IDENTIFICATION IDENTIFICATION MARKERS & MARKER POSTS	WAT–1300



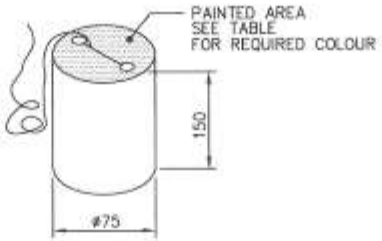
VALVES DEEPER THAN STANDARD DEPTH



VALVES & HYDRANTS AT STANDARD DEPTHS

COLOUR IDENTIFICATION TABLE FOR SURFACE FITTINGS

COLOUR / COVER	RED	WHITE	BLUE	YELLOW
PLASTIC IDENTIFICATION COVER	CLOSED VALVE	OPEN VALVE	DIALYSIS PATIENT	N/A
SURFACE BOX FOR STOP VALVE	NORMALLY CLOSED VALVE	SERVICE STRUCTURE FITTINGS (RESERVOIRS, WPS, ETC)	N/A	TRUNK & RETICULATION MAIN FITTINGS
SURFACE BOX FOR HYDRANT	N/A	N/A	N/A	FIRE BRIGADE USE



PLASTIC IDENTIFICATION COVER FOR SLUICE VALVE SPINDLES

(SEE NOTE 3)

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. VALVES DN 200 AND GREATER TO BE RESTRAINED WHERE SPECIFIED BY WATER AGENCY. SEE WAT-1207.
3. WHERE SPECIFIED BY WATER AGENCY INSTALL PLASTIC IDENTIFICATION COVERS. TOP OF IDENTIFICATION COVERS AND SURFACE BOX TO BE PAINTED WITH AN APPROVED ROAD MARKING PAINT. SEE TABLE FOR COLOUR CODES.
4. TO PREVENT THE TRANSFER OF TRAFFIC LOAD TO THE MAIN, ENSURE SHROUD AND ANY SHROUD SUPPORT RING DOES NOT COME IN CONTACT WITH THE GATE VALVE OR HYDRANT.
5. INSTALL AN EXTENSION SPINDLE WHERE DEPTH FROM SURFACE LEVEL TO TOP OF GATE VALVE EXCEEDS 350.
6. DI PIPES AND FITTINGS WITH BITUMINOUS EXTERNAL COATING TO BE PROTECTED WITH POLYETHYLENE SLEEVING.
7. DEPTH OF MAIN MAY BE LOCALLY INCREASED TO ACHIEVE REQUIRED MINIMUM VALVE SPINDLE COVER.

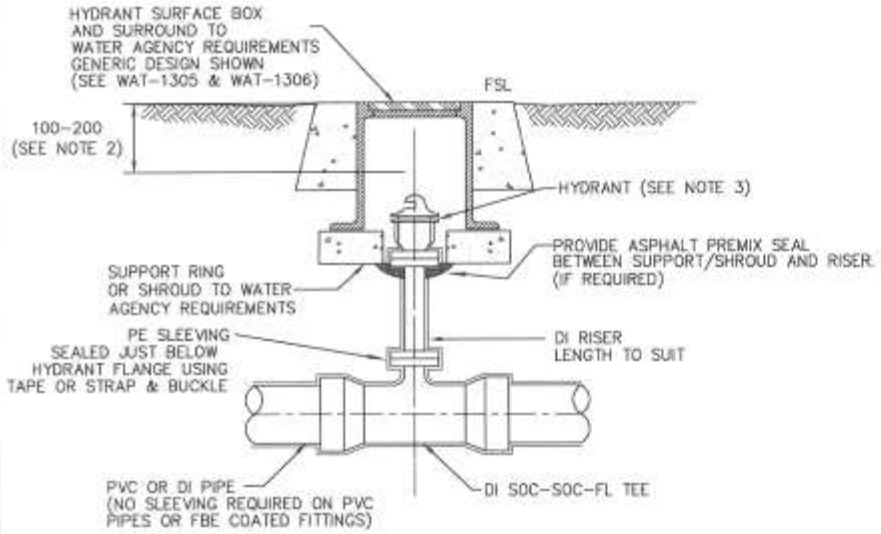
WATER SERVICES ASSOCIATION of Australia

WATER SUPPLY CODE OF AUSTRALIA

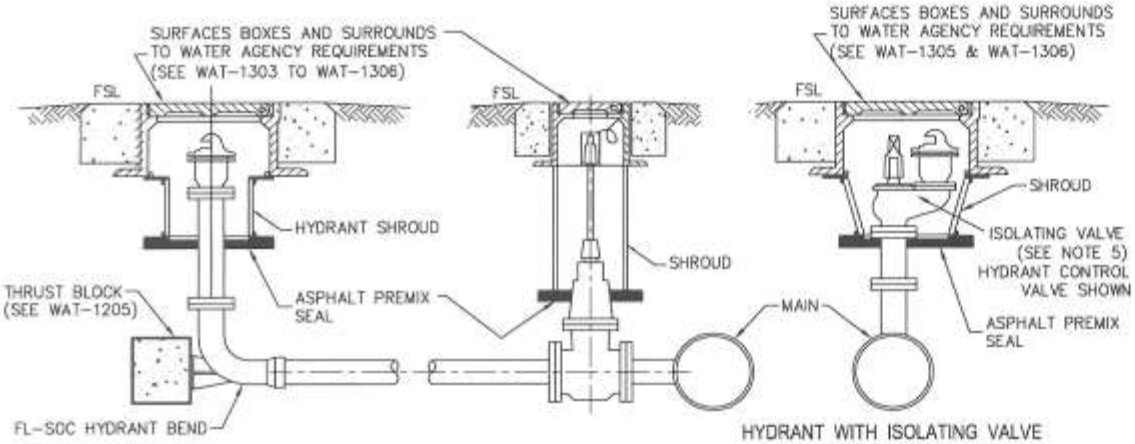
TYPICAL VALVE & HYDRANT INSTALLATION
VALVE ARRANGEMENT

NOT TO SCALE

WAT-1301



TYPICAL HYDRANT ARRANGEMENT

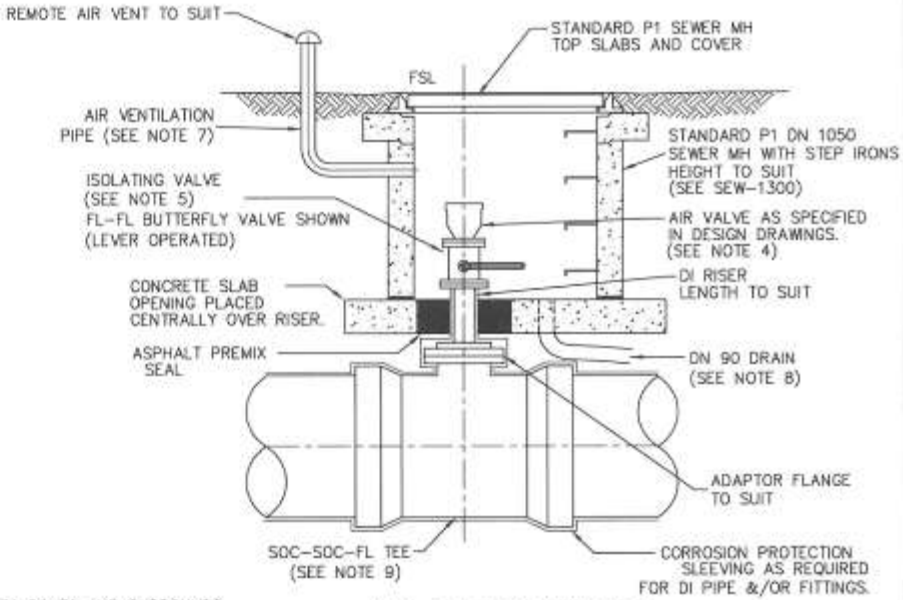


OFFSET ASSEMBLY INSTALLATION (TO CLEAR ROAD PAVEMENT)

HYDRANT WITH ISOLATING VALVE

ALTERNATIVE HYDRANT ARRANGEMENTS

(WHERE SPECIFIED IN DESIGN DRAWINGS)



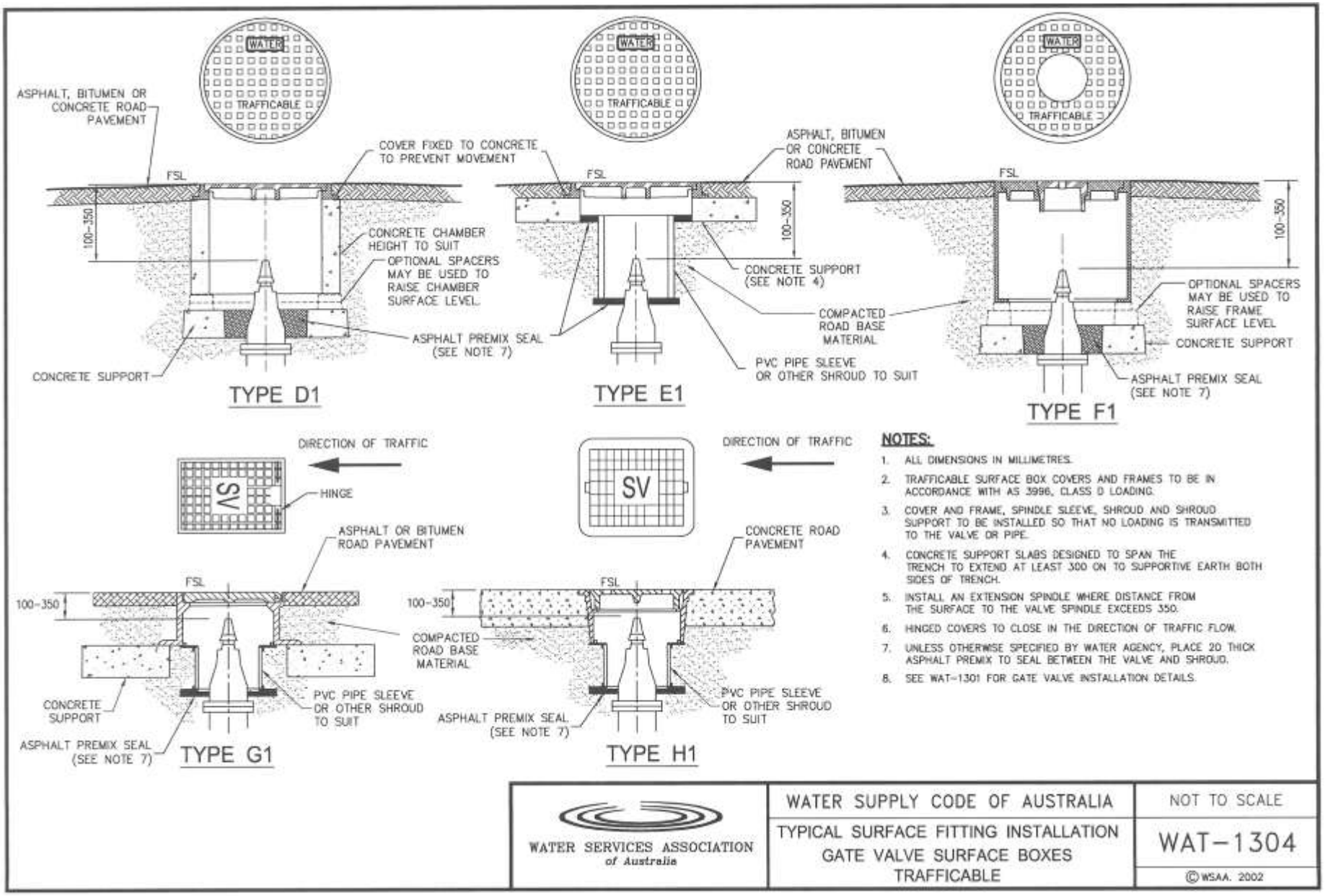
AIR RELIEF VALVE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. DEPTH OF MAIN MAY BE LOCALLY INCREASED TO ACHIEVE SPECIFIED COVER.
3. HYDRANT TO BE DN 80 UNLESS OTHERWISE SPECIFIED.
4. AIR VALVES TO BE SINGLE OR DOUBLE ORIFICE AS DETAILED IN DESIGN DRAWINGS. VALVE TO BE DN 80 UNLESS SPECIFIED OTHERWISE.
5. ISOLATING STOP VALVE TO BE AUTHORISED VALVE, EG. BUTTERFLY, GATE, BALL HYDRANT CONTROL VALVE etc. ISOLATING VALVE TO BE INSTALLED SUCH THAT THE AIR VALVE CAN BE REMOVED WITH THE VALVE IN PLACE.
6. TO PREVENT CORROSION, WHERE POSSIBLE ALL VALVES AND FITTINGS TO BE FUSION BONDED COATED AND JOINED USING 316 STAINLESS STEEL FASTENERS. CORROSIVE PROTECTIVE SLEEVING OR WRAP NOT REQUIRED WHERE THIS SYSTEM IS USED.
7. PROVIDE VENTILATION TO AIR VALVE CHAMBER.
8. DIRECTION AND GRADE OF DRAINAGE PIPE TO SUIT THE POSITION OF THE STORMWATER DRAIN.
9. FLANGED BRANCH DIAMETER TO BE AS SHOWN IN DESIGN DRAWINGS.

WATER SERVICES ASSOCIATION of Australia

WATER SUPPLY CODE OF AUSTRALIA	NOT TO SCALE
TYPICAL VALVE & HYDRANT INSTALLATION HYDRANTS AND AIR RELIEF VALVES	WAT-1302


WATER
TRAFFICABLE
ASPHALT, BITUMEN OR CONCRETE ROAD PAVEMENT
FSL
COVER FIXED TO CONCRETE TO PREVENT MOVEMENT
100-350
CONCRETE CHAMBER HEIGHT TO SUIT
OPTIONAL SPACERS MAY BE USED TO RAISE CHAMBER SURFACE LEVEL
ASPHALT PREMIX SEAL (SEE NOTE 7)
CONCRETE SUPPORT
TYPE D1
ASPHALT, BITUMEN OR CONCRETE ROAD PAVEMENT
CONCRETE SUPPORT (SEE NOTE 4)
COMPACTED ROAD BASE MATERIAL
PVC PIPE SLEEVE OR OTHER SHROUD TO SUIT
TYPE E1
OPTIONAL SPACERS MAY BE USED TO RAISE FRAME SURFACE LEVEL
CONCRETE SUPPORT
ASPHALT PREMIX SEAL (SEE NOTE 7)
TYPE F1
DIRECTION OF TRAFFIC
SV
HINGE
ASPHALT OR BITUMEN ROAD PAVEMENT
CONCRETE SUPPORT
ASPHALT PREMIX SEAL (SEE NOTE 7)
TYPE G1
CONCRETE ROAD PAVEMENT
COMPACTED ROAD BASE MATERIAL
PVC PIPE SLEEVE OR OTHER SHROUD TO SUIT
TYPE H1
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. TRAFFICABLE SURFACE BOX COVERS AND FRAMES TO BE IN ACCORDANCE WITH AS 3996, CLASS D LOADING.
3. COVER AND FRAME, SPINDLE SLEEVE, SHROUD AND SHROUD SUPPORT TO BE INSTALLED SO THAT NO LOADING IS TRANSMITTED TO THE VALVE OR PIPE.
4. CONCRETE SUPPORT SLABS DESIGNED TO SPAN THE TRENCH TO EXTEND AT LEAST 300 ON TO SUPPORTIVE EARTH BOTH SIDES OF TRENCH.
5. INSTALL AN EXTENSION SPINDLE WHERE DISTANCE FROM THE SURFACE TO THE VALVE SPINDLE EXCEEDS 350.
6. HINGED COVERS TO CLOSE IN THE DIRECTION OF TRAFFIC FLOW.
7. UNLESS OTHERWISE SPECIFIED BY WATER AGENCY, PLACE 20 THICK ASPHALT PREMIX TO SEAL BETWEEN THE VALVE AND SHROUD.
8. SEE WAT-1301 FOR GATE VALVE INSTALLATION DETAILS.
WATER SERVICES ASSOCIATION of Australia
WATER SUPPLY CODE OF AUSTRALIA
TYPICAL SURFACE FITTING INSTALLATION
GATE VALVE SURFACE BOXES
TRAFFICABLE
NOT TO SCALE
WAT-1304
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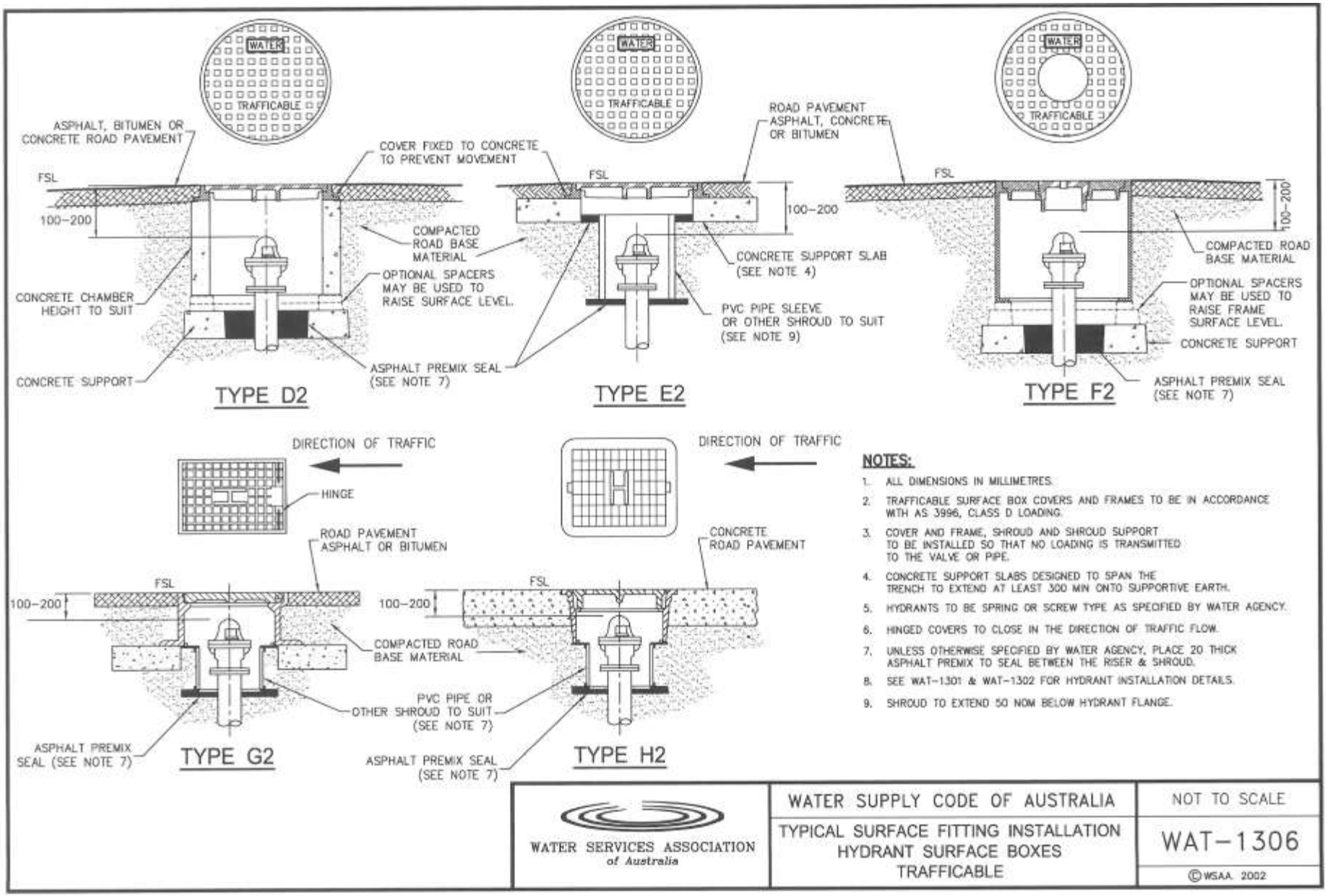
WATER
TRAFFICABLE
ASPHALT, BITUMEN OR CONCRETE ROAD PAVEMENT
COVER FIXED TO CONCRETE TO PREVENT MOVEMENT
FSL
100–200
COMPACTED ROAD BASE MATERIAL
OPTIONAL SPACERS MAY BE USED TO RAISE SURFACE LEVEL.
CONCRETE CHAMBER HEIGHT TO SUIT
CONCRETE SUPPORT
ASPHALT PREMIX SEAL (SEE NOTE 7)
TYPE D2
ROAD PAVEMENT ASPHALT, CONCRETE OR BITUMEN
CONCRETE SUPPORT SLAB (SEE NOTE 4)
PVC PIPE SLEEVE OR OTHER SHROUD TO SUIT (SEE NOTE 9)
TYPE E2
COMPACTED ROAD BASE MATERIAL
OPTIONAL SPACERS MAY BE USED TO RAISE FRAME SURFACE LEVEL.
CONCRETE SUPPORT
ASPHALT PREMIX SEAL (SEE NOTE 7)
TYPE F2
DIRECTION OF TRAFFIC
HINGE
ROAD PAVEMENT ASPHALT OR BITUMEN
COMPACTED ROAD BASE MATERIAL
PVC PIPE OR OTHER SHROUD TO SUIT (SEE NOTE 7)
ASPHALT PREMIX SEAL (SEE NOTE 7)
TYPE G2
CONCRETE ROAD PAVEMENT
TYPE H2
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. TRAFFICABLE SURFACE BOX COVERS AND FRAMES TO BE IN ACCORDANCE WITH AS 3996, CLASS D LOADING.
3. COVER AND FRAME, SHROUD AND SHROUD SUPPORT TO BE INSTALLED SO THAT NO LOADING IS TRANSMITTED TO THE VALVE OR PIPE.
4. CONCRETE SUPPORT SLABS DESIGNED TO SPAN THE TRENCH TO EXTEND AT LEAST 300 MIN ONTO SUPPORTIVE EARTH.
5. HYDRANTS TO BE SPRING OR SCREW TYPE AS SPECIFIED BY WATER AGENCY.
6. HINGED COVERS TO CLOSE IN THE DIRECTION OF TRAFFIC FLOW.
7. UNLESS OTHERWISE SPECIFIED BY WATER AGENCY, PLACE 20 THICK ASPHALT PREMIX TO SEAL BETWEEN THE RISER & SHROUD.
8. SEE WAT–1301 & WAT–1302 FOR HYDRANT INSTALLATION DETAILS.
9. SHROUD TO EXTEND 50 NOM BELOW HYDRANT FLANGE.
WATER SERVICES ASSOCIATION of Australia
WATER SUPPLY CODE OF AUSTRALIA
TYPICAL SURFACE FITTING INSTALLATION HYDRANT SURFACE BOXES TRAFFICABLE
NOT TO SCALE
WAT–1306
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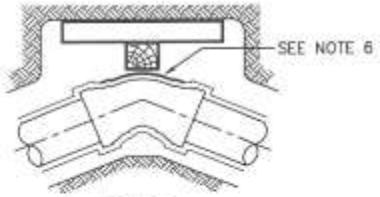
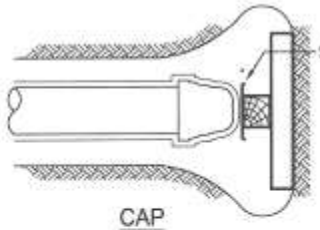
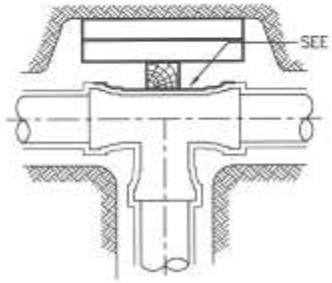


BEND



CAP



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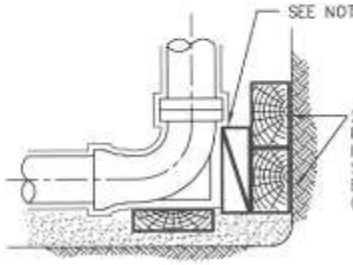


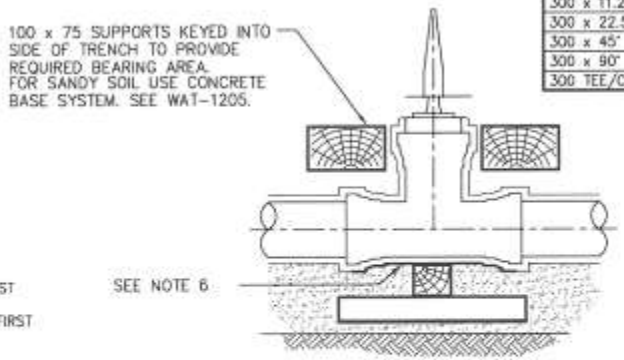
FLUSHING / WASHOUT BEND

ALLOWABLE APPLICATIONS FOR TIMBER & RECYCLED PLASTIC THRUST BLOCKS

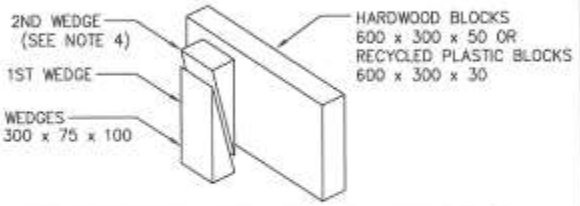
FOR TEST PRESSURE OF 1000 kPa (NOM 100 m HEAD) AND BELOW

FOR FITTINGS NOT MARKED WITH '•' IN TABLE, CONCRETE THRUST BLOCKS ARE REQUIRED IN ACCORDANCE WITH WAT–1205.

FITTINGS	SOIL CLASSIFICATIONS & ALLOWABLE HORIZONTAL BEARING PRESSURE																	
	STIFF CLAY MEDIUM DENSE SAND 50 kPa AHBP						VERY STIFF CLAY DENSE SAND/GRAVEL 100 kPa DECOMPOSED ROCK AHBP						HARD CLAY SOUND ROCK 200 kPa AHBP					
	DESIGN HEAD (m)						DESIGN HEAD (m)						DESIGN HEAD (m)					
	40	60	80	100	120	140	40	60	80	100	120	140	40	60	80	100	120	140
100 x 11.25°	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
100 x 22.5°	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•
100 x 45°	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•
100 x 90°	•						•	•	•	•	•		•	•	•	•	•	•
100 TEE/CAP	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•
150 x 11.25°	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•
150 x 22.5°	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•
150 x 45°	•						•	•	•				•	•	•	•	•	•
150 x 90°							•						•	•	•	•		
150 TEE/CAP							•	•					•	•	•	•	•	•
200 x 11.25°							•						•	•	•			
200 x 22.5°							•						•	•	•			
200 x 45°							•						•	•				
200 x 90°													•					
200 TEE/CAP							•						•	•				
250 x 11.25°							•						•	•				
250 x 22.5°							•						•	•				
250 x 45°							•						•	•				
250 x 90°													•					
250 TEE/CAP													•					
300 x 11.25°													•					
300 x 22.5°													•					
300 x 45°													•					
300 x 90°																		
300 TEE/CAP																		



VALVE ASSEMBLY



THIS SYSTEM MAY ONLY BE AUTHORISED AS A TEMPORARY SUPPORT SYSTEM BY SOME WATER AGENCIES.

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
2. PLACE BLOCKS IN THE TRENCH AS SHOWN AND AGAINST UNDISTURBED TRENCH WALL/FLOOR OR OTHER ACCEPTABLY COMPACTED MATERIAL.
3. SOIL CLASSIFICATIONS USED IN THIS DRAWING ARE EXPLAINED IN WAT–1200.
4. INSTALLATION OF WEDGES:
   - PLACE THE FIRST WEDGE WITH ITS THIN END UP AND AGAINST THE FITTING.
   - PLACE THE SECOND WEDGE BETWEEN THE BLOCK AND THE FIRST WEDGE AND DRIVE HOME UNTIL ALL SLACK IS TAKEN UP.
5. FOR DETAILS OF PRODUCTS USED IN THIS DRAWING REFER TO WSA–03 PART 2 OR WATER AGENCY AUTHORISED PRODUCTS LIST.
6. FOR PE FITTINGS AND FUSION BONDED COATED FITTING/VALVES PLACE ADDITIONAL SHEETS OF POLYETHYLENE SLEEVING BETWEEN THE FITTINGS AND THE FIRST WEDGE.
7. SUPPORT PVC FITTINGS USING SHAPED BLOCKS AVAILABLE FROM PRODUCT MANUFACTURER.

WATER SERVICES ASSOCIATION of Australia

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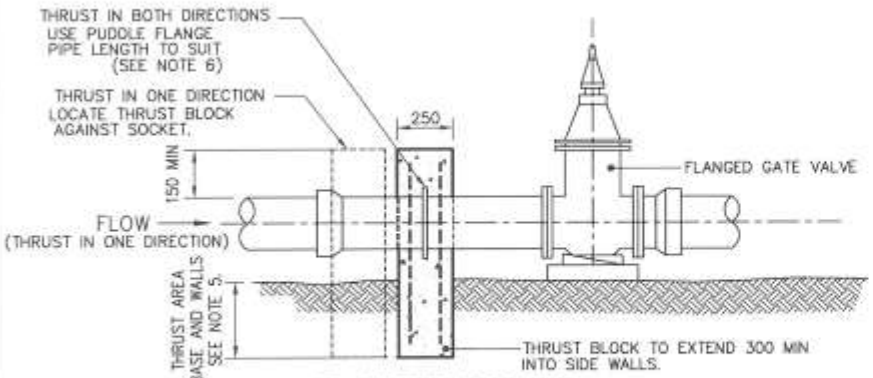
THRUST BLOCK DETAILS TIMBER & RECYCLED PLASTIC BLOCKS

NOT TO SCALE

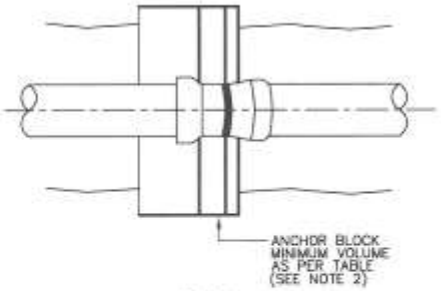
WAT–1206



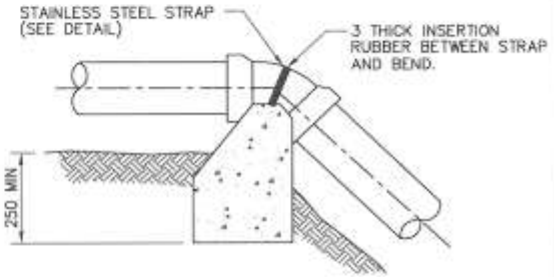
FLANGED VALVES

MINIMUM BLOCK VOLUME FOR ANCHORAGE VERTICAL BENDS FOR TEST PRESSURE OF 1000 kPa (SEE NOTE 2)			
PIPE DN	CONCRETE VOLUME m³		
	11.25° BEND	22.5° BEND	45° BEND
100	N	N	0.3
150	N	0.3	0.6
200	0.2	0.5	1.1
225	0.3	0.6	1.4
250	0.3	0.7	2.5
300	0.4	1.1	3.8
375	0.7	1.8	5.8
450 500 600 750	DETAILED DESIGN REQUIRED (ALTERNIVE METHODS TO BE CONSIDERED)		

'N'–NO ADDITIONAL RESTRAINT REQUIRED
(COMPACTED TRENCHFILL SUFFICIENT)

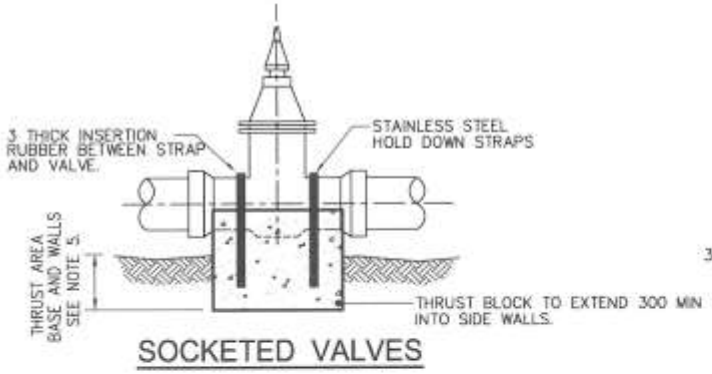


PLAN

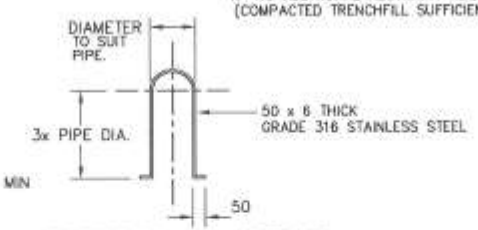


ELEVATION

VERTICAL BENDS



SOCKETED VALVES



TYPICAL SS STRAP

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
2. ANCHOR BLOCKS IN THE TABLE ARE DESIGNED FOR A TEST PRESSURE OF 1000 kPa (100 m HEAD). ADJUST CONCRETE VOLUME TO SUIT ACTUAL TEST PRESSURE.
3. WHERE DI PIPES AND FITTINGS WITH RESTRAINED JOINTS ARE USED THRUST BLOCKS ARE NOT REQUIRED. SEE WAT-1208.
4. THRUST BLOCK REINFORCEMENT AS SPECIFIED IN DESIGN DRAWINGS.
5. WHERE SPECIFIED PROVIDE CONCRETE THRUST BLOCKS FOR SOC-SOC VALVES. THRUST AREA TO BE AS FOR DEAD ENDS AS SHOWN IN WAT-1205.
6. INSTALL PUDDLE FLANGES ON CLASS K12 DICL PIPE.

ANCHOR BLOCK CONSTRUCTION NOTES:

- LOCATE ANCHOR BLOCK CENTRALLY AROUND BEND.
- KEY ANCHOR BLOCK INTO BASE OF TRENCH A MINIMUM DEPTH OF 250.
- POUR CONCRETE AGAINST A SOLID EXCAVATION FACE.
- USE GRADE N20 CONCRETE.
- KEEP CONCRETE CLEAR OF ALL BOLTS, NUTS AND PIPE JOINTS.

WATER SERVICES ASSOCIATION of Australia

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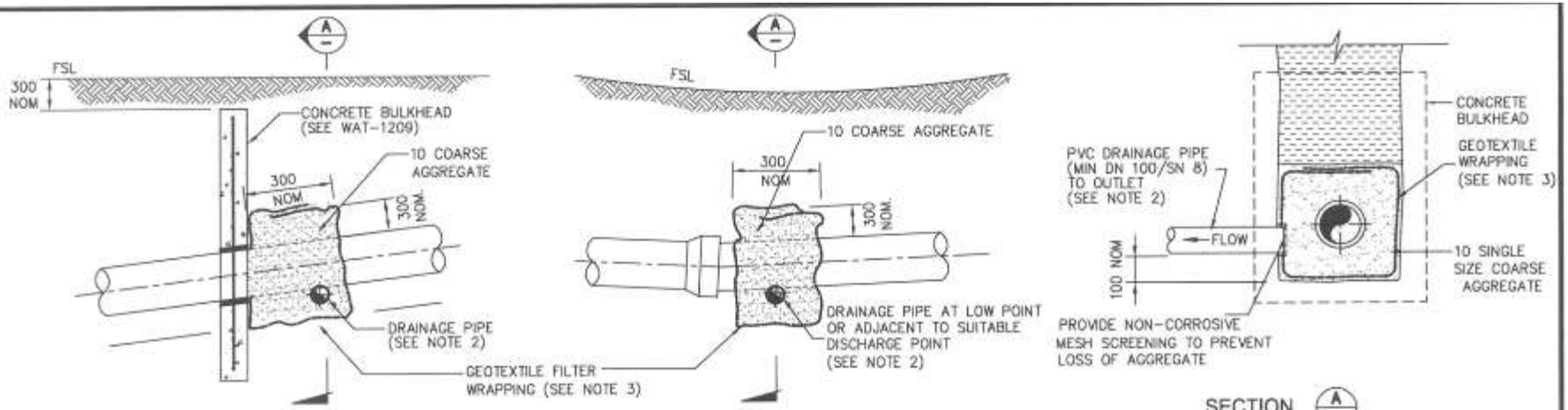
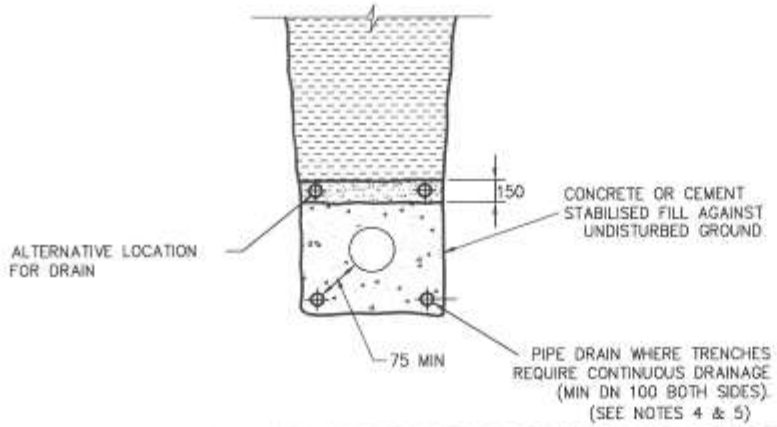
THRUST AND ANCHOR BLOCKS
GATE VALVES AND VERTICAL BENDS

NOT TO SCALE

WAT–1207



TYPICAL DISCHARGE SYSTEM FOR PIPE TRENCHES



TRENCH DRAINAGE FOR CONCRETE ENCASEMENT/STABILISATION

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. DRAINAGE PIPES TO DISCHARGE INTO AUTHORISED WATER DISCHARGE AREAS (AS SHOWN IN DESIGN DRAWINGS).
3. LAY GEOTEXTILE FILTER FABRIC IN TRENCH SUCH THAT IT FULLY ENCAPSULATES THE DRAINAGE MATERIAL (COARSE AGGREGATE). PROVIDE MINIMUM OF 250 LAP AT ALL FILTER FABRIC JOINTS.
4. PROVIDE CONTINUOUS DRAINAGE PATH:
   - THROUGH BULKHEADS.
   - IN TRENCH EXCAVATIONS ACROSS ROADWAY.
5. WHERE REINFORCING IS USED LOCATE DRAIN INSIDE THE REINFORCING. DEPTH MAY NEED TO BE INCREASED TO COMPENSATE.

WATER SERVICES ASSOCIATION of Australia	WATER SUPPLY CODE OF AUSTRALIA TRENCH DRAINAGE TYPICAL SYSTEMS	NOT TO SCALE WAT-1210 © WSAA 2002

APPENDIX A – Checklists – Water Reticulation Design

Item No.	Description	Reference	Developer Confirmation	GSC Confirmation	Comments
1	Water Servicing Strategy	4.5.2			
2	Future Demands	4.5.3			
3	Water Reticulation Areas	4.6			
4	Trickle Flow Areas	4.7			

4.8 APPENDIX B – Information to be shown on Water Reticulation Drawings

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
1	**General**			
1a	Cover Sheet with Locality Plan, List of Drawings and DA number			
1b	Plans prepared in A1 format at a scale of 1:500			
1c	Drawing Scale is shown on drawings as a bar scale			
1d	Scale of Detail Drawings is shown as appropriate			
1e	Schedule of Symbols			
1f	Benchmark within 100 metres of development site is shown			
1g	North Point shown			
1h	Site topography is shown via contour lines			
1i	Datum reference incl. Benchmark at A.H.D adopted by N.S.W. Dept. of Lands			
1j	Each plan to be numbered with revision no. and revision schedule			
1k	Road names or number			
1l	Drawings to be signed by respective Consultant / Engineer			
1m	Lettering, line work and symbols to conform to AS 1100			
1n	Water mains to be shown on road cross sections			
2	**Water Layout Plans**			
2a	Existing water mains and services are shown			
2b	Lot boundaries and numbers shown			
2c	Pipelines are numbered			
2d	Pipeline centreline chainages are shown			
2e	Pipeline diameters are shown			
2f	Terminations at Cul-de Sac's through pathways, reserves or loop shown			
2g	Location and size of water services shown			
2h	Type and class of pipe work and fittings clearly indicated			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
2i	Location of hydrants, stop valves especially at intersections, scour valves, air valves and other fittings to be shown			
2j	Alignment of mains and services in accordance with respective footpath allocations for urban and rural residential			
2k	Location of proposed easements reserves etc. incl. downstream if required			
2l	Location of all drainage lines, sewer lines and other utility lines crossing the mains to be shown			
2m	Limit of construction to be shown including staging			
2n	Mains to be extended to the full length of the subdivision			
2o	Service connection to each block			
2p	A hydrant is to be located at dead ends			
2q	Hydrant spacing to be as per guidelines			
2r	Thrust blocks to be indicated where required			
2s	Water services at right angles to road centreline and parallel to the radius on curves and in Cul-de-Sac ends			
2t	Metal detectable tape to be shown when non metallic pipe is proposed			
3	**Water Longitudinal Sections**			
3a	Sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
3b	Levels to be shown at 20m chainage intervals, high and low points and pipe junctions			
3c	Chainages as per layout plan			
3d	RL of existing surface, design surface and pipe invert at each location of 3b above and at major variations in natural surface such as roads, gullies etc.			
3e	Location of hydrants, stop valves, scour valves, air valves and other fittings			
3f	Design grades including extent of each gradient			
3g	Pipe diameters and material type and class to be shown			
3h	Air valves or hydrants at high points			
3i	Scour valves at low points			
3j	Location and size of existing and proposed services and utilities crossing the main complete with invert levels			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
3k	Sections to be taken along intersecting roads for a sufficient distance to allow connection design			
3l	Trench stops shown as required on steep grades			
3m	All new water services to be shown			
3n	Mains satisfy cover requirements			
5	**Miscellaneous**			
5a	Show differing water supply zones if applicable			
5b	Design is satisfactory for future extension			
5c	Pipe sizes conform to current strategies for future development			
5d	Detailed engineering drawings are required for any structures such as reservoirs and pumping stations proposed for construction in conjunction with water supply works			
5e	All allotments including areas set aside for recreation to be provided with a reticulated water supply sufficient for both domestic and fire fighting purposes except where trickle flow has been determined			
5f	Engineering plans and subdivision plans agree			
5g	Engineering conditions of consent included in design plans			
5h	Water service sizes in accordance with N.S.W. Code of Practice for Plumbing and Drainage 2006			
5i	Mains to be designed to satisfy minimum cover requirements			
5k	Minimum pipe size is 100mm diameter for residential and 150mm diameter for commercial and industrial areas.			

PART 5

GUIDELINES FOR

SEWERAGE

RETICULATION

DESIGN

5 SEWERAGE RETICULATION DESIGN

5.1 Introduction

This document outlines Gunnedah Shire Council's recommended practice for design of sewerage reticulation. It is in no way a comprehensive "Design Manual" and it is intended to be read in conjunction with and as a supplement to, relevant government department publications.

The other parts of the Engineering Design Guidelines for Subdivisions and Developments are as follows:

Part 1 General Requirements

Part 2 Guidelines for Design of Roads

Part 3 Guidelines for Design of Drainage

Part 4 Guidelines for Water Reticulation Design

Part 6 Guidelines for Landscaping

5.2 Definitions

Any reference to Director in this section will be taken as a reference to the Director – Infrastructure Services, or nominated representative.

5.3 Gravity, Pump Out or Low Pressure

Councils preferred method of providing sewerage services to individual properties is via gravity sewer connected into Council's existing reticulation.

Individual connections in both residential and industrial/commercial areas that cannot be connected to the existing reticulation via gravity can be connected to the existing reticulation via a pump out system, but only after it has been demonstrated that the provision of gravity sewer is not possible. Certain conditions including responsibility for various components of the system may apply and council approval prior to any design or construction is essential.

5.4 General Requirements

The design of sewers is controlled by the application of design and construction guidelines as detailed below.

The guidelines apply to the design of sewer in industrial or residential areas including medium density development.

5.4.1 DESIGN

Any development application that involves changes to the existing, new, or extension of existing sewer infrastructure must be accompanied by documentation that complies with the requirements detailed in the following sections including plans and calculations at the time of submission.

5.4.2 SERVICING STRATEGY

All design elements submitted must comply with the Servicing Strategy approved by Council as part of the conditions of development consent issued for the subject development, as appropriate.

Changes to the approved Servicing Strategy must be approved by the Director prior to the submission of plans and associated documentation.

5.4.3 FUTURE LOADING

Reticulation components are to be sized to cater for proposed future development.

In certain cases where Developers are requested by Council to construct infrastructure that caters for future loading as well as their own development, Council will reimburse the difference in cost between constructing the larger components and the size required to service the development.

For further details please refer to Council's policy:- Reimbursement of Developers for Construction of Water and Sewer Infrastructure.

5.4.4 PLANS AND CALCULATIONS

The Checklist – Sewer Design in **APPENDIX A** shall be completed and submitted with the Drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to Council, the Drawings shall be returned to the developer for amendment. Council shall only commence review of the design drawings once it is satisfied that all the requirements of the checklist have been met.

Design drawings and calculations shall be submitted to Council for approval. Information to be included in the design drawings is detailed in **APPENDIX B** – Information to be shown on Sewer Reticulation Drawings. The completed Checklist shall be submitted with the Drawings.

5.4.5 EXCAVATING OR BUILDING ADJACENT TO OR OVER EXISTING SEWER MAINS

Council has adopted a policy entitled Sewer- *Building Over Sewer Mains* which provides details of circumstances when building, filling or excavating adjacent to or over existing sewers will or will not be approved and the minimum requirements if work is approved.

The policy can be viewed on Council's website.

5.5 Gravity Sewer

5.5.1 LOCATIONS AND COVER

Sewers should be located wherever possible as follows:

a) on public road reserves

- within the footpath allocation as detailed in the General Requirements Section of these Guidelines.

b) on private property

- adjacent to and parallel to a property boundary.

Where sewer mains are located within lots adjacent to storm water drainage lines, the sewer should be laid with a minimum 0.5m separation between the outside of the sewer and the outside of the stormwater pipe in the horizontal direction.

Sewer mains shall extend to the extremity of the development where potential exists for future developments.

Minimum cover required to mains and junctions is 900 millimetres in road carriageways and 600 millimetres elsewhere and 750 in private residential properties subject to vehicle loading.

Where sewers of different diameters intersect or join, the maximum depth of the smaller pipe is to be such that the pipe inverts are at the same level.

5.5.2 MATERIALS

Reticulation pipelines and fittings may be of any of the following materials manufactured in accordance with the relevant Standards,

uPVC SN10, -A.S. 1260

Twin – walled corrugated Polyethylene SN10

All pipes shall be rubber ring jointed or butt welded in the case of polyethylene.

PVC pipes are to be maximum 3 metres in length.

5.5.3 JUNCTIONS

Where depth to the invert of the main exceeds 1.5 metres, sewer junctions are to be raised on a vertical shaft so that depth to invert is not greater than 1.5 metres.

5.5.4 SIDELINES

Junctions exceeding 10 metres in length are considered to be a side line and require an access chamber where they enter the main. When the sewer main is outside the property boundary the service should be perpendicular to the sewer mains.

5.5.5 MARKING OF JUNCTIONS AND SIDELINES

The position of each riser, junction or end of a sideline should be clearly marked by the Contractor on completion of backfilling.

A red survey peg should be used to indicate the location of sewer junctions. The peg should be tied to an underground identification tape, connected to the sewer junction. The contractor should adjust the levels of pegs where necessary to conform to final surface level at the time of notification of completion.

The position of each riser, junction or end of a sideline, dimensioned relative to at least 2 adjacent property boundaries must be shown on Works as Executed drawings to allow location at some future date.

Each junction should have the junction distance from the nearest downstream manhole and depth indicated on the W.A.E. plans.

5.5.6 ACCESS CHAMBERS

Sewer access chambers are required at all changes of grade, deflections, line intersections and at all dead-ends exceeding 10 metres in length.

The bases for access chambers may be either cast-in-situ or precast whilst chambers are to be precast. The developer is required to submit detailed drawings of proposed access structures for approval.

Sewer access chambers should not be located in road carriageways.

An internal manhole drop between inlet and outlet is required as follows:

Deflection Angle	Drop (mm)
0°to 45°	30
46° to 90°	50
91° to 135°	100

Part 5 – Table A – Internal Manhole Drop

Deflections greater than 135° are not permitted.

Maximum spacing for access chambers should be as follows:

Pipe Size(mm)	Access Chambers Spacing (m)
150	80
225	100
300	120
375 and above	150

Part 5 – Table B – Spacing for Access Chambers

5.5.7 EXISTING ACCESS CHAMBERS AND SERVICES

Where the development is utilising existing sewer mains or junctions, the mains, access chambers or junctions must be upgraded to meet the current guideline requirements.

5.5.8 SOFFIT REQUIREMENT

Council has adopted the Sewer Code of Australia which stipulates as follows:

5.5.8.1 Minimum depth of sewer connection point

5.5.8.1.1 *General*

The soffit requirement is the depth from the controlling surface level on the property to the soffit of the sewer connection point (refer Figure 5.1). The soffit requirement is based on providing assurance that a reticulation sewer, flowing at full capacity, will not surcharge via the customer sanitary drain.

There are two controlling factors viz. soffit and physical losses, either of which may determine the minimum depth of the sewer connection point. Where the minimum soffit depth is greater than the physical losses, then soffit shall be used as the minimum depth control. Alternatively, where the physical losses are greater than the soffit depth, the physical losses shall be used to calculate the connection level.

5.5.8.1.1 *Soffit requirement*

The soffit requirement applies to all sewered properties and shall be:

(a) 750 mm where water seals are not required as part of the customer sanitary drain;

(b) 900 mm where water seals are required as part of the customer sanitary drain; and

(c) apply to all sewered buildings, existing and proposed.

With the approval of the Water Agency, the soffit requirements of 750 mm and 900 mm may be reduced by 150 mm where:

(i) the number of properties connected upstream of the subject property does not exceed 10 or the equivalent loading; or

(ii) the grade of the sewer downstream of the property connection is steeper than 3.0%.

Where the minimum soffit requirement cannot be met for an existing property, alternative means of safeguarding against surcharge shall be determined e.g. pumping system, installation of reflux valve. Such measures shall comply with AS/NZS 3500.2.2 and the Plumbing Regulator's requirements.

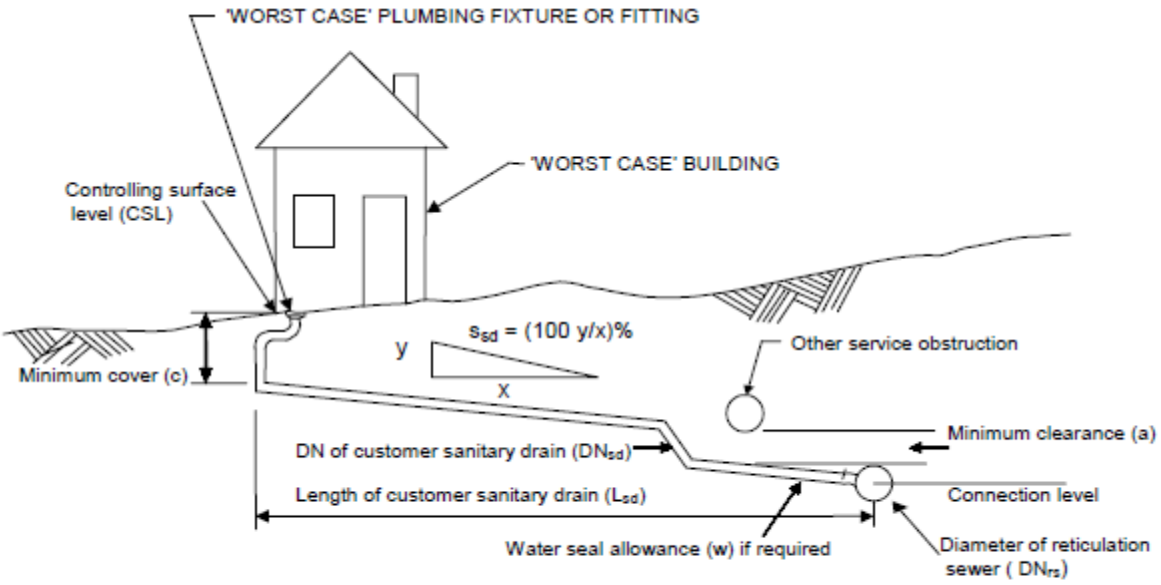


FIGURE 5.1 PHYSICAL LOSSES IN CUSTOMER SANITARY DRAINS

5.5.9 SEWER EASEMENTS

Easements are required over Council's sewer mains crossing private property. It is the responsibility of the developer to obtain sewer easements from any other land if required. (The Subdivision Certificate will not be released until the above requirements have been complied with).

The developer should transfer to Council any sewer easements provided in the subdivision and execute a transfer and grant of easement in favour of Council pursuant to Section 88B of the Conveyancing Act 1919, as amended. The minimum width of sewer easement should be 3.0m. In “shared” easements this width may need to be increased.

5.5.10 DESIGN CRITERIA

All lots are to be provided with a sewer junction, so placed that the whole of the lot can be gravity sewered.

A 150 millimetre diameter sewer junction is to be provided within each lot. The depth of the junction is to be such that any location within the lot can be drained to it via a pipe with a minimum 300 millimetres of cover laid at a grade of 1 in 60.

5.5.10.1 DESIGN FLOWS

The design flows should be calculated in accordance with the AWA Sewer Code of Australia 2002

5.5.10.2 DESIGN OF SYSTEM COMPONENTS

The sewerage system components should be designed generally in accordance with AWA Sewer Code of Australia 2002

5.5.10.3 MAXIMUM AND MINIMUM ALLOWABLE LOADINGS - RETICULATION MAINS

The minimum size for gravity sewer mains is 150 millimetre diameter

Gravity reticulation mains capacity should be greater than or equal to P.W.W.F. and grading sufficient to achieve self-cleansing velocity at Peak Dry Weather Flow (P.D.W.F.)

Part 5 Table D gives maximum and minimum allowable loadings for various diameter pipes.

The maximum acceptable grade for any sewer is 1 in 30, whilst the minimum acceptable grades are detailed in Part 5 Table D.

5.5.10.4 VALUES FOR ROUGHNESS

The values of roughness to be used in the design of gravity sewers are detailed Part 5 Table A:

Nominal Pipe Size (mm)	Full Flow – for estimation of Peak Hydraulic Capacity	Partial Flow – for estimation of Self-Cleansing Flows
150 – 300	k = 0.6mm	k = 1.5 normal k = 3.0 for control lines
375 – 600	K = 0.6mm	K = 3.0mm
Above 600	K = 1.5mm	K = 6.0mm

Part 5 - Table C – Value of Roughness

Note: Control Lines are those lines which affect the overall depth of system.

GRADING TABLE - GRAVITY SEWERS

150 - 600mm Nominal Size Pipelines

Pipe Diameter (mm)	150			225			300			375		450		525		600			Pipe Diameter (mm)
Grade 1 in	Tenements			Tenements			Tenements			Tenements		Tenements		Tenements		Tenements			Grade 1 in
	K	Min. 1.5	Min. 3.0	Max 0.6	Min. 1.5	Min. 3.0	Max 0.6	Min. 1.5	Min. 3.0	Max 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	K	
80	1	1	221																80
90	3	2	208																90
100	6	4	196	11	8	609													100
110	9	7	186	15	11	580													110
120	13	10	178	20	15	553	28	22	1225										120
130	18	14	170	25	20	530	33	27	1175										130
140	23	18	164	31	25	510	38	32	1129	39	2081								140
150	30	24	158	36	30	492	43	36	1089	44	2007								150
160	35	30	152	41	35	475	49	41	1053	49	1941	58	3188						160
180	48	41	143	52	45	446	61	52	989	61	1825	71	3000						180
200	65	56	135	66	57	422	76	65	936	75	1727	86	2839	98	4313				200
220	89	77	128	83	71	401	92	79	890	90	1642	103	2703	116	4104				220
250	204	176	119	113	97	374	120	105	832	117	1536	131	2527	146	3840	163	5511		250
300				186	161	339	184	159	755	172	1395	188	2296	207	3492	227	5013		300
350				324	283	312	269	234	695	242	1287	259	2118	281	3222	305	4627		350
400							389	340	648	332	1199	347	1975	370	3006	396	4316		400
450							577	507	608	448	1120	585	1855	475	2826	504	4060		450
500							1175	1039	575	602	1066	747	1757	600	2674	628	3843		500
550										819	1013	953	1670	748	2544	773	3656		550
600		Normal Flattest grade be adopted								1191	967	1226	1596	926	2430	940	3494		600
650		in reticulation design - - - - -										1630	1531	1138	2331	1134	3351		650
700												2829	1471	1400	2242	1362	3222		700
750													1420	1732	2162	1628	3109		750
800		Absolute limiting grade for pipeline												2186	2089	1948	3006		800
850		designed to be cleaned by gravity												2925	2024	2341	2926		850
900		flows														2850	2825		900
1000																5668	2673		1000

Part 5 – Table D – Maximum and Minimum allowable loadings

5.6 Rising Mains

Velocity in the rising main should not exceed 3.0 metres per second and be a minimum of 0.7 metres per second.

5.6.1 MATERIALS

All rising mains must be constructed from material which is compatible with Ductile Iron fittings.

Council may direct that any rising main should be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with AS2280.

All cast or ductile iron fittings should be cement or epoxy lined and conform to AS2544 and AS 2280 respectively. Stop valves and scour valves are to be clockwise closing (CC) and resilient seated, with stop valves to have a minimum pressure rating of Class 16.

Where it is proposed to use pipe material other than Ductile Iron the Developer will be required to show that the material proposed conforms as follows:

- Pipe is suitable to meet pressure requirements at the proposed location;
- Has the required minimum required pressure rating of PN16, SDR 11;
- Is compatible with Ductile Iron fittings;
- Fatigue and/or cyclical load testing indicates the material will meet a minimum 50 year design life;
- Will not be adversely effected, in terms of shape and strength by construction loading;
- Installation method to manufacturers instruction for minimum 50 year design life; and
- Complies with a relevant Australian Standard.

5.6.2 VALVES, FITTINGS AND VENTS

Each pump discharge line is to be provided with a reflux valve and stop valve, the stop valve is to be positioned upstream from the reflux valve.

An approved air valve is required at high points in the main.

A scour valve and line is required to enable the rising main to be completely drained of sewage.

The receiving manhole is to be vented.

The developer is required to submit detailed drawings of rising mains and receiving access chambers for approval.

5.6.3 PUMPING STATIONS

Wet well capacity is to be sufficient for the total ultimate Peak Wet Weather Flow (P.W.W .F.).

Pumps are to be sized for a maximum 10 starts per hour and provide a self cleansing velocity of 0.6 metres per second in the rising main.

Minimum volume from top water level to bottom water level is to be the volume pumped in 90 seconds.

The combined detention time in the wet well and rising main should not exceed 4 hours. Full stand-by pump capacity is required.

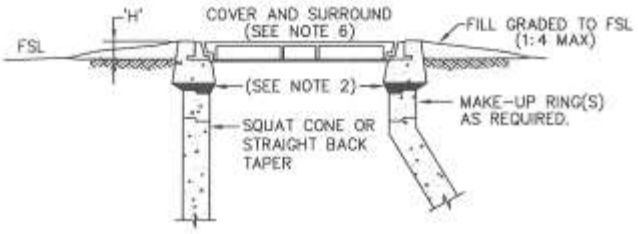
All incoming lines to a pump station are to be fitted with a knife type isolation valve at the end of the incoming line.

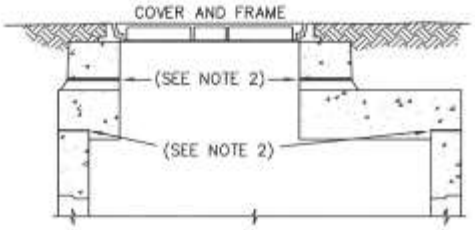
5.7 Low Pressure Sewer

Council is not generally in favour of low pressure sewer systems however some advice is provided for developers in Appendix C. Special approval must be obtained from Council and no other economic alternatives are available.

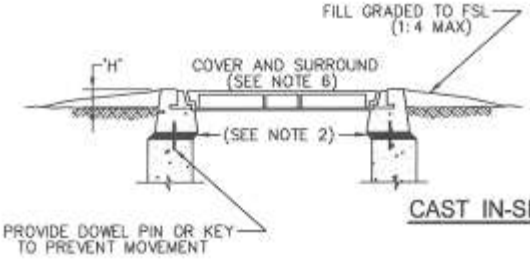
5.8 DRAWINGS - Sewerage Reticulation

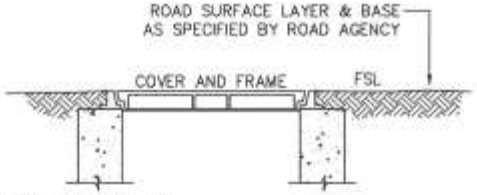
Sewerage Reticulation - Manhole Covers	**SEW-1308**
Sewerage Reticulation -Access chambers	**SEW-1301, 1303, 1304, 1315, 1316, 1317**
Precast Manhole Components	**SEW-1300**
Sewer Main Trench Details	**SEW-1201, 1202, 1203**
Design Layout	**SEW-1100**



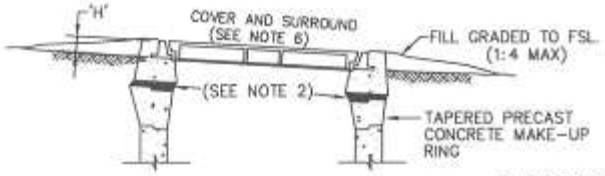


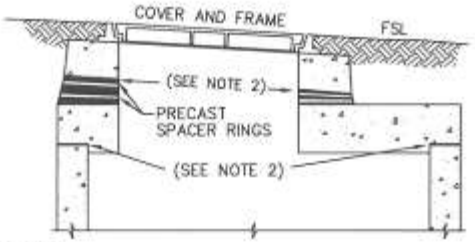
PRECAST MAINTENANCE HOLES





CAST IN-SITU MAINTENANCE HOLES





SLOPING GROUND
(SEE NOTE 5)

NON TRAFFICABLE COVERS

TRAFFICABLE COVERS

FINISHED LEVELS OF MH COVERS	
LOCATION	H
UNDEVELOPED AREAS	100
NEW SUBDIVISIONS	75
ROADS, LANE WAYS, FOOTWAYS & DRIVEWAYS	FLUSH
EXISTING BUILT UP AREAS	25
OTHER AS SPECIFIED (EG ABOVE FLOOD LEVEL)	

SELECTION OF MH COVERS	
ALL COVERS TO BE WATER TIGHT (SEE NOTE 7)	
LOCATION	CLASS
RESERVES	B – NON-TRAFFICABLE
ROADWAYS	D – TRAFFICABLE
LOCATIONS SUBJECT TO FLOODING etc.	D – TRAFFICABLE WITH BOLT-DOWN (SEE NOTE 3)

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. SEALING METHODS
   (a) MAKE JOINTS BETWEEN SHAFT TOP/MAKE-UP RING AND COVER SUPPORT RING USING
   - BUTYL-MASTIC, OR
   - MORTAR MADE FROM 3 PARTS SAND TO 1 PART CEMENT.

   (b) APPLY BUTYL-MASTIC IN ACCORDANCE WITH MANUFACTURERS SPECIFICATION.
   (c) THICKNESS OF CEMENT MORTAR AT ANY JOINT TO BE NO GREATER THAN 50.
   (d) SCABBLE AND CLEAN JOINT SURFACES SO THAT ALL LOOSE OR SOFT MATERIAL IS REMOVED.
   (e) JOINT SURFACES TO BE BRUSHED CLEAN, SPONGED WET AND PRIMED WITH A CEMENT/WATER SLURRY PRIOR TO PLACING THE CEMENT MORTAR.
3. IN AREAS SUBJECT TO SURCHARGE, USE CAST IN-SITU MH DOWEL OR BOLT COVER SLABS, DI COVER AND FRAME TO THE SHAFT SECTION IN SUCH A MANNER THAT SEPARATION DURING SURCHARGE IS PREVENTED. SEE SEW-1301.
4. WHERE SPECIFIED JOIN METAL FRAME TO CAST IN-SITU MH RISER AS FOLLOWS:
   (a) MAKE JOINTS BETWEEN SHAFT TOP AND METAL FRAME USING BUTYL-MASTIC AND LOCKING DOWN BOLTS, EQUALLY PLACED AROUND THE CIRCUMFERENCE.
   (b) USE 12 DIAMETER GALVANISED OR STAINLESS STEEL BOLTS EXTENDING 75 MIN INTO CONCRETE.
   (c) FOR NON-TRAFFICABLE LOCATIONS USE A MINIMUM OF TWO BOLTS.
   (d) FOR TRAFFICABLE LOCATIONS USE A MINIMUM OF FOUR BOLTS.
5. MAXIMUM PERMISSIBLE SLOPE OF COVERS:
   CLASS "B" 1 IN 4
   CLASS "D" 1 IN 10
6. COVERS MAY BE METAL, METAL WITH CONCRETE INFILL OR CONCRETE.
7. WHERE SPECIFIED USE GAS TIGHT COVERS.

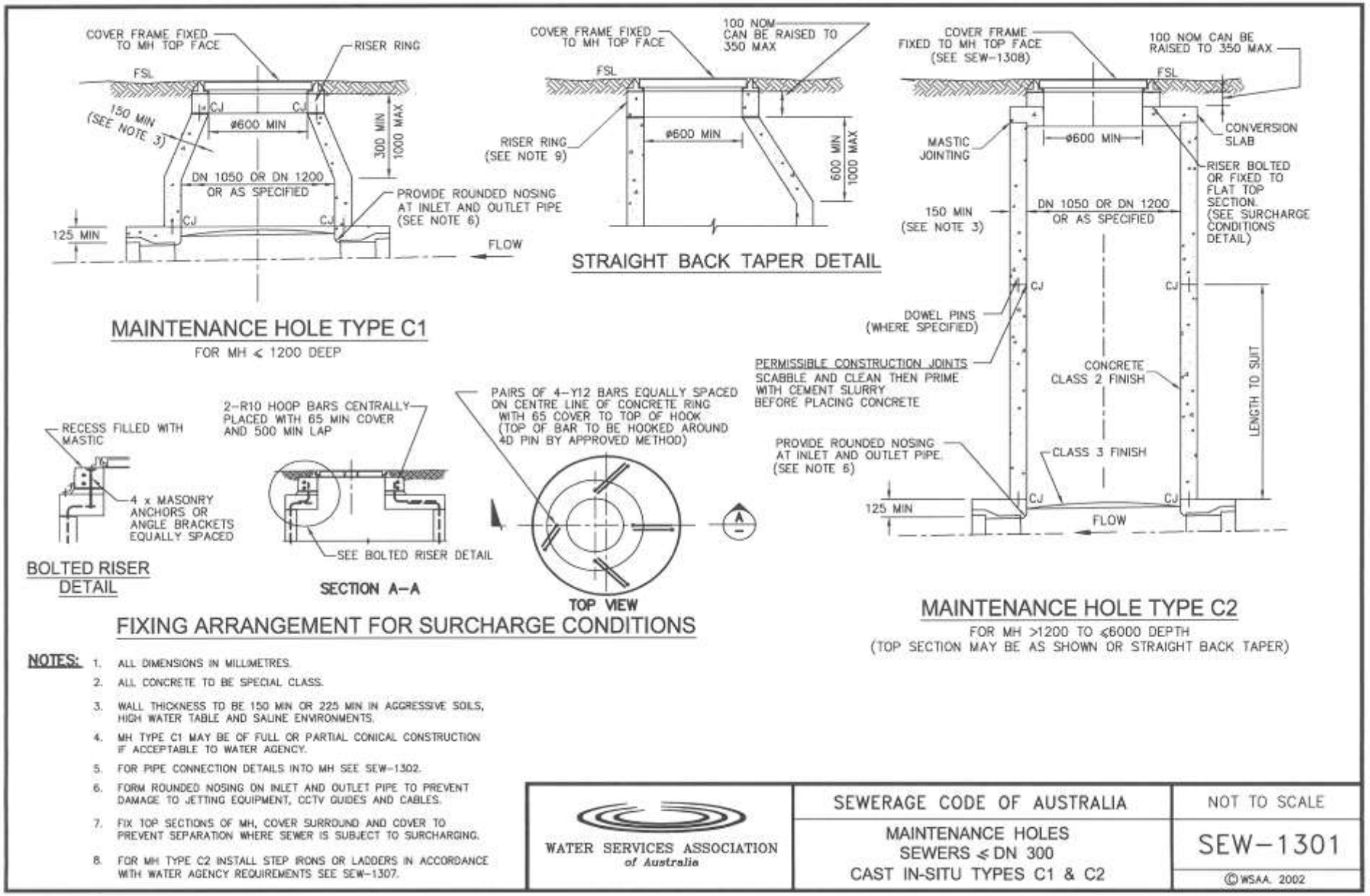
WATER SERVICES ASSOCIATION of Australia

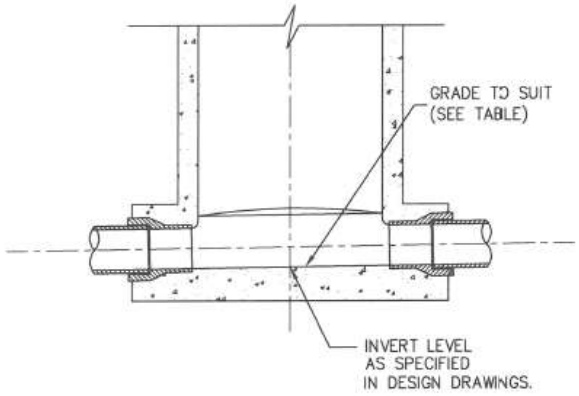
SEWERAGE CODE OF AUSTRALIA

MAINTENANCE HOLES
TYPICAL MH COVER ARRANGEMENTS

NOT TO SCALE

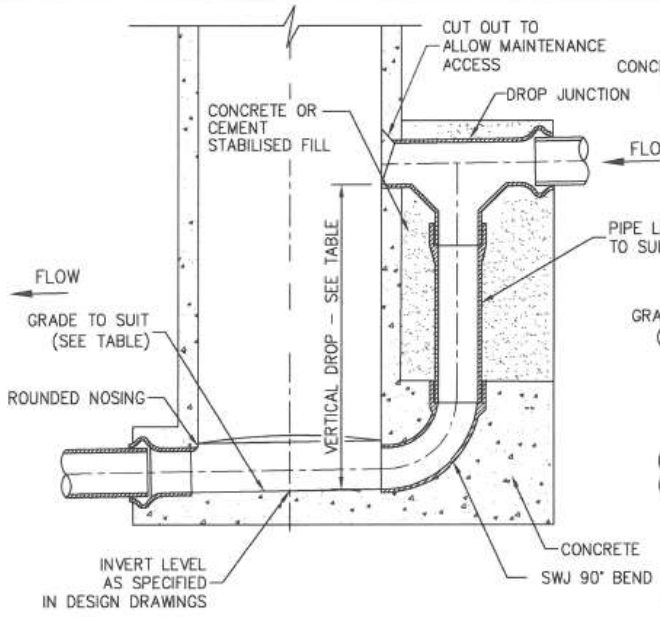
SEW-1308


COVER FRAME FIXED TO MH TOP FACE
RISER RING
FSL
150 MIN (SEE NOTE 3)
CJ
ø600 MIN
300 MIN
1000 MAX
DN 1050 OR DN 1200 OR AS SPECIFIED
PROVIDE ROUNDED NOSING AT INLET AND OUTLET PIPE (SEE NOTE 6)
125 MIN
FLOW
MAINTENANCE HOLE TYPE C1
FOR MH ≤ 1200 DEEP
COVER FRAME FIXED TO MH TOP FACE
100 NOM CAN BE RAISED TO 350 MAX
RISER RING (SEE NOTE 9)
600 MIN
STRAIGHT BACK TAPER DETAIL
COVER FRAME FIXED TO MH TOP FACE (SEE SEW-1308)
100 NOM CAN BE RAISED TO 350 MAX
MASTIC JOINTING
CONVERSION SLAB
RISER BOLTED OR FIXED TO FLAT TOP SECTION. (SEE SURCHARGE CONDITIONS DETAIL)
DOWEL PINS (WHERE SPECIFIED)
PERMISSIBLE CONSTRUCTION JOINTS SCABBLE AND CLEAN THEN PRIME WITH CEMENT SLURRY BEFORE PLACING CONCRETE
CONCRETE CLASS 2 FINISH
CLASS 3 FINISH
LENGTH TO SUIT
MAINTENANCE HOLE TYPE C2
FOR MH >1200 TO ≤6000 DEPTH
(TOP SECTION MAY BE AS SHOWN OR STRAIGHT BACK TAPER)
RECESS FILLED WITH MASTIC
4 x MASONRY ANCHORS OR ANGLE BRACKETS EQUALLY SPACED
BOLTED RISER DETAIL
2-R10 HOOP BARS CENTRALLY PLACED WITH 65 MIN COVER AND 500 MIN LAP
SEE BOLTED RISER DETAIL
SECTION A-A
PAIRS OF 4-Y12 BARS EQUALLY SPACED ON CENTRE LINE OF CONCRETE RING WITH 65 COVER TO TOP OF HOOK (TOP OF BAR TO BE HOOKED AROUND 4D PIN BY APPROVED METHOD)
TOP VIEW
FIXING ARRANGEMENT FOR SURCHARGE CONDITIONS
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL CONCRETE TO BE SPECIAL CLASS.
3. WALL THICKNESS TO BE 150 MIN OR 225 MIN IN AGGRESSIVE SOILS, HIGH WATER TABLE AND SALINE ENVIRONMENTS.
4. MH TYPE C1 MAY BE OF FULL OR PARTIAL CONICAL CONSTRUCTION IF ACCEPTABLE TO WATER AGENCY.
5. FOR PIPE CONNECTION DETAILS INTO MH SEE SEW-1302.
6. FORM ROUNDED NOSING ON INLET AND OUTLET PIPE TO PREVENT DAMAGE TO JETTING EQUIPMENT, CCTV GUIDES AND CABLES.
7. FIX TOP SECTIONS OF MH, COVER SURROUND AND COVER TO PREVENT SEPARATION WHERE SEWER IS SUBJECT TO SURCHARGING.
8. FOR MH TYPE C2 INSTALL STEP IRONS OR LADDERS IN ACCORDANCE WITH WATER AGENCY REQUIREMENTS SEE SEW-1307.
WATER SERVICES ASSOCIATION of Australia
SEWERAGE CODE OF AUSTRALIA
MAINTENANCE HOLES SEWERS ≤ DN 300 CAST IN-SITU TYPES C1 & C2
NOT TO SCALE
SEW-1301
© WSAA. 2002



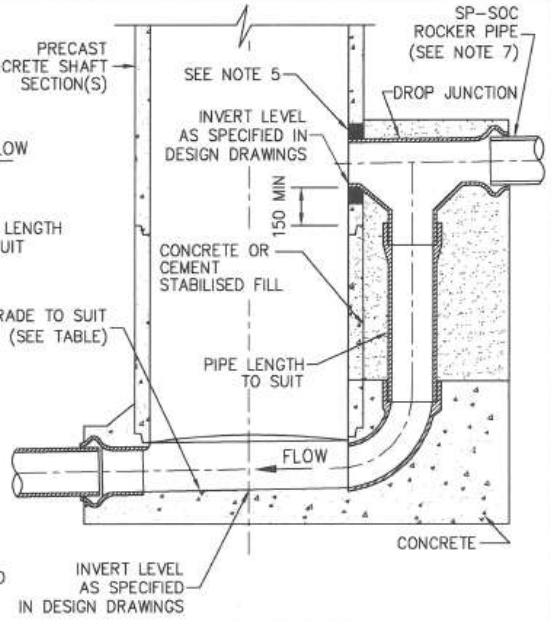
STRAIGHT THROUGH SEWER

VC PIPES SHOWN



CAST IN-SITU MH

SEE SEW–1301

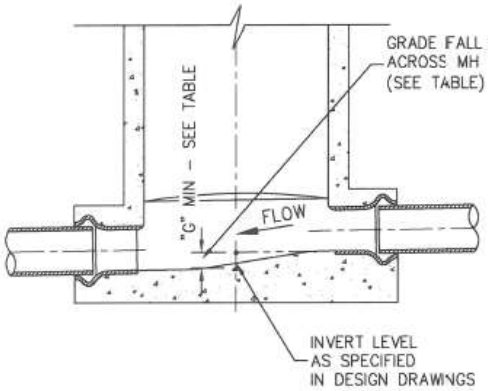


PRECAST MH

SEE SEW–1300

EXTERNAL DROP JUNCTION

PVC PIPES SHOWN



FALL ACROSS MH (INLET TO OUTLET INVERT)	
DEFLECTION ANGLE	"G" MIN
0° – 30°	30
>30° – 60°	50
>60°	80

VERTICAL DROP	
PIPE SIZE DN	MINIMUM ▲
150	460
225	710
300	880

▲ BASED ON CURRENT FITTING AVAILABILITY

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. THIS DRAWING APPLICABLE TO PRECAST AND IN–SITU MH.
3. ALL CONNECTION TYPES SHOWN IN THIS DRAWING ARE APPLICABLE TO VC, PVC SOLVENT WELD (SWJ), & PVC RUBBER RING (RRJ), PE & GRP PIPES, UNLESS OTHERWISE SPECIFIED.
4. TO ENSURE BONDING COAT PVC AND GRP PIPES CAST INTO MH WALL AND BASE WITH RESIN/SOLVENT & SAND OR ABRADE FOR THE LENGTH OF WALL PENETRATION.
5. FILL JOINT AROUND INSERT PIPE WITH AUTHORISED EPOXY OR MASTIC SEALING MATERIAL.
6. FOR DETAILS OF PIPE CONNECTION TO MH SEE SEW–1302.
7. ROCKER PIPE LENGTHS AND CONNECTION SYSTEMS TO BE AS SHOWN IN SEW–1302.
8. MAXIMUM FALL ACROSS MH TO BE 150

CHANGE IN DIRECTION THROUGH MAINTENANCE HOLE

PVC (RRJ) PIPES SHOWN

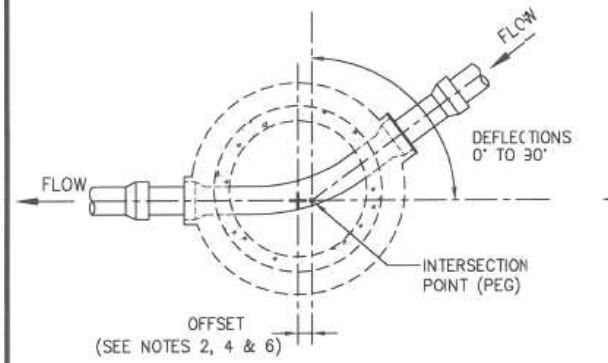
WATER SERVICES ASSOCIATION of Australia

SEWERAGE CODE OF AUSTRALIA

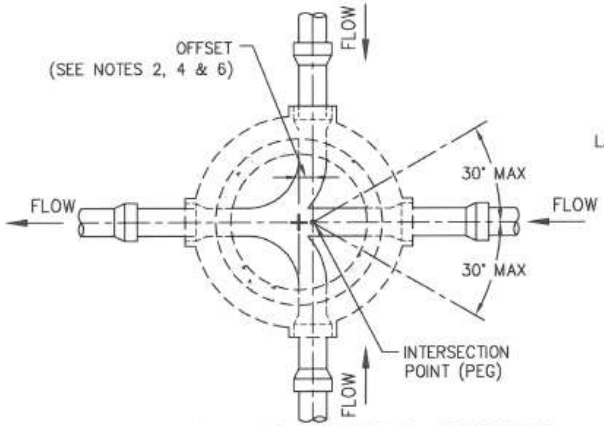
MAINTENANCE HOLES
SEWERS ⩽ DN 300
CHANGES IN LEVEL DETAILS

NOT TO SCALE

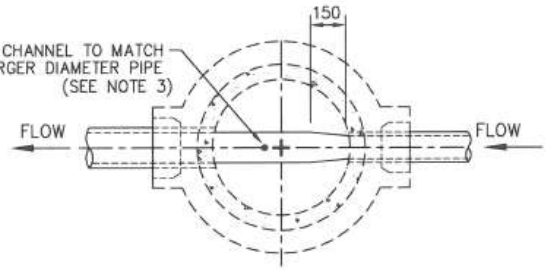
SEW–1303



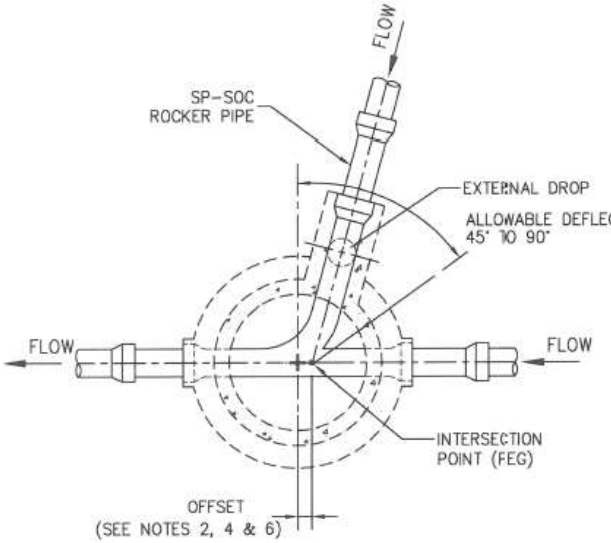
CHANGE IN DIRECTION OF SEWER

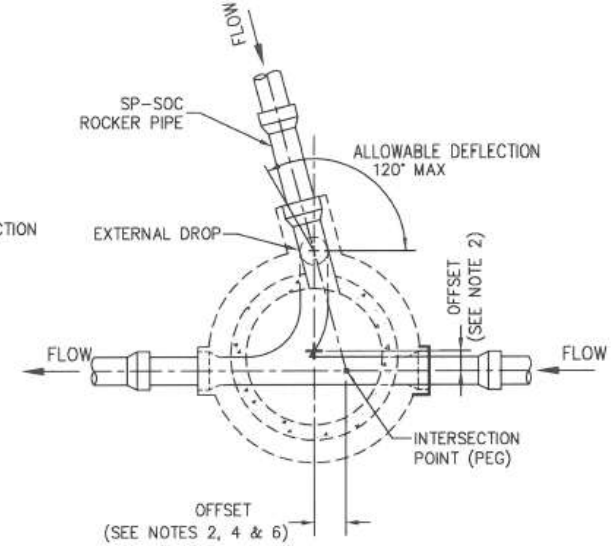


MULTIPLE INCOMING SEWERS



CHANGE IN DIAMETER OF SEWER





INCOMING SEWERS HAVING EXTERNAL DROP

LEGEND:

INTERSECTION POINT

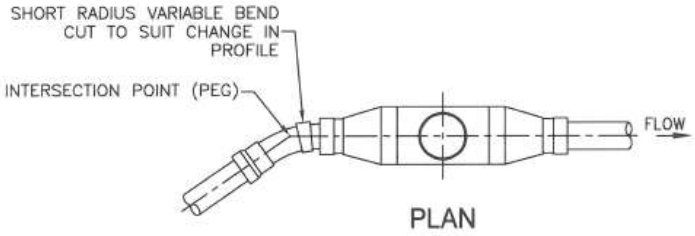
CENTRELINE OF MH

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. WHERE NECESSARY PULL MH OFF CENTRELINE OF SEWER (MAX 200) TO IMPROVE FLOW AND ACCESSIBILITY PROVIDED THE FOLLOWING CONDITIONS ARE MET:
   - ALL TANGENT POINTS TO BE CONTAINED WITHIN MH.
   - SUFFICIENT WORK AREA AVAILABLE.
   - MAINTENANCE EQUIPMENT CAN BE USED IN ALL MAINS.
   - OFFSET AS SPECIFIED.
3. INVERT LEVELS TO BE AS SHOWN IN DESIGN DRAWINGS.
4. FOR CHANNEL INTERSECTION AND OFFSET DETAILS SEE SEW-1305.
5. FOR INLET – OUTLET ARRANGEMENTS SEE SEW-1303.
6. FOR SEWERS ON STEEP GRADES OR WHERE THE INTERSECTION ANGLE IS <45° USE DROP JUNCTION AS SHOWN ON SEW-1306.

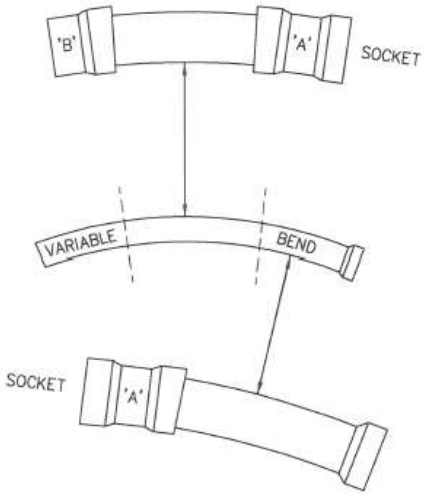
WATER SERVICES ASSOCIATION *of Australia*	SEWERAGE CODE OF AUSTRALIA	NOT TO SCALE
	MAINTENANCE HOLES SEWERS ⩽ DN 300 TYPICAL CHANNEL ARRANGEMENTS	SEW-1304

LEGEND



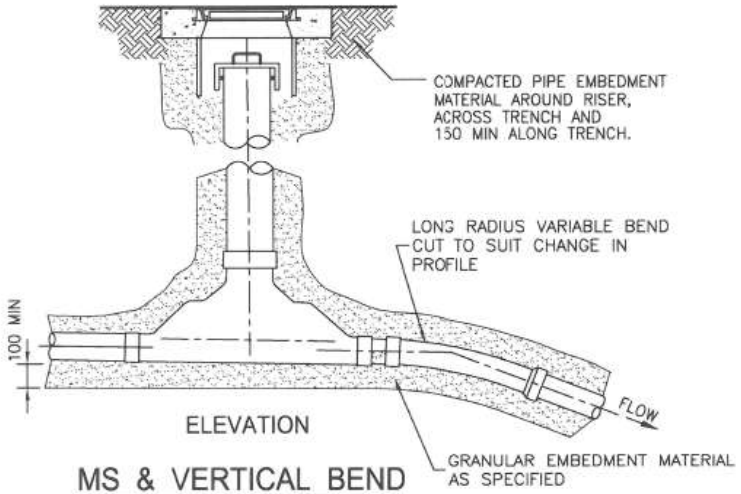
PLAN

MS & HORIZONTAL BEND



TYPICAL VARIABLE BENDS

(ALL COMBINATIONS OF ENDS ACCEPTED)



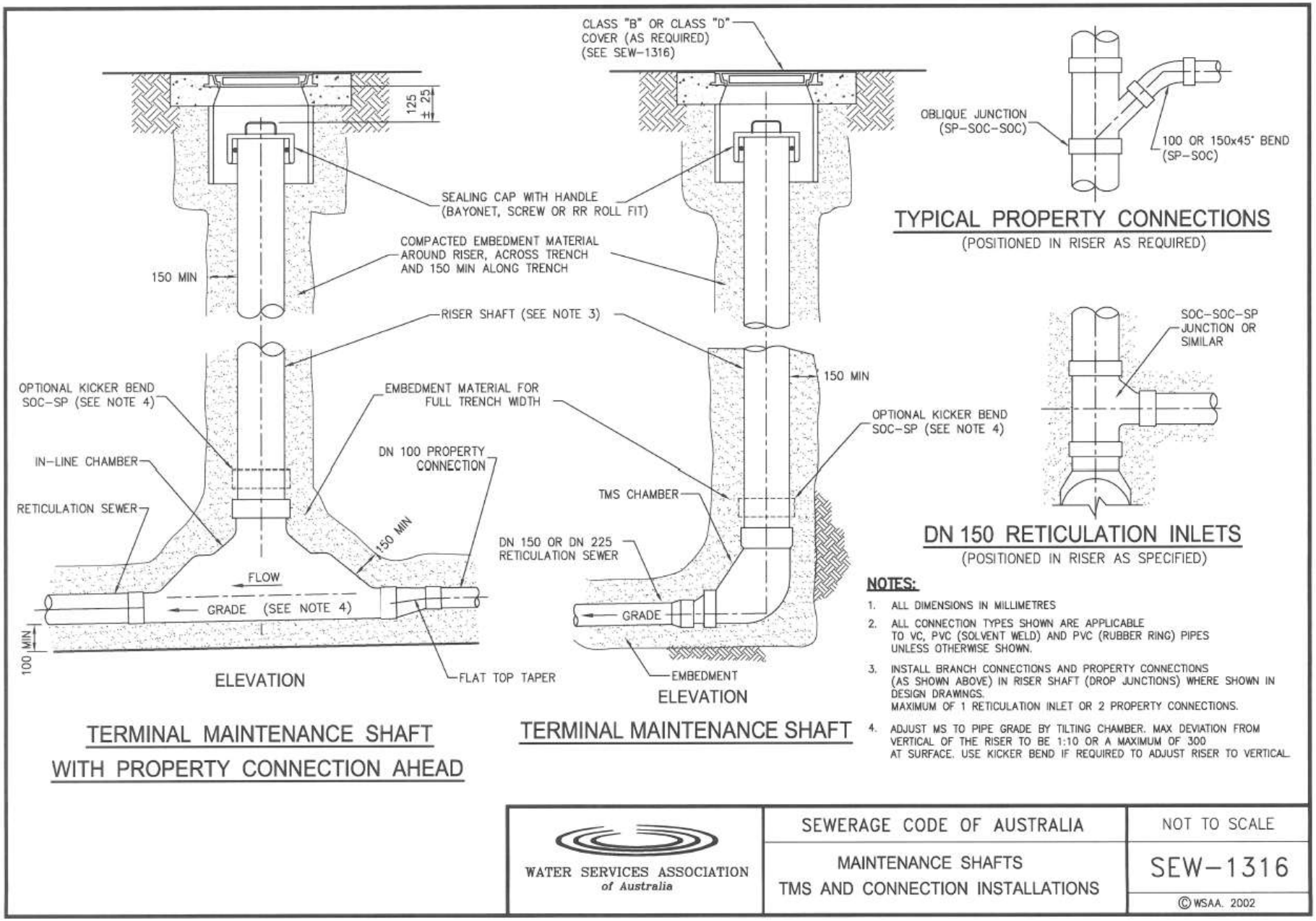
ELEVATION

MS & VERTICAL BEND

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. VARIABLE BEND CUT TO LENGTH TO ACHIEVE REQUIRED DEFLECTION.
3. RECORD DETAILS OF BEND LOCATIONS AND ANGLES ON WORK AS CONSTRUCTED DRAWINGS.

WATER SERVICES ASSOCIATION of Australia	SEWERAGE CODE OF AUSTRALIA	NOT TO SCALE
	MAINTENANCE SHAFTS MS & VARIABLE BEND INSTALLATIONS	SEW–1315


CLASS "B" OR CLASS "D" COVER (AS REQUIRED) (SEE SEW-1316)
125 + 25
SEALING CAP WITH HANDLE (BAYONET, SCREW OR RR ROLL FIT)
COMPACTED EMBEDMENT MATERIAL AROUND RISER, ACROSS TRENCH AND 150 MIN ALONG TRENCH
150 MIN
RISER SHAFT (SEE NOTE 3)
OPTIONAL KICKER BEND SOC-SP (SEE NOTE 4)
EMBEDMENT MATERIAL FOR FULL TRENCH WIDTH
IN-LINE CHAMBER
DN 100 PROPERTY CONNECTION
RETICULATION SEWER
150 MIN
FLOW
GRADE (SEE NOTE 4)
100 MIN
FLAT TOP TAPER
ELEVATION
TERMINAL MAINTENANCE SHAFT
WITH PROPERTY CONNECTION AHEAD
150 MIN
OPTIONAL KICKER BEND SOC-SP (SEE NOTE 4)
TMS CHAMBER
DN 150 OR DN 225 RETICULATION SEWER
GRADE
EMBEDMENT
ELEVATION
TERMINAL MAINTENANCE SHAFT
OBLIQUE JUNCTION (SP-SOC-SOC)
100 OR 150x45° BEND (SP-SOC)
TYPICAL PROPERTY CONNECTIONS
(POSITIONED IN RISER AS REQUIRED)
SOC-SOC-SP JUNCTION OR SIMILAR
DN 150 RETICULATION INLETS
(POSITIONED IN RISER AS SPECIFIED)
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES
2. ALL CONNECTION TYPES SHOWN ARE APPLICABLE TO VC, PVC (SOLVENT WELD) AND PVC (RUBBER RING) PIPES UNLESS OTHERWISE SHOWN.
3. INSTALL BRANCH CONNECTIONS AND PROPERTY CONNECTIONS (AS SHOWN ABOVE) IN RISER SHAFT (DROP JUNCTIONS) WHERE SHOWN IN DESIGN DRAWINGS. MAXIMUM OF 1 RETICULATION INLET OR 2 PROPERTY CONNECTIONS.
4. ADJUST MS TO PIPE GRADE BY TILTING CHAMBER. MAX DEVIATION FROM VERTICAL OF THE RISER TO BE 1:10 OR A MAXIMUM OF 300 AT SURFACE. USE KICKER BEND IF REQUIRED TO ADJUST RISER TO VERTICAL.
WATER SERVICES ASSOCIATION of Australia
SEWERAGE CODE OF AUSTRALIA
MAINTENANCE SHAFTS TMS AND CONNECTION INSTALLATIONS
NOT TO SCALE
SEW-1316
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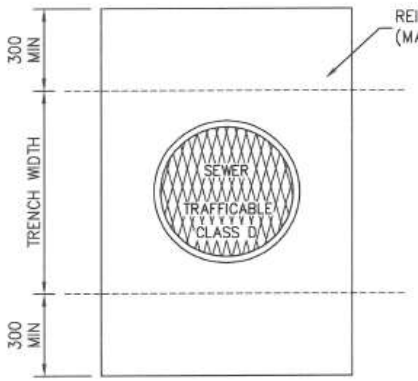
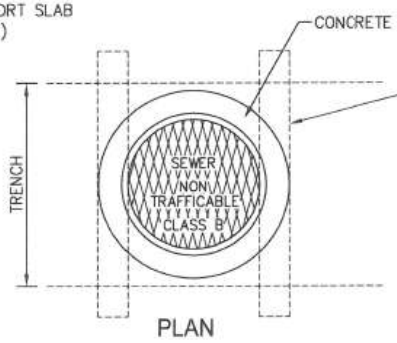
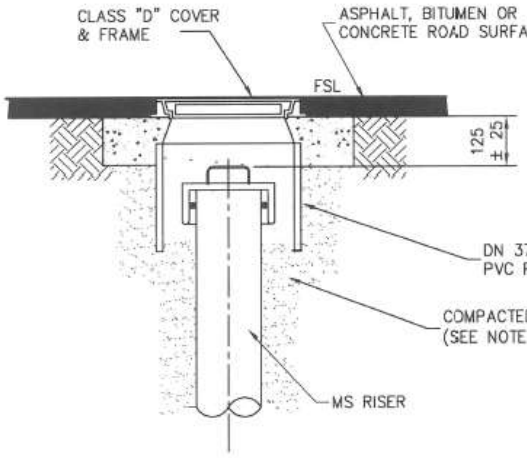


PLAN



PLAN

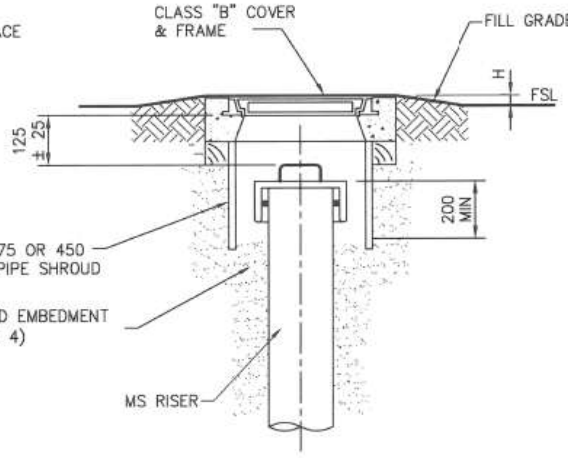
FINISHED LEVELS OF MS COVERS	
LOCATION	**H**
UNDEVELOPED AREAS	100
NEW SUBDIVISIONS	75
ROADS, LANE WAYS, FOOTWAYS & DRIVEWAYS	FLUSH
EXISTING BUILT UP AREAS	25



ELEVATION

TRAFFICABLE COVER

(CLASS D)



ELEVATION

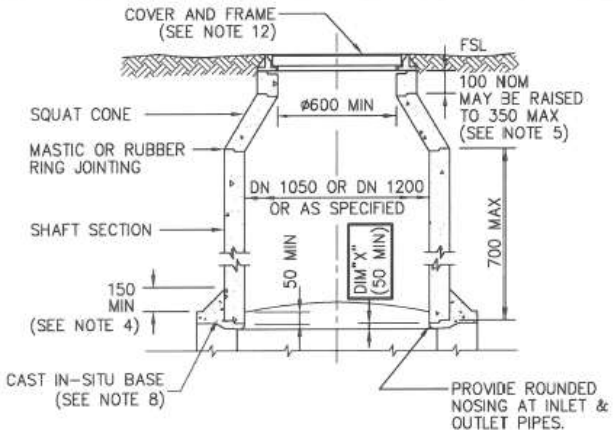
NON TRAFFICABLE COVER

(CLASS B)

NOTES:

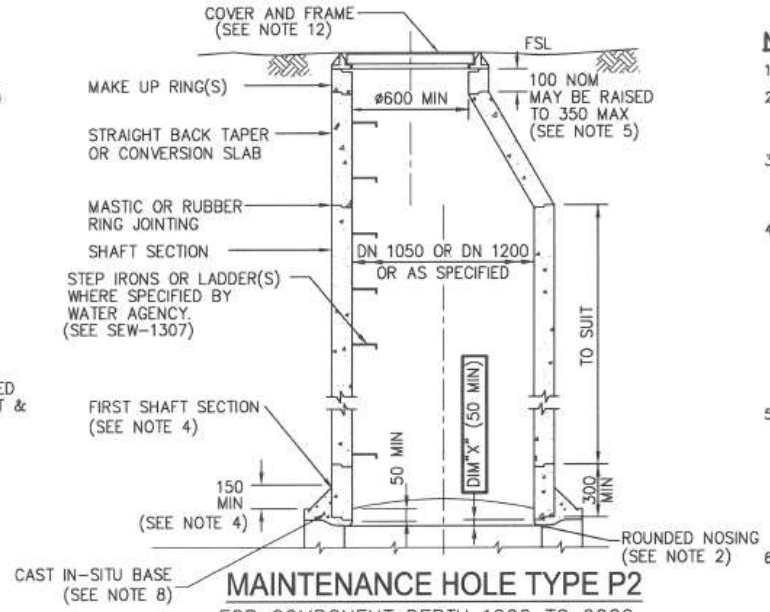
1. ALL DIMENSIONS IN MILLIMETRES
2. COVER PLACEMENT:
   - CLASS "B" FOR FOOTWAYS, PARKS AND EASEMENTS.
   - CLASS "D" FOR TRAFFICABLE AREAS.
3. COVERS AND MEANS OF SUPPORT TO BE AS AUTHORISED BY THE WATER AGENCY.
4. COMPACT BACKFILL UNDER ACCESS COVER CONCRETE SUPPORT SLABS AND SURROUNDS IN ACCORDANCE WITH DESIGN DRAWINGS.

WATER SERVICES ASSOCIATION *of Australia*	SEWERAGE CODE OF AUSTRALIA	NOT TO SCALE
	MAINTENANCE SHAFTS TYPICAL MS COVER ARRANGEMENTS	SEW–1317



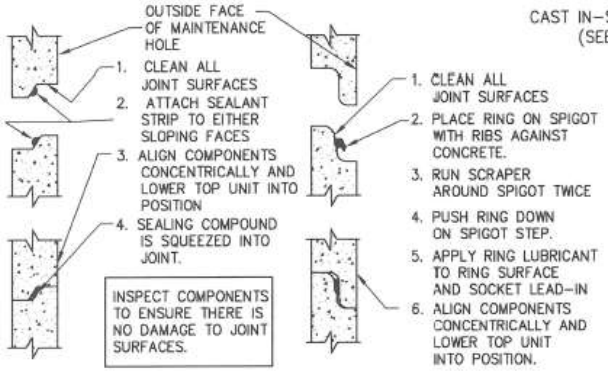
MAINTENANCE HOLE TYPE P1

FOR COMPONENT DEPTH ≤1200
(SEE NOTE 8)



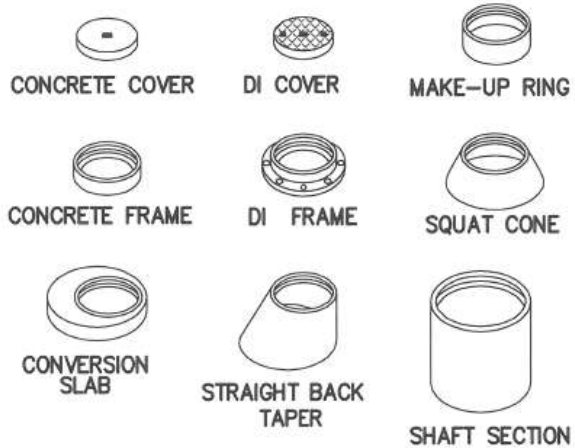
MAINTENANCE HOLE TYPE P2

FOR COMPONENT DEPTH 1200 TO 6000



MASTIC JOINT DETAILS

RUBBER RING JOINT DETAILS



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. PROVIDE ROUNDED NOSING ON INLET AND OUTLET PIPE TO PREVENT DAMAGE TO JETTING EQUIPMENT AND CCTV GUIDES AND CABLES.
3. CONSTRUCTION MAY BE A COMBINATION OF PRECAST AND IN-SITU TO SUIT APPLICATION (WATER AGENCY AUTHORISATION REQUIRED).
4. LOCATION OF FIRST SHAFT SECTION:
   a) FIRST SHAFT SECTION TO BE BETWEEN 300-600 LONG TO ALLOW FORMING OF CHANNEL AND BENCH.
   b) WHERE STEP IRONS ARE USED, CORRECTLY ORIENTATE BOTTOM STEP.
   c) PRIME COMPONENT 200 FROM BOTTOM WITH CEMENT SLURRY. EMBED SHAFT SECTION 50 INTO WET CONCRETE BUILD UP OUTSIDE FILLET TO 150.
5. MAKE-UP RINGS:
   a) USE MINIMUM OF ONE MAKE-UP RING (PREFERABLY 100 OR 150) PER MH DURING CONSTRUCTION TO ALLOW FOR FUTURE SURFACE ADJUSTMENT WITHOUT AFFECTING THE SHAFT SECTIONS.
   b) SEE SEW-1308 FOR TAPERED MAKE UP RING ON SLOPING GROUND.
6. BACKFILL AROUND MH.
   a) THE METHOD OF BACKFILL AND COMPACTION AROUND MH TO BE GENERALLY AS FOR PIPE EMBEDMENT.
   b) TAKE CARE TO RAISE SELECT FILL EQUALLY ALL AROUND THE MH TO AVOID UNBALANCED LATERAL LOADING.
7. FOR MH TYPE P2 INSTALL STEP IRONS OR LADDERS IN ACCORDANCE WITH WATER AGENCY. REQUIREMENTS. SEE SEW-1307
8. CONCRETE BASE TO BE SPECIAL CLASS.
9. IN WATER CHARGED GROUND OR WHERE THERE IS SIGNIFICANT RISK OF SURCHARGE USE ONLY CAST IN-SITU MH.
10. FOR PIPE CONNECTIONS TO MH SEE SEW-1302.
11. WHERE THERE IS SIGNIFICANT RISK OF INFILTRATION OR TREE ROOT INTRUSION APPLY AN EXTERNAL BITUMASTIC SEAL TAPE 150 WIDE OVER A COAT OF MANUFACTURERS RECOMMENDED PRIME SEAL TO ALL JOINTS.
12. FOR MH COVER CLASS SELECTION AND FINISHED LEVELS SEE SEW-1308.

CALCULATING TOTAL PRECAST COMPONENT DEPTH
(REFER NOTE 4)

TOTAL DEPTH OF PRECAST COMPONENT = DEPTH TO INVERT OF HIGHEST NON-DROP INLET PIPE MINUS (ID OF INLET PIPE + PIPE WALL THICKNESS + DIM "X")

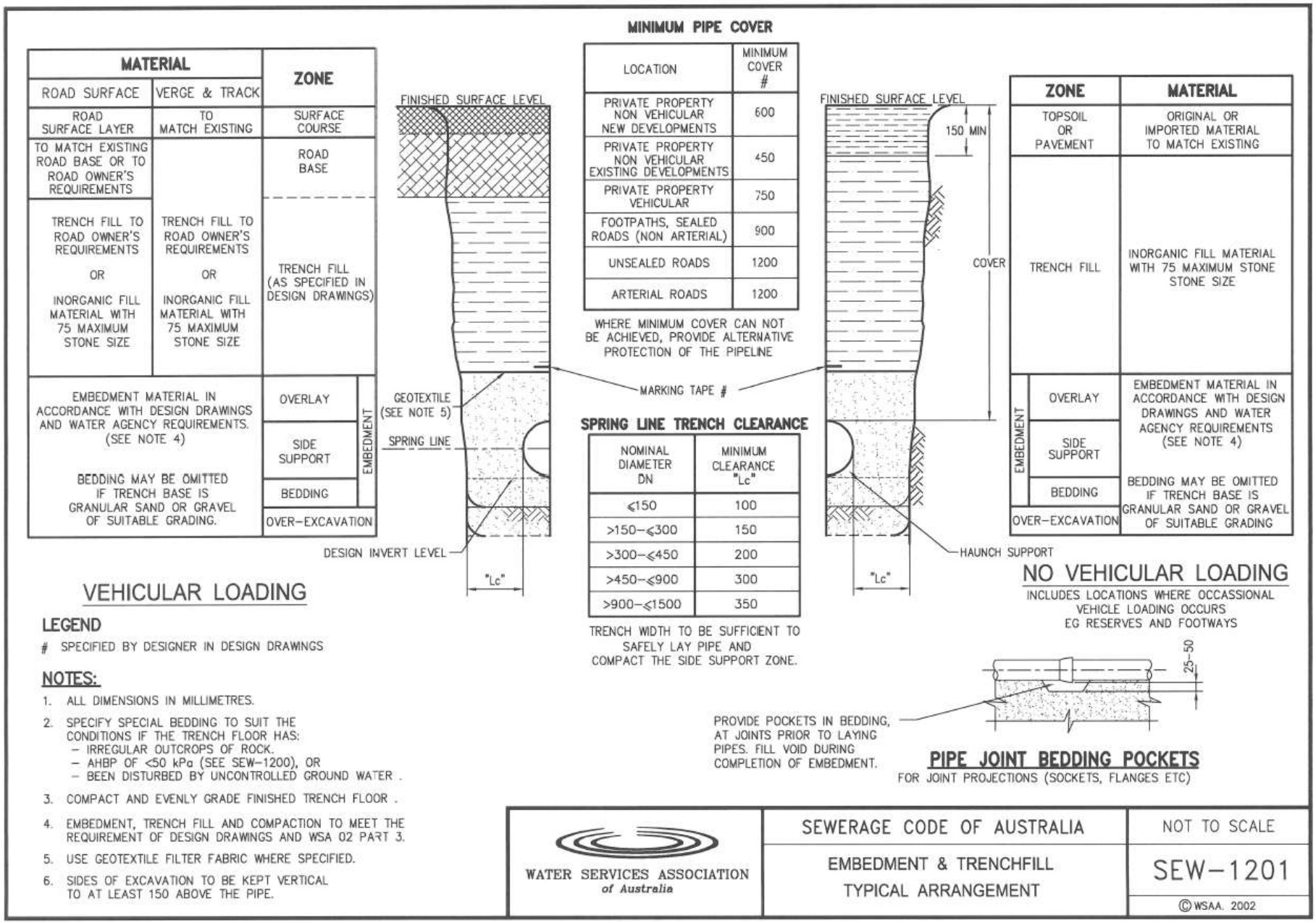
WATER SERVICES ASSOCIATION *of Australia*

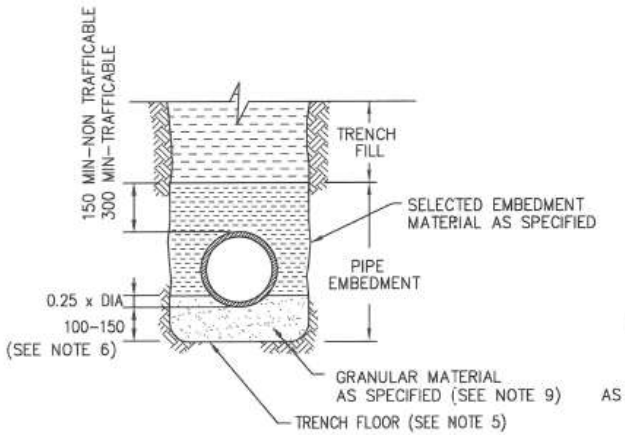
SEWERAGE CODE OF AUSTRALIA

MAINTENANCE HOLES
SEWERS ≤ DN 300
PRECAST TYPES P1 & P2

NOT TO SCALE

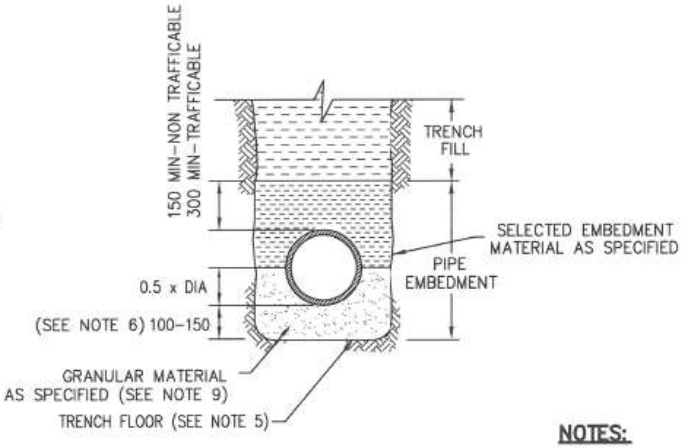
SEW-1300


MINIMUM PIPE COVER
MATERIAL
ROAD SURFACE
VERGE & TRACK
ZONE
ROAD SURFACE LAYER
TO MATCH EXISTING
SURFACE COURSE
TO MATCH EXISTING ROAD BASE OR TO ROAD OWNER'S REQUIREMENTS
ROAD BASE
TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4)
BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING.
OVERLAY
SIDE SUPPORT
BEDDING
EMBEDMENT
OVER-EXCAVATION
FINISHED SURFACE LEVEL
GEOTEXTILE (SEE NOTE 5)
SPRING LINE
DESIGN INVERT LEVEL
"Lc"
LOCATION
MINIMUM COVER #
PRIVATE PROPERTY NON VEHICULAR NEW DEVELOPMENTS 600
PRIVATE PROPERTY NON VEHICULAR EXISTING DEVELOPMENTS 450
PRIVATE PROPERTY VEHICULAR 750
FOOTPATHS, SEALED ROADS (NON ARTERIAL) 900
UNSEALED ROADS 1200
ARTERIAL ROADS 1200
WHERE MINIMUM COVER CAN NOT BE ACHIEVED, PROVIDE ALTERNATIVE PROTECTION OF THE PIPELINE
MARKING TAPE #
SPRING LINE TRENCH CLEARANCE
NOMINAL DIAMETER DN
MINIMUM CLEARANCE "Lc"
≤150 100
>150–≤300 150
>300–≤450 200
>450–≤900 300
>900–≤1500 350
TRENCH WIDTH TO BE SUFFICIENT TO SAFELY LAY PIPE AND COMPACT THE SIDE SUPPORT ZONE.
FINISHED SURFACE LEVEL
150 MIN
COVER
HAUNCH SUPPORT
"Lc"
ZONE
MATERIAL
TOPSOIL OR PAVEMENT
ORIGINAL OR IMPORTED MATERIAL TO MATCH EXISTING
TRENCH FILL
INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE STONE SIZE
EMBEDMENT
OVERLAY
SIDE SUPPORT
BEDDING
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS (SEE NOTE 4)
BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING
OVER-EXCAVATION
VEHICULAR LOADING
LEGEND
SPECIFIED BY DESIGNER IN DESIGN DRAWINGS
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. SPECIFY SPECIAL BEDDING TO SUIT THE CONDITIONS IF THE TRENCH FLOOR HAS:
– IRREGULAR OUTCROPS OF ROCK.
– AHBP OF <50 kPa (SEE SEW-1200), OR
– BEEN DISTURBED BY UNCONTROLLED GROUND WATER .
3. COMPACT AND EVENLY GRADE FINISHED TRENCH FLOOR .
4. EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENT OF DESIGN DRAWINGS AND WSA 02 PART 3.
5. USE GEOTEXTILE FILTER FABRIC WHERE SPECIFIED.
6. SIDES OF EXCAVATION TO BE KEPT VERTICAL TO AT LEAST 150 ABOVE THE PIPE.
NO VEHICULAR LOADING
INCLUDES LOCATIONS WHERE OCCASSIONAL VEHICLE LOADING OCCURS EG RESERVES AND FOOTWAYS
25–50
PROVIDE POCKETS IN BEDDING, AT JOINTS PRIOR TO LAYING PIPES. FILL VOID DURING COMPLETION OF EMBEDMENT.
PIPE JOINT BEDDING POCKETS
FOR JOINT PROJECTIONS (SOCKETS, FLANGES ETC)
WATER SERVICES ASSOCIATION of Australia
SEWERAGE CODE OF AUSTRALIA
EMBEDMENT & TRENCHFILL TYPICAL ARRANGEMENT
NOT TO SCALE
SEW–1201
© WSAA. 2002



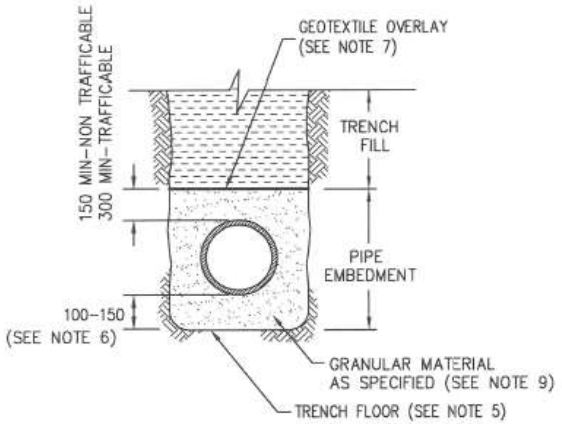
TYPE 1 SUPPORT

FOR RIGID PIPES ONLY (SEE NOTE 3)



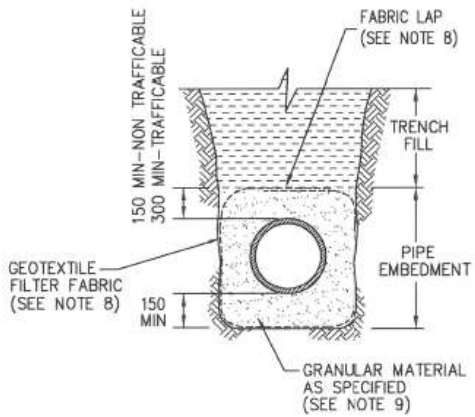
TYPE 2 SUPPORT

FOR RIGID PIPES ONLY (SEE NOTE 3)



TYPE 3 SUPPORT

FOR FLEXIBLE & RIGID PIPES (SEE NOTE 3)



TYPE 4 SUPPORT

WITH GEOTEXTILE

FOR FLEXIBLE & RIGID PIPES (SEE NOTE 3)

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH SEW–1201.
3. PIPE CLASSIFICATION
   (a) RIGID PIPES: VC AND RC
   (b) FLEXIBLE PIPES: PVC, GRP, STEEL, DI AND PE.
4. PLACEMENT OF EMBEDMENT, TRENCHFILL & COMPACTION TO MEET THE REQUIREMENTS OF WSA 02 PART 3.
5. EXCAVATE OR COMPACT TRENCH FLOOR TO PROVIDE A FLAT FIRM BASE TO SUPPORT BEDDING MATERIAL AND MIMIMISE PIPELINE SETTLEMENT. WHEN EXCAVATED, REPLACE WITH GRANULAR MATERIAL AS SPECIFIED FOR BEDDING OR ADOPT TYPE 5, 6, 7 OR 8 SUPPORT AS REQUIRED.
6. ENSURE BEDDING IS DEEP ENOUGH THAT PIPE JOINT PROJECTIONS (SOCKETS, FLANGES) DO NOT TOUCH TRENCH FLOOR.
7. TYPE 4 SUPPORT TO BE USED WHERE MIGRATORY NATIVE SOILS (SANDS & CLAYS) ARE ENCOUNTERED ADJACENT TO THE EMBEDMENT ZONE AND SINGLE SIZE AGGREGATE IS USED:
8. LAY GEOTEXTILE FILTER FABRIC AGAINST TRENCH FLOOR AND WALLS SUCH THAT IT FULLY ENCASES THE EMBEDMENT.
   – PRESS FABRIC INTO THE VOIDS BEFORE INSTALLING EMBEDMENT TO PREVENT FABRIC TEARING.
   – PROVIDE A MINIMUM OF 250 OVERLAP AT ALL FABRIC JOINTS.
9. PURCHASE SPECIFICATIONS FOR TRENCH FILL AND EMBEDMENT MATERIAL ARE DETAILED IN WSA 02 PART 2.

EMBEDMENT TYPES TO BE SPECIFIED IN DESIGN DRAWINGS

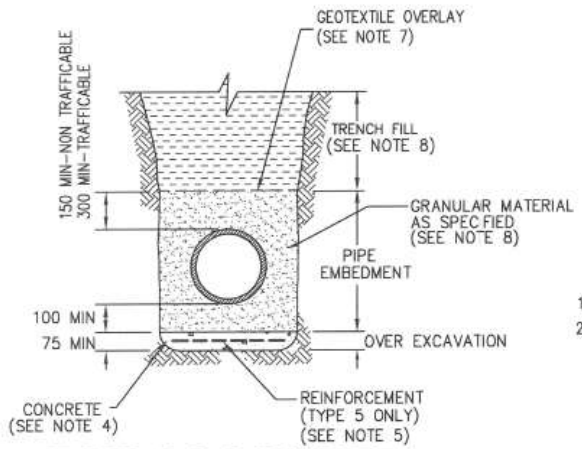
WATER SERVICES ASSOCIATION *of Australia*

SEWERAGE CODE OF AUSTRALIA

STANDARD EMBEDMENT FLEXIBLE & RIGID PIPES

NOT TO SCALE

SEW–1202

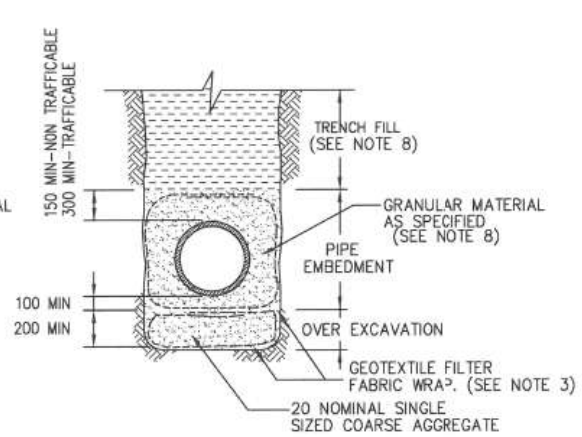


TYPES 5 & 6 SUPPORT

UTILISING CONCRETE FOUNDATION

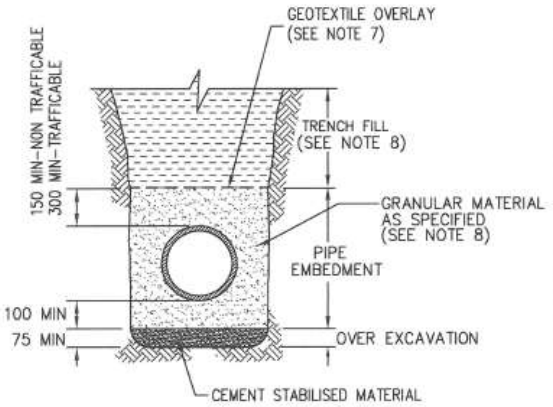
NON-REINFORCED (TYPE 5)
REINFORCED (TYPE 6)
(RIGID & FLEXIBLE PIPES)

USE LIMITED TO 1 000 SPANS OF LOW BEARING CAPACITY GROUND. (SOFT CLAYS AND LOOSE SAND)
LONGER LENGTHS SUBJECT TO INDIVIDUAL ASSESSMENT.



TYPE 7 SUPPORT

UTILISING GEOTEXTILE PILLOW FOUNDATION
(RIGID & FLEXIBLE PIPES)



TYPE 8 SUPPORT

UTILISING CEMENT STABILISED FOUNDATION
(RIGID & FLEXIBLE PIPES)

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. USE THESE SUPPORT TYPES ONLY WHERE SPECIFIED BY THE DESIGNER. DETAILS TO BE PROVIDED IN DESIGN DRAWINGS.
3. LAY GEOTEXTILE FILTER FABRIC AGAINST THE TRENCH FLOOR AND WALL SUCH THAT IT FULLY ENCASES THE FOUNDATION MATERIAL IN THE OVER EXCAVATION. EMBEDMENT (IF REQUIRED) ENCASE SEPARATELY. PROVIDE A MINIMUM OF 250 LAP AT ALL FILTER FABRIC JOINTS. SEE SEW-1202 FOR GEOTEXTILE SYSTEM DETAILS.
4. UNREINFORCED CONCRETE TO BE CLASS N20, AND REINFORCED CONCRETE N25. FOR AGGRESSIVE CONDITIONS USE SPECIAL CLASS CONCRETE.
5. MINIMUM STEEL REINFORCEMENT OF 0.4% OF CONCRETE CROSS SECTION PLACED CENTRALLY AND WITH 65 MINIMUM COVER TO EXTERNAL FACE. REINFORCEMENT DETAILS FOR THE APPLICABLE LOADING TO BE INCLUDED IN THE DESIGN DRAWINGS.
6. BEDDING TO BE DEEP ENOUGH TO ENSURE PIPE JOINT PROJECTIONS (SOCKETS, FLANGES) DO NOT TOUCH FOUNDATION.
7. GEOTEXTILE OVERLAY IS REQUIRED FOR COARSE AGGREGATE EMBEDMENT. (IE SINGLE SIZED GRANULAR FILL $\geq$ 5 mm).
8. PURCHASE SPECIFICATIONS FOR TRENCH FILL & EMBEDMENT MATERIAL ARE DETAILED IN WSA 02 PART 2.

EMBEDMENT TYPES TO BE SPECIFIED IN DESIGN DRAWINGS

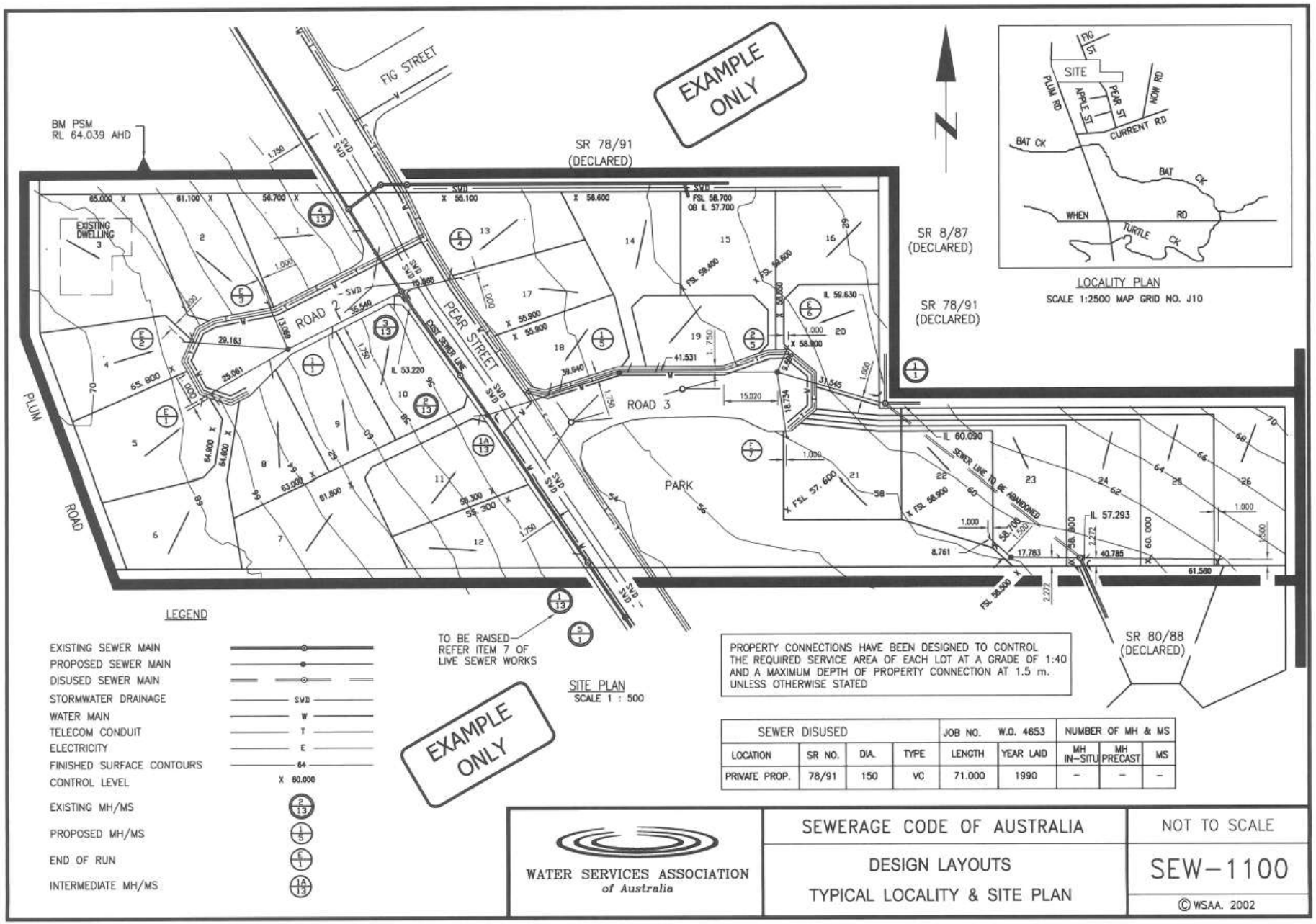
WATER SERVICES ASSOCIATION of Australia

SEWERAGE CODE OF AUSTRALIA

SPECIAL EMBEDMENT
INADEQUATE FOUNDATIONS
REQUIRING OVER EXCAVATION & REPLACEMENT

NOT TO SCALE

SEW-1203


EXAMPLE ONLY
FIG STREET
BM PSM
RL 64.039 AHD
SR 78/91
(DECLARED)
SR 8/87
(DECLARED)
SR 78/91
(DECLARED)
SR 80/88
(DECLARED)
EXISTING DWELLING
ROAD 2
PEAR STREET
ROAD 3
PARK
PLUM ROAD
SEWER LINE TO BE ABANDONED
TO BE RAISED
REFER ITEM 7 OF
LIVE SEWER WORKS
SITE
FIG ST
PLUM RD
APPLE ST
PEAR ST
NOW RD
CURRENT RD
BAT CK
WHEN
TURTLE
RD
LOCALITY PLAN
SCALE 1:2500 MAP GRID NO. J10
SITE PLAN
SCALE 1 : 500
LEGEND
EXISTING SEWER MAIN
PROPOSED SEWER MAIN
DISUSED SEWER MAIN
STORMWATER DRAINAGE
WATER MAIN
TELECOM CONDUIT
ELECTRICITY
FINISHED SURFACE CONTOURS
CONTROL LEVEL
EXISTING MH/MS
PROPOSED MH/MS
END OF RUN
INTERMEDIATE MH/MS
PROPERTY CONNECTIONS HAVE BEEN DESIGNED TO CONTROL THE REQUIRED SERVICE AREA OF EACH LOT AT A GRADE OF 1:40 AND A MAXIMUM DEPTH OF PROPERTY CONNECTION AT 1.5 m. UNLESS OTHERWISE STATED
SEWER DISUSED
JOB NO. W.O. 4653
NUMBER OF MH & MS
LOCATION | SR NO. | DIA. | TYPE | LENGTH | YEAR LAID | MH IN-SITU | MH PRECAST | MS
PRIVATE PROP. | 78/91 | 150 | VC | 71.000 | 1990 | – | – | –
WATER SERVICES ASSOCIATION of Australia
SEWERAGE CODE OF AUSTRALIA
DESIGN LAYOUTS
TYPICAL LOCALITY & SITE PLAN
NOT TO SCALE
SEW–1100
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5.9 APPENDIX A – Checklist - Sewer Design

Item No.	Description	Reference	Developer Confirmation	GSC Confirmation	Comments
1	Sewer Servicing Strategy	5.4.2			
2	Excavation or Building adjacent to or over Existing Sewer Mains	5.4.5			
3	Pumping Stations and Rising Mains	5.6			
4	Maximum and Minimum Allowable Loadings – Reticulation Mains	Table B & 5.5.10.3			
5	Low Pressure Sewer	5.7			
6	Low Pressure Sewer Pump Units Residential Property System – Advice for Developers	Appendix C			

5.10 APPENDIX B – Information to be shown on Sewer Reticulation Drawings

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
1	**General**			
1a	Cover Sheet with Locality Plan, List of Drawings and DA number			
1b	Plans prepared in A1 format at a scale of 1:500			
1c	Drawing Scale is shown on drawings as a bar scale			
1d	Scale of Detail Drawings is shown as appropriate			
1e	Schedule of Symbols			
1f	Benchmark within 100 metres of development site is shown			
1g	North Point shown			
1h	Site topography is shown via contour lines			
1i	Datum reference incl. Benchmark at A.H.D adopted by N.S.W. Dept. of Lands			
1j	Each plan to be numbered with revision no. and revision schedule if required			
1k	Road names or number			
1l	Drawings to be signed by respective Consultant / Engineer			
1m	Lettering, line work and symbols to conform to AS 1100			
1n	Sewer mains to be shown on cross sections			
2	**Sewer Layout Plans**			
2a	Catchment area plan including sub-catchments and areas is submitted			
2b	Existing sewer mains, junctions, side lines and manholes are shown			
2c	Lot boundaries and numbers shown			
2d	Sewer main lines and manholes are numbered as per Council Numbering System			
2e	Pipeline centreline chainages are shown			
2f	Pipeline diameters are shown			
2g	Dead end length to conform with guidelines			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
2h	Side lines to conform with guidelines			
2i	Type and class of pipe work and fittings clearly indicated			
2j	Alignment of mains, side lines, junctions, dead ends, manholes etc. to be shown			
2k	Location of mains etc. in accordance with respective footpath allocations for urban and rural residential to be shown			
2l	Location of proposed easements reserves etc. incl. downstream if required			
2m	Location of all drainage lines, water mains and other utility lines crossing the mains to be shown			
2n	Limit of construction to be shown including staging			
2o	Mains to be extended to the full length of the subdivision			
2p	Junction to each block slope type if main is within property, square type if main is external to property			
2q	Spot levels as necessary at the lot extremities to show that the whole of the lot can be sewered			
2r	Manhole spacing to be in accordance with maximum spacing according to main size			
2s	Rising mains to be shown with appropriate details according to guidelines			
3	**Sewer Longitudinal Sections**			
3a	Sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
3b	Levels to be shown at 20m chainage intervals, manhole locations, dead-ends for gravity mains and high and low points for rising mains			
3c	Chainages as per layout plans			
3d	RL of existing surface, design surface and pipe invert at each location of 3b above and at major variations in natural surface such as roads, gullies etc.			
3e	Design RL of all inlet and outlets at each manhole and all changes of grade			
3f	Design grades including length of each gradient between manholes			
3g	Pipe diameters and material type and class to be shown			
3h	Air valves and scour valves on rising mains at respective low and high points			
3i	Minimum cover requirements have been achieved			

Item No.	Item Description	Developer Confirmation	Council Confirmation	Notes/Comments
3j	Location and size of existing and proposed services and utilities crossing the main complete with invert levels			
3k	Sections to be taken along intersecting roads for a sufficient distance to allow connection design			
3l	Trench stops shown as required on steep grades			
4	**Miscellaneous**			
5a	Design is satisfactory for future extension			
5b	Pipe sizes and design conform to current strategies for future development			
5c	Detailed engineering drawings are required for any rising main structures such as pumping stations and specialised manholes and vents proposed for construction in conjunction with sewer supply works			
5d	Sufficient capacity in downstream reticulation system to cater for development			
5e	Engineering plans and subdivision plans agree			
5f	Engineering conditions of consent included in design plans			
5g	Junctions to each lot to comply with the soffit requirements in accordance with N.S.W. Code of Practice for Plumbing and Drainage 2006			
5h	Mains to be designed to satisfy minimum cover requirements			
5i	Minimum pipe size is 150mm diameter			
5j	Pressure sewer designed in accordance with WSA guidelines			

5.11 APPENDIX C – Low Pressure Sewer - Residential Property System – Advice for Developers

For the information of Developers the following additional information is provided in relation to on property installation of low pressure sewer pump units. Council is not generally in favour of low pressure sewer systems. All other economic alternatives must be investigated by the developer and exhausted prior to seeking Council approval to consider this option..

OWNERSHIP OF THE UNITS

The ownership of the units will reside with Council and includes the following:

- Pump;
- Storage vessel;
- Ancillary fittings;
- Property delivery line/s;
- Control panel; and
- Boundary kit.

Council ownership terminates at the first flexible joint on the inlet side to the pressure sewerage storage vessel.

In general Council will not seek to take out an easement over any part of the installation. Council reserves the right to create an easement if required on a particular property to ensure the safe ongoing operation of the system, the minimisation of any health concerns or the protection of Council Property.

SUPPLY OF THE UNIT

Council will supply and maintain the following components where a pressure sewerage system is to be installed:

- The storage vessel;
- Pump;
- Ancillary fittings;
- Control panel;
- Boundary kit;
- Valves (On Property); and
- Stand for control panel, where required.

STANDARD INSTALLATION PARAMETERS

A standard installation includes the provision of:

- One pump and tank;
- 40m of pipework from the boundary kit to the tank;
- The tank is to be located within 10m of the main building contributing the majority of the flow; and
- Connection of pools or spas with a capacity less than 250L.

All additional costs for items outside of the above parameters are to be met by the property owner.

PROPERTY INSTALLATION

The following will be required for pump/tank installation:

- The individual property owner must provide to Council six weeks notice to arrange the installation of the pump/tank units;
- The pump/tank units are only to be installed after storm water and sewer main lines have been constructed;
- The location of the pump/tank unit will be determined in consultation with the property owner; and
- The installation will be subject to the owner entering into a Maintenance Agreement with Council. Connection to Council's sewer system will not be approved until such an Agreement is entered into. Continued connection is conditional upon continuing such a Maintenance Agreement.

MAINTENANCE AGREEMENT

Every property owner will be required to enter into a formal maintenance agreement with Council as a precondition to being connected to Councils reticulation system. Such an agreement will set out what is expected of both parties.

This is a separate stand alone document.

OPERATION OF THE PUMPING UNIT

Pumping units operate automatically and do not require any specific input from the property owner. In relation to the overall operation of the pumping unit the following will apply:

- The property owner will meet the individual power costs.
- Council will meet all operational costs.

ON PROPERTY DESIGN

The design limits for the on property works will be from the outlet of the boundary kit to the inlet to the pumping station (i.e. the household drainage inlet). The standard design will include:

- Installation of the pumping station (pump unit);
- Electrical connections;
- Construction of the property delivery line;
- All restoration; and
- Making the pump accessible.

Council requires the property owner's written consent with the "on-property" layout design before commencing the installation. Where possible the property owner's reasonable needs will be accommodated.

STANDARDS AND REGULATIONS

All designs will be carried out in accordance with the WSAA Pressure Sewerage Code of Australia and the relevant Australian Standards. If those carrying out the design believe there is any conflict then these matters should be raised with the nominated Director.

PUMP DUTY POINTS

The pump supplied is capable of meeting the following duty points.

Head = 45m

Flowrate = 0.45l/s

The 45m head should be taken as the maximum head the pump is designed to accommodate (i.e. the total static head plus the friction losses that will occur in the designed reticulation system).

The flow rate of 0.45l/s is the minimum flow rate the pump should be capable of discharging under normal operating requirements. Higher flowrates are permissible.

NUMBER OF PUMP UNITS PER PROPERTY

A single pumping unit is to be provided for each residential property. Other alternatives will be investigated if a single pumping unit is not appropriate for the application.

PUMPING UNIT STORAGE VESSEL SIZE

The pumping station supplied will have:

Minimum Effective Storage - 600 Litres; or

Minimum Emergency Storage - 400 Litres.

INSTALLATION OF PUMP STORAGE VESSEL

The following steps need to be applied in relation to all pumping station installations in Gunnedah:

- The pumping station should be installed as close as practical to the building contributing the majority of flow contributions on the property;
- The pumping station is not to be installed in a ground depression, where rainfall runoff water would normally pond;
- The pumping station must be installed within direct line of sight of the pressure sewerage control panel;
- A concrete ring beam is to be poured around the base of the storage vessel. The size of the ring beam will be in accordance with the Technology Suppliers requirements; and
- Excavation holes for the pumping station are not to be left open overnight.

VENTING

Where the 1 in 100 year flood level impacts the property, the venting of the pumping station is to be provided to a minimum of 500mm above the designated flood level.

HYDRAULIC CONNECTIONS

The lines need to be flushed to ensure no construction debris is in the lines before connecting to the pumping station.

The homes plumbing is to be tested in accordance with the NSW Plumbing Code prior to connection to the pumping station. The plumber will then need to attest in the supporting document that the house lines meet this requirement.

An overflow relief gully is required in accordance with the NSW Plumbing Code, to prevent internal overflows. This is to be included by the property owner's plumber, and must not be covered once the pump is operational.

INLETS AND OUTLETS

Pipe connections to the tank should be capable of being made without leakage through the joints. The pumping station should be supplied with appropriate sealing devices for these connections.

On the inlet side a short length of pipe should be extended to connect the household drainage lines. On the outlet side the internal pipework should be extended a short distance (minimum 1.0 metre length) beyond the pumping station to connect the property delivery line.

RESIDENTIAL PIPE MATERIALS

The property delivery lines for all Gunnedah applications will be:

- 32mm internal diameter polyethylene pipe;
- Pipe Class PN12.5; and
- Where possible the pipe should be purchased in long rolls to minimise the number of joins required.

PIPE COLOURS

Cream striped black polyethylene pipe is to be used for pressure sewerage systems in accordance with the Australian Standard.

JOINING THE PIPES

All pipes are to be joined by electro fusion techniques in accordance with the manufacturer's requirements. Those carrying out the pipe joins are to be appropriately qualified, capable of demonstrating their experience with this technique and have the right equipment to affect the welds. Council will also consider butt welding of the pipes by persons with the appropriate qualifications, equipment and experience.

DEPTH AND LOCATION OF PIPEWORK

The property delivery line is to be connected to the boundary kit located at the low side of the front boundary. All pipelines are to be laid approximately 1.0m from the boundary and run parallel, to that boundary. Where the properties are large and this requirement is unreasonable, it will be laid in a position as agreed with the property owner.

The pipe will be laid to a depth where there is a minimum 450mm of cover over the pipeline in areas with no vehicular loading and a minimum cover of 600mm in areas with vehicular loading.

The pipe can in most instances simply be backfilled with the excavated material where the trench has been dug by a trenching machine such as a ditch witch. This assumes that the main is excavated in what are all soil conditions.

Where rock or gravel is encountered in the trench or in some circumstances where there are a large number of timber pieces that might puncture the pipe then the pipe is to have a minimum of 50 mm of sand backfilling on all sides. Where sand fill is required, the trench is to be excavated an additional 50 mm with the pipe to be laid on top of this sand bed. The trench excavation will need to be wide enough to allow for the sand filling around the pipe.

Where it is difficult to gain the depth due to excavation difficulties, then the pipe is to be encased in a minimum of 100 mm of concrete. The trench will need to be widened to accommodate this encasement.

MARKING THE PIPES

The locations of pressure sewerage pipes are to be marked in the following manner:

- Tracer wire, (capable of being energised) is to be laid in the trench for both the reticulation and residential pipe materials;
- Pipes are to be laid at the standard depth. Where the main is laid at depths greater than 600mm, this will be marked clearly on the plan; and
- A brightly coloured marker tape is to be laid 300mm above the top of the pipe. This marker tape should indicate that there is a pressure sewerage system below it. Councils preference is that the tape be yellow and at least have the letters PS on it, but is happy to negotiate these colours with the pipelayer if yellow is not readily available at the time.

CONTROL PANEL INSTALLATION

All electrical connections are to be carried out in accordance with AS 3500 and must be carried out by an appropriately qualified electrician.

In affixing the control panel to the building, the Installer and electrician are to:

- Ascertain the 1 in 100 year flood levels for the property and ensure that the bottom of the control panel is a minimum of 500mm above the level designated;
- Ascertain the local electrical supplier requirements and ensure that Installers Staff always meets those requirements;

- Ensure that the control panel and the pumping station always remain within an easy line of site of the pump storage vessel; and
- Affix the contact numbers sticker when the installation is completed.

The Control panel is to be generally mounted on the dwelling wall. Where the pumping station is to be installed away from the dwelling a stand-alone post (fit for the purpose) and as supplied by the Technology Supplier may be used.

SPA'S

Council requires that any installation of a spa include a device to regulate the discharge to prevent system alarms or overflows from the pressure sewerage system. Each installation will be determined on a case by case basis with formal approval of Council required

The costs for any additional equipment that is required to be installed to accommodate large sudden discharges will be met by the property owner.

In general:

Spa's with less than 250 litres in normal operating volume: Require that no special provisions are made and as such they can be treated as a standard household water-using appliance.

Spas between 250 litres and 700 litres capacity in normal operating volume: Require some additional measures be fitted to the pressure system to avoid system alarms. Typically these could involve the following and will be dealt with on a case by case basis, with the property owner to be advised by Council on what is the preferred option.

- Time delays to the alarm switch.
- Restricting the discharge rate of the Spa into the pressure unit.

Spas with a normal operating volume in excess of 700 litres: Require that differing flow restriction devices be added to the system. Typically these will involve the following and will be dealt with on a case by case basis, with the property owner to be advised by Council on what is the preferred option:

- Providing some form of upstream storage with a limited discharge rate to more closely match that of the pressure sewerage unit.
- Time delays on the alarm.

Spas with a backwash facility: Will be dealt with the same as for a swimming pool.

SWIMMING POOLS

Council requires that any installation of a swimming pool include a device to regulate pool backwash volumes and rates, to prevent system alarms or overflows from the pressure sewerage system. Each installation will be determined on a case by case basis with formal approval of Council required.

The costs for any additional equipment that is required to be installed to accommodate large sudden discharges will be met by the property owner.

In general:

Pools with a backwash pump up to 0.45l/s: Require some additional measures be fitted to the pressure system to avoid system alarms. Typically these could involve the following and will be dealt with on a case by case basis, with the property owner to be advised by Council on what is the preferred option.

- Time delays to the alarm switch; or
- Restricting the discharge rate of the pool into the pressure unit.

Pools with a backwash pump that exceeds 0.45l/s: An additional storage with a controlled discharge of less than 0.45l/s will be placed between the pool's discharge pump and the sewerage pumping station unless the pool pumps discharge can be regulated to below 0.45l/s.

PLANS

Following the initial meeting with the property owner, the Designer is to prepare a plan of the proposed on property design. This plan at minimum must show the following:

- Location of the pumping station, relative to the buildings, including tie lengths to any suitable reference points;
- The pipeline route, including ties at any change of direction;
- The location of the boundary kit;
- The point of connection to the Council reticulation mains, where the main is on the same side as the property;
- The location of the overflow relief gully;
- Any proposed under boring; and
- Any unique features of the property, which have impacted the design such as gardens, structures, etc.

The layout plan is to be in plan view only as it will be assumed the property main will be minimum depth. Where this is incorrect the plan view will show the locations, where the depth has varied. Details of the depth at the start of the deviation, as well as at 2m intervals along the deviation will be required.

It is intended that the property layout plan will become the property Work as Executed drawing, provided that there are not too many changes to the layout. It should also be in an electronic format compatible with Council's GIS system.

CONSTRUCTION REQUIREMENTS - COUNCIL TO INSTALL

Council will undertake or arrange installation of all units.

HOMEOWNERS MANUAL

Council will provide Homeowners' Manuals, which provides basic instructions on how to use the pressure sewerage system. It also provides basic instructions on what to do if an alarm is activated.

PART 6

DESIGN GUIDELINES

FOR

LANDSCAPING

6 DESIGN GUIDELINES FOR LANDSCAPING

6.1 Introduction

This document outlines Gunnedah Shire Council's recommended practice for Street Tree Planting. It is in no way a comprehensive design "Manual" and it is intended to be read in conjunction with and as a supplement to relevant Office of Water, Office of Environment & Heritage and Department of Primary Industries publications.

It is recommended that the handbook by the New South Wales Department of Housing (1993-94) - Soil & Water Management for Urban Development, be followed.

All references to the Director should be interpreted as referring to the Director – Planning and Environmental Services or his nominated representative.

The other parts of the Design Guidelines for Subdivisions and Developments are as follows:

Part 1 General Requirements

Part 2 Guidelines for Design of Roads

Part 3 Guidelines for Design of Drainage

Part 4 Guidelines for Design of Water Reticulation

Part 5 Guidelines for Design of Sewerage Reticulation

6.2 Landscaping General Requirements for Road Verges and Public Reserves

The developer should prepare a comprehensive Landscaping Plan, which should be approved by Director – Planning and Environmental Services, prior to issue of the Construction Certificate.

6.3 Landscape Plan

For Landscape Design approval, the developer is to submit at least the following information. Plans should be designed in accordance with conditions of development consent and other relevant plans.

Three copies of the Landscape Plan including any Working Drawings and associated Landscape Specifications should be provided addressing items listed in **APPENDIX A.**

6.4 Planting Details

At the pre-construction stage detailed Planting information must be provided. It should show the location and species name of the proposed plants in a key format that relates back to a plant schedule, the plant schedule should have at least the following information:

- Botanical and common name relating back to the key name given;
- Number of plants to be used;
- Size of plant container; and
- The expected size of plant to be planted at the time of planting.

The developer is also required to submit details of proposed maintenance programs of all landscaping elements and undertake to maintain all landscaping in sound health and condition until the expiry of the maintenance bond period

Prior to acceptance Council will inspect the landscape works before signing off and accepting future maintenance responsibilities. During the maintenance period, horticultural best practices must be undertaken to ensure quality workmanship throughout the development before Council will accept the works.

6.5 Trees & Shrubs

The developer will, with the approval of the Director, plant one approved street tree per standard residential lot, such trees are to be located on the road verge central to the lot and in accordance with the approved services locality plan.

Trees proposed for street planting shall be semi advanced tree species from an accredited supplier, unless otherwise approved by the Director.

The theme of trees and shrubs to be planted should be identified in the landscape plan and approved by Council based on criteria including suitability to site conditions, compatibility with existing vegetation and planting themes for the locality.

6.6 Road Verges and Public Reserves

Parks and public reserves should be provided with a 32mm water service and a 20mm meter. The following conditions should be satisfied prior to notification of completion;

- the ground surface of all road verges, parks and public reserves should be of uniform grade and generally consistent with no obvious depressions and be free of boulders, foreign material and debris;
- all areas should be trimmed as per the design contours in accordance with AS1428, to facilitate easy and safe mowing;
- parks and public reserves should be provided with clear access;
- entrance statements not to be placed on public reserves or road verges;
- existing vegetation, both above and below ground, that is located on road verges, parks and public reserves is to be protected from damage resulting, or likely to result from, from subdivision development works;
- existing vegetation located on road reserves, proposed parks and public reserves that is deemed by Council to be dead or dangerous is to be removed or made safe by the Developer prior to date of handover;
- Urban residential road verges are to be trimmed/graded in line with Council's footpath policy and revegetated prior to date of handover; and
- areas allocated for Public Open Space shall not be utilized for the purpose/function of drainage or stormwater retention.

6.7 Topsoil

On construction disturbed sites, developers should provide for topsoil to be stripped following the clearing of vegetation and stockpiled for re-use. Additional imported topsoil may be needed to establish vegetative cover on some hard or denuded sites.

The developer shall use topsoil stockpiled on site, where imported topsoil is required it shall comply with AS4419 and shall;

(i) be of a friable, porous nature;

(ii) be free of weeds and weed seeds, bulbs, corms and vegetable propagules;

(ii) contain no refuse, contamination, or materials toxic to plant growth;

(iv) contain no stumps, roots, clay lumps or stones larger than 50mm in size;

(v) have an organic content of at least 3 per cent by mass;

(vi) have a pH neither less than 5.5 nor more than 7.5; and

(vii) have a soluble salt content not exceeding 0.06 per cent by mass.

Topsoil shall be uniformly applied to provide an average compacted thickness of 50mm with a minimum compacted thickness of 30mm at any location. The topsoiled area shall be cultivated to a depth of 50mm to provide a roughened surface with soil lumps not exceeding 50mm dimension.

6.8 Roundabouts and Median Landscaping

Roundabout and median strip landscape design must have due regard for plant siting and maintenance requirements. Planting in roundabouts and medians are to be set back from the inside kerb edge as follows:

6.9 Roundabouts

Grass should generally be avoided for use in roundabout landscapes.

- 0.0m - 1.0m setback - appropriate pavement material;
- 1.0m - >3.0m setback - shrubs / groundcovers only with a maximum mature unpruned height of 600mm above the road pavement (not top of kerb);
- 3.0m - >3.0m setback - trees and shrubs/ground covers. Roundabouts of 6.0m in diameter in low speed zones of 50km/h or less, a small single trunked tree with a mature diameter of 100mm may be located in the centre of the roundabout, providing such achieves a clear trunk height at planting of 1.5m above the road pavement level; and
- Turf is to be discouraged in roundabouts.

6.10 Median Islands

Grass should generally be avoided for use in median landscapes. Preference should be given to paving or concrete with textured or stencilled finishes.

- 0.0m - 0.3m - appropriate pavement treatment;
- 0.0m - 1.0m setback - appropriate ground covers, 200mm high, with minimal pruning requirements;
- 1.5m setback - shrubs / ground covers only. Shrubs and ground covers to have a maximum maintained mature height of 900mm above the road pavement (not top of kerb);min. 1.5m setback - trees and shrubs / ground covers. Trees are to be primarily single trunked species. Tree species chosen will depend on the species spatial requirements and clearance from service elements and light poles;
- Trees will generally not be planted in medians with an internal width less than 3.0m;
- In median strips, three (3) metres or wider, trees may be located centrally or staggered provided such accords with traffic engineering visibility requirements. Tree species will be selected for appropriate canopy shape;
- Ends of median strips require special consideration and discussion with Council with regards to clear zones and safety requirements;
- Irrigation is to be placed in medians with subsoil drainage installed to adequately stop the ingress of water into the roadway. Irrigation shall be of such a design and quality of material and workmanship that the ingress of water into the pavement due to failure or damage is avoided;
- The root system of plants must not interfere with subsurface drainage and should have root control system where necessary to protect Council services (water and sewer) from root damage;
- The design should minimise the requirements for maintenance;

- Interfaces between grass and areas of chip mulch are to be avoided. Where grass does interface with chip mulch, a concrete mowing strip of 300mm wide must be provided.

The mature unpruned height of under plantings on road verges or in roundabouts, medians and splitter islands is not to exceed 600mm above road surfaces. This height, however, may be reduced at the discretion of the Director and may vary from site to site.

6.11 APPENDIX A – Checklist – Landscape Plan

Item No.	Description	Reference	Developer Confirmation	GSC Confirmation	Comments
1	Detail boundaries, easements, fences, footpaths, gutter crossings, drainage and grassed areas. Services should be indicated on the plan and show at least, underground services (water, electricity, gas, telephone, sewer and stormwater);	6.3			
2	The location of overhead wires;	6.3			
3	Proposed surface materials including, turf, pathways, patios, mulched garden beds, etc. are to be shown and specified;	6.3			
4	All structures including existing and proposed building footprints and building F.L's are to be shown;	6.3			
5	Other landscape structures such as pergolas, gazebos, entry statements etc, with detailed documentation of how they are to be constructed, materials, colours etc;	6.3			
6	Fencing and retaining walls details and specifications;	6.3			
7	A contour plan showing all existing levels and proposed new levels;	6.3			
8	Lighting if applicable;	6.3			
9	Site furniture and play equipment, including type and colour;	6.3			

10	Details of edging treatment;	6.3			
11	Irrigation systems, including the location of the RPZ valve and the proposed location of the control box;	6.3			
12	Where the irrigation is to become part of Council's responsibility separate irrigation plans will need to be submitted for approvals by Council;	6.3			
13	Site drainage including any subsoil drainage and drainage pit locations.	6.3			