SINGLETON COUNCIL

TECHNICAL SPECIFICATIONS- Sewer Infrastructure

2023

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CONTENTS

1 INTRODUCTION

This document outlines Singleton Council's technical requirements and practices for the design and construction of sewerage infrastructure and specifications for various components.

It is in no way a comprehensive "Design Manual" and it is intended to be read in conjunction with and as a supplement to:

Water Services Association Australia WSA 01 - 2004 Polyethylene Pipeline Code
Water Services Association Australia WSA 02 - 2014 Gravity Sewerage Code of Australia
Water Services Association Australia WSA 04 - 2005 Sewage Pumping Station Code of Australia
Water Services Association Australia WSA 07- 2007 Pressure Sewerage Code of Australia

AS2200 Design Charts for water supply and sewerage
AS/NZ3500 Plumbing and Drainage Code
Plastics Industry Pipe Association (PIPA) POP Guidelines
NSW Streets Opening Conference Guide to Code and Practices for Streets Opening

Council's required practice for design and construction of water reticulation is contained within Technical Specifications – Water Infrastructure.

Engineering Guidelines for all other aspects of Subdivisions and Developments are included in Council's Engineering Specifications document.

1.1 DEFINITIONS

The Engineer Refers to the Director Infrastructure and Planning , or their appointed representative.

Council Refers to Water and Sewer Group within Council.

The Developer Refers to the owner or their agent who has applied for the development consent. The Developer will be represented by a nominated person with authority to make decisions, usually the Project Manager. For Capital works projects the Developer refer to the Contractor.

The Contractor Refers to the party engaged by the Developer to carry out works for the Developer, to Council's requirements.

Approval Refers to acceptance of materials or treatments determined by the Engineer or in accordance with the relevant standards.

Asset Owner Refer to Council when referring to sewer assets.

2 GENERAL REQUIREMENTS

2.1 DISCUSSION OF REQUIREMENTS

It is recommended that the Developer consults with the Engineer prior to commencement of design and construction to discuss the following requirements:

conditions of consent
local conditions
intended design
existing system capacity
capacity requirements for future development
construction methods and materials to clarify any points in regard to this specification

Design and construction is to be carried out in accordance with this specification current at the time of approval of the engineering plans. Should the approved engineering plans be more than 2 years old, the design is to be resubmitted to Council for approval to ensure that the construction works shall be in accordance with Council's current Specification.

Private sewers shall not be located within a Council easement. The Torrens title owner and strata title owner shall be responsible for and own private sewer infrastructure.

2.2 GENERAL DESIGN

This specification is for the design, supply and delivery of sewer pipes and fittings and the construction of reticulation sewers, connections, maintenance holes, rising mains and pump stations.

All works are to be carried out in accordance with this specification, the regulations of the relevant statutory authorities and manufacturers recommended procedures where appropriate.

2.2.1 Design Philosophy

The overall objective of the sewerage design is to provide a functional sewerage system that meets Council's obligations under its environmental protection licence and customer contract for provision of sewerage services to its customers.

As a minimum, the design shall provide:

- Least life-cycle cost;
- A level of service to the Council's customers in accordance with Council's policies, customer charters and operating contracts including satisfying local zoning requirements;
- Minimal adverse environmental and community impact;
- Compliance with environmental requirements including pollution to waters and land, odour, noise and vibration requirements;
- Compliance with WHS requirements;
- Minimum visual impact on neighbourhood;
- Sufficient hydraulic capacity to service the full catchment;
- Ability to be staged if necessary or appropriate;
- Automatic and reliable operation without operator intervention;
- Minimal maintenance;

- Easy all weather access for maintenance and emergency activities;
- Security and protection against vandalism;
- Retention of all sewage within the system;
- Minimal infiltration / exfiltration over the life of the system;
- Resistance to entry of tree roots;
- Control of septicity;
- Safe and easy access for operations and maintenance;
- Resistance to internal and external corrosion and chemical degradation; and
- Resistance to applied external loads.

Reticulation components are to be sized to cater for proposed future development in accordance with Council's Integrated Water Cycle Management Plan or further developed strategic planning document. Council's current reticulation analyses will be used as a guide in assessing size requirements.

In certain cases where Developers are instructed by Council to construct infrastructure that caters for future loading over and above their own development, Council shall reimburse the difference in costs between constructing the larger components and the size required to service the development. For further details please refer to Council's Sewer Services Policy.

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 will be returned to the developer for amendment. Council will 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.

2.2.2 Servicing Philosophy

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 Engineer prior to the submission of plans and associated documentation.

2.2.3 Design Life

All sewerage systems shall be designed for a nominal asset life of at least 100 years without rehabilitation. Some components such as pumps, valves, metering and control equipment may require earlier renovation or replacement. The design shall include consideration for future maintenance and replacement of these components.

Typical asset design lives for sewer supply distribution items are shown below.

System	Item	Minimum Design Life (Years)
Gravity Sewers	Sewers	100
	Maintenance Holes	100
Pumping Stations	Civil Structures / Wet Wells	100
	Pumps	20
	Valves	30
	Electrical	15
Rising Mains	Pipelines	100
Pressure Sewers	Pump	10
	Tanks	50
	Pipelines	100
Pressure Sewer cont.	Electrical	15
	Valves	30
Telemetry	SCADA	15

2.2.4 Mine Subsidence

Where the rising main is to be laid in an area identified by the Engineer as likely to be influenced by mine subsidence or blasting, the design shall detail measures to be taken to ensure integrity of the pipeline. Measures may include:

Fully welded continuous Polyethylene pipe; and

Incorporation of fully welded or flanged jointing systems in the pipeline adjacent to fixed structures such as valve and discharge chambers.

Pipeline construction in declared mine subsidence areas requires consent of the Mine Subsidence Board. The design shall be submitted to the Mine Subsidence Board for approval.

The expected strains on a pipeline resulting from potential subsidence shall be addressed in the design using area-specific anticipated ground strains available from the Department of Mines (refer www.minesub.nsw.gov.au).

Upon receipt of the Mine Subsidence Board's approval of a design, the Design Drawings shall be notated with conditions specified by the Board and the plans endorsed as follows: "Designed in accordance with the Mine Subsidence Board's approval dated ……, File No ……."

2.2.5 Other Service Providers

Where proposed sewer main crosses other services, the depth of those services shall be determined as part of the design. Details of underground services shall be obtained from the Asset Owner.

During the design phase a services location survey of the proposed pipeline route is to be undertaken to determine the proximity of other services to the sewerage lines. Where other services are parallel to the sewer mains and these intrude into the sewer system allocation, the designer shall consult both the Engineer and the other service provider. Actions to be taken shall be decided on a case by case basis.

Pipelines shall cross other services at 90° if practicable, but not less than 45°.

Location of Services

Verify the exact location of all services which may be affected by construction activities. The Asset Owner must be notified if services are affected in any way.

Road, Rail and Creek Crossings

Pipeline crossings of roads, railway lines, creeks and underground services shall, as far as practicable, be at right angles. Pipelines shall be located and designed to minimise crossing restoration and maintenance of the main in the crossing. Specific approval may be required when crossing main roads and rail infrastructure. The design should consider extending conduits beyond the boundaries of rail corridors to facilitate maintenance works without interruption of train services.

Before You Dig Australia

Before You Dig Australia, BYDA is a free service which facilitates the provision of asset plans and information to anyone working in and around infrastructure assets directly from owners of utility services. Enquiries may be made online via their website at Before You Dig (1100.com.au) or by phone at 1100. Nevertheless, hand excavation (pot-holing) or non-destructive digging is recommended to determine the exact location and depth of underground obstructions during design and again immediately prior to excavation.

Underground services and other obstructions such as power conduits / cables, gas mains, drains, telecommunication conduits / cables, oil / petrochemical pipelines and the underground portions of surface obstructions (tree roots, pits, etc.) may affect the proposed alignment of sewer main components both in plan and in level.

Note: Council's stormwater assets are not provided on BYDA plans. Location plans of these assets should be requested through Council's Customer Service Centre.

Shared Trenching

Shared trenching is not permitted unless approved by the Engineer.

Protection and Maintenance of Services

Protect and maintain existing services to the satisfaction of the Asset Owner including, if necessary, relocation, temporary diversion or support of the service.

Clearance Requirements

Pipeline clearances from other service utility assets shall be in accordance with Asset owner's requirements. Guidance on clearances is provided in Gravity Sewerage Code of Australia - WSA02-2014-3.2.

Repairs of Services

Any damage to a Council owned asset must be reported immediately to Council. Council reserves the right to recover compensation for loss or damage and repair costs to any of its assets irrespective of provisions of plans or undertaking location on site. Repairs made to

Council assets are to be carried out by **Council employees or Council approved contractors only**. A minimum charge shall be applied to any repairs carried out, refer to Council's Annual Fees and Charges available at Fees and Charges | Singleton Council (nsw.gov.au).

If a service is damaged during execution of the work, subject to Asset Owner approval, arrange or perform repair to the satisfaction of the Asset Owner. Obtain from the Asset Owner a certificate stating that the repair has been carried out to their satisfaction.

If the service is not under the control of an authority and the Owner cannot be located within a reasonable time, report the damage, and arrange or perform repair to an approved standard. Do not backfill, cover up or make the repair inaccessible prior to obtaining approval.

Building in the Vicinity of Sewer Infrastructure

Council's Building in the Vicinity of Sewer and Trunk Water Mains Policy and associated Guidelines provide 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 Building in the Vicinity of Sewers and Trunk Water Mains Policy is available on Council's website.

2.2.6 Trenchless Technologies

Trenchless technologies may be considered and approved where justification for such techniques can be clearly explained. The designer is to consider other standard construction methods, and if found to be unsuitable, propose trenchless works, including appropriate material selection and protection. Specific approval from the Engineer is required prior to proceeding with any works.

Trenchless technology may be adopted for alignments passing through:

- Environmentally sensitive areas;
- Built-up or congested areas to minimise disruption and reinstatement; and
- Other areas not suitable for trenching eg railway and freeway crossings.

Excavation by methods such as directional-boring, thrust-boring, micro-tunnelling and pipe-jacking may be used in order to lessen the impact of the works on existing pavements and trees. For further information refer to the Australasian Society for Trenchless Technology (www.astt.com.au) and relevant Australian Standards and/or Authority requirements. All process details including location of access pits and exit points shall be documented and shall address:

- Achievement of clearances from services and obstructions.
- Depth at which the water main is to be laid to ensure minimum cover is maintained.
- Pipe support and ground compaction.
- Required alignment tolerances.

2.2.7 Associated Structures

Detailed engineering drawings shall be provided for all structures such as sewer pumping stations proposed for construction in conjunction with sewer reticulation. These drawings shall be submitted to the Engineer for approval.

Structures shall be designed in accordance with all relevant Australian Standards.

2.2.8 Soffit Requirement

Council adheres to the requirements of Australian Standard AS3500 Plumbing and Drainage Set, which stipulates a minimum height differential between the soffit of the receiving sewer and the lowest fixture of the house drain connecting to that point.

The height difference is 1.2m with any variations to be approved by the Engineer.

2.3 SYSTEM PLANNING

All lots are to be provided with a sewer junction, so placed that the whole of the lot can be serviced by gravity sewer.

The depth of the lot junction is to be such that any location within the lot can be drained via internal pipework installed with a minimum grade of 1 in 60, and with a minimum of 300mm of cover to invert level over the pipework. All lot junctions shall be no greater than 1.8m in depth and no less than 1.0m from lowest side property boundaries. The riser shall be 150mm diameter and finish at least 75mm above ground level. All pipework to the dwelling connection shall be 150mm diameter at a minimum.

2.3.1 Loadings

The minimum size for gravity sewers is 150mm diameter.

Gravity reticulation sewers capacity shall be greater than or equal to peak wet weather flow (PWWF) and sewer grades shall be sufficient to achieve self-cleansing velocity at Peak Dry Weather Flow (PDWF). Further clarification of these design factors can be found in Section 3.1 - Design of Gravity Sewer Network - General.

2.3.2 Development Staging and Lot Layout

Sewer design plans are to include proposed staging of a subdivision. Approval of plans will be based on the staging plan provided.

Changes to staging of a development or lot layout may require re-assessment of and re-approval of sewer plans. The revised plans submitted must show the entire sewer design to service the new lot layout and/or new staging of the subdivision. Any changes to lot layouts shall require re-survey of lot boundaries and re-pegging to ensure any installed junctions are located wholly within, and with a satisfactory off-set to each lot boundary.

2.3.3 Easements

Easements are required over Council's sewer mains located within 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 shall 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 shall be 3.5m, this width may need to be increased depending upon depth of main, size of main or shared trench with other services with the approval of the Engineer.

Where shared trench is with a storm water pipe, the sewer shall be located nearest the lots being serviced where practical. All sewer mains to be run centrally to the easement and at a minimum spacing of 600mm between the services.

2.3.4 Bush Fire Protection Measures

Adequate bush fire protection is to be provided for all buildings / structures associated with the waste water network in accordance with NSW Rural Fire Services Planning For Bush Fire Protection, November 2019. The protection measures shall include an asset protection zone of 15m minimum at maximum grade of 15 degrees, capable of being cleared by ride on lawn mower.

Where applicable structures constructed for the wastewater network must include the following ember protection components:

- Enclosing all openings or covering openings openable (windows, doors, vents, weepholes, and eaves) with a with steel, bronze, or aluminium to maximum allowable aperture of 2mm,
- For doors (both pedestrian and vehicle) establish weather strip with a flammability index not greater than 5 (AS1530.2) and door seal to inhibit embers entering the internal building compartments

External plastic conduit, pipes and fittings will be exposed to high radiant heat levels, which will deform and potentially increase the likelihood of the facility failing during a bush fire. All external conduits or plastic pipes above ground shall be metal or shielded with a metal cover. The shield must extend from the ground to the associated cabinet or masonry shield. Alternatively, steel conduit or electrical metal tubing (EMT) may be used for external cable protection.

2.4 PUMPED SEWERAGE SYSTEMS

2.4.1 Components

The Developer shall address, in consultation with the Engineer, the following aspects and, as appropriate, include in the design:

- the most appropriate system configuration;
- the most appropriate locations for the pumping station and discharge point;
- system characteristics including:
- head;
- pumping and discharge capacity;
- pump type;
- rising main and pipework requirements;
- bypass provisions
- Emergency storage
- emergency overflows
- provision of dewatering rising main at the pumping station;
- valve types;
- wet-well, inlet chamber and collection sump volumes; and
- operating levels;
- sewer and rising main layouts and alignments including:
- route selection;
- topographical and environmental aspects;
- easements;
- foundation and geotechnical aspects;
- provisions for future extensions;
- types and locations of maintenance structures; and
- environmental impact assessment for proposed overflow locations.

2.5 PRESSURE SEWER SYSTEMS

Singleton Council's preference is for the use of gravity sewers with pump stations where required in the network. In very limited situations a pressure sewer system may provide the most economical transportation method. Prior to selection of a pressure sewer system a servicing strategy must be prepared and submitted to Council for approval. A comparative analysis of the life cycle cost of the pressure sewer system against a traditional gravity system must be prepared providing justification for a pressure sewer system.

If Council agrees to a pressure sewer system, the design shall consider Council's requirements for access and requirements as set out in Water Services Association Australia WSA 07- 2007 Pressure Sewerage Code of Australia.

A Pressure Sewer System generally comprises a series of pump/tank arrangements, with one arrangement per property, and a common pressure pipeline collecting from each property and discharging to a Council sewerage asset. Council may accept pressure sewer system solutions in specific cases where conventional sewer is not practical. Council requires that persons with appropriate skills and experience, in pressure sewerage design, undertake the design work.

Where possible, the Pressure Sewer System shall be designed complete by a single supplier to ensure that each component is compatible with the overall system.

Pressure sewer mains are to be located in the footpath large radius bends to be used rather than tight bends. All individual property connections are to be located on the opposite property boundary from the water connection fronting the road.

Pressure sewer design is to be approved by the Engineer.

2.6 GENERAL CONSTRUCTION

2.6.1 Pre-Construction

No work shall commence on the site until the development has the following;

Development and Construction approval;

Notification of Requirements under Section 306 of Water Management Act advice;

Engineering plans and specifications authorised and stamped by Council;

Conditions of Consent and Notification of Requirements under Section 306 of Water Management Act required prior to commencement of works have been satisfied;

Bonds paid; and

The Engineer notified.

Two working days' notice is required prior to the commencement of site works. This notice is to be given by the Developer.

2.6.2 Project Manager

On all Projects the Owner or Developer must nominate a person to act as Project Manager for the entire project. This person must be readily available and have sufficient authority and ability to discuss and resolve any operational problems that occur during the development.

2.6.3 Contractors and Contract Work

All work shall be carried out by appropriately trained and qualified contractors in a competent manner in accordance with the approved engineering plans and this specification. No variation from the plan is to be made unless authorised in writing by the Engineer. This may require submission of a redesign for approval.

2.6.4 Quality Control, Inspections and Testing

It shall be the ultimate responsibility of the Developer to construct and present to Council completed works complying with the approved engineering plans, specification requirements herein (including testing) and any additional works advised in writing by the Engineer.

Any testing required shall be at the full cost to the Developer.

During progress of the work uninterrupted access shall be given to the Engineer. Where necessary the Contractor's equipment or personnel are to be made available for the use by the Engineer for examination or testing purposes. The Engineer may instruct the removal or amendment of any such work or material considered to be unacceptable, whether fixed or not.

In the event of a dispute regarding material quality of uncompleted or completed work, the material concerned shall be submitted for testing to an independent authority.

The Engineer shall generally assume the role of quality control inspector, not a construction supervisor.

2.6.5 Materials

All materials used shall be in as new condition and of an approved standard, free of structural damage or defects. If required, the Contractor shall provide full information as to source of supply and mode and place of manufacture. Test results of the particular material proposed shall be submitted to the Engineer for approval.

Some suppliers have materials that are regularly tested and have been accepted by the Engineer and upon application these materials may be accepted without further testing. Specific requirements are detailed in the relevant sections of this specification

2.6.6 Setting Out

The Developer shall be responsible for all pegging and setting out. The Engineer shall not carry out any such work or accept responsibility for its accuracy.

2.6.7 Final Site Cleaning

Upon completion of the works, all buildings, plant, spoil, debris, excess and discarded material assembled or used for the development shall be removed and the site left in a clean and tidy state.

2.6.8 State Survey Marks

Adequate precaution is to be taken to protect and preserve any state survey marks relative to or affected by the development. The Developer shall be responsible for the subsequent replacement of marks by a Registered Surveyor. An appropriate plan of survey showing the relocated marks shall be provided by the surveyor and lodged with the Surveyor General's Office in accordance with the *Surveying and Spatial Information Regulations 2017 (NSW)*.

2.6.9 Safety

The Developer shall be responsible for adequate safety precautions during progress of the works, in accordance with the relevant legislation and related standard codes of practice. This includes the provision and erection of any signs, lights and barricades necessary for pedestrian and traffic safety in public roads or places. Council shall not be held responsible for any consequence arising from Developers failure to take such precaution, whether specifically instructed or not.

2.6.10 Working Hours

No work shall be performed outside the hours that apply under the Department of Environment and Climate Change NSW Interim Construction Noise Guideline. No subdivision construction works shall be carried out on Sunday or public holiday, by or on behalf of the Developer without the express approval of the Engineer. Inspections outside normal working

hours can be arranged refer to section 4.2.2 Inspection of Work – Inspection outside Normal Council Hours for details.

2.6.11 Practical Completion

Practical Completion shall be deemed to be that stage in the execution of the work when it is complete except for minor omissions and minor defects:

- Which do not prevent the works from being reasonably capable of being used for its intended purpose; and
- In relation to which there are reasonable grounds for not promptly rectifying or constructing them; and
- Rectification or construction of which shall not prejudice the convenient use of the works or users of the amenity.

It is essential that the Developer gives Council at least 24 hours notice of the departure of a Contractor from a section of work that is proposed for practical completion.

2.6.12 Remedial Work

If it becomes necessary for remedial work to be performed, the maintenance period for such remedial work shall commence on the day on which the remedial work is approved by the Engineer. The maintenance period on any remedial work shall be 12 months, unless otherwise approved by the Engineer.

2.6.13 Maintenance Period and Maintenance Bond

Prior to final written acceptance of satisfactory completion of works and release of linen plan, Bank Guarantees or cash shall be lodged with Council for the maintenance period to provide for maintenance and/or rectification of any work found to be faulty or suffering deterioration within a period of 12 months from the date of such acceptance (Certificate of Practical Completion). The rate for this maintenance bond is listed in Council's Annual Fees and Charges.

To recover the bond it shall be the responsibility of the Developer/Contractor to arrange a final inspection with the Engineer approximately one week before the end of the maintenance period. No monies shall be refunded unless such an inspection has been carried out in the presence of the Developer and all defects subsequently repaired.

2.6.14 Rectification of Defects

Rectification of defects shall be completed within one month of written notification or work shall be carried out by Council and the cost thereof deducted from bond monies.

2.6.15 Storage of Materials

Storage of pipes, gravel and other materials in public roads or reserves shall not be permitted, unless the express approval of the Engineer is obtained. All materials shall be stored in a safe and tidy manner and shall not cause a nuisance. It may be necessary to erect signposting, safety barriers and silt fences.

2.6.16 Road Opening Permits

Council shall reserve the right to decline permission to open roads and request either tunnelling or boring methods.

Road opening permits may be obtained from Council's Infrastructure Services Group. The cost of the road opening permit shall be in accordance with Council's Annual Fees and Charges and shall apply to both crossing methods.

2.6.17 Bond to Secure Incomplete Works

Generally, bonds shall not be accepted to enable early release of the linen plan, but due consideration shall be given in cases where major works are substantially complete and minor items are delayed by circumstances beyond the reasonable control of the Developer/Contractor. All services to each allotment however should be completed and tested before any bonding shall be considered. The rate for this bond is listed in Council's Annual Fees and Charges.

2.6.18 Sub-Contractors

The identity of sub-contractors and their proposed works are to be supplied to the Engineer prior to engagement. Council reserves the right to preclude any such sub- contractor.

Council must be notified at least 24 hours prior to the arrival and departure of any sub-contractor from the site.

2.6.19 Extra Work

Ancillary requirements such as batter stabilisation, sediment control etc. shall be indicated on the engineering plan. However, variations in the extent of work may be identified during construction. These works are to be completed as directed by the Engineer. Further details and plans may be required. It is in the Developer's interest to provide for the possibility of such extra works when preparing cost estimates for the work.

2.6.20 Erosion Control

For developments where there is a probability of dust or water erosion problems, the advice of the EPA should be sought and in such cases these requirements shall be endorsed by the Engineer, as the minimum requirements.

All other erosion control shall be as details in Council's Development Engineering Specification – Design and Development Engineering Specification – Construction.

2.6.21 Insurance

Public Liability Insurance Policy

Contractors engaged on Development or Subdivisional works are to obtain Public Liability Insurance to the value of $20 million before commencing work. The policy is to indemnify Singleton Council.

Workers Compensation

Contractors engaged on Development or Subdivisional works are to carry a current Workers Compensation Insurance Policy for all employees as required by Statute.

2.6.22 Other Utility Service Providers

All work shall be carried out in accordance with the provisions of relevant authorities and related legislation e.g., Office of Environment and Heritage, EPA, SafeWork NSW etc. The Developer is responsible for obtaining all necessary approvals.

2.6.23 Environmental Protection

Environmental protection measures are to apply to all works and to all persons, Contractor and Sub contractors where the works involve any disturbance to vegetation, which include grasses, shrubs and trees.

2.6.24 Inspection and Testing

Inspections will be required by the Engineer for the following items:

- Pipework before backfilling;
- Maintenance Hole base and connecting pipework before placement of precast maintenance hole chambers and backfill;
- Maintenance hole bench plastering;
- Pressure testing of pipes, including a log of tests, remedial action and date passed final inspection;
- Maintenance hole pressure test or vacuum test;
- Measure sewer junctions before backfilling; and
- Final surface alignment with maintenance hole lids and surrounds.

It is the responsibility of the contracted plumber to ensure all plumbing work carried, including works by any sub-contractor, meets all applicable standards and this specification. While Council may give direction directly to a sub-contractor, Council is not the supervisor of a sub-contractor. Any shortcoming with works carried out is the responsibility of the contracted plumber and is to be corrected.

Notice of Inspection

24 hours' notice shall be given for any of the above inspections. Failure to notify the need for inspection may lead to the portion of the work not being approved by the Engineer.

It shall be necessary for the Developer to meet the Engineer on site at each inspection to receive written approval to proceed to the next stage of works or be instructed to amend any work.

Inspections outside Normal Council Hours

It may be possible to arrange inspections of work outside of Council's normal working hours. The cost of the inspection shall be borne by the Developer or their Contractor. This cost shall be determined by Council and must be paid to Council's cashier prior to receipt of approval from the Engineer.

Written Approval for Works

In order to receive a final Certificate of Compliance under section 307(1) of the *Water Management Act 2000 (NSW)* for the development works, the Developer must have obtained approval under section 305 of the *Water Management Act 2000 (NSW)* of the various components of the development work and complied with the Notification of Requirements under Section 306 of the Water Management Act 2000 (NSW). Only the Engineer can issue advice and approvals under the above sections of the *Water Management Act 2000 (NSW)*.

Approval to proceed from one component of works to the next, in no way absolves the Developer from the responsibility of defects or failure.

It is the Developer's responsibility to obtain approval from the Engineer.

Limitation of Approval

During construction, approval of any component of work shall be given in regard to structural standard only at the time of inspection. This does not absolve the Developer of the responsibility for any damage or deterioration occurring before the final inspection or during the maintenance period.

Linen Release and Work as Executed Plans

Prior to linen release the following is required:

- Final inspection and certificate of Practical Completion of the development to enter the maintenance period.
- A Surveyor's Statement and "Works as Executed Plans" verifying all work is constructed and located in accordance with the approved engineering plans and construction tolerances detailing all requirements of this policy.
- Such "Works as Executed Plans" are to be certified as correct by a Registered Surveyor and submitted on copies of the approved engineering originals.
- Where departures from approved plans are made during the course of construction without approval the Works as Executed Plans must be accompanied by a report prepared by the Design Consultant or, if appropriate, a Registered Surveyor, providing an explanation as to how the departures comply with Council's Engineering Requirements for Development.

3 DESIGN OF GRAVITY SEWER NETWORK

3.1 GENERAL

All levels shown on the drawings are to be to Australian Height Datum. The locations and reduced levels of the master benchmarks used for the design are to be detailed on the drawings.

The minimum size for gravity sewers is 150mm diameter.

Gravity reticulation sewers capacity shall be greater than or equal to peak wet weather flow (PWWF) and sewer grades shall be sufficient to achieve self-cleansing velocity at Peak Dry Weather Flow (PDWF)

Where possible, data collected from existing flows should be adopted for design purposes. If existing data is not available, gravity reticulation sewers capacity shall be greater than or equal to peak wet weather flow (PWWF) and sewer grades shall be sufficient to achieve self-cleansing velocity at Peak Dry Weather Flow (PDWF) and calculated as follows:

Average Dry Weather Flow:

$$ADWF = 0.011\ (litres/s\text{econd/tenement})$$

Peak Dry Weather Flow:

$$PDWF = r \times ADWF$$

Where:

$$r = \sqrt{\left(1.74 + \frac{56}{T^{0.4}}\right)}\ (for\ T > 30)$$

$$= \sqrt{2.26 + \frac{44}{T} \times 0.5 + \frac{970}{T} \times 1.5 + \frac{477}{T} \times 2.5}\ (for\ T \leq 30, K = 1.5mm)$$

$$= \sqrt{2.13 + \frac{44}{T} \times 0.5 + \frac{970}{T} \times 1.5 + \frac{59}{T} \times 2.5}\ (for\ T \leq 30, K = 3.0mm)$$

Where K represents the values of roughness to be used in the design of gravity sewers are detailed in Part 5.3.1 Table A.

T = the number of tenements available immediately to provide self-cleaning OR the number of tenements ultimately to be connected.

Self-Cleansing Flow:

$$Q_{sc} = 0.75 \times PDWF$$

Storm Allowance:

$$SA = 0.058 \times T \text{ (litres/second)}$$

Peak Wet Weather Flow:

$$PWWF = PDWF + SA$$

Sewer capacity, Q_f must be greater than or equal to the PWWF or the maximum design discharge.

Sewer capacity, Q_f must be greater than or equal to the PWWF or the maximum design discharge.

The maximum acceptable grade for any sewer is 1 in 10 (10%), whilst the minimum acceptable grades are detailed in 3.1 Design of Gravity Sewer Network – General - Table A below. Grades steeper than 10% may be approved at the discretion of the Engineer with special design requirements. 3.1 Design of Gravity Sewer Network – General - Table B also gives maximum and minimum allowable loadings for various pipe diameters.

Design flow details for sewers in industrial areas, mobile home/caravan parks etc. are to be obtained from the Engineer prior to the commencement of the design. Council requirements is based on the Gravity Sewerage Code of Australia WSA02-2014-3.1 design criteria and further as specified in this Developer Specification.

Permanent, substantial and easily accessible benchmarks are to be provided by the Developer and their location and level are to be shown on the drawings.

The values of roughness to be used in the design of gravity sewers are detailed in 3.1 Design of Gravity Sewer Network – General - Table A, below:

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

Note: Control Lines are those lines which affect the overall depth of system.

3.1 Design of Gravity Sewer Network - General - Table B (overleaf) also gives maximum and minimum allowable loadings for various pipe diameters.

Buoyancy

The designer shall consider buoyancy and floatation risk when designing for water charged ground in accordance with cl 9.4.5 Gravity Sewerage Code of Australia – 02-2014.

Group

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 %
K	Min		Max	Min		Max	Min		Max	Min	Max	Min	Max	Min	Max	Min	Max	
	1.5	3	0.6	1.5	3	0.6	1.5	3	0.6	1.5	0.6	1.5	0.6	1.5	0.6	1.5	0.6	
80	1	1	221															1.25
90	3	2	208															1.11
100	6	4	196	11	8	609												1.00
110	9	7	186	15	11	580												0.91
120	13	10	178	20	15	553	28	22	1225									0.83
130	18	14	170	25	20	530	33	27	1175									0.77
140	23	18	164	31	25	510	38	32	1129	39	2081							0.71
150	30	24	158	36	30	492	43	36	1089	44	2007							0.67
160	35	30	152	41	35	475	49	41	1053	49	1941	58	3188					0.63
180	48	41	143	52	45	446	61	52	989	61	1825	71	3000					0.56
200	65	56	135	66	57	422	76	65	936	75	1727	86	2839	98	4313			0.50
220	89	77	128	83	71	401	92	79	890	90	1642	103	2703	116	4101			0.45
250	204	176	119	113	97	374	120	105	832	117	1536	131	2527	146	3840	163	5511	0.40
300				186	161	339	184	159	755	172	1395	188	2296	207	3492	227	5013	0.33
350				324	283	312	269	234	695	242	1287	259	2118	281	3222	305	4627	0.29
400							389	340	648	332	1199	347	1975	370	3006	396	4316	0.25
450							577	507	608	448	1120	585	1855	475	2826	504	4060	0.22
500							1175	1039	575	602	1066	747	1757	600	2674	628	3843	0.20
550										819	1013	953	1670	748	2544	773	3656	0.18
600										1191	967	1226	1596	926	2430	940	3494	0.17
650												1630	1531	1138	2331	1134	3351	0.15
700												2829	1471	1400	2242	1362	3222	0.14
750													1420	1732	2162	1628	3109	0.13
800														2186	2089	1948	3006	0.13
850														2925	2024	2341	2926	0.12
900																2850	2825	0.11
1000																5668	2673	0.10

Normal Flattest grade to be adopted in reticulation design: - - - - - - - - - - - - - - - -

Absolute limiting grade for pipeline designed to be cleaned by gravity flows: ———————

3.2 DESIGN DRAWINGS

Contours are to be shown at a maximum interval of 1.0m.

All existing services including water mains, sewers, electricity supplies, property of Telstra, stormwater pipes or other services not specifically detailed are to be shown on the long section together with the design invert and design surface levels of the sewer main, type, class and grade of pipe, total contributing equivalent tenements (ET's), depth of sewer, spacing of trench stops or bulkheads and details of special bedding if required. The full extent and details of all lots to be served by the development, is to be detailed on the design drawings.

All easements for sewer mains are to be arranged and completed by the Developer. The details of relevant easements are to be shown on the design drawings.

The design drawings are to accurately locate the maintenance holes. All tie dimensions are to be shown in metres and parts thereof and are to be taken from corners of buildings, surveyed property boundaries or other similar permanent marks. Ties to fence post, trees and other impermanent structures are not permitted.

Maintenance hole and junction types shall be marked designed and installed in accordance with section 4.9 Maintenance Holes and shall be detailed on the design drawings.

Proposed overflow lines shall be shown on design drawings.

All sewer design drawings are to be submitted to the Engineer for approval by the Engineer.

Plans to be drawn to a scale at 1:500 or 1:1000 if previously approved.

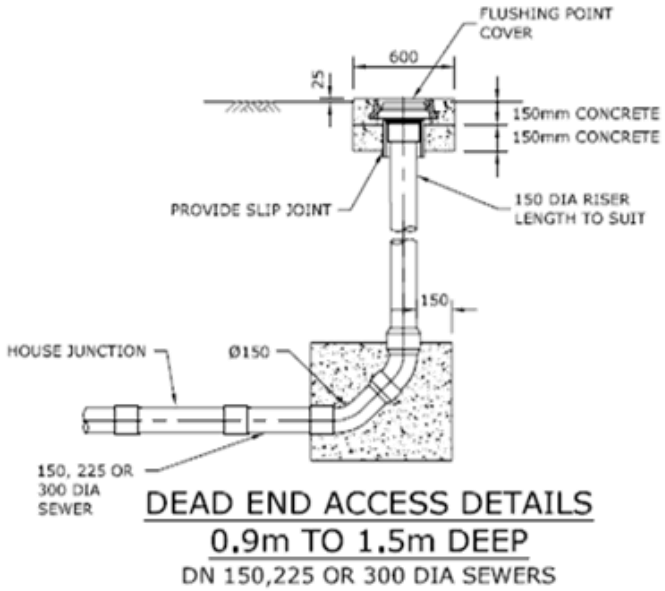
3.3 GRAVITY MAINS

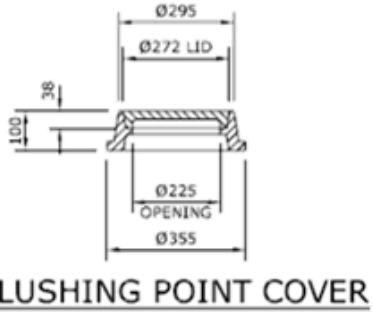
3.3.1 Distance

Maximum distance along a dead end line shall be 37m.

3.3.2 Depths and Access of Dead End Lines

Access to dead end lines up to 1.5m deep is to be provided by an access shaft in accordance with the drawings below; all dimensions are in millimetres.





Dead ends deeper than 1.5m will require the construction of a maintenance hole. This section is to be designed and developed in conjunction with section 4.9 Maintenance Holes

3.3.3 Provision to Service Future Development

Where a proposed development is downstream of future sub dividable land, the sewer is to be designed to accommodate future loading from the upstream land. Council's Water and Sewer Group should be contacted to ascertain this future loading requirement.

The sewer is to be constructed up to the extremities of the next stage or development and terminate in a maintenance hole.

Capped pipe stubs are to be provided at the end maintenance holes for the connection of future upstream works.

3.4 LOCATION OF MAINS

Sewer mains are to be constructed and laid in the locations shown on the approved engineering plans or as directed by the Engineer. Laying of pipelines will commence at the downstream end of the line and progress upstream unless otherwise approved by the Engineer.

Gravity Sewers shall be located where possible as follows:

- In public road reserves: within the footway allocation in accordance with NSW Street Opening Conference Guide to Code and Practices for Street Openings.
- In private property: Adjacent to and parallel to a property boundary.
    a. 1.0m from rear boundary to centreline of pipe;
    b. 1.6m from rear boundary to centreline of pipe when laid parallel to inter-allotment drainage;
    c. 1.0m from side boundary to centreline of pipe;
    d. 1.0m to 4.0m from front boundary to centreline of pipe.

The alignment of maintenance holes will be such that they are not located on property boundaries. In some situations, alignments may slightly vary from the above to locate maintenance holes sufficiently clear of fence corners etc. to obtain easy access for maintenance.

Where sewer mains are located within lots adjacent to storm water drainage lines, the sewer shall be installed/laid with a minimum 600mm 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 900mm in road carriageways (except RMS Roads where special treatment is required) and 600mm elsewhere (unless approved otherwise in special circumstances by The Engineer). Minimum cover required to mains and junctions in private property is 750mm where vehicular loading is anticipated, and 600mm where no vehicular loading is possible.

Where sewers of different diameters intersect or join, the pipe obverts shall be at the same level.

For buried sewerage components located close to structures such as foundations for brick walls and buildings, the components shall be located clear of the “zone of influence” of the structure foundations to ensure that the stability of the structure is maintained and that excessive loads will not impose on the sewerage component.

3.5 CROSSINGS

Where a pipeline or structure crosses, or is located within a main road or creek, or construction of the work affects plant, assets or property under the control of any other Authority, the work will be carried out in accordance with the requirements of that Authority for such work. The Developer will obtain all necessary approvals for the work from the Authority concerned and it will be the Developer’s responsibility to notify the Authority of the intention to construct and to complete any written notification as required.

Where proposed sewerage crosses other services, the depth of those services shall be determined as part of the design. Details of underground services shall be obtained from the Asset Owner.

Pipelines and services shall cross at 90° if practicable, but not less than 45°.

3.6 PIPE MATERIAL

Gravity reticulation pipelines and fittings may be of any of the following materials, manufactured in accordance with the relevant Standards:

PVC - SN8 (Rubber Ring Joints) to AS 1260 (PVC pipes and fittings for drain, waste and vent applications); Note: The date of manufacture of pipe should not be more than 12 months prior to start of the contract works.

DICL - pipes for sewerage gravity mains shall be Tyton 2100 Series TYTONXTREME pipe, calcium aluminate cement mortar lining, PN 35 Tyco Water or approved equivalent;

FRP - under special circumstance; and

Any other materials, as approved by the Engineer.

All pipes shall be rubber ring jointed.

3.7 PIPE FITTINGS – GENERAL

All junctions, bends and fittings for gravity pipelines are to conform with the relevant Australian Standards as applicable to the material being used.

3.8 OTHER PIPE MATERIAL AND FITTINGS

Where the approved engineering plans indicate pipeline or fittings constructed of other materials, these items are to have performance ratings equivalent or better than the PVC alternative and are to comply with all other aspects of this specification. Where other pipe materials and fittings are offered, full technical details including WSA compliance are to be submitted to the Engineer for approval.

Notwithstanding the above, alternative pipeline and associated fittings materials are not to be used without the prior written approval of the Engineer.

3.9 MAINTENANCE HOLES

Maximum spacing for maintenance holes shall be as follows:

Pipe Size(mm)	Maintenance Hole Spacing (m)
150	80
225	100
300	120
375 and above	150

Part 5 - Table A: Spacing for Maintenance Holes

Changes in direction of sewers must be achieved at a maintenance hole. Curved sewers are not permitted.

The vertical drop between chamber inlet and outlet shall be provided as follows:

Deflection Angle	Drop (mm)
0°to 45°	30
46° to 90°	50
91° to 120°	100

Part 5 - Table B: Internal Maintenance Hole Drop

Maintenance hole deflections greater than 120° are not permitted. Maximum Allowable Deflections through a maintenance hole shall be as follows:

Deflection Angle in Plan	Condition
Up to 90°	For DN150 to DN300 sewers: For internal fall along the access chamber channel
Up to 120°	For DN150 to DN300 sewers: Where there is a large fall at the Access chamber using an internal or external drop structure
Up to 150°	DN150 sewers only. Where there is a large fall at the Access chamber using an internal or external drop junction

Part 5 – Table C: Maintenance Hole Deflection

Where the development is utilising existing sewer mains or junctions, the mains, maintenance holes or junctions must be upgraded to meet the current guideline requirements.

For larger size pipes where bodily access is possible greater spacing may be permitted subject to the approval of the Engineer. Advice should be sought from the Engineer in this regard.

Maintenance holes are not to be located within 5.0m of each other unless otherwise approved.

All maintenance holes installed at the end of line shall be constructed from polyurethane and installed as per Manufacturer's specifications.

Material other than concrete can be used with approval from the Engineer. Concrete maintenance holes shall be used in trafficable areas such as driveways, footpaths and roadways.

Maintenance holes installed in roadways and water charged or flood affected area shall have an approved access lid as specified by the Engineer.

Maintenance hole shall be marked designed and installed in accordance with section 4.9 Maintenance Holes and shall be detailed on the design drawings.

The designer shall consider buoyancy and floatation risk when designing for water charged ground in accordance with cl 9.4.5 Gravity Sewerage Code of Australia – 02-2014 V 3.1.

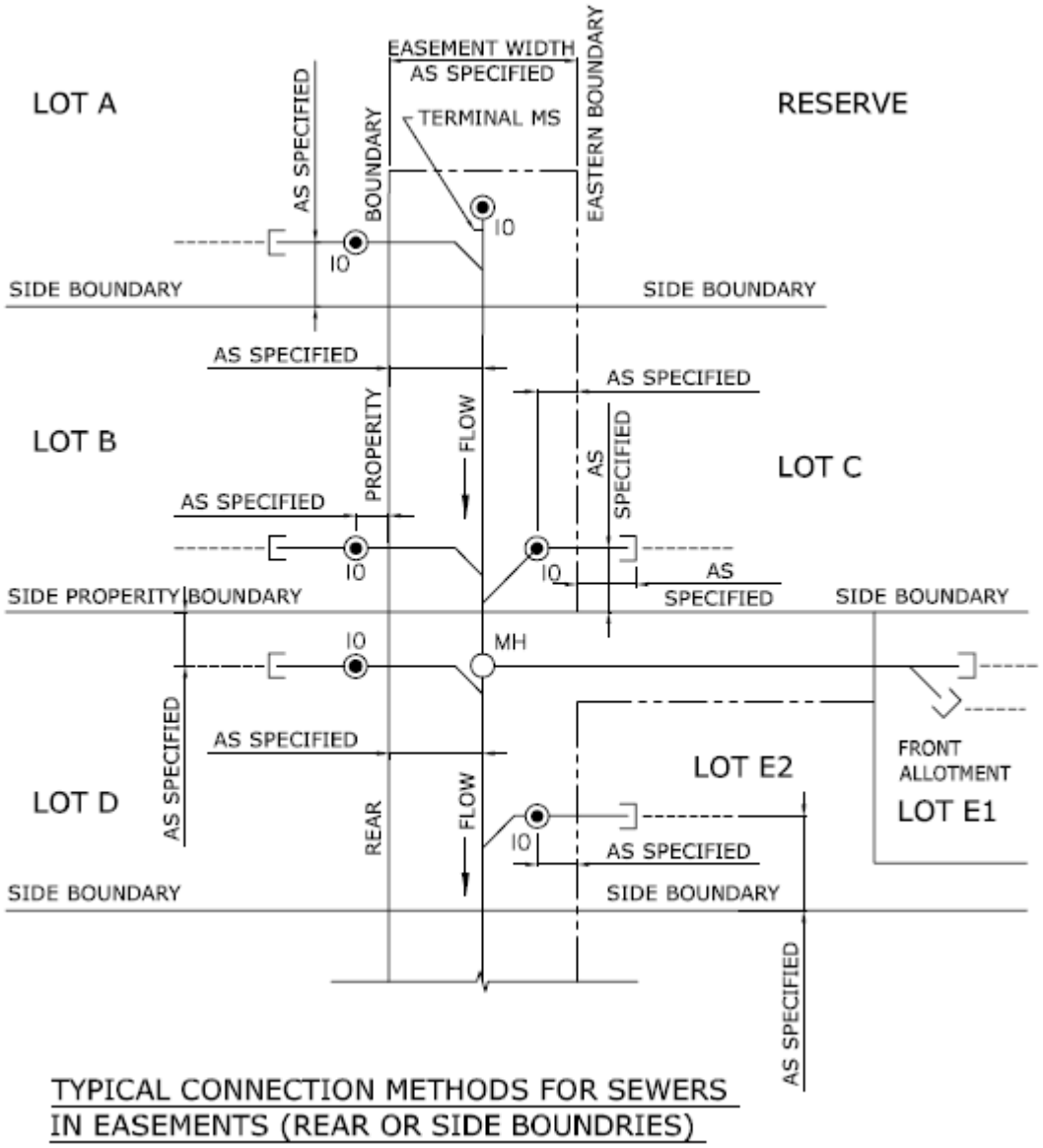
3.10 PROPERTY CONNECTIONS / JUNCTIONS

A property shall have a sewer connection made to the reticulation main for each existing and proposed lot serviced by the network at the same time as the main is installed. Lines from the reticulation mains to the service connection shall be perpendicular to the reticulation main and positioned to ensure the whole of the lot can be gravity sewered.

3.10.1 Property Connection / Junction Location

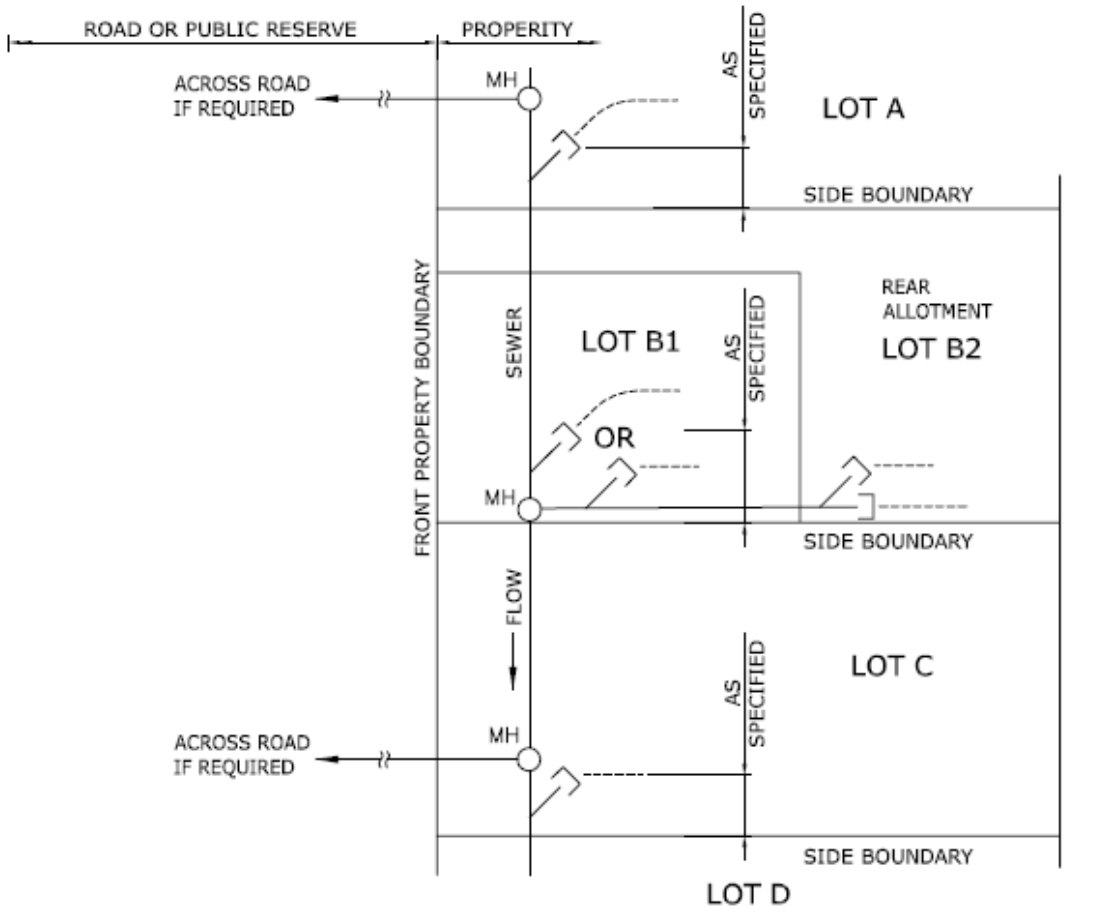
The service connection shall be located a maximum of 1.0m from the front and side property boundary. The depth of the junction is to be such that any location within the lot can be drained to it via a pipe with a minimum 300mm of cover laid at a grade of 1 in 60.

Typical connection methods for sewers in easements (rear or side property boundaries) are detailed in the drawings below; all dimensions are in millimetres.



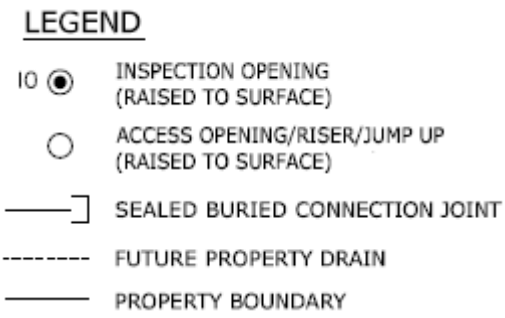
TYPICAL CONNECTION METHODS FOR SEWERS IN EASEMENTS (REAR OR SIDE BOUNDRIES)

Typical connection methods for sewers in road reserve (front property boundaries / Footpath) are detailed in the drawings below; all dimensions are in millimetres.



TYPICAL CONNECTION METHODS FOR SEWERS
INSIDE FRONT PROPERTY BOUNDARY

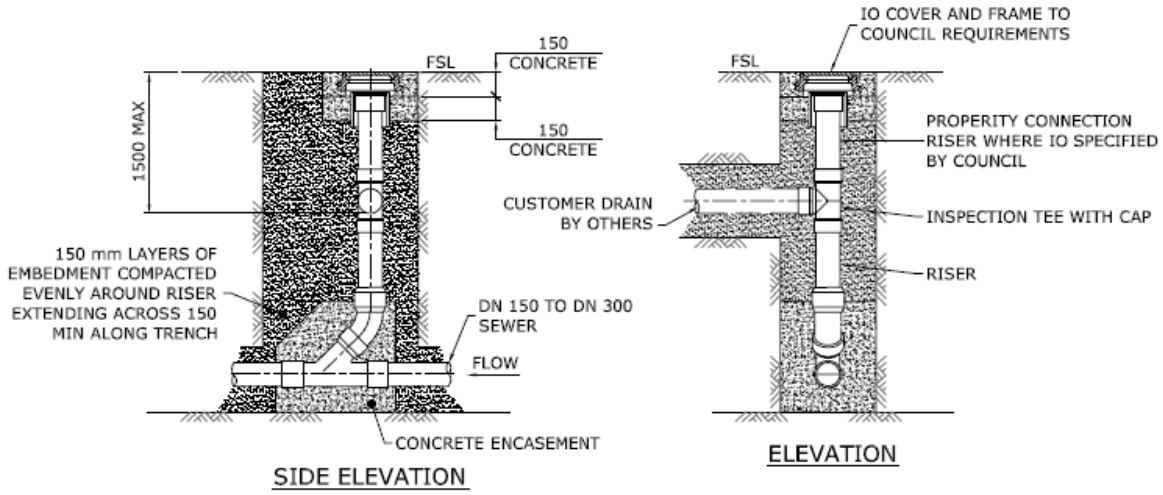
Legend details for above drawings are;



3.10.2 Property Connection / Junction Details

Where depth to the invert of the receiving sewer exceeds 1.8m, the property connection sewer shall be connected to the junction with the receiving sewer by a vertical shaft so that depth to invert of the property connection sewer a maximum 1.5m.

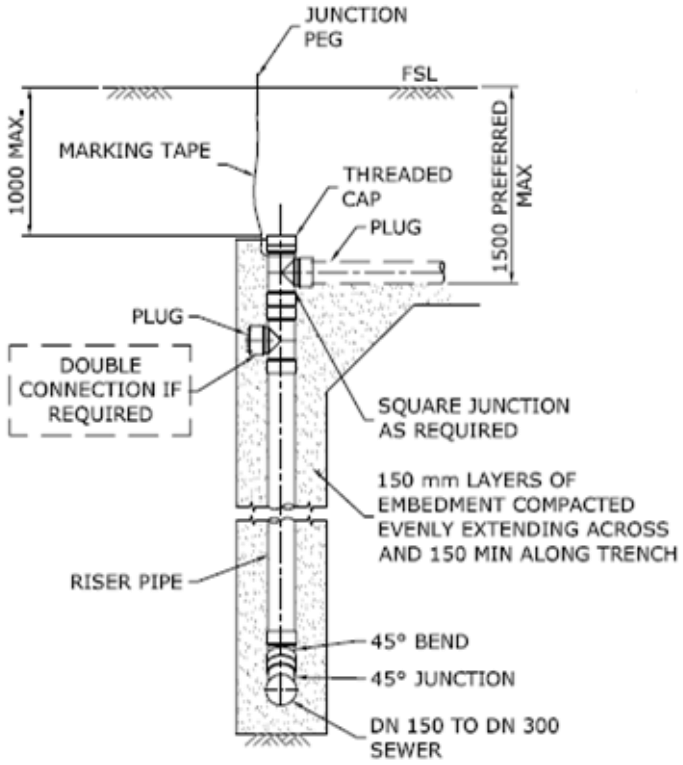
Typical vertical riser with single or double connection for sewers are detailed in the drawings below; all dimensions are in millimetres.



CONNECTION TO DEEP SEWERS IN PRIVATE PROPERITY
ON DN 150–DN 300 SEWERS

Construction of the vertical shaft shall not be undertaken if it precludes gravity sewer servicing of the entire lot. Junction is to be located a minimum of 1.0m from the property side boundary. Boundaries are to be surveyed prior to construction work.

When the sewer main is outside the property boundary the service shall be perpendicular to the sewer mains, where practical with the approval of the Engineer. Typical vertical riser with single or double connection for sewers are detailed in the drawings below; all dimensions are in millimetres.



ELEVATION
VERTICAL RISER WITH SINGLE OR DOUBLE CONNECTIONS

All marking pegs and marking tape installations shall be in accordance with section 4.3.3 - Marker / Detector Tape.

4 CONSTRUCTION OF GRAVITY SEWER NETWORK

4.1 WORKS CARRIED OUT BY COUNCIL

Connections to Council's existing sewerage system shall be carried out by Council where the execution of such works may result in a sewerage surcharge, disruption to other customers or additional work to Council, resulting from debris entering the sewerage system. The Engineer shall determine the extent of work that shall have to be undertaken by Council.

At the Developer's request, Council shall provide estimated costs to carry out the works. The estimates shall be based on the use of Council or contracted labour, plant and materials and shall include an allowance for overheads and on costs. As the payment is based upon an estimate only, actual costs shall be charged to the Developer on completion of the works. This may require payment of an additional amount or may result in a refund depending upon final costs. Pre-payment of the estimated amount shall be required prior to Council commencing any works.

The work shall be commenced within 20 working days of the date of receipt of payment, or delivery of material or upon written notification by the contractor to commence work, whichever is later.

The Developer is advised that several weeks lead time after payment may be required for the supply of non-stock materials. Council shall not be held responsible for any delays incurred by the Developer or their agents through a failure to obtain a timely quotation, make payment or make written notification for the required works.

A maximum duration of the shutdown shall be specified for each project. If no project specific maximum is specified, the duration shall be no more than 4 hours.

Before giving notice of the date that shutdown is required.

- Plan all work to minimise the duration of the shutdown.
- Obtain approval of the proposed connection procedures including methods to confirm the sewer main has been shut down effectively.
- Make all components required for the cut-in available for inspection.

Give notice of the shutdown at least 20 working days prior to the date on which the shutdown is required.

To minimise the duration of the shutdown, Council shall not commence the shutdown unless:

- All pipes and fittings required for the connection are available at the connection point and, where

possible, have been assembled above ground ready to lift into place.

- The excavation required for the connection is complete and made safe prior to Council's shutdown personnel arriving on site.

4.2 INSPECTION OF WORKS

4.2.1 Notice of Inspection

24 hours' notice shall be given for any of the above inspections. Failure to notify the need for inspection may lead to the portion of the work not being approved by the Engineer.

It shall be necessary for the Developer to meet the Engineer on site at each inspection to receive written approval to proceed to the next stage of works or be instructed to amend any work.

4.2.2 Inspection Outside Normal Council Hours

It may be possible to arrange inspections of work outside of Council's normal working hours. The cost of the inspection shall be borne by the Developer or their Contractor. This cost shall be determined by Council and must be paid to Council's cashier prior to receipt of approval from the Engineer.

4.3 SUPPLY OF PIPES AND FITTINGS

The Developer is to supply and deliver all pipes, fittings and other materials (with the exception of material supplied by Council under section 4.1 - Construction of Gravity Sewer Network - Works Carried out by Council) required to construct the work as detailed on the approved engineering plans and in accordance with the following:

4.3.1 Quality Assurance

In regard to the manufacture of products detailed in section 4.3 – Supply of Pipes and Fittings, the Manufacturer shall have implemented a Quality Control/Assurance System to ensure that all testing and manufacturing equipment, manufacturing processes, hardware, materials and workmanship meet the requirements of the specification or relevant Australian Standard.

Except where otherwise specified, the Quality Control/Assurance system is to meet the minimum requirements of AS3902 (Quality Systems for Production and Installation).

Prior to the use of any product on site, the Developer is to provide the Engineer with a Certificate of Compliance in accordance with section 4.3.2 – Supply of Pipes and Fittings – Certificate of Compliance for Materials from the Manufacturer stating that all products supplied and which are listed in section 4.3 – Construction of Gravity Sewer Network - Supply of Pipes and Fittings have been manufactured in accordance with AS3902 (or the applicable Quality Standard) and comply with all requirements.

Where the Manufacturer of any of the products listed involves a number of Manufacturers, a certificate from the Head Manufacturer or supplier shall be accepted subject to the Head Manufacturer establishing Quality Procedures for the product supplied from other Manufacturers and verifying such quality in accordance with the required standard.

4.3.2 Certificate of Compliance

As a prerequisite to acceptance of any pipe, fitting or valve delivered to site, the Developer is to obtain from the Manufacturer and provide to the Engineer, upon delivery, a certificate indicating that all items listed on the certificate comply with the appropriate Australian standards, sections of the standard Specification and any other relevant conditions of the Specification.

Furthermore, the certificate is to bear the following:

the Developers name or reference number;

the name of the Manufacturer;

the plant where the items were fabricated;

the signature of the Manufacturers Quality Assurance Officer at the plant and the signature of the Developer's representative on site, confirming compliance of items with the contract conditions.

Any items which are delivered without a certificate are liable to rejection.

The acceptance of the items by the Engineer based on the above certificate do not relieve the Developer of any obligations under this Specification to supply the items as specified and shall not negate the Engineer's right to later reject items which are not as specified.

A product appraisal certificate from Water Services Association of Australia is the preferred Compliance document as it provides a coordinated assessment of compliance with the relevant Australian Standard for each product.

4.3.3 Marker / Detector Tape

A plastic mesh style detectable fair warning tape complying with Australian Standard AS2648 shall be laid with water mains in accordance with the manufacturer's specifications. The tape shall be beige in colour and/or container the word "sewer" and contain a minimum of 0.7mm grade stainless steel tracer wire.

All marker/detector tape is to include depth indication markings adjacent to the pipe. Tape shall loop around risers, junctions and other fittings. Tape is to be long enough to just above the finished surface level.

Where pipes are installed via trenchless or pipe bursting techniques a tracer wire shall be installed. Tracer wire specific to the installation method shall be used. Selection of the tracer wire should consider the installation method and should be robust to prevent breakage.

4.3.4 Witness Marks

A full circle witness mark is to be provided on each spigot of all pipes supplied by the pipe manufacturer. The Developer is to install the pipes such that the centreline of the witness mark or groove or at least one point thereof, is in the plane of the face of the socket and such that no portion of the centreline is inside the socket. The permissible deflection as recommended by the Manufacturer is not to be exceeded, provided that the requirements of the specification shall take precedence. Any pipes cut to length are to have their witness mark reinstated at the position recommended by the Manufacturer prior to joining.

4.3.5 Fasteners

Unless otherwise approved in writing by the Engineer, all bolts and washers for flanged coated fittings that are to be buried in the ground are to be stainless steel Grade 316 to AS1444. All nuts are to be stainless steel Grade 304. All other bolts, washers and nuts that are not buried in the ground may be hot dipped galvanised in accordance with AS1650.

Before and during assembly all stainless steel components are to be thoroughly coated with a copper impregnated anti-seize paste/grease or an approved equivalent.

All exposed bolt heads and nuts are to be hexagonal, and the length of all bolts is to be such that when fitted with a nut and tightened down, the threaded portion shall fill the nut and not protrude from the face thereof by more than half a diameter.

4.4 HANDLING AND STORAGE

The method of loading and storage of pipes and fittings is to be in accordance with the Manufacturers recommendations and further as follows.

- PVC pipes and fittings are to be stored, transported and handled generally in accordance with the relevant provisions of AS2032 and with equipment such as to preserve their dimensional and physical properties and to avoid damage to the pipes and fittings.

  Pipes and fittings are to be handled with care at all times and in particular with regard to the following:

  a. The impact resistance of PVC is considerably reduced at low temperatures; it is also greatly and permanently reduced by surface notches and scratches and by prolonged exposure to direct sunlight.
  b. High temperatures tend to soften PVC and may result in permanent distortion of PVC pipes and fittings.
- When handling PVC pipes and fittings, the Developer shall comply with the following particular requirements:
  a. Pipes and fittings are not to be dropped. Impact with other objects shall be avoided, especially in cold weather.
  b. When pipes are stacked the height of the stack shall be limited to seven layers of pipe, unless otherwise allowed or directed by the Engineer. Side supports used in rectangular stacking is to be spaced not further than 1.5m apart. Pipes shall be positioned alternatively in the stack, spigot end against socket end, with sockets protruding sufficiently

to ensure contact along the full length of the barrel. When storing different classes of pipe in the same stack, the heaviest class is to be placed at the bottom.

c. If pipes are nested (i.e. pipes stored inside pipes of larger diameter) the number of layers of pipes in a stack shall be reduced so that the total weight of the pipes is a normal stack (i.e. where the pipes are not nested and where the specified maximum height of the stack is not exceeded).
d. Any pipes which are to be stored for more than 5 weeks shall be protected from sunlight, if necessary, by covering with building paper or other approved material).
e. When pipes and fittings are to be jointed, the spigot is to be pushed into the sockets by hand or the joint may be effected using approved implements such as pullers having jaws lined with rubber or similar material in order to avoid scoring the pipe. The use of lever bars shall only be permitted if adequate and suitable protection from damage is applied to the end of the pipe being levered.

4.5 EARTH WORKS

4.5.1 General

All excavations shall be to the lines, grades and forms shown on the approved drawings or as directed by the Engineer in accordance with the requirements of this section

4.5.2 Existing Services

All existing services in the vicinity of works are to be located and marked prior to excavation. Services in close proximity to works are to be carefully exposed (by non-mechanical/non-destructive excavation or potholing) to ensure the risk of damage when excavating is minimised (eliminated) and appropriate clearances maintained during construction.

Location of Services

Verify the exact location of all services which may be affected by construction activities. The Asset Owner must be notified if services are affected in any way.

Protection and Maintenance of Services

Protect and maintain existing services to the satisfaction of the Asset Owner including, if necessary, relocation, temporary diversion or support of the service.

Asset Owner permission may be required in some circumstances, eg power, telecommunications, gas, etc.

Before You Dig Australia

Before You Dig Australia, BYDA is a free service which facilitates the provision of asset plans and information to anyone working in and around infrastructure assets directly from owners of utility services. Enquiries may be made online via their website at Before You Dig (1100.com.au) or by phone at 1100. Nevertheless, hand excavation (pot-holing) or non-destructive digging is recommended to determine the exact location and depth of underground obstructions during design and again immediately prior to excavation.

Underground services and other obstructions such as power conduits / cables, gas mains, drains, telecommunication conduits / cables, oil / petrochemical pipelines and the underground portions of surface obstructions (tree roots, pits, etc.) may affect the proposed alignment of sewer main components both in plan and in level.

Note: Council's stormwater assets are not provided on BYDA plans. Location plans of these assets should be requested through Council's Customer Service Centre.

Repairs of Services

Any damage to a Council owned asset must be reported immediately to Council. Council reserves the right to recover compensation for loss or damage and repair costs to any of its assets irrespective of provisions of plans or undertaking location on site. Repairs made to Council assets are to be carried out by **Council employees or Council approved contractors only**. A minimum charge shall be applied to any repairs carried out, refer to Council's Annual Fees and Charges.

If a service is damaged during execution of the work, subject to Asset Owner approval, arrange or perform repair to the satisfaction of the Asset Owner. Obtain from the Asset Owner a certificate stating that the repair has been carried out to their satisfaction.

If the service is not under the control of an authority and the Owner cannot be located within a reasonable time, report the damage, and arrange or perform repair to an approved standard. Do not backfill, cover up or make the repair inaccessible prior to obtaining approval.

Disused Sewer Mains

Unless noted otherwise on the Design Drawings, cap all disused pipelines at each end to prevent ingress of seepage water. Remove and dispose of all redundant surface and other fittings and marker plates as advised.

Do not commence any excavation until all equipment and materials necessary to make the excavation safe are on site and available for use. This includes any necessary fencing and barriers, as well as trench support systems and signage

Assess site for prior excavations and consider their impact on the new excavation.

Conduct a site hazard and safety assessment prior to commencement of any excavation to identify all potential hazards and safety measures required.

4.5.3 Limits of Excavation

The extent of clearing and excavation is to be kept to the minimum practicable to allow efficient construction of the Works. Obtain the approval of Council or the Asset Owner for the removal of any trees and prevent damage to trees that shall remain.

Stockpile topsoil separate from other excavated material and use the topsoil to make good the surface after backfilling.

Unless specified otherwise, keep the sides of excavations vertical to at least 150mm above the main.

Ensure that the minimum cover requirements shall be satisfied following any earthworks that may occur in the area of the water main. This is particularly relevant in new subdivisions or developments where earthworks are expected to form roads, driveways, footways and for general shaping of the surfaces. If minimum cover cannot be achieved, propose an alternative for approval by the Engineer.

4.5.4 Excavation Across Improved Surfaces

Obtain written permission of the Asset Owner prior to commencing any excavation across improved surfaces**.** If pipework is to cross improved surfaces such as pavements, driveways, kerbs and gutters, use tunnelling or boring if practicable.

If open excavations across improved surfaces are necessary, keep the trench width to the minimum allowed. Saw cut neat straight lines at least 150mm beyond the outer limits of the excavation through bitumen, asphalt and concrete. Assessment of extent of concrete pavement to remove may require consideration of nearby expansion joints. Remove pavers, blocks or brick pavements by hand, clean them and set them aside for later replacement.

Road reinstatement is to be carried out in accordance with the Asset Owner's requirements.

4.5.5 Excavation in Root Zones

Ensure that no undue damage is caused to a tree root system. Cleanly cut all roots ≤60mm diameter encountered during excavation.

Tunnel or bore to avoid tree roots larger than 60mm diameter.

4.5.6 Drainage and Dewatering

Keep all excavations free of water. Provide, maintain and operate intercepting Works to prevent surface water from entering the excavations. Provide all equipment necessary for dewatering the excavations and keeping the Works free from water.

Only lower the water table by well points or other external dewatering methods if no damage is likely to be caused to adjacent structures and services or the environment.

Ensure that all downstream Works that are under construction, completed or in use are protected at all times against the effects of any drainage that is discharged or likely to be discharged from the Works.

Do not discharge dewatering to sewers, storm water drains or watercourses without appropriate authorisation and without complying with the Owner's or Regulator's requirements.

4.5.7 Excavation Width

Minimum Width:

For all gravitation sewers or PVC rising mains the minimum clear width of trench (inside internal faces of travelling box, if used) to a height of 150mm above the top of the pipe will be the nominal size of the pipeline plus 250mm.

Maximum Width:

For all gravitation sewers or PVC rising mains, the maximum width of trench from the trench base to a height of 150mm above the top of the pipe will be the outside diameter of pipe barrel plus 400mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580mm plus the outside diameter of the pipe barrel.

Extra Width Excavation:

Where the width of trench below a level of 150mm above the top of the pipe is greater than the maximum width specified above, either as a result of over excavation or due to collapse of one or both walls of the trench from any cause whatsoever before or after laying of the pipe, the Developer is to remove all disturbed material from the trench. The Engineer may then direct one or more of the following:

Bedding and laying, as specified further in section 4.6 - Construction of Gravity Sewer Newtork – Pipe Embedment and Section 4.7 - Construction of Gravity Sewer Newtork – Laying and Jointing of this specification for the same pipe;

Installation of a heavier class of pipe;

Filling the space between the pipe and the undisturbed ground on both sides of the pipe and to a height of 300mm above the top of the pipe with sand or granular material of the type approved for pipe bedding as specified in section 4.6 - Construction of Gravity Sewer Newtork – Pipe Embedment. Such sand or granular material is to be compacted in layers not greater than 150mm thick.

Bedding of the pipe and concrete cradle extending a minimum of 100mm on each side of the outside diameter of the pipe, a minimum of 100mm under the barrel and to a level above the bottom of the pipe of one quarter of the external diameter of the pipe.

Backfilling and compaction for the remainder of the trench will be as directed by the Engineer.

4.5.8 Excavation Depth

For all gravitation and pressure pipelines, excavation is to be carried out to a depth of not less than 75mm below the underside of the pipe barrel and socket or coupling in the case of earth foundations and 100mm below the underside of the pipe barrel and socket or coupling in the case of rock foundations.

Extra Excavation Depth

Where, in the case of poor ground conditions, the Engineer directs extra depth to be excavated in order to obtain a firm trench bottom, the portion so excavated will be refilled to the level required for bedding of the pipe with an approved free draining non cohesive material such as sand, fine crushed rock or granular material (blue metal) free from fly ash, as directed by the Engineer, placed in layers 150mm thick and compacted by approved means.

Notwithstanding the above, where excavation in a trench has been carried out to a level deeper than the level required for the bedding of the pipe and such extra excavation has not been ordered by the Engineer, the Developer is to remove all disturbed material from the bottom of the trench and supply, place and compact, to the satisfaction of the Engineer, such quantity of an approved material as required to refill the over excavated portion to the required level.

Where the ground at the foundation level of the structures of trench is of a spongy or boggy nature and over excavation and use of non-cohesive backfill alone is considered to be unsuitable, the Engineer may direct that the Developer carry out the following works:

- Supply and place clean ballast of not less than 75mm size, or of a size determined by the Engineer on site from time to time depending on ground conditions, in layers and compact by ramming into the boggy ground until an approved firm foundation is obtained at the level required for the bedding layer. The Developer is to remove any surplus material displaced by placing of ballast and dispose of same in a manner satisfactory to the Engineer; and/or
- Supply and place “Terra Firma” Grade 1000, separation membrane or approved equivalent across at least the full trench widths and extending up each side of the trench to a level of 340mm above the top of the pipe as directed by the Engineer; and/or
- Supply and place “Terra Firma” Grade 1000, separation membrane or approved equivalent to form a pillow in trench bottom where directed by the Engineer as follows:
- Cut the stabilising fabric with the following dimensions:
- Length – as required by the Engineer
- Width – 3 x (width of trench as excavated) plus 500mm

When laying the stabilising fabric membrane, the Contractor will proceed as follows:

- Over excavate to a depth of at least 300mm below the required invert level as required by the Engineer;
- Centrally place the stabilising fabric along the trench and backfill with non-cohesive material to a minimum depth of 200mm or a depth as directed by the Engineer across the trench onto the fabric; and
- Form a pillow of the non-cohesive material with the stabilising fabric ensuring at least one trench width overlaps at the top surface of the so formed pillow and providing overlaps of 500mm between each section of fabric laid on the trench along the pipe route.

The overlay will be stitched to the preceding section if nominated by the Engineer in accordance with Manufacturers requirements.

- When the Developer has been directed to carry out the work described in (2) and (3) above without the use of any other foundation stabilisation method and if the material is boggy and

cannot adequately support the geofabric material, the Developer will initially prepare the foundation material by the use of clean granular material or ballast placed as directed by the Engineer.

4.5.9 Erosion and Sediment Control

In the event of any trenching being left open for an extended period of time (ie longer than one week), the Developer will provide erosion control measures to ensure minimal soil disturbance and material loss off the site. These measures are to be provided as outlined in – Control of Erosion and Sedimentation.

Additional control measures may be necessary as detailed below:

- Provision of trench stops every 30m along a trench with provision for overtopping to be directed to the kerb.
- Placement of blue metal bags along kerb and gutter at maximum 30m spacings.
- Placement of blue metal bags around downstream drainage pits.
- Construction of diversion banks to divert the uphill catchment water from entering the trench.

4.5.10 Backfilling and Compaction

- When laying and jointing of a pipeline has been completed and before backfilling is commenced, an inspection by the Engineer will be required.
- Backfill to within 150mm of the pipe surround (refer section 4.6.2 - Constructuion of Gravity Sewer Network - Pipe Embedment - Bedding Specification) is to be selected backfill free of large stones, rocks or hard nodules, fly ash and may, as far as is practicable be taken from the excavated material. The backfill material is to be compacted to a height of 150mm over the top of the pipe surround.
- For all trenches that are to be subject to vehicular traffic, or as directed by the Engineer, all backfill material is to be fully compacted in layers not more than 150mm thick to 70% density index determined in accordance with AS1289 for non-cohesive material to the subgrade level of the road or the finished surface level as directed. The use of cohesive material for backfill is not permitted. Backfill to the road surface level is to be an approved road base material to a minimum depth of 300mm. Compaction of the backfill material is to be by flooding including mechanical assistance. Prior to backfilling and compaction of vehicular trafficable trenches, bulkheads consisting of polyethylene bags are to be provided across the full width of the excavated trench directly behind the kerb to contain the compacted material. The bulkheads are to be recessed into the sides of the trench excavation a minimum of 100mm in solid firm ground and as directed by the Engineer in other ground types. Bulkheads are to extend a minimum of 100mm from the top of the pipe (refer section 4.6.2 - Constructuion of Gravity Sewer Network - Pipe Embedment - Bedding Specification).
- Undertake testing of fill compaction and/or density in accordance with AS 1289 Part E. Engage an approved body registered by NATA for the particular tests to be undertaken. Submit test results.

-

The minimum number of tests shall be:

Area	Zone	Number of Tests
Hardstand	Pavement	Two
	Backfill and Subgrade	Two for each 900mm layer
Access Road	Pavement	Two tests for every 50m length o f access road but not less than two.
	Backfill and Subgrade	Two tests for each 900mm layer for every 50m length of access road but not less than two tests per 900mm layer.

- Tests shall be considered to apply to a section of work being either the hardstand area or 50 lineal metres of the access road. If a test fails, the relevant section of work shall be considered to be defective. Elect to either rectify the work or undertake two further tests in the section deemed to have failed within one week of the failed test. The locations of the additional tests shall be where directed. If both additional tests pass, the section shall be accepted. If one or both of the additional tests fail, rectify the work.
- Within two weeks of the completion of any rectification work, perform two more tests where directed. If one or both of the tests fail, rectify the work and continue to retest and rework until all test results are satisfactory.
- Determine density of compacted materials in accordance with AS1289 and the following table. If the results of any test at a site fails to meet the relevant acceptance criteria, re-compact and re-test the entire layer until all tests meet the acceptance criteria.

Layer	Number of Tests	Minimum Acceptance Criteria
Sub-grade	2	98% maximum standard dry density
Fill	1 per layer	100% maximum standard dry density
Sub-base	3 per layer	95% maximum modified dry density
Base	3 per layer	98% maximum modified dry density

- When the excavated material is considered by the Engineer to be unsuitable for use as backfill, then the Engineer may order that backfill material of a non- cohesive nature, such as sand or river gravel be used and compacted in accordance with section 4.5.10 - Construction of Gravity Sewer Network - Earthworks – Back Filling and Compaction. Alternatively, the Developer may elect to import selected backfill material borrowed from sources arranged by the Developer and approved by the Engineer and compact this by mechanical means. Notwithstanding the above, all surplus excavated material is to be removed and disposed of in areas approved by the Engineer. The Developer is to pay all costs involved in such removal and disposal.
- Where compaction is ordered and the trench has been externally dewatered, the dewatering equipment is to be kept operating until the compaction of the trench has been completed. Water discharge from external dewatering equipment may be used for compaction by flooding.
- Where compaction is ordered (especially within lots in integrated housing developments), in areas other than under roadways, the backfill will be compacted to the approval of the Engineer, by manual or mechanical tampers in layers of not more than 150mm thick to 95% of the standard maximum dry density in accordance with AS1289 or, when approved by the Engineer, by flooding with water as backfilling proceeds. Tamping will only be carried out with backfill damp but not sodden. Flooding of cohesive material will not be permitted as a means of

compacting backfill.

- Water for compaction by flooding is to be introduced onto each 300mm layer of material placed so as to permeate downwards in order to obtain the highest possible density which can be obtained by this method of compaction. Not to be used in highly saturated soil types.
- Backfilling and compaction will be carried out without damaging the pipe or its external coating or producing any movement of the pipe. Any subsidence or scouring of the trench backfill during the specified maintenance period will be rectified by the Developer at no cost to Council.

4.5.11 Restoration

Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling is to be carried out or the original backfill trimmed in order that the surface of the completed trench may then conform to the adjacent surface level.

Where, within public or private property, the reasonable convenience of persons shall require such, the Engineer may order trenches to be levelled off at the time of backfilling. The area disturbed during construction shall then be topsoiled and seeded or turfed if required. Any subsequent settlement is to be made good by the Developer.

The Engineer may require the Developer to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching. Backfilling is to be carried out so as to restore full support to those surfaces. The Developer shall remain responsible for the maintenance and repair of the improved surfaces, if subsequent damage occurs due to subsidence or erosion of the backfill, until the end of the Maintenance Period.

Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement is to be temporarily restored. Where the trench crosses bitumen or concrete pavement, a pre mixed asphaltic material shall be used for such temporary restoration. Temporary restoration is to be maintained by the Contractor until final restoration is carried out. Final restoration of the pavement shall be carried out to restore the pavement and its sub base to no less than the original condition. Final restoration may include, if required by the Engineer, the removal of temporary restoration.

Where an existing access crossing is cut, broken or disturbed to provide services in trenches, the whole access is to be removed and replaced to its original condition.

4.5.12 Maintenance

All restored surfaces are to be maintained by the Developer until the expiry of the Maintenance Period applicable to those surfaces.

4.5.13 Thrust Boring Under Roads

Where the provision of sewer mains requires the crossing of existing Council roads and where the Engineer directs such crossing are required to be constructed by thrust boring the method is to be as detailed hereunder:

- Construction shall be by means of thrust boring or pipe jacking or another approved

method.

- The Contractor is to supply all materials for the work including but not limited to carrier pipe, exterior encasing sleeve, grout and cradles.
- The encasing pipe is to be steel or reinforced concrete complying with the respective requirements of a) and b) below:
  a. Steel encasing pipe is to be fabricated from steel having specified minimum yield strength of 230MPa and shall have a minimum wall thickness of 8mm for inside diameter less than 450mm or 12mm for encasing pipes of larger inside diameter up to 800mm;
  b. Reinforced concrete encasing pipes are to comply with AS4058 with reinforced concrete rebated joints – the minimum class of pipe shall be Class 4.
- The inside diameter of the encasing pipe is to be at least 100mm greater than the largest outside diameter of the carrier pipe as measured at the joint or coupling to allow installation of the line to its design grade and line within the specified tolerances.
- Subject to compliance with tolerance for line, grade and level, the carrier pipe may be located anywhere within the encasing pipe. These requirements may be varied to allow the tolerance for line and level to be ±100mm.
- The Contractor is to supply and install suitable pipe support cradles to the satisfaction of the Engineer which shall allow installation of the carrier pipes in accordance with the foregoing requirements. The first and last cradle is to be within 1m from each end of the encasing pipe.
- After construction, installation and pressure testing of the carrier pipes the Contractor shall fill the annular space between the carrier and encasing pipe completely with a grout mix complying with item 8 of this section (below). All precautions are to be taken to ensure that there is no movement of the carrier pipe from its line and grade during grouting. The carrier pipeline shall be filled with water prior to grouting.
- Grout to be used for the sealing of the annular space is to be a mixture of cement and water, plus an admixture if specified or approved.
- These materials are to be mixed to a consistency which satisfies the Engineer, who shall require that such consistency be the stiffest at which, in his opinion, the grout can reasonably be forced through the air space at the specified or approved pressure, so as to completely fill all voids in the ducts. The water cement ration (by mass) shall not be greater than 0.60.
- Testing of the line is to be in accordance with section 4.10 – Testing and Inspection.

Where the provision of sewer mains requires thrust bored crossings of RMS or ARTC property the requirements of the relevant authorities is to be sought and complied with.

4.6 PIPE EMBEDMENT

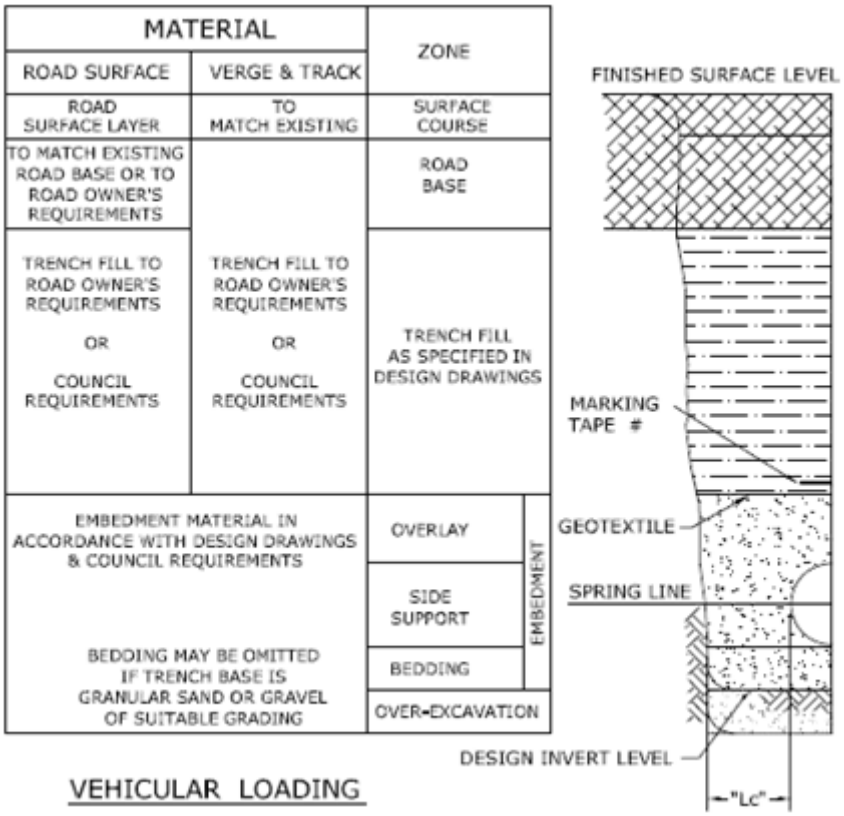
4.6.1 General

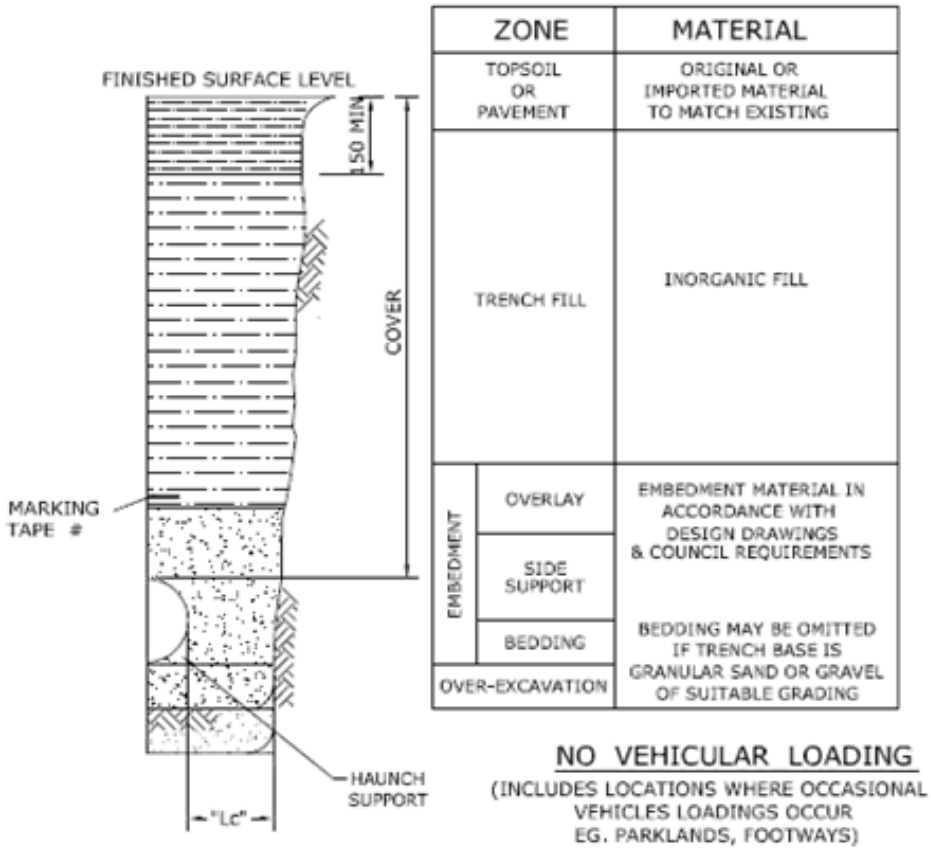
When excavation of a trench has been completed and approved by the Engineer, the Developer is to provide for bedding of the pipe in accordance with the following requirements.

Pipe embedment types and specifications shall be shown on the design drawings and shall include the embedment materials and reinforcement details, where required.

Standard embedment types shall be designed and constructed in accordance with Gravity Sewerage Code of Australia WSA02-2014-3.1 *Figures 9.2 Type 1 Support for Rigid Pipes Only (Stable Trench Conditions),* Figure 9*.3 Type 2 Support for Rigid Pipes (Other)* and *Figure 9.4 Type 3 Support for Flexible and Rigid Pipes (Stable Trench Conditions).*

A typical arrangement of a buried pipe in a trench showing embedment and trenchfill zones for trafficable and non-trafficable loadings are shown below.





Minimum cover depths shall be in accordance with the tables below; unless otherwise outlined in this specification.

MINIMUM PIPE COVER

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 TO 1500

WHERE MINIMUM COVER CAN NOT BE ACHIEVED, PROVIDE ALTERNATIVE PROTECTION OF THE PIPLINE

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 THE PIPE AND COMPACT THE SIDE SUPPORT ZONE.

Minimum cover under a sealed carriageway (road pavement) shall be taken from below the finished road level as required by the RMS and the Engineer. Minimum pipe cover requirements shall only be reduced with the approval of the Engineer.

4.6.2 Bedding Specification

For all sewer pipelines and rising mains, the material to be used for pipe bedding (underlay a minimum of 75mm below the pipe barrel and socket for earth foundations and 100mm for rock foundations), side support and overlay to a minimum depth of 150mm above the top of the pipe (as specified in Figure 5.1 in AS2032) will be sand or other approved non cohesive granular free draining material, either crushed natural or blended and its grading is to fall within the following limits:

Sieve Size Aperture Width (AS1152)	Equivalent BS Size (BS410)	Percentage Passing
9.55mm	3/8 inch	100
6.7mm	1/4 inch	90 – 100
425 µm	No 36	40 – 90
150 µm	No 100	0 – 10

The material is to be compacted under, around and to a minimum of 150mm above the top of the pipe and is to extend for the full width of the excavated trench.

Product specifications for trench fill and embedment material are detailed in Gravity Sewerage Code of Australia WSA02-2014-3.1 – Part 2: Construction.

4.6.3 Special Embedment

A geotechnical assessment shall be made for all pipes where historical data or evidence indicated geotechnical problems (e.g. steep slopes, land fill site, mine subsidence and road conditions etc). The design drawings shall incorporate all geotechnical requirements.

Considerations for concrete encasement, cement stabilised fill systems and geotextile surround systems shall be designed and constructed in accordance with Gravity Sewerage Code of Australia WSA02-2014-3.1 *Figure 9.5 Type 4 Embedment Support with Geotextile Filter Fabric, Figures 9.6 Types 5 (non-reinforced) and 6 (reinforced) Support Utilising Concrete Foundations, Figure 9.7 Type 7 Support Utilising Geotextile Pillow Foundations, Figure 9.8 Type 8 Support Utilising Cement Stabilised Foundation, Figure 9.9 Type 9 Embedment support, Figure 9.12 Type 12R Support Concrete Embedment, Figure 9.13 12U Support Concrete Encasement* and *Figure 9.14 Type 13 Support Utilising Cement Stabilised Embedment*, and the details in this Developer Specification.

Pipe embedment types and specifications shall be shown on the design drawings and shall include the embedment materials and reinforcement details, where required and shall be approved by the Engineer.

4.6.4 Non-Standard Conditions

The Engineer may direct that granular bedding and surround material be used, when in their opinion sand bedding and surround is not suitable and further as follows:

Notwithstanding the requirements of section 4.6.2 - Construction of Gravity Sewer Networks – Pipe Embedment – Bedding Specifications for gravitation sewers (but not rising mains) laid in impermeable material such as rock and clay, or where trench conditions are set, the material used for pipe bedding (underlay), side support and overlay (to a depth of 150mm over the top of the pipe) may be graded aggregate, either crushed rock or gravel and its grading is to fall within the following limits:

Sieve Size Aperture Width (AS1152)	Equivalent BS Size (BS410)	Percentage Passing
19.0mm	3/4 inch	100
16.0mm	5/8 inch	50 – 80
13.2mm	1/2 inch	30 – 65
8.0mm	5/16 inch	15 – 50
4.75mm	No 4	0 – 10

The material is to be placed and satisfactorily compacted as specified in AS2032 Clause 5. 2. 2. 3 (b), (f) and (g). Where such graded aggregate is being used, the installation of trench stops will not be required.

4.6.5 Pipe Damage

Any pipes and fittings damaged, or in any way changed from original designed condition in any way that may affect longevity and performance and may be rejected by the Engineer. Reasons for rejection of a pipe and fitting may include but not limited to – scratching, deformity, bending, chipping, incorrect grade or type, internal roughness, incorrect chamfering and de-burring etc.

4.7 LAYING AND JOINTING

4.7.1 General

When the bedding for pipes has been prepared as specified in section 4.6 - Construction of Gravity Sewer Newtork – Pipe Embedment and approved by the Engineer, pipes will be laid and jointed in accordance with the Manufacturer's instructions and the provisions of this specification.

All pipes, fittings, valves etc. will be of the class or wall thickness and size specified unless otherwise directed by the Engineer. Before being laid, all pipes, fittings, valves etc. are to be cleaned and examined by the Developer and, if required, by the Engineer, the Developer is to suspend each or anyone in a sling or enable the Engineer to examine it. If directed by the Engineer, the Developer will oil valves and repack valve glands.

Except where laying, cleaning or testing is in progress, the Developer will temporarily seal the ends of all incomplete and completed pipelines so as to prevent soil, mortar, water or other foreign matter from entering the pipe. The Developer will install suitable temporary plugs in maintenance holes of upstream ends of incomplete sections where house connections may or have been made, to prevent drainage, silt and debris entering the sewers.

The Developer will take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports are to be removed prior to completion of backfilling unless approved by the Engineer.

Gibault joints are not to be used in sewer applications.

4.7.2 Steel Pipelines

- All gravitation sewers laid on grades of 15% to 50% will be bedded on Grade 20Mpa concrete. Such concrete is to have a thickness of at least 75mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe or 150mm minimum thickness, whichever is

greater and a width across the trench not less than the minimum width specified. Refer to

- section 4.6 - Pipe Embedment

Trench stops of concrete bulkheads in accordance with section 4.7.9 - Construction of Gravity Sewer Network – Laying and Jointing – Trench Stops and section 4.7.10 - Construction of Gravity Sewer Network – Laying and Jointing – Concrete Bulkheads respectively will be required.

- All gravitation pipelines and rising mains laid on grades steeper than 50% is to be encased in concrete as specified in section 4.8.1 - Construction of Gravity Sewer Network – Protection of Pipelines – Concrete Encasement.

4.7.3 Cutting of Pipes

Pipes may be cut as needed or directed to suit closing lengths, to remove damaged parts or to remove sockets if necessary, when jointing a socketed fitting.

For field cuts, only an approved mechanical pipe cutter is to be used, except that PVC pipes may be cut using a power saw or a fine toothed hand saw and mitre box. Cuts are to be square, de-burred internally and correctly chamfered.

All cutting of pipes shall allow for expansion and contraction of pipe material, as per Manufacturer's specifications.

Any pipes cut in the field are to have their ends prepared in accordance with the Manufacturer's instructions, or as directed by the Engineer.

4.7.4 Reinstatement of Witness Marks

For PVC pipes, only the antibacterial lubricant specified by the Manufacturer is to be applied in making the joint. When the joint is made, the witness mark is at no point to be more than 1mm from the end of the socket.

Where pipes are to be cut in the field, a witness mark is to be made on the pipe at the length from the end of the pipe specified by the Manufacturer. Scoring of PVC pipes is not permitted. Pencil or similar is to be used to make the witness mark. Where spigots and sockets are not made by the same Manufacturer, reference is to be made to the socket manufacturer for the correct marking depth (refer to section 4.3 – Supply of Pipes and Fittings).

4.7.5 Pipe Grading and Alignment

All pipelines will be laid on the grade and alignment as shown on the approved drawings or as directed by the Engineer.

Appropriate equipment is to be used to ensure pipe is laid within horizontal and vertical tolerances specified in the specification.

4.7.6 Pipe Cover

Minimum cover required to mains and junctions is 900mm in road carriageways (except RMS Roads where special treatment is required) and 600mm elsewhere (unless approved otherwise in special circumstances by The Engineer). Minimum cover required to mains and junctions in private property is 750mm where vehicular loading is anticipated, and 600mm where no vehicular loading is possible. Where sewers of different diameters intersect or join, the pipe inverts shall be at the same level.

4.7.7 Trench Stops

Where a gravitation sewer or rising main (excepting PVC pipes in trenches of rock or other impermeable material) is laid on bedding accordance with Section 4.6 – Construction of Gravity Sewer Network - Pipe Embedment at a grade of 2.5% or steeper, adequate trench drainage shall be installed to prevent trench scouring and subsidence due to high permeability of the bedding and trench fill. Trench stops shall be installed in accordance with Gravity Sewerage Code of Australia WSA02-2014-3.1 *Figures 9.17 Typical Trenchstop Detail.*

Typical trench drainage systems shall be in in accordance with Gravity Sewerage Code of Australia WSA02-2014-3.1 *Figure 9.18 Typical Trench Drainage Detail at Bulkhead, Figure 9.19 Typical Trench Drainage Discharge, Figure 9.20 Typical Trench Drainage Detail at Low Point in Trench, Figure 9.21 Typical Trench Drainage Detail at Concrete Encased Sections* and *Figure 9.22 Typical Trench Drainage Discharge Around MHs.*

Bags shall be required on the rear of the socket side of the joint nearest to the position of a stop in accordance with the formula below. Bags shall not be placed onto sand bedding.

The distance between trench stops will be determined by the following formula:

D = 100/G

Whereby:

D = Distance between stop in m

G = Grade of pipe expressed as a percentage

Where PVC pipes in trenches of rock or other impermeable material are laid on bedding in accordance with Section 4.6.2 – Pipe Embedment – Bedding Specification, at a grade of 1.5% percent or greater, trench stops will be installed at intervals determined by the formula:

D = 100/G

Pipe material in steep grades shall be approved by Council on a case by case basis. The location and details of all trench stops shall be indicated on the design drawings.

4.7.8 Concrete Bulkheads

Where a pipeline is installed at a grade of 10% or steeper concrete bulkheads of Grade 20 concrete 150mm minimum thickness shall be constructed in accordance with Water Supply Code of Australia WSA03-2011-3.1 *Figures 9.15 Typical Concrete Bulkhead Detail* and *Figure 9.16 Typical Road Crossing Bulkhead.*

- Where concrete bedding or encasement to pipe is required as specified in Section 4.7.2 - Construction of Gravity Sewer Network – Laying and Jointing – Steel Pipelines, the 150mm thick bulkhead will be cast integral with the concrete bedding or encasement across the width of trench and be keyed into both sidewalls a minimum of 150mm in OTR and 75mm in rock. The bulkhead is to extend to surface level or lower as directed by the Engineer.
- Where other bedding, or no beddings, is applicable the bulkhead will also be keyed into the bottom of the trench 150mm in other than rock (OTR) and 75mm in rock for the full width of trench.
- A 75mm nominal diameter drain hole is to be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel will be placed in and at the upstream end of the drain hole to act as a filter. The gravel will be 10mm to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel to 2mm to 10mm in size will be placed. An approved filter fabric may be used in lieu of the 150mm thick gravel surround.

The distance between concrete bulkheads will be determined by the following formula:

D = 100/G

Whereby:

D = Distance between stop in m

G = Grade of pipe expressed as a percentage

The location and details of all bulkheads shall be indicated on the design drawings.

4.7.9 Marking of Junctions

The position of each riser and junction shall be clearly marked by the Contractor on completion of backfilling.

A red survey peg shall be used to indicate the location of sewer junctions. The peg shall be tied to an underground identification tape, connected to the sewer junction. The contractor shall adjust the levels of pegs where necessary to conform to final surface level at the time of notification of completion.

As an alternative to providing a red survey peg, the vertical riser can be constructed but shall have a bolted trap screw (BTS) fitted at a minimum size of 150mm. The sewer riser shall be marked red, solvent capped, protected from vandalism and easily identifiable for future internal drainage connection.

The position of each riser and junction dimensioned relative to at least 2 adjacent property boundaries shall be shown on Works as Executed drawings to allow location at future date. Distance and depth to junctions from downstream access chambers shall also be indicated.

4.7.10 Kerb Impressions and Markers

Where kerb and gutter is constructed adjacent to the main the locations of inspection shafts, valves and other fittings shall be clearly identified by formed kerb impressions in accordance with figure below and by stainless steel location disc.

'S' to marked on the kerb adjacent to the water main or fitting. Kerb paint shall be approved high UV resistant Line Marking Paint and applied using a stencil. Markers shall be marked in orange. Markers shall be size 200mm long on face and on top of kerb. Marker letters shall be 80mm high x 80mm wide x 15mm stroke width and placed on top of the kerb adjacent to the shaft or fitting.

In addition, or where no kerb and gutter is available the locations of sewer valves or fittings shall be delineated by stencilled markers as above on the adjacent road pavement with an arrow indicating the direction of the fitting. Stencils are to be 400mm high x 400mm wide x 50mm stroked width in size.

Where valves or fittings are obscured by vegetation or topography, such as trees and gullies. The location shall be marked on a plan and Council shall install a poly post with hydrant markers in keeping with the street amenity.

Sewer service connections shall be marked with kerb impression 'S' as well as a stainless steel location disc in line with the property connection / junction.

4.7.11 Marker Posts and Plates

Marker posts shall only be installed at the request of the Engineer. Marker posts shall be constructed of high tensile powder coated steel with UV resistance and superior weathering; have depth markers for ease of installation and be 1500mm long and 75mm wide. The following colours shall be orange for Sewer.

Marker posts shall be fitted with vertical marker plates or stickers featuring distinct reflective letters for clear visibility at night. All marker plates shall be of heavy gauge galvanised steel and marker stickers shall use high bond adhesive for outdoor surfaces.

Marker plates may be attached to walls, fence posts or power poles. Where no such structure is available, marker posts shall be placed on the property boundary.

Marker posts and plates shall only be considered when the specifications of section 4.7.12 Kerb Impressions and Markers are deemed unfit by the Engineer.

4.8 PROTECTION OF PIPELINES

4.8.1 Concrete Encasement

Where pipes in gravity sewers or rising mains have less than 450mm of cover above the top of the pipe barrel and also in situations where directed by the Engineer, the pipe will be encased in concrete. Such concrete will be of Grade 20Mpa and have the following minimum dimensions:

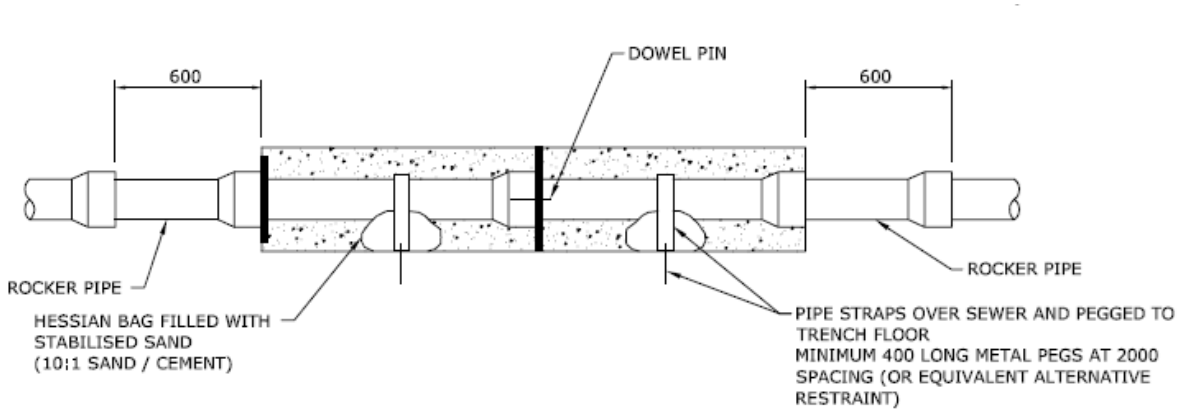
- For trenches in other than rock: 150mm under, on both sides and on top of the pipe barrel.
- For trenches in rock: 100mm under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12mm thick will be formed in the concrete encasement at the face of each socket or at one face of each coupling. Where appropriate, reinforcement is to be continuous through the joint, where steel fibre reinforced concrete is used dowels will be used as specified on the approved engineering drawings.

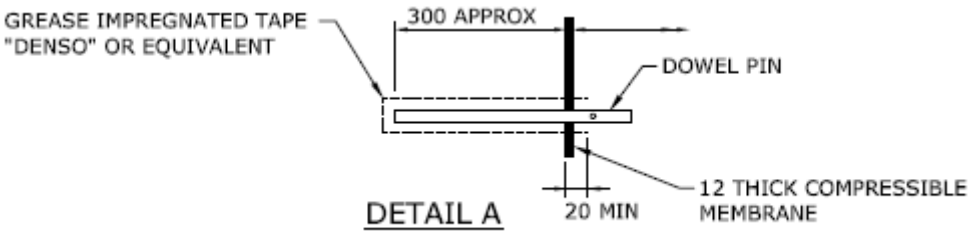
Concrete will conform to the following criteria:

- The applications for the different grades of concrete will be as shown on the approved engineering drawings or as specified in above.
- No admixture will be used in the manufacture of ready mixed concrete for the work unless approved or expressly ordered by the Engineer.
- Each load delivered to the site is to be accompanied by a Despatch Slip stating the time at which the concrete was batched and further as follows:
  a. the size of the load in cubic metres (m);
  b. the type of concrete eg Grade 15 or Grade 20;
  c. the total cement content of the load in kilograms (kg);
  d. the amount of free water batched in litres (L); and
  e. the slump at the time of batching in millilitres (mm).

Typical concrete encasement joint details are shown in the drawings below; all dimensions are in millimetres. All concrete encasement locations and details shall be details on the design drawings.



CONCRETE ENCASEMENT - JOINT DETAILS



4.9 MAINTENANCE HOLES

4.9.1 General

Sewer maintenance holes are required at all changes of grade, deflections and line intersections and at all dead-ends exceeding 37m in length. All lines less than 37m shall have a DN150 inspection shaft at the end of the line with 2 x 45 degree bends, refer to drawing SD514.

Maintenance holes shall be constructed in accordance with Drawing SD508.

The Developer is required to submit detailed drawings of proposed access structures for approval.

Step Irons shall not be installed in maintenance holes unless approved by the Engineer. Sewer maintenance holes shall not be located in road carriageways.

4.9.2 Cast-in-situ

Maintenance holes when cast in-situ, will be in accordance with details approved by the Engineer. Mechanical vibrators, approved by the Engineer will be used for the compaction of all concrete placed in maintenance holes. All concrete used for cast in-situ maintenance holes will conform to the requirements of section 4.8.1 - Protection of Pipes - Concrete Encasement Concrete Specification

Concrete for use in precast maintenance hole components will conform to section 4.8.1 - Protection of Pipes - Concrete Encasement and further as follows:

- minimum batched cement content per cubic metre for concrete will be 400kg.
- maximum water/cement ratio will not exceed 0.45 (by mass).

4.9.3 Workmanship and Finish

Workmanship and finish for all components will comply with the requirements of Clause 2.5 of AS1342. The type of finish will be as shown on Drawing No SD508 to SD511 and further as follows:

- Precast maintenance hole components that exhibit cracks exceeding 0.1mm in width will be rejected.
- All components will be free of porous, segregated or honeycombed concrete. Except where specified, any surface irregularities will not exceed 3mm in depth. Hand finishing of concrete

which has only just taken its initial set will be permitted, provided no cracking or other deterioration of the concrete occurs as a result. However, no bagging of components is permitted.

- The depth of any single air void will not exceed the following values:
  a. 10mm for external surfaces of unreinforced components;
  b. 3mm for internal surfaces (including joint surfaces) of all components. For the purpose of this document, joint ends of components will be deemed to be internal surfaces.
- Surface irregularities (excluding those detailed in b. above) will not exceed 3mm in depth
- Step irons will not be displaced from their specified position by more than 5mm.

Any precast maintenance hole component, whether delivered or installed, that does not meet the criteria will be rejected and removed from site at the full cost of the Developer.

4.9.4 Jointing Compound

Jointing compound will be "Bostic 5322" or approved equivalent comprising a butyl rubber sealing compound and will have an internal thread to prevent elongation or distortion. A primer is to also be applied to the concrete face which the jointing compound will seal.

4.9.5 Maintenance Hole Base

The maintenance hole base will be placed in-situ using a concrete mix as specified in section 4.8.1 - Protection of Pipes - Concrete Encasement and compacted using vibrators approved by the Engineer and further as follows:

- Benching to be graded to allow self-cleansing.
- Where the lowest component of the chamber section is entirely above the pipes embedded in the base, there will be a minimum of 30mm of in-situ placed concrete between barrel of the largest pipe or coupling in the base and the bottom edge of that component.
- Where the concrete in the lowest component is being cut away to accommodate the various pipes in the base, the cut away section will be such that there will be a minimum clear space of 30mm between the top of any pipe barrel or coupling and the concrete in the cut away section of the lower component, when the latter is resting on the concrete in the base.
- The lowest component will be of the shortest possible length without step irons, which will be suitable in accordance with the approved design of each maintenance hole.
- The joints between the concrete in the base, and where applicable the pipes, and the concrete in the lowest component will be such as to prevent ingress of water and other foreign matter.
- Constructed in accordance with SD508 to SD511.

4.9.6 Make Up Rings

Generally, maintenance hole chambers will be made up of sections of lengths such as to minimise the number of joints required. Make up rings (spacer rings) may be used between cone sections and surrounds to make up height differentials of less than 350mm. A maximum of 2 make up rings will be accepted.

4.9.7 Backfill

Backfill for all precast maintenance holes will be of a non-cohesive granular material placed and compacted evenly around each maintenance hole to a level of 300mm above the top of the highest incoming pipe for the full width of the excavation. The maintenance hole retaining

backfill will be placed to the finished surface level in accordance with section 4.5.10 – Earthworks – Backfilling and Compaction.

4.9.8 Access Covers

Access chamber covers are to be finished 75mm finished level for new developments allowing adequate provision for landscaping without covering the chamber lid.

4.10 INSPECTION AND TESTING

4.10.1 General Inspection

Inspections will be required by the Engineer for the following items:

- Pipework before backfill;
- Maintenance hole base and connecting pipework before placement of precast maintenance hole chambers and backfill;
- Maintenance hole bench plastering;
- Pressure testing of pipes, including a log of tests, remedial action and date passed final inspection;
- Maintenance hole pressure test or vacuum test;
- Measure sewer junctions before backfill; and
- Final surface alignment with maintenance hole lids and surrounds.

4.10.2 Testing Procedure

Initial Test of Gravitation Sewers

The initial testing of gravitation sewers will be made with static pressure. If this test in inconclusive additional testing by vacuum or compressed air, in accordance with the relevant requirements and methods of testing specified below, shall be undertaken as directed by the Engineer.

Before the initial test is performed, all pipe laying on the section will be completed and backfill will be compacted to the level of the centre of the pipe barrel.

Where the Engineer approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline will be initially tested before backfilling together with the downstream portion of the maintenance hole length under construction except as detailed in section 4.10.2 (2) - Inspection and Testing - Testing Procedure.

Any fault detected will be rectified and a satisfactory test obtained before the remainder of backfill is placed.

- When a trench support system is used which requires leapfrogging and thus progressive backfilling, the Developer may elect to carry out initial testing following backfilling, subject to the following conditions:
  a. The initial test must be carried out at the completion of each maintenance hole length or

the end of a days work on any incomplete length, whichever is the sooner.

b. If the initial test fails, the Contractor must immediately locate the cause and carry out all necessary repairs to the satisfaction of the Engineer and repeat the initial test. This procedure will be repeated until testing is successful.

Initial Test of Maintenance Holes (Static Testing)

Each completed maintenance hole must be initially tested for leakage within 7 days of backfilling. The initial test will be carried out with the maintenance hole cover surround fitted but prior to any rendering of channels and benches.

The test will be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs will be positioned in the pipes as near as practicable to the internal face of the maintenance hole.

After allowing an interval for absorption, to be determined by the Engineer, the maintenance hole will be refilled and the loss of water during the following 30 minutes measured. The test on the maintenance hole will be considered satisfactory provided the water lost is less than 3mm depth in the top section of the maintenance hole for each 1.0m depth of maintenance hole. The depth of maintenance hole is to be taken from the bottom of the maintenance hole cover recess in the cover surround to the invert of the outlet from the maintenance hole. The plug of the outlet will be fitted with a suitable release for emptying the maintenance hole on satisfactory completion of the test.

Vacuum Testing of Maintenance Holes

Vacuum test all maintenance hole by the following procedure unless otherwise accepted by the engineer. Plug and brace all outlets and inlets. Evacuate the maintenance hole to a pressure of -3.4m head of water and disconnect the vacuum pump. The test is unsatisfactory if the pressure rises to above -3.0m head of water within 120 seconds.

Pressure gauges used in vacuum testing shall be inspected by the Engineer prior to testing and may require calibration on the Engineer's direction.

Acceptance Test of Gravitation Sewers and Maintenance Holes

Notwithstanding the acceptance test on all components in the section of the main, by any method may produce satisfactory test results, the Engineer reserves the right to reject any pipeline or maintenance holes where in the opinion of the Engineer the component is faulty. Such rejection will not be made unreasonably.

Method of Carrying Out Air Test

The method of setting up and carrying out the test will be as follows:

- Insert a blank plug at one end and a disc with air hose connection at the other end of the line. Care must be taken to ensure that the force due to pressure on the disc is not taken by pipe

joints but is taken by struts bearing on the disc or on the end pipe in the line.

- Couple test equipment to line under test and compressor or airline.
- Slowly increase the air pressure in the line from 0 to 28kPa (over one minute approximately).
- Hold air pressure at 28kPa for 3 minutes to stabilise temperature.
- Close gate valve to shut off air supply to test equipment.
- Measure the time it takes for the pressure to drop from 25kPa to 18kPa. If the time is less than that permitted in Allowable Pressure Drop Times, detailed below or if the line cannot be pressurised to 28 kPa, then the test is unsatisfactory, and the pipeline should be checked for leaks.
- To check pipeline for leaks:
  c. Open the gate valve from the air supply sufficiently to maintain a pressure of 14 to 23kPa in the pipeline.
  d. Move along the pipeline coating it with detergent solution. Bubbles will indicate a point of leakage. Special attention should be paid to joints, discs and horns of junctions.
  e. If leaks are detected, they will be repaired as directed by the Engineer.
  f. Retest as abovementioned until the time taken for the pressure to drop is greater than that shown in Allowable Pressure Drop Times, detailed below.

Allowable Pressure Drop Times

The time taken for the pressure to drop from 25kPa and 18kPa will be greater than:

Pipe Size DB	Test Length in Metres					
	50	100	150	200	250	300
	Minimum test times for 7kPa pressure change					
100	2	2	2	2	3	3
150	3	3	3	5	6	6
225	4	5	8	10	13	15
300	6	9	14	18	23	29
375	7	14	22	29	36	43

Timing of the test duration is to start after an initial 3 minute period. Additional pipe size test time are as per table 21.3 of Gravity Sewerage Code of Australia WSA02-2014-3.1.

Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes must be thoroughly saturated with water before testing or alternatively a hydrostatic test applied.

In any case, where the specified allowable pressure drop time cannot be attained and there are no visible leaks, a hydrostatic test is to be applied in accordance with the 'Hydrostatic Testing' provisions outlined below.

Hydrostatic Testing

The hydrostatic test will be carried out by connecting to the pipeline or section thereof under test, a pipe or hose terminating in a 150mm diameter container not less than 100mm deep. All other open ends of the pipeline will be plugged.

The pipeline under test and the pipe or hose with container, will be filled with water until the free surface of the water is level with the top of the container, when that container is suspended in accordance with the requirements set out hereunder:

The test container will be suspended at a level such that the test head applied to the pipeline is as follows:

- For initial test where
  a. No junctions or risers are constructed – a minimum head of 2m above the pipe invert at the upstream end of the line under test; or
  b. Junctions and/or risers are constructed – a minimum head of 2m above the highest invert in the line under test, including its risers and junctions.
- For acceptance test, a minimum head of 2m above the highest invert in the line under test, including its risers and junctions, or above the free standing level of ground water in the vicinity, whichever is the higher.
- Variations are at the discretion of the Engineer.

Where appropriate, the free standing level of ground water will be determined by the Developer at their own expense by a method acceptable to the Engineer.

After allowing an interval for absorption, to be determined by the Engineer, any fail of the free water surface is to be made good by adding extra water to the container. The fall in water level during ten minutes thereafter will be measured.

The pipeline will be regarded as satisfactory if there are no visible leaks and if the fall in water level is not more than 25mm for each standard test length of the pipeline under test.

A hydrostatic system test pressure in metre equivalent to 10 times the PN rating of the pipe eg for PN 6 pipe test at 60 m head (600 kPa), in accordance with section 21.10.2 of the Gravity Sewerage Code of Australia WSA02-2014-3.1.

- Where the pipeline under test is all of the same size, the effective diameter will be the nominal size of the pipeline.
- Where the pipeline under test has junctions and/or risers of smaller nominal size than the main sewer line, then the effective diameter will be calculated as follows:

  The product of the length and the nominal size of the larger pipe will be added to the product of the length and the nominal size of the smaller pipe; this sum will be divided by the total length of pipeline under test; the result will be the effective diameter.

Vacuum Testing of Maintenance Holes

All necessary equipment is to be supplied by the Developer and kept in a condition acceptable to the Engineer.

Vacuum gauges are to be tested daily by static water column. At least one spare gauge per test rig is to be kept on the job at all times.

Vacuum equipment, pipe plugs and adaptor plate with gauges are to be capable of obtaining the required vacuum in a reasonable time. Spare pipe sealing plugs are to be held on site to ensure there is minimal interruption to the testing process.

Vacuum test all maintenance holes by the following procedure unless otherwise accepted by the Engineer. Plug and brace all outlets and inlets. Evacuate the maintenance hole to a pressure of -3.4m head of water and disconnect the vacuum pump. The test is unsatisfactory if the pressure rises to above -3.0m head of water within 120 seconds.

Pressure gauges used in vacuum testing shall be inspected by the Engineer prior to testing and may require calibration on the Engineer's direction.

Visual Inspection and Measurement of Infiltration

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of ground water (ie 1.5m or more above the soffit of the sewer main provided that ground water is at least 150mm above any junction included in the test) at the discretion of the Engineer, the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration.

In such circumstances, the Developer will provide full details of the method by which the infiltration is to be measured, to the Engineer.

If the Engineer, at his discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Engineer is to determine, at his discretion, the duration over which infiltration is to be measured. The rate of infiltration will not exceed that determined hereafter.

$$Q1 = 0.65 (l1\ d1\ h1 + l2\ d2\ h2 + \ldots\ldots\ ln\ dn\ hn) + Ha$$

Where:

Q1	=	the rate of infiltration in litres/hour
l	=	the length of pipe in m
d	=	the nominal size of pipe in m
h	=	the average head of ground water over the invert level of the pipe in the section under test in m
Ha	=	the level of ground water above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test

The head of ground water will be determined by the Contractor at his own expense by a method acceptable to the Engineer.

5 PUMPED SEWERAGE SYSTEMS

5.1 DESIGN OF PUMP STATIONS

5.1.1 General

The Developer shall address in consultation with the Engineer, the following aspects and, as appropriate, include in the design:

- the most appropriate system configuration;
- the most appropriate locations for the pumping station and discharge point;
- system characteristics including:
  - head;
  - pumping and discharge capacity;
  - pump type;
  - rising main and pipework requirements;
  - valve types;
  - wet-well, inlet chamber and collection sump volumes; and
  - operating levels;
- sewer and rising main layouts and alignments including:
  - route selection;
  - topographical and environmental aspects;
  - easements;
  - foundation and geotechnical aspects;
  - provisions for future extensions; and
  - types and locations of maintenance structures, overflows and vents.

5.1.2 Location and Layout

A circular, wet well pumping station with submersible pumps shall be adopted.

Pumping station sites shall be located as far as practicable from residential properties and, where possible, be surrounded by public open space to minimise noise and odour nuisance during periods of normal operation and maintenance.

Where the pumping station is to be built in a flood prone area the following conditions shall be met:

- The top slab of the wet-well shall be at least 1500mm above the 1 in 100 year flood level and 500mm above the estimated maximum ground water table.
- The power and control cubicle shall be at least 1500mm above the 1 in 100 year flood level.

Where the pumping station does not front a public road, the land defined for transfer to Council shall include the access road. Where that is not practicable, a suitable access easement shall be created in favour of Council.

Specific consideration of the access to the site shall be given so as to minimise any traffic hazard on the public road caused by vehicles entering and leaving the site. Appropriate parking and turning areas for nominated vehicles shall also be provided.

Access and clearances for maintenance of electrical equipment shall comply with AS3000.

5.1.3 Packaged Pump Stations

Council will accept packaged pumping stations subject to demonstration that the product complies with this Specification. Packaged pump stations shall have an external valve pit. Council does not approve the use of internal valve pits.

5.1.4 Access

All weather access from sealed public road shall be provided to sewer pump stations and other key fittings.

The access shall allow safe entry and exit from the site and be trafficable by a 5 tonne maintenance vehicle (unless larger vehicle nominated). The following shall be provided:

- Minimum width 3m, and wider where turning circles require this.
- Maximum grade less than 12%, unless approved by Council Representative. Concrete pavement may be required.
- Cross fall in the range of 3% to 5%.
- A turning area to enable maintenance vehicles to a safe turning area, where required at reservoir, pump station or control valve sites.
- Drainage lines and waterways to have culverts or similar to allow.
- Adequate hardstand area for parking of maintenance vehicles, and to enable access for franners, cranes or other maintenance equipment as required.

5.1.5 Minimum Design Characteristics

The pumping station shall be sized to pump the total ultimate Peak Wet Weather Flow (PWWF) with a single duty pump running and shall be designed to limit pump starts to a maximum 10 starts per hour. The minimum volume from top water level to bottom water level shall be the volume pumped in 90 seconds.

A standby pump shall be installed and shall start automatically if the duty pump fails. The duty and standby pump shall alternate as the duty pump, each pumping cycle.

Pumps shall be selected for maximum 10 starts per hour and shall provide a minimum self-cleansing velocity of 0.6m per second in the rising main, and a maximum velocity of 3m per second.

The combined detention time in the wet well and rising main shall not exceed 4 hours at Average Dry Weather flow (ADWF). In the event of pumping failure, a minimum of 4 hours storage is required at ADWF.

The pumping station shall have a single pipeline entering the wet well on the opposite side to the pumps. The incoming pipe shall be fitted with a gate type isolation valve to enable isolation of the wet well for maintenance. The pump station inlet maintenance hole is to be located approximately 10m from incoming wet well.

5.1.6 Pumps

Pumps and ancillary components shall comply with the following:

- Be submersible, close-coupled pumps, with the impeller mounted on a 1-piece vertical motor shaft.
- The pump shall operate coupled to a cast iron pedestal which is fixed to the wet well floor. Installation and removal of the pump from the pedestal shall be by lifting with a chain from above the wet well.
- A stainless steel guide-rail system shall be installed for each pump to ensure the pump slides freely and seats correctly in its working position on the pedestal without requiring fixings, or man-entry to the wet well. The guide rails shall incorporate a top mounting bracket and intermediate brackets sufficient to hold the rails in position and enable the pump to slide freely.
- The pumps shall be suitable for long-term submersion and operation in raw, un-screened sewage containing grit, rags and sanitary napkins.
- Thee pumps shall also be suitable for operation un-submerged for up to four hours.
- All components of the pumps shall be rated in excess of the maximum pressure that can be generated by the pump under any conditions.
- Each pump shall be fitted with a stainless steel lifting chain to AS 2321 sufficient for the installation and removal of the pump. The chain shall be tagged with its lifting capacity. A stainless streel chain hook shall be installed for each chain at the surface to attach the chain when not in use.
- Anchor suitable for electrical cables.

The pump including housing, impeller, and casing ports shall be capable of pumping solid spheres of the following diameters:

- Pump discharge port ≤100mm dia. 60mm dia. sphere.
- Pump discharge port 100 to 300mm dia. 80mm dia. sphere.
- Pump discharge port >300mm dia. 150mm dia. sphere.

The impeller shall be dynamically balanced to AS 3709, grade G6.3 prior to pump assembly.

Shaft sealing between shaft and casing shall be by maintenance-free tandem mechanical seal arrangement suitable for the operating conditions of sewage pumping and designed for a minimum of 5,000 hours under normal operating conditions. Seals shall be bi-directional.

Pumps of 7.5kW rating and over shall incorporate a seal leak detection device which raises an alarm if leakage is detected.

5.1.7 Pump Motors

Pump motors shall be in accordance with AS1359 and be supplied with type test certificates.

Motors shall comply with the following requirements:

- Capable of 10 starts per hour.
- 415V, 3 Phase, 50Hz induction type motor
- No greater than 4 pole speed (1450rpm)
- Power factor ≥0.8 when running at 75% load
- Efficiency ≥85% when running at 75% load
- IP68 for submerged operation to AS 1939
- Resistant to corrosive sewer gases such as Hydrogen Sulfide
- Have 10% greater power capability than the maximum required at the pump shaft for the installed impeller
- Suitable for DOL (direct on line) and reduced voltage starting using either auto transformer, electronic soft-start or VSD (also requires shielded cable)
- Incorporate an earthing terminal within the pump terminal box.
- The locked rotor current shall not exceed 7x rated full-load current
- Be able to withstand 20m depth submergence without leakage
- Be rated not to overheat during continuous operation under any hydraulic conditions including non-submergence.
- Incorporate a moisture detection device in the motor housing and the cable termination housing.

If VSD (variable speed drive) operation is to be used, the pump and motor manufacturer shall be consulted to ensure that the increased levels of harmonic currents and increased voltage stress on insulation are considered. Motor windings shall have an impulse to withstand voltage rating and a dV/dT rating engineered to the characteristic output of the VSD and length of cable between the motor and the VSD. The effects of common mode currents flowing through the bearings shall be taken into account by the motor manufacturer.

The motor shall be protected from overheating by at least one thermal switch fitted to the stator windings. Alternatively, resistance temperature detector elements can be used (100 ohm)

For motors above 7.5kW, or motors operated using VSD protection shall be provided by a compatible thermistor device fitted to each phase of the stator, with each thermistor connected in series to terminals adjacent to the stator terminals.

Pump / motor bearings shall be fully sealed and designed for an L10 rating fatigue life of at least 40,000 hours at the maximum operating speed. Thrust bearings shall be fitted to support all axial loads.

5.1.8 Pump Cables

Cables shall be compliant with AS 3116, be suitable for immersion in sewage and shall be supplied at least 15m long.

Cables shall incorporate additional cores for the thermal switch, thermistor or RTD protection system, moisture detection system and mechanical seal failure detection device.

Cable entries shall be glanded to a single demountable flange.

5.1.9 Electrical and Control Cabinets

All outdoor electrical and control cabinets shall conform to the following requirements:

- Degree of protection: IP56 in accordance with AS1939
- Manufacture all switchboard metalwork (including inner doors and escutcheons) from 2.5mm aluminium grade C5251-h34 or 1.5mm stainless steel grade 316
- Floor mounted and free standing aluminium switchboards shall be mounted on a full perimeter minimum 100mm high x 50mm wide x 6mm thick aluminium channel plinth
- Mount the operator panels and field instrument panels with the centre of the enclosure at 1.6m from the finished walkway surface on a stand fabricated from aluminium grade C5251-h34 or 316 grade stainless steel. The stand should be designed with no sharp edges or trip hazards and shall be robust, rigid. Ensure that clearance of not less than 600mm is provided for access and maintenance around the front of all outdoor switchboards with doors open.
- The enclosure shall be separated from its support stand by appropriate corrosion barriers. Switchboards shall be mounted on dedicated support brackets and not attached to hand rails or guard rails.
- All fixings shall be stainless steel
- Shall be fitted with stainless steel swing handles fitted with 81/3 padlocks
- Install in the PLC cubicle a metal pocket for the storage of A3 drawings and a fold down support base to support a laptop computer on the inside of the door.
- Outdoor pumping station switchboards shall have a 24Vdc IP54 LED light strip with 12 modules in one row in each cubicle between the inner and outer doors. All the light strips shall be supplied from the PLC cubicle 24Vdc power supply. They shall operate from a pushbutton in pump 1 cubicle mounted next to the level override pushbutton and shall be timed to turn lights off after 30 minutes.

5.1.10 Automatic Wash-down

To reduce the frequency of wet-well cleaning and the formation of H2S, wet-wells shall be fitted with an approved wet well washer system or flushing valve as directed by the Engineer. The system is to be controlled by a PLC or pump controlled to run at appropriate intervals to achieve a total of 20 minutes running time per day.

The designer shall consider the following when designing wet-well washers:

- Wet-well washers clean by water volume; and are not intended to be high pressure cleaners. The best results are achieved with a slow rotation speed - one nozzle directed at the wall and the other at the pumps / guide rails / floats etc.;
- The wet-well washer unit should be installed just above the cut-in level (say 1m) so that the spray can be directed at the cut-in level and below, where most of the fats build up. Note that the washers don‘t mind being submerged occasionally if the level gets above the cut-in level.)
- A backflow prevention device (high hazard type) must be installed to the water supply for the wet well washer.
- Potable water should only be used for well washing if recycled water is unavailable.
- Flushing valves may be fitted to each pump as an alternative to well washers.

5.1.11 Wet Well

The wet well shall be designed and constructed in accordance with AS3735 Concrete Structures for Retaining Liquids.

An exposure Classification of D (severe/extreme) shall be used for all internal wall surfaces

Wet well chambers shall be made from a minimum 50MPa concrete with Angaston Marble calcareous aggregate or approved equivalent.

Premixed concrete shall be manufactured by quality endorsed companies to AS/NZS ISO 9001.

Reinforcement shall comply with AS4671: 2001 Steel reinforcing materials. Reinforcing bars and fabric to Grade 500.

Concrete cover to reinforcement shall be minimum 65mm for all internal faces and minimum 50mm for external faces of wet well components.

Total wet well wall thickness shall be minimum 140mm.

In applications where there is a likelihood of sewage septicity and/or Hydrogen Sulphide corrosion of the wet well (e.g. where sewage age is routinely greater than 8 hours) the wet well shall be lined with either Megapoxy MC2 or AGRU HDPE liner or approved equivalent. The lining shall cover the base, walls and all faces of the cover slab which are exposed to aggressive wet well conditions.

The HDPE lining (AGRU Grip HDPE lining) shall be set into the concrete at the time of casting with integral HDPE anchoring studs which integrate into the concrete.

Where separately cast modular segments are utilised a water tight joint must be installed between joint segments.

After completion, the wet-well shall be tested for liquid–tightness. This shall be achieved by filling the wet well with water and demonstrating no visible drop in water level over a 24 hour period.

Structures shall be designed for 80kN vehicle loading

Structures shall be designed to resist buoyancy with an empty chamber with design ground water level, also for design operating levels with ground water table at the surface level.

5.1.12 Geotechnical Design

A geotechnical report shall be prepared with information determined from soil samples taken at the Sewage Pumping Station site in order to verify the structural integrity of the design. As a minimum the geotechnical report shall contain soil classification, information on the water table location, the soil bearing capacity and the lateral earth pressure coefficients.

5.1.13 Valves and Valve Chamber

Each pump discharge line shall be provided with a reflux valve and stop valve which shall be installed in the horizontal plane with the stop valve downstream from the non-return valve.

Stop valves shall be ductile iron resilient seated gate valves to AS AS2638 (Gate valves for waterworks purposes) with a minimum pressure rating of Class 16.

Stop valves and scour valves shall be clockwise closing as specified by the Engineer. Indicating plates shall be installed to indicate the direction of opening/closing.

Non-return valves shall be swing-check type unless otherwise approved by the Engineer.

The valves shall be installed in a chamber external to the wet-well. Isolation from the wet-well shall be provided to prevent H2S gas from collecting in the valve chamber.

The valve chamber shall be designed to prevent water ingress and shall drain any water to the wet-well by provision of a P-trap with a non-return flap.

Valves shall be operated from above ground by a tee-key device. The valve chamber shall be sized and arranged to allow access for maintenance and enable removal of all equipment including flange bolts.

A bypass pumping connection shall be installed on the downstream side of the pump station valves.

5.1.14 Access Covers

Access covers to the wet well and valve chamber shall permit normal operation and maintenance procedures.

The wet well access shall be adequately sized and aligned with pump guide rails and discharge bends so that pumps can readily pass through.

Access covers shall be a fabricated aluminium cover to suit site conditions. Alternative cover types may be installed at the Engineer's discretion.

Aluminium covers shall be grade 5005 designed and fabricated to AS/NZS 1734:1997 Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate

Welding and inspection shall comply with AS/NZS 1664:1997 Aluminium Structures.

Structural design of covers shall ensure that, under a centrally placed load of 120kg, deflection of the cover does not exceed 20mm.

Access covers shall comply with WHS regulations and shall include a safety grill (mesh) over the access cover opening to minimise the risk of personnel falling into the wet-well.

5.1.15 Miscellaneous Components

Pumping stations shall be supplied complete with all required miscellaneous items such as fasteners, mounting brackets, hinges, etc. which shall be manufactured from grade 316 or 316L stainless steel.

5.1.16 Benching

The pumping station wet-well base shall be designed with benching to provide self-cleansing properties, while also guiding sewage flow into the suction of the pumps. The

self-cleansing benching shall extend such that there are no dead areas where grit can accumulate, or sedimentation can occur.

5.1.17 Natural Ventilation

Wet-well ventilation using an induct and educt vent combination shall be used.

The distance between the outlet of the induct vent and the inlet of the educt vent shall be maximized, with the inlet of the educt vent being located as close as practicable to the underside of the roof of the wet-well.

The ventilation effect shall act to discharge and disperse any foul air above the roofs of surrounding houses and buildings.

Filtering and odour control may be required at the discretion of the Engineer.

5.1.18 Operating Levels and Settings

The pumping station operating levels shall be set to minimise the detention time in the wet-well and rising main without exceeding the maximum number of starts per hour.

The Design Drawings and/or Specification shall specify at least the following operating levels:

- Cut-out level.
- Cut-in level.
- High-level alarm.
- Low-level alarm.
- Overflow level.

The telemetry system shall be capable of connection to Council's telemetry system.

The pump station emergency storage level shall be designed such that it does not backup flow above the soffit level of upstream service connections.

5.1.19 Alarms

Locally displayed alarms and remote alarms shall be specified in accordance with the requirements of Council. Flashing lights shall not be used as alarms without the Engineers approval.

5.1.20 Operation and Maintenance Requirements

The valve chamber shall be arranged with sufficient space for operatives to stand and work comfortably and safely where required for operation and routing maintenance.

Pumps (including cables), valves and instruments shall be arranged such that they can be safely and easily removed and replaced, and all routine maintenance can be undertaken without requiring man-entry to the wet well.

Operation and Maintenance (O&M) Manuals shall be provided including the following Information (in English):

- contents page;
- description of the work under the contract;
- operational requirements, settings and constraints for the work;
- listing of installed components, including pumps, motors, valves, flowmeters;
- draft Maintenance Schedules for all components of the work;
- copies of test certificates for components of the work;
- copies of performance curves or capability statements for components (particularly pump curves);
- proposed Spare Parts list;
- Work-as Executed drawings;
- supplier documentation and warranties;
- Initial values and working range of programmable settings. These may include timer/level/current settings or valve positions.
- Design for all maintenance and access requirements

5.1.21 Right of Occupancy and Access

Council shall be granted a clearly defined, free and unrestricted right of occupancy and access to the site of all pumping stations.

Council retains ownership of the pumping station land and access area.

5.1.22 Odour Suppression

Where special system features, such as long rising mains to the treatment plant, the need for control storage devices, etc. are required, then the Developer shall detail all odour suppression arrangements proposed, for the Engineer approval. Council has no particular preference for the type of odour suppression arrangements other than:

- They shall be effective for the instances required; and
- They shall be consistent with other Council odour suppression arrangements.

5.2 DESIGN OF SEWER RISING MAINS

5.2.1 General

This Section details the requirements for pumped pressure sewerage pipelines.

A sewerage pipeline shall be dedicated to a single pumping station. Multiple pumping stations connected in parallel to the same pipeline shall not be permitted, unless specifically approved by the Engineer.

5.2.2 Location and Cover

Sewer rising mains shall be located wherever possible as follows:

- In Council owned land
- In public road reserves:
- Within the footway allocation as determined on a case by case basis.

Where these locations cannot be achieved, an easement shall be provided over the pipeline corridor to enable Council access for maintenance.

The pipeline shall be located with the following requirements:

- Aligned parallel to property boundaries or road features eg kerb;
- With adequate clearance from structures and other infrastructure
- With easy access for repairs and maintenance.

Where sewer rising mains are located within lots adjacent to storm water drainage lines, the sewer rising main shall be installed with a minimum 0.6m separation between the outside of the sewer and the outside of the stormwater pipe in the horizontal direction.

Minimum cover required to sewer rising mains is 900mm in road carriageways (except RMS Roads where special treatment is required) and 600mm elsewhere. Minimum cover required to mains and junctions in private property is 750mm where vehicular loading is anticipated, and 600mm where no vehicular loading is possible.

For buried sewerage components located close to structures such as foundations for brick walls and buildings, the components shall be located clear of the "zone of influence" of the structure foundations to ensure that the stability of the structure is maintained and that excessive loads will not impose on the sewerage component.

Changes in direction and grade shall be made using appropriately angled bends.

The Design Drawings shall nominate the locations and types of isolating, gas release, and scour valves.

5.2.3 Crossings – Road, Rail etc

Pipeline crossings of roads, railway lines, creeks and underground services shall, as far as practicable, be at right angles. Pipelines shall be located and designed to minimise crossing restoration and maintenance of the main in the crossing.

5.2.4 Materials

Sewer rising mains (pressure pipelines) may be constructed of any of the following materials manufactured in accordance with the relevant Standards:

- Ductile iron cement lined pipe PN35 or PN20 (Rubber ring joints) to AS 2280 Ductile Iron Pipes and Fittings.
- PE pipe (Welded joints) to AS4130 Polyethylene pipes for pressure applications (solid cream or sheathed cream in colour).
- PVC-o to AS4441 Oriented PVC (PVC-O) pipe for pressure applications cream in colour 1"
- PVC-m to AS4765 Modified PVC (PVC-M) pipes for pressure applications (cream in colour).
- GRP to AS3571.1 Plastic piping systems SN10000 – Glass reinforced thermo setting plastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure

drainage and sewerage.

Cream is defined in accordance with RAL7 DESIGN colour numbers as being no lighter than RAL 080 90 20 and no darker than RAL 075 80 20.

PVC rising main pipelines must incorporate Ductile Iron fittings for all bends, tees and tapers.

The Engineer may direct that any rising main shall be constructed from PN35 Ductile Iron Cement Lined, spigot and socket pipe.

Ductile iron fittings shall be cement or epoxy lined and conform to AS2544 and AS 2280 respectively.

Where it is proposed to use pipe material other than Ductile Iron the Developer will be required to demonstrate 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;
- Fatigue and/or cyclical load testing indicates the material will meet a minimum 100 year design life;
- Will not be adversely affected, in terms of shape and strength by construction loading;
- 100 year design life.

For all non-metallic pipes, including property services lay detectable marking to form a continuous connection start to finish.

5.2.5 Pipeline Size

Sewer rising main pipelines shall be sizes such that the velocity in the rising main shall not exceed 3.0m per second and be a minimum of 0.6m per second.

5.2.6 Embedment

Where the provision of sewer mains requires the crossing of existing Council roads by under boring, the following requirements are to be met:

- Construction will be by means of thrust boring, pipe jacking or another non surface disruptive construction method. Marker tape in accordance with section 4.3.3 Marker / Detector Tape shall be attached to pipe.
- The Contractor is to supply all materials for the work including but not limited to carrier pipe, exterior encasing sleeve, grout and cradles.
- The encasing pipe is to be steel or reinforced concrete complying with the respective requirements of (a) and (b) below:
  a. Steel encasing pipe is to be fabricated from steel having specified minimum yield strength of 230 MPa and will have a minimum wall thickness of 8mm for inside diameter less than 450mm or 12mm for encasing pipes or larger inside diameter up to 800mm.
  b. Reinforced concrete encasing pipes are to comply with AS1342 with reinforced concrete rebated joints – the minimum class of pipe will be Class Z
- The inside diameter of the encasing pipe is to be at least 100mm greater than the largest outside diameter of the carrier pipe as measured at the joint or coupling to allow installation of the line to its design grade and line within the specified tolerances.
- Subject to compliance with tolerance for line, grade and level as outlined in section 4.7.5 - Laying and Jointing - Pipe Grading and Alignment, the carrier pipe may be located

anywhere within the encasing pipe. These requirements may be varied to allow the tolerance for line and level to be ± 100mm.

- The Contractor will supply and install suitable pipe support cradles to the satisfaction of the Engineer which will allow installation of the carrier pipes in accordance with the foregoing requirements. The first and last cradle is to be within 1000mm from each end of the encasing pipe.
- After construction, installation and pressure testing of the carrier pipes the Contractor will fill the annular space between the carrier and encasing pipe completely with a grout mix as approved by the Engineer. All precautions are to be taken to ensure that there is no movement of the carrier pipe from its line and grade during routing. The carrier pipeline will be filled with water prior to grouting.
- Grout to be used for the sealing of the annular space is to be a mixture of cement and water, plus an admixture if specified or approved

These materials are to be mixed to a consistency which satisfies the Engineer, who will require that such consistency be the stiffest at which, in his opinion, the grout can reasonably be forced through the air space at the specified or approved pressure, so as to completely fill all voids in the ducts. The water cement ratio (by mass) will not be greater than 0.60.

Testing of the line is to be in accordance with section 4.10 - Construction of Gravity Sewer Network - Inspection and Testing.

5.2.7 Mine Subsidence and Blasting

Where the sewer main is to be laid in an area identified by the Engineer as likely to be influenced by mine subsidence or blasting, the design shall detail measures to be taken to ensure integrity of the pipeline. Measures may include:

Fully welded continuous Polyethylene pipe; and

Incorporation of fully welded or flanged jointing systems in the pipeline adjacent to fixed structures such as valve and discharge chambers.

Sewer main construction in declared mine subsidence areas requires consent of the Mine Subsidence Board. The design shall be submitted to the Mine Subsidence Board for approval.

The expected strains on a pipeline resulting from potential subsidence shall be addressed in the design using area-specific anticipated ground strains available from the Department of Mines (refer www.minesub.nsw.gov.au).

Upon receipt of the Mine Subsidence Board's approval of a design, the Design Drawings shall be notated with conditions specified by the Board and the plans endorsed as follows: "Designed in accordance with the Mine Subsidence Board's approval dated ……, File No ……."

5.2.8 Air Valves, Fittings and Vents

An approved air valve is required at high points in the main.

A scour valve and drainage line is required at the lowest point to enable the rising main to be completely drained of sewage.

Where required by the Engineer, a vent shaft shall be provided at the receiving maintenance hole.

The Developer is required to submit detailed drawings of rising mains and receiving maintenance holes for approval.

Construction: Air release valves, inspection pipes and other fittings, will be installled where shown on the drawings or as directed by the Engineer. The Developer will supply all materials and labour necessary to complete these installations as detailed in section 3.10 - Property Connections / Junctions.

Valves and fittings shall be marked in accordance with section 4.7.12 Kerb Impressions and Markers.

5.2.9 Thrust Blocks

Thrust blocks shall be specified for un-restrained jointed rising main pipelines (eg with rubber ring joints) at all changes in direction, tees, valves, tapers and termination points.

Thrust blocks shall be designed to resist the total unbalanced thrust and transmit all thrust loads into the adjacent native soil or rock. Calculation of the unbalanced thrust shall be based on the maximum pipeline pressure (usually the test pressure).

Guidance for the calculation of Thrust block size is provided in SD514.Construction: Thrust and anchor blocks are to be constructed at valves, tees, dead ends, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures shall occur. Thrust block construction is to be consistent with Manufacturer's specifications.

The Developer is to provide permanent thrust blocks of minimum Grade 20MPa concrete such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the calculated bearing area or as directed by the Engineer.

The Developer is to provide permanent anchor blocks complete with all necessary straps or reinforcement to a minimum Grade 20MPa concrete of a volume not less than that specified on the approved engineering plans or as directed by the Engineer.

All thrust and anchor blocks are to be designed by the Developers Consultant and approved by the Engineer.

5.2.10 Hydrostatic Testing of Sewer Pressure Pipelines

Hydrostatically pressure test all pressure pipelines in accordance with AS 2566.2 Appendix M, paragraph M4 or M5 as appropriate. Do not pressure test during wet weather. Provide all temporary equipment/sealing to enable tests.

Measure the test pressure at the pressure tapping point in the valve pit, downstream of non-return valves.

The test length shall be acceptable where:

- there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component; and
- there is no visible leakage; and
- for other than polyethylene pipelines:

  $Q \leq 0.14LDH$

  where:

  Q = allowable make-up water in litres per hour

  D = nominal diameter of the test length in m

  L = length of the test length in km

  H = average test pressure over the test length in m
- for polyethylene pipelines:

  $V2 \leq 0.55V1+Q$

  where:

  Q = determined as for other than polyethylene

  V1 = make-up water in litres between hours 2 and 3

  V2 = make-up water in litres between hours 4 and 5

6 PRESSURE SEWER

6.1 DESIGN OF PRESSURE SEWER SYSTEMS

Council may consider a pressure sewer system solution in cases where conventional sewer is not practical. Council requires that persons with appropriate skills and experience, in pressure sewerage design, undertake the design work. Pressure sewer design is to be approved by the Engineer.

Where possible, the Pressure Sewer System shall be designed to ensure that each component is compatible with the overall system.

Pressure Sewer Units where approved by the Engineer are to be installed and commissioned in accordance with manufacturer's specifications.

6.1.1 Location of Pressure Sewer Units

All pressure sewer units installed by Council will be located within 3m of the front boundary. The developer will be required to consult with Council to confirm the depth of the connection that would be available for the property. If there is insufficient grade for a gravity connection to the pressure sewer unit the developer may investigate installing a private pump on the property which would pump to Council's Pressure Sewer unit at the front of the property. This

will be subject to a Non-Standard Sewer Connection Application and approval section 68 of the Local Government Act 1993.

6.2 PRESSURE SEWER PIPELINES

The diameter of the pipes should ensure that effluent is stored in the pipelines for a minimal time. Sewage shall be no older than 24 hours when it reaches the sewage treatment plant. It is recommended that where sewage is determined to be older than

24 hours that preliminary discussion be held with the Engineer regarding odour suppression options.

Ideally, the pipeline should be designed to achieve a minimum velocity of 0.7m/s at least once every 24 hours for self-cleansing purposes.

6.2.1 Pipeline Materials

The reticulation mains are to be:

- Of varying diameter (DN40mm – DN315mm) cream stripe polyethylene pipes;
- Class PN 16 (unless otherwise stated in dedicated areas);
- Minimum lengths of the pipe rolls to be 100m;
- Tight radius bends not allowed eg 90^{o} elbows;
- Readily available in the commercial market place so that additional lengths can be purchased for repair or extension purposes;
- Capable of being crimped if required to effect repairs

6.2.2 Valves and Fittings

The valves and fittings to be used on the pipelines are to be compatible with polyethylene pipe and the class of pipe used. The types of valves should also be readily available in the commercial market place and of a type compatible with the pumping stations.

The reticulation system must incorporate a number of designated isolating valves and may require the use of air valves. Details of their use (or non-use) must be provided to the Engineer with the proposed design.

6.2.3 Flushing Points

A flushing point shall consist of a tee (in line) or 90 degree bend (end of line), a sampling valve located on a vertical riser and an isolation valve and quick connection coupling.

All dead-ends to pressure sewers shall be provided with an end flushing point where the number of connections in a branch line exceeds five (5).

In line flushing points shall be provided;

- downstream of isolation valves, except where there is a downstream flushing point within 100m;
- where there is more than one upstream connecting line; and
- at intervals not exceeding 500m.

Flushing points shall be designed to allow for scouring/flushing with flow initiation from the end flushing points and progressively downstream via in-line flushing points to the discharge end of the network.

Flushing points shall be located in pits with appropriate covers. The size of the pit shall allow for adequate clearance between any part of the fitting and the pit to permit operation of the valve and the replacement of any component.

6.2.4 Joining of Pipes

All pipes are to be joined by electro fusion techniques in accordance with the manufacturer's requirements. Those carrying out the pipe joints are to be appropriately qualified, capable of demonstrating their experience with this technique and have the right equipment to affect the welds.

6.2.5 Depth and Location of Pipes

The mains are to be laid on a route that causes minimum disruption to the area involved.

All pipework is to be laid within the footway allocation in accordance with NSW Street Opening Conference Guide to Code and Practices for Street Openings and laid parallel with the property boundaries. Minimum cover required to mains and junctions is 900mm in road carriageways (except RMS Roads where special treatment is required) and 600mm elsewhere (unless approved otherwise in special circumstances by The Engineer). Minimum cover required to mains and junctions in private property is 750mm where vehicular loading is anticipated, and 600mm where no vehicular loading is possible.

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 50mm of sand backfilling on all sides. Where sand fill is required, the trench is to be excavated an additional 50mm with the pipe to be laid on top of this sand bed. The trench excavation is 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 150mm of concrete. The trench is to be widened to accommodate this encasement. Plans showing details of the proposed concrete encasement must be provided to the Engineer for approval prior to encasement.

Marker tape shall be installed above or attached to the pipework in accordance with section 4.3.3 Marker / Detector Tape.

6.2.6 Road Crossings

All pressure sewer reticulation that crosses public roads must be within a suitable conduit to protect the pipework. PN9, PVC pipe is required as a conduit.

Where the road is a sealed surface the pipeline route is to be excavated using under boring techniques. The pipe is then to be drawn through the excavation conduit in accordance with the appropriate Australian Standard. For unsealed roads, excavation can be by either open trench excavation or under boring of the road.

The under boring must be done with sufficient width of the sealed road so as not to compromise the integrity of normal operation of the road carriage way and in accordance with the traffic management plans.

6.2.7 Location Markers

The locations of pressure sewerage pipes are to be marked in the following manner:

- A metal detectable tape complying with Australian Standard AS2648 shall be laid with pressure sewerage pipes in accordance with section 4.3.3 Marker / Detector Tape; and
- A brightly coloured marker tape is to be laid 300mm above the top of the pipe. This marker tape shall indicate that there is a pressure sewerage system below it. Council's preference is that the tape be yellow and at least have the letters PS on it, but may negotiate these colours with the Contractor if yellow is not readily available at the time

6.2.8 Other Services

During the design phase a services location survey of the proposed pipeline route is to be undertaken to determine the proximity of other services in the vicinity of the pressure sewerage lines. Where other services are parallel to the pressure sewer mains and intrude into the pressure sewer system allocation, the designer will work with both the Engineer and the other service provider to consider a suitable outcome. Actions to be taken will be decided on a case by case basis.

The mains should where practical, cross other services at as close to right angles as can be practically achieved.

6.2.9 Residential Access and Driveways

Where driveways are made of the following materials, the pipeline route is to be excavated using under boring:

- Sealed Surfaces (irrespective of nature);
- Concrete Surfaces
- Paved Surfaces; and
- Decorative Surfaces.

Where there is no defined driveway, and the pipeline is installed by open excavation then the driveway is to be compacted as soon as possible thereafter to minimise the loss of access to

the property. The Contractor will provide a minimum of three working days' notice prior to constructing the works in that street.

The Contractor may provide this notice by letterbox drop; the information contained should include:

- Date the pipeline is to be constructed;
- Estimated time trenches will be open;
- If property access will be interrupted;
- Method of excavation ; and
- Contact number for further enquiries

6.2.10 Property Connections

A property shall have a connection made to the reticulation main at the same time as the main is installed. Lines from the reticulation mains to the service connection shall be perpendicular to the reticulation main with a PVC ball valve and a 150mm PVC riser installed vertically over the valve and capped no less that 300mm below finished ground level.

The minimum service size for connection of properties on pressure sewer to the pressure sewer reticulation main shall be 50mm for industrial properties and 40mm residential for residential properties.

The service connection shall be located a maximum of 1.0m from the front and side property boundary opposite the water service connection.

6.2.11 Discharge Point to Council Sewer System

Where the pressure sewer discharges into a gravity reticulation zone, this zone must be clearly marked on the design drawings.

Typically this will be one of the following:

- A Sewage Treatment Plant;
- Pumping Station in gravity reticulation system; or
- Maintenance hole in gravity reticulation system (subject to the Engineer approval).

The pressure system shall discharge to a point where the receiving system has sufficient capacity to receive the discharges and transport it to the sewage treatment plant. A full analysis of the discharge point and downstream system capacity shall be provided with the design.

If the receiving systems capacity is insufficient during peak periods, then a controlled discharge structure may be considered to store peak system discharges. This would allow discharge at a controlled rate and take advantage of the systems peak capacity.

Such structures will be constructed on the basis of:

- Costs;
- System capacity;
- Odour suppression of any stored sewage (if required); and
- Ability to periodically clean the retaining structure.

Where developments are to be staged the design must address the need for low, intermediate and high flow lines to service the development from the initial to the final stage. Chemical dosing may be considered, subject to the Engineers approval.

7 ACCEPTANCE OF WORKS

7.1 CCTV INSPECTION

CCTV inspections are to be carried in accordance with WSA 05 Conduit Inspection Recording Code of Australia. Inspect and report on each pipeline length reporting and recording the following details:

- Maintenance hole depth to invert at both start and finish maintenance holes
- Pipe section including start and finish maintenance hole
- Pipe diameter
- Pipe grade
- Pipe material
- Junction location along pipe from downstream maintenance hole
- Junction angle
- Pipe condition

Defects to be noted are to include, but not limited to:

- Pipe cleanliness
- Pipe joint defects
- Pipe shape issues
- Pipe joint ring defects
- Grade defects
- Incorrect orientation of junction
- Any other defect

Provide to Council the following on completion of CCTV inspection:

- Electronic copies of CCTV footage
- Electronic copies of CCTV reports each sewer main section
- Electronic copies of information in a format approved by Council.

Apply the following requirements to the CCTV inspection:

- Use certified CCTV operators.
- Only accept CCTV footage of such quality that an accurate assessment of the internal condition

of the sewer can be made.
- Provide the CCTV records to the Superintendent as specified.

Apply the acceptance / rejection criteria of Appendix E - Scoring of Defects and the Preliminary Grading of Apparent Condition of Maintenance Structures of WSA 05-2013 3.2 – Conduit Inspection Reporting Code of Australia.

Rectify all defects prior to conducting any further inspection. These rectification works require further approval by Council upon completion.

If CCTV equipment used to conduct the inspection is not calibrated to NATA's requirements for quantifying observations, record the estimated value as an addendum to the test report.

7.2 WRITTEN APPROVAL FOR WORKS

In order to receive a final Certificate of Compliance under section 307(1) of the *Water Management Act 2000 (NSW)* for the development works, the Developer must have obtained approval under section 305 of the *Water Management Act 2000 (NSW)* of the various components of the development work and complied with the Notification of Requirements under Section 306 of the Water Management Act 2000 (NSW). Only the Engineer can issue advice and approvals under the above sections of the *Water Management Act 2000 (NSW)*.

Approval to proceed from one component of works to the next, in no way absolves the Developer from the responsibility of defects or failure.

It is the Developer's responsibility to obtain approval from the Engineer.

7.2.1 Limitation of Approval

During construction, approval of any component of work shall be given in regard to structural standard only at the time of inspection. This does not absolve the Developer of the responsibility for any damage or deterioration occurring before the final inspection or during the maintenance period.

7.2.2 Linen Release and Work as Executed Plans

Prior to linen release the following is required:

- Final inspection and certificate of Practical Completion of the development to enter the maintenance period.
- A Surveyor's Statement and "Works as Executed Plans" verifying all work is constructed and located in accordance with the approved engineering plans and construction tolerances detailing all requirements of this policy.
- Such "Works as Executed Plans" are to be certified as correct by a Registered Surveyor and submitted on copies of the approved engineering originals.
- Where departures from approved plans are made during the course of construction without approval the Works as Executed Plans must be accompanied by a report prepared by the Design Consultant or, if appropriate, a Registered Surveyor, providing an explanation as to how the departures comply with Council's Engineering Requirements for Development.
- The receipt by Council of Works as Executed Plans shall form part of compliance requirements

for issue of a Certificate of Compliance under Section 307(1) of the *Water Management Act 2000* (NSW).

7.3 WORKS AS EXECUTED (WAE) DRAWINGS

Prepare Work as Executed (WaE) Information and provide Council with electronic copies in Auto CAD and pdf format. Drawings shall be provided at least four (4) weeks prior to release of a Certificate of Practical Completion.

Work as Executed drawings are required to be submitted to the Engineer by the Developer immediately after completion of the works. The Work as Executed drawings shall show, but not be limited to the following details:

- Minimum of two ties to maintenance holes in relation to lot boundaries or other permanent marks;
- Minimum of two ties to dead ends lines in relation to lot boundaries or other permanent marks;
- The reduced level of maintenance hole and dead end inverts and the downstream side of maintenance hole surrounds;
- Information on sewer junction for each lot serviced covering:
  g. distance from the centre of the downstream maintenance hole ;
  h. depth from finished surface level to the top of the junction shown “D” and height of the riser shown “R” if required;
  i. length of projection shown “P”;
  j. the height of riser from invert of main shown “R” where applicable
- The pipe sizes, class and type of pipe used and the Work as Executed pipe grade;
- Extent of concrete encasing.

“Work as Executed” plans are to be certified as correct by a registered surveyor and submitted on copies of the original for Council to retain prior to the linen release

All Work as Executed drawings are to be in accordance with Singleton Council - Work as Executed - WaE – Specification August 2014 or its replacement.

7.4 TRANSFER OF ASSETS

Assets shall transfer to Council upon registration of plans at the NSW Land Registry Service for subdivisions, and release of the s307 Certificate for all other developments. The Maintenance Period shall end 12 months after hand over of works.

8 GLOSSARY OF TERMS AND ABBREVIATIONS

8.1 GLOSSARY

The purpose of this glossary is to assist with interpretation of terminology used in this document:

Term	Definition
Access Chamber	Refer to Maintenance hole
Access Cover	A removable cover that is installed at or above finished surface level to allow access to a maintenance hole
Australian Height Datum, AHD	A level datum, uniform throughout Australia, derived from mean sea level observations at 30 tide gauge locations located along the Australian coastline and used as a base reference for “derived” datum levels throughout Australia; replaces “Australian Levelling Survey” and other datum
Average Dry Weather Flow (ADWF)	The combined average daily sanitary flow into a sewer from domestic, commercial and industrial sources. Based on empirical evidence, ADWF is deemed to be 630 L/d/ET or 0.0073 L/s/ET (180 L/d/EP or 0.0021 L/s/EP)
Backfill	Material (including embedment and trench fill) and procedure used to fill an excavation. See also engineered fill
Bedding	Zone between the foundation and the bottom of a pipeline. See also embedment
Boring	A method of machine excavation working from a shaft or pit and creating a cylindrical tunnel
Boundary	Survey line separating adjoining properties for the purposes of defining ownership/title
Boundary Trap	An inverted siphon trap installed in a customer sanitary drain to prevent sewer gas passing and entering the building through the drain. See also water seal
Bulkhead	A structural partition across a pipeline trench, built to minimise longitudinal and lateral movement of the pipeline, to minimise ground movement in the trench, and to restrict movement of fines within and along the trench caused by infiltration and ground water flow through the embedment and trench fill materials
Carriageway	Portion of a road or bridge assigned to the movement of vehicles, inclusive of any shoulders and auxiliary lanes. It is designated as that part of a public road (way) between kerbs. See also local road, major road, road, road reserve
Catchment Area	That area (watershed) made up of properties that discharge or have potential to discharge to a sewerage system
Connection Point	Point of connection between the property connection sewer and the customer sanitary drain. Also called property connection point
Customer Sanitary Drain	A pipeline installed by a licensed plumber within the property boundary and operated by a property owner to convey sewage from buildings to the connection point; constructed to plumbing code standards; also called house drain, house service line, house sewer, sanitary connection, property drain, sanitary drain

Term	Definition
Design Drawings	Plans, elevations and drawings required for the construction of the sewer systems and showing the locality including roads and sewer details, the site plan including lots, boundaries, roads, proposed and existing sewers, proposed property connection sewers, pumping stations, pressure mains, water mains, drains, watercourses, site contours, proposed aqueducts, proposed boreholes, a longitudinal section, construction details and a connection to existing sewer schedule. Supplementary information may include proposed buildings, existing services, and groundwater and watercourse levels
Design Flow	The estimated maximum flow into a sewer comprising the sum of peak dry weather flow (PDWF), ground water infiltration (GWI) and stormwater inflow and infiltration (IIF). See also peak dry weather flow, groundwater, infiltration, inflow, stormwater
Diec	Ductile Iron Epoxy Coated
Drop	Difference in level between the inlet and outlet pipes at a Maintenance Hole
Drop Junction	A fitting, usually of a tee configuration, used in the pipework of drop structures and vertical risers. See vertical riser and drop structure
Drop Structure	A vertical section of pipe inside or just outside a maintenance hole to connect a sewer that is at a considerably higher level than the outlet
Easement	A right held by one party to make use of the land of another for certain purposes
Embedment	Zones around a pipe between the foundation, the trench or embankment fill and the trench walls. See bedding, haunch support, side support and overlay
Equivalent Tenements (ET)	The equivalent hypothetical number of residential tenements or residential units that would produce the same peak dry weather flow as that contributed by the area under consideration ie all zonings including residential, commercial and industrial
Equivalent Population (EP)	The equivalent hypothetical residential population that would produce the same peak dry weather flow as that contributed by the area under consideration ie all zonings including residential, commercial and industrial
Fitting	A component of a pipeline, other than a pipe, which allows pipeline deviation, change of direction or bore. In addition, valves, flanged-socketed pieces, flanged-spigot pieces, junctions, inspection openings, collars and couplings are also defined as fittings
Flexible Joint	A joint that permits angular deflection, both during and after installation, and which can accept a slight offset to the centreline
Groundwater	Water present in the sub-surface strata

Term	Definition
Head, H	Pressure expressed in terms of the height of a column of water (in m). The head is a factor of 9.81 (nominally 10) lower than the equivalent value in kPa, eg 800 kPa ≅ 80 m
Infiltration	Ingress of groundwater into a sewer system
Invert	Lowest point of the internal surface of a pipe or channel at any cross-section
Joint	A connection between the ends of two pipeline components including the means of sealing
Lot	A property for which a separate title may be held or issued to be serviced by the sewerage system
Maintenance Hole	A chamber with a removable cover which allows human and machine access to a (typically buried) sewer; abbreviation MH retains the traditional abbreviation for “maintenance hole ”. Also referred to as Access Chamber
Maintenance Period	The maintenance period is the period following completion of a construction project during which the contractor is responsible for certain maintenance issues under the many building or engineering contracts.
Nominal Size, DN	An alphanumeric designation of size for components of a pipeline system, which is used for reference purposes; it comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections
Non Standard Conditions	Impermeable material such as rock and clay, or where trench conditions are set.
Non-trafficable Area	Any area where vehicular traffic is unlikely or occurs no more than three monthly, eg most areas of private lots, many footways, parks, reserves, recreational areas and easements.
Obvert	Inside top of a pipeline, also referred to as soffit
Overflow	Condition where sewage overflows from a sewerage system due to blockage, choke or hydraulic overloading and either discharges to the environment or enters buildings. See surcharge See Emergency Relief Structure
Owner	Agency, Authority, Board, Company, Controlling Authority, Corporation, Council, Department, Individual, Regulator, Utility or other legal entity who is the owner of the asset and/or who has responsibility for the asset
Peak Dry Weather Flow PDWF	The most likely peak sanitary flow in the sewer during a normal day. It exhibits a regular pattern of usage with morning and evening peaks related to water usage for toilets, showers, baths, washing and other household activities

Term	Definition
Property Connection Sewer	A short sewer, owned and operated by Council, which connects the main sewer and the customer sanitary drain; it includes a junction on the main sewer, a property connection fitting, in some cases a vertical riser, and sufficient straight pipes to ensure the property connection fitting is within the lot to be serviced
Regulator	Entity that has the power to enforce Regulations related to the activities and responsibilities of a Commonwealth, State, Territory or Local government. It applies to environmental management and protection, occupational health and safety and the like
Reticulation Sewer	A sewer operated by Council, generally DN 150 to DN 300, for the collection of wastewater from individual properties and conveyance to branch and trunk sewers or to a point of treatment.
Road	A surface devoted to public travel and movement of goods by vehicles; a road covers the entire width between opposite property boundaries in a road reserve including the road pavement, footways, cycleways (where applicable) and verges.
Road Reserve	Land set aside for the road pavement, footway(s) and verge(s)
Roughness Coefficient, N	A measure of the resistance of the surface of a pipe or channel under turbulent flow which is expressed as a dimensionless constant; it is used in the Manning formula
Roughness Value, Ks	A measure of the resistance of the surface of a pipe or channel under turbulent flow which is expressed in mm; it is used in the Colebrook White formula
Self-Cleansing	Ability of the flow in a sewer to carry away solid particles, which would otherwise be deposited in the pipe
Sewage	Water polluted by use and discharged to a sewer system
Sewer	Pipeline or other construction, usually buried, designed to carry sewage from more than one source; See also reticulation sewer, branch sewer, customer sanitary drain, main sewer, property connection sewer, trunk sewer
Sewer System	Network of pipelines and ancillary works that conveys sewage to a treatment works or other place of disposal
Sewerage	Network of pipelines and ancillary works that conveys sewage to a treatment works or other place of disposal. Same as sewer system
Side Support	Embedment zone between the bottom and top of a pipe
Sideline	See property connection sewer
Soffit	Inside top of a pipeline, also referred to as obvert
Specification	The document detailing the work involved in the particular project in hand

Term	Definition
Specifications	Precise standards of performance for construction work, materials and manufactured products. Specifications make it possible to express expected values when work or items are purchased or contracted for, and they provide a means of determining conformance with expectations after purchase or construction
Spring Line	Projection of the horizontal centreline to the walls of a pipe
Standards	Documents that specify the minimum acceptable characteristics of a product or material, a test procedure, an installation method etc., issued by an organisation that develops such documents eg Standards Australia. Such standards may or may not be used as (or called) specifications A set numerical limit eg a contaminant limit set by a regulatory agency
Stormwater	Runoff due to rainfall from roofed areas and paved and unpaved areas, which has not seeped into the ground. Also termed surface water. See also groundwater
Street Alignment	Horizontal shape of the boundary between a road reserve and adjoining lots. See also road
Surcharge	Condition in which sewage is held under pressure within a gravity sewerage system but does not overflow. See overflow
System Planning	A process of examining the present, recognising trends, making projections and developing plans to ensure sewerage systems have the capability to achieve agreed customer, stakeholder and regulator outcomes
Trafficable Area	Any area where vehicular traffic is likely, eg road pavement and driveways
Trench Fill	Fill material placed over the overlay for the purpose of refilling a trench
Trench Stop	A non-structural partition across a pipeline trench built to restrict movement of fines within and along the trench caused by infiltration and ground water flow through the embedment and trench fill materials
Vent Shaft	A structure provided to limit pressure fluctuations within the sewerage system, for air to enter the system and for sewer gases to escape from the system
Verge	Areas between the boundaries of a road reserve and the carriageway. This term is usually applied where there are no formed footways
Water Seal	An arrangement that traps water and prevents passage of gas and controls odours; may be installed in a double MH, in a sewer adjacent to an MH, or in a customer sanitary drain; water seals in MHs are also known as gas check chambers; water seals in customer sanitary drains are also known as boundary traps

Term	Definition
Work as Constructed (WaE)	Documentation showing details of work as actually constructed (in contrast to Design Drawings). Also called Work As Executed (WaE)
Works	All those Works being sewers, maintenance structures, pumping stations, pressure mains and accessories and shall include valve chambers and storage facilities as shown on the Design Drawings and includes any part or parts of the Works
Y Connection	A fitting (junction) used on a property connection sewer that allows the sewer to serve two lots
Zone Of Influence	An area likely to be influenced by building loads, the extent of which depends on the nature of the ground on which the structure is to be located

8.2 ABBREVIATIONS

The purpose of this glossary is to assist with interpretation of abbreviations used in this document:

Abbreviation	Interpretation
ADWF	Average Dry Weather Flow
AHBP	Allowable Horizontal Bearing Pressure
AHD	Australian Height Datum
ARI	Average Recurrence Interval
AS	Australian Standard
DI	Ductile Iron
DICL	Ductile Iron Cement (Mortar) Lined
DN	Nominal Size
EP	Equivalent Population
ET	Equivalent Tenement
FSL	Finished Surface Level
GRP	Glass Reinforced Polyester
H	Head (In M)
H2S	Hydrogen Sulphide
HGL	Hydraulic Grade Line
HWC	Hunter Water Corporation
IL	Invert Level
kPa	Kilopascal
L	Litre

Abbreviation	Interpretation
L/s	Litres/Second
m	Metre
m/s	M Per Second
MGA	Map Grid Of Australia
MH	Maintenance hole / Maintenance Hole = Access Chamber
mm	Millimetre
MPa	Mega Pascal
N	Newton
PDWF	Peak Dry Weather Flow
PE	Polyethylene
PLC	Programmable Logic Controller
PN	Pressure Class (Number)
PP	Polypropylene
PVC	Polyvinylchloride
PWWF	Peak Wet Weather Flow
Q	Flow (In Cubic M/Second)
RC	Reinforced Concrete
REF	Review Of Environmental Factors
RL	Reduced Level
RRJ	Rubber Ring (Seal) Joint
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition
SCL	Steel Cement (Mortar) Lined
SDR	Standard Dimension Ratio
SN	Stiffness Class (Number)
SPS	Sewage Pumping Station
VC	Vitrified Clay
WaE	Work As Executed
WHS	Work Health and Safety
WSAA	Water Services Association of Australia Limited
WWPS	Waste Water Pumping Station

9 REFERENCED DOCUMENTS

The documents related to or referenced in these specifications include but are not limited to those listed below.

9.1 AUSTRALIAN STANDARDS

The latest version of the Australian Standard including published amendments applies, except where the year of publication is stated in the text.

Standard	Title
AS1170	Structural design actions
AS1289.1	Methods for testing soils for engineering purposes
AS1579	Arc-welded steel pipes and fittings for water and wastewater
AS2033	Installation of polyethylene pipe systems
AS2124	General conditions of contract
AS2159	Piling – Design and Installation
AS2280	Ductile iron pressure pipes and fittings
AS2566	Buried flexible pipelines
AS2648	Underground marking tape
AS3500	Plumbing and Drainage Set
AS3600	Concrete structures
AS3680	Polyethylene sleeving for ductile iron piping
AS3681	Application of polyethylene sleeving for ductile iron piping
AS3725	Design for installation on buried concrete pipes
AS4041	Pressure piping
AS4060	Loads on buried vitrified clay
AS4087	Metallic flanges for waterworks purposes
AS4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS4331	Metallic flanges – Steel Flanges
AS4799	Installation of underground utility services and pipelines within railway boundaries
AS4853	Electrical hazards on metallic pipelines
ISO31000	Risk Management – Principles and Guidelines

9.1.1 Relevant Legislation

The relevant Acts and Regulations associated with this Developer Specification including but are not limited to:

Local Government Act 1993 and Local Government (General) Regulation 2021 (NSW);

Water Management Act 2000 and Water Management (General) Regulation 2018 (NSW);

Plumbing and Drainage Act 2011 and Plumbing and Drainage Regulation 2017 (NSW);

Protection of the Environment Operations Act 1997, Protection of the Environment Operations (General) Regulation 2022 and Protection of the Environment Operations (Noise Control) Regulations 2017 (NSW);

Environmental Planning and Assessment Act 1973 and Environmental Planning and Assessment Regulations 2021 (NSW); and

Surveying and Spatial Information Act 2002 and Surveying and Spatial Information Regulations 2017 (NSW).

9.1.2 Related Documents

The relevant external documents listed below are related to or referenced in this Developer Specification:

Plumbing Code of Australia 2016

Department of Environment and Climate Change Interim Construction Noise Guideline; and

NSW Streets Opening Conference Guide to Code and Practices for Streets Opening.

Water Services Association of Australia (WSAA)

May be purchased from www.wsaa.asn.au.

Reference	Title
WSA02	Gravity Sewerage Code of Australia
WSA07	Pressure Sewerage Code of Australia
WSA132	Access covers for water supply and sewerage
WSA200	Australian Sewage Quality Management Guidelines

Plastics Industry Pipe Association of Australia (PIPA)

Specifications are downloadable from www.pipa.com.au.

Reference	Title
POP001	Electrofusion jointing of PE pipe and fittings for pressure applications
POP003	Butt fusion jointing of PE pipes and fittings – Recommended parameters
POP102	Solvent cement jointing of PVC Pipe
POP103	Depth of engagement or PVC Pipe

Singleton Council

Related documents listed in the table below are Council (internal) documents related to or referenced in this Developer Specification and are available for download from www.singleton.nsw.gov.au:

Reference	Title
20/38793	Singleton Council Fees and Charges Schedule (updated annually)
POL/26031	Sewer Services Policy
POL/26013	Building in the Vicinity of Sewer and Trunk Water Mains Policy
14/16271	Singleton Council - Work as Executed - WaE – Specification – August 2014
POL/23003	Development Engineering Specifications – Design Specifications
POL/23002	Development Engineering Specifications – Construction Specifications

10 APPENDICES

Appendices are provided in separate document;

Developer Specifications - Technical Drawings – Maintenance Holes

Developer Specifications - Checklist – Sewer Reticulation Design

Developer Specifications - Checklist – Sewer Reticulation Drawings; and

Developer Specifications - Checklist – Sewer Reticulation – Completion of Construction.

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