

COFFS HARBOUR CITY COUNCIL



**DEVELOPMENT SPECIFICATION
DESIGN**

***1361 Sewerage - reticulation and pump stations
(Construction)***

Version 1 01 January 2009

1361 SEWERAGE – RETICULATION AND PUMP STATIONS (CONSTRUCTION)

1 SCOPE AND GENERAL

1.1 SCOPE

Inclusions

The Work to be constructed under this worksection consists of the construction of:

- Gravitation sewers up to DN 600 nominal size;
- Common effluent sewers, both gravity and pressurised;
- Vacuum sewerage systems;
- Rising mains up to DN 600 nominal size;
- Standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers;
- Small pump stations, usually limited to single wells with submersible pumps.

Exclusions

This worksection excludes the construction activities for:

- Treatment plants;
- Headworks;
- Dosing plant;
- Larger pump stations;
- Works controlled by others, including overflow management.

Sequential design and construction

This is a construction Specification suitable for use in a Sequential Design and Construction (not Design/Construct) delivery of work method, with separate contracts for Design, then Construction, where:

- A development subdivision is likely to be certified.
- State Government subsidises a small town sewerage scheme where the Project Director elects not to use performance based contracts for the Service Providers where the work is likely to be supervised by a designated person appointed by the Principal with defined authority.
- Where the augmentation is small and relates to a component or sub-component of a larger facility where the work is likely to be supervised by a designated person appointed by the Principal with defined authority.

Sewerage Code of Australia drawings (WSAA 03 Part 4) shall be used in preference to Department of Commerce (PWS) Standard Drawings held by NSW Department of Commerce.

Water directorate

AUS-SPEC appreciates the role of the Water Directorate in comprehensively updating the design and construction specifications for water and sewer works.

1.2 COMPLIANCE WITH STANDARDS

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents and, in particular, in accordance with the Sewerage Code of Australia (WSA 02), except as otherwise specified herein.

1.3 PRECEDENCE

Where any standard drawing used in conjunction with this worksection includes technical requirements that conflict with this worksection, the requirements of this worksection shall take precedence.

1.4 TERMINOLOGY

For the purposes of this worksection, 'access chambers' are referred to as 'maintenance holes'.

1.5 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.6 REFERENCED DOCUMENTS

References to the Sewerage Code of Australia (WSA 02) are made where there are parallel sections or equivalent clauses to those in this worksection.

Where not called up as part of this worksection, these references are identified by part and section numbers and enclosed in brackets thus (WSAA Part, Section).

Worksections

0161 *Quality (Construction)*

0310 *Minor concrete works*

1101 *Control of traffic*

1102 *Control of erosion and sedimentation*

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

Standards

AS 1111	ISO metric hexagon bolts and screws—Product grade C
AS 1111.1	Bolts
AS 1111.2	Screws
AS 1112.1	ISO metric hexagon nuts - Style 1 - Product grades A and B
AS 1152	Specification for test sieves
AS 1272	Unsintered PTFE tape for thread sealing applications
AS 1289	Methods for testing soils for engineering purposes
AS1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 1349	Bourdon tube pressure and vacuum gauges
AS 1444	Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS 1565	Copper and copper alloys – Ingots and castings
AS 1579	Arc-welded steel pipes and fittings for water and waste-water
AS 1627	Metal finishing—Preparation and pre-treatment of surfaces
AS 1627.4	Abrasive blast cleaning
AS 1646	Elastomeric seals for waterworks purposes
AS 1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation
AS 1741	Vitrified clay pipes and fittings with flexible joints—Sewer quality
AS 1830	Grey cast iron
AS 1939	Degrees of protection provided by enclosures (IP Code)
AS/NZS 2032	Code of practice for installation of UPVC pipe systems
AS 2033	Installation of polyethylene pipe systems
AS 2129	Flanges for pipes, valves and fittings
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2837	Wrought alloy steels—Stainless steel bars and semi-finished products (Withdrawn)
AS 3571	Glass filament reinforced thermosetting plastics (GRP) pipes—Polyester based – Water supply, sewerage and drainage applications
AS 3578	Cast iron non-return valves for general purposes (Withdrawn)
AS 3681	Guidelines for the application of polyethylene sleeving to ductile iron pipelines and

	fittings
AS 3690	Installation of ABS pipe systems
AS 3972	Portland and blended cements
AS 3996	Access covers and grates
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4060	Loads on buried vitrified clay pipes
AS 4198	Precast concrete access chambers for sewerage applications (Read 'maintenance hole' for 'access chamber')
AS 4441(Int)	Oriented PVC (PVC-O) pipes for pressure applications
AS 4794	Non return valves—Swing check and tilting disc
AS/NZS 1260	PVC-U pipes and fittings for drain, waste and vent application
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS1594	Hot-rolled steel flat products
AS/NZS 2280	Ductile iron pipes and fittings
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural Design
AS/NZS 2566.2	Installation
AS/NZS 3000	Wiring Rules
AS/NZS 3008	Electrical installations –Selection of cables
AS/NZS 3008.1.1	Cables for alternating voltages up to and including 0.6/1 kV—Typical Australian installation conditions
AS/NZS 3439	Low-voltage switchgear and controlgear assemblies
AS/NZS 3518	Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications
AS/NZS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications
AS/NZS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 4680	Hot-dip bed galvanised (zinc) coatings on fabricated ferrous articles
AS/NZS 4765 (Int.)	Modified PVC (PVC-M) pipes for pressure applications
BS410	Test sieves. Technical requirements and testing.
BS410.1	Test sieves of metal wire cloth
BS410.2	Test sieves of perforated metal plate

Other publications

Institute of Public Works Engineering Australia (IPWEA)

Streets Opening Conference Information Bulletin on Codes and Practices (Sections 3 and 4 detailing locations and depths of other services and preferred location for water reticulation pipes)

NSW Department of Public Works and Services (DPWS)

MEW E101 Electrical Services Minimum Requirements

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

Water Services Association of Australia (WSAA)

WSA 01 Polyethylene Pipeline Code

WSA 02 Sewerage Code of Australia Second Edition Version 2.3

WSA 04 Sewerage Pumping Station Code

WSA 05 Sewer Inspection Reporting Code of Australia

Standard Drawings

2 MATERIALS

2.1 GENERAL

Compliance with manufacturer's recommendations

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this worksection.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

Gravity reticulation pipes

All gravity reticulation pipes shall be rubber ring (elastomeric complying with AS 1646) jointed to the type, size and class as shown on the Drawings.

2.2 PVC PIPES AND FITTINGS

Non-pressure Pipe PVC

PVC pipes and fittings for gravity systems shall comply with AS/NZS 1260, shall be suitable for rubber rings (elastomeric) joints and shall be of the class and size as shown on the Drawings (WSA 02 Part 2, Section 10.4 and Table 10.1).

Pressure Pipe PVC

PVC pipes and fittings for rising mains and suction pipes shall comply with AS/NZS 1477 AS 4441 (Int) or AS/NZS 4765, shall be suitable for elastomeric seals complying with AS 1646 and shall be of the class and size as shown on the Drawings (WSAA 02 Part 2, Section 10.4 and Table 10.3).

Installation

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

Protection

Pipes and fittings are to be handled and stored in accordance with WSA 02 or AS/NZS 2032.

Where storage beyond the times specified in WSA 03 and AS/NZS 2032 are required, the Contractor shall provide protection for the pipes and fittings from ultra violet light and damage as recommended in the standards for the pipes and fittings.

The Contractor shall take account of the time for storage and type of shelter.

2.3 POLYETHYLENE (PE) PIPE AND FITTINGS

Standard

Polyethylene pipes and fittings shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the Drawings (WSA 02 Part 2, Section 10.4 and Table 10.1) and installed in accordance with AS 2033.

Jointing

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with mechanical fittings.

Fittings

Fittings shall comply with AS/NZS 4129.

Internal diameter and wall thickness

The Contractor shall provide pipe and fittings with minimum wall thickness and minimum internal diameter as shown on the Drawings.

2.4 GLASS REINFORCED PLASTIC (GRP) PIPE AND FITTINGS

Standard

Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571 and shall be of the class and size as shown on the Drawings and installed in accordance with AS/NZS 2566.1 and AS/NZS 2566.2 (WSAA 02 Part 2, Section 10.4 and Table 10.1).

Protection

Where storage beyond the times specified in WSA 02 is required, the Contractor shall provide protection for the pipes and fittings from ultra violet light and damage.

2.5 DUCTILE IRON (DI) PIPE AND FITTINGS

Standard

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the Drawings, and installed in accordance with AS/NZS 2566.1 and AS/NZS 2566.2. Flanged pipe shall be manufactured from AS/NZS 2280 Flange Class pipe.

Jointing shall be with elastomeric seals to the class and type as shown on the Drawings.

Ductile iron epoxy lined (DIEL) pipes, of nominal diameters 300 to 750mm, may be used for gravity reticulation pipelines, but only if specifically approved by the Principal and so indicated on the Drawings.

Flanges

Flanges shall be to the table shown on the Drawings.

Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the Drawings.

Corrosion protection

All pipework, unless specified otherwise, shall be coated and lined. All pipework shall be sleeved externally with polyethylene sleeving in accordance with AS 3681.

All fittings shall be fusion-bonded coated, in accordance with AS 4158 or sleeved in accordance with AS 3681.

If it is not possible, or desirable, to protect all joints using the above methods, the Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

2.6 STEEL PIPELINE

Standard

Steel pipelines and fittings shall comply with AS 1579 and shall be of the size, minimum wall thickness, lining and coating as shown on the Drawings. (WSA 02 Part 2, Section 10.4 and Table 10.1)

Corrosion protection

The Contractor shall protect all unprotected joints in the trench with a suitable corrosion protection system (e.g., petrolatum tape system or alternative) approved by the Superintendent.

Joints

The jointing system shall be elastomeric seal joint with seals complying with AS 1646 or butt-welded, unless shown otherwise on the Drawings.

2.7 VITRIFIED CLAY

Vitrified clay (VC) pipes and fittings shall comply with AS 1741 and shall be of the class of pipe, complying with the loading requirements of AS 4060, and size as shown on the Drawings and suitable for rubber ring (elastomeric) joints. (WSA 02 Part 2, Section 10.4 and Table 10.1)

2.8 PREFORMED MAINTENANCE HOLES (MH)

Prefomed maintenance hole components shall comply with AS/NZS 1477, AS 4441 (Int) or AS/NZS 4765 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete. (WSAA 02 Part 2 Section 10.4 and Part 3, Section 18).

2.9 PREFORMED MAINTENANCE SHAFTS (MS) AND TERMINAL MAINTENANCE SHAFTS (TMS) INCLUDING COVER

Prefomed maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477, AS 4441 (Int) or AS/NZS 4765 for PVC, AS/NZS 4130 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete. (WSAA 02 Part 2 Section 10.4 Part 3 Section 19, SEW 1314, 1316, 1317). These shall be only where specified on the drawings.

2.10 MAINTENANCE HOLE COVERS AND FRAMES

Maintenance hole covers and frames and their installation shall comply with AS 3996. The size and class shall be as shown on the Drawings.

Concrete covers and frames shall also comply with AS 4198.

Unless otherwise indicated on the Drawings:

- Covers, capable of being bolted down, shall be used in the area below the 1 in 100 flood level.
- AS 3996 Class D covers shall be used on areas likely to be subjected to vehicular traffic.
- AS 3996 Class B covers shall be used elsewhere.

2.11 STEELWORK

Corrosion protection

Structural steelwork, including ladders, brackets and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4, Class 2.5 and hot dip galvanized to AS/NZS 4680.

Step irons

The Contractor shall supply and install step irons as shown on the Drawings or plastic encapsulated step irons. (WSAA 02 Part 3, Section 18, SEW 1307, 1311, 1312).

3 PIPELINE CONSTRUCTION

3.1 GENERAL

Accreditation

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work.

Proof of accreditation constitutes a HOLD POINT.

The approval of the Superintendent, to the supplied documentation, shall be required prior to the release of the hold point.

Alignment changes

The Contractor shall not change the pipeline alignment without the prior concurrence of the Sewer Authority.

The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to the Sewer Authority.

This action constitutes a HOLD POINT.

The Superintendent shall obtain the decision of the Sewer Authority prior to the release of the hold point.

3.2 LOCATION

The location of the sewers, maintenance holes, rising mains and pump stations, sizes and grades of sewers and rising mains, the types of maintenance holes and maintenance hole covers and the classes of pipes shall be as shown on the Drawings.

The Contractor shall commence laying of pipelines at the lower end of the line unless directed otherwise by the Superintendent.

The Contractor shall lay pipelines to grades and locations shown on the Drawings unless directed otherwise by the Superintendent. (WSA 02 Part 3, Sections 13.1, 13.2).

If there is a conflict between the levels or grades, or between the Drawings and the written Specification Clauses, then the Contractor shall immediately advise the Superintendent and seek clarification.

3.3 COVER OVER PIPELINES

Minimum cover

The minimum depth of cover to be provided over pipelines shall be as given in Table 3.1 (WSA 02 Part 3, Section 15.2).

Cover reduction

Lesser covers may be permitted where special protection of the pipelines has been shown on the Drawings or directed by the Superintendent.

Table 3.1 Minimum cover over pipelines

Location	Minimum cover (mm)
Private property non vehicular – New	600

Location	Minimum cover (mm)
developments	
Private property non vehicular – Existing developments	450
Private property vehicular	750
Footpaths, sealed roads (non Arterial)	900
Unsealed roads	1200
Arterial	1200

3.4 CROSSINGS

Authority requirements

Where a pipeline crosses a Main or State road, creek or involves features shown on the Drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority.

The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. (WSAA 02 Part 3, Section 17.13).

The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested.

This action constitutes a WITNESS POINT.

The Superintendent shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised.

Existing road crossings

Where shown on the Drawings, the Contractor shall use trenchless methods for the installation of the sewer mains.

The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation. (WSAA 02 Part 3, Section 15.3).

Trenchless installation methodology

The Contractor shall address, in its Method Statement for trenchless conduit installation, the following:

- General description of method and sequence of operation.
- Size, depth and position of temporary pits required.
- Use of specialist subcontractors.
- Specialist equipment to be used.
- Grout type and method of injection.

Encasement pipe

The encasement pipe shall be as detailed on the Drawings.

The encasement pipe shall extend 1.0 m behind the back of the kerb on either side of the carriageway.

Support cradles

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

Grouting

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler. (WSA 02 Part 3, Section 17.12).

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene sleeving.

3.5 EARTHWORKS

Conformance with drawings and Superintendent's directions

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the Drawings, or as directed by the Superintendent, within the specified tolerances.

The Contractor shall comply with all requirements of the appropriate Authority including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners (WSAA 02 Part 3, Section 15).

Excavated material

The Contractor shall leave a clear space of 600 mm minimum between the edge of any excavation and the inner toe of stockpiles.

No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence.

Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling (WSAA 02 Part 3, Sections 14.7, 15.9).

Public safety

At the completion of work each day, the Contractor shall: install safety fencing to Statutory requirements along the edges of open excavations to isolate them from the public; plug any open pipelines to prevent ingress of soil or other material; backfill to prevent flotation any laid pipelines.

All such safety fencing installations shall be of adequate size and strength and shall be illuminated to prevent accidents (WSAA 02 Part 3, Section 15).

Access to property

The Contractor shall provide fenced walkways and vehicular crossways across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise beforehand all affected residents.

All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents (WSAA 02 Part 3, Sections 13.6, 15.1)

Existing services

The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor’s expense. (WSAA 02 Part 3, Section 13.7)

Erosion control

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with 1102 *Control of erosion and sedimentation*.

Limiting excavations

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open (WSAA 02 Part 3, Section 15.2).

3.6 MINIMUM TRENCH WIDTH FOR PIPELINES

Clear width of trench

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as given in Table 3.2. (WSAA 02 Part 3, Section 15.2)

Table 3.2 Minimum trench widths

Nominal size of pipe (DN)	Minimum clear width of trench (mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE pipe
80	400	350
100	400	350
150	450	400
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800

Nominal size of pipe (DN)	Minimum clear width of trench (mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE pipe
525	850	800
600	950	900

Minimum disturbance

Where the Drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum.

Bitumen and concrete surfaces shall be carefully cut, by sawcutting, or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges (WSA 02 Part 3, Section 15.3)

Widen for fittings

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

3.7 MAXIMUM TRENCH WIDTH

Pipes other than PVC/PE

For gravitation sewers or rising mains of pipe materials other than PVC or PE, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table 3.3.

The Superintendent may, however, restrict the width of trench due to local conditions. The Superintendent shall not restrict the width of trench to less than as shown in column (iii) of Table 3.3.

Where the depth to invert exceeds that shown in column (ii) of Table 3.3, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in column (iii) of Table 3.3.

Table 3.3 Maximum trench widths

Nominal size of pipe (mm)	Maximum depth to invert, unlimited width trench (m)	Maximum trench width, depths greater than in column (ii) (mm)
(i)	(ii)	(iii)
150	8.0	750
225	6.5	825
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

PVC/PE Pipe

For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150 mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400 mm.

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 580 mm plus the outside diameter of the pipe barrel.

Special controls

The Contractor shall supply a method statement of any special construction control, where shown on the Drawings, to the Superintendent's approval.

3.8 EXCAVATION DEPTH

Rock foundations

For rock foundations, the Contractor shall excavate trenches to 75 mm below the underside of the pipe barrel and socket or coupling, or as otherwise shown on the Drawings (WSA 02 Part 3, Section 15.8, , SEW-1201).

Pipe support

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of the barrel with chases provided for joints and wrapping.

3.9 SUPPORT OF EXCAVATION

Precaution against slips or falls

The Contractor shall adequately support all excavations as the Works proceed.

When withdrawing supports, the Contractor shall exercise every precaution against slips or falls. (WSAA 02 Part 3, Section 15.6).

Timber left in place

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

3.10 PIPE BEDDING

Approval of excavation

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding.

This action constitutes a HOLD POINT.

The Superintendent's approval of the excavated trench is required prior to the release of the hold point (WSA 2 Part 3, Section 16).

Crusher screenings

Crusher screenings may only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations.

Gravity sewers—Pipes other than PVC/PE

Pipes for gravitation sewers (excluding PVC/PE pipes), shall be bedded on sand or other non-cohesive material.

Pipe bedding shall consist of a non-cohesive granular material, having a minimum thickness of 75 mm below the barrel and socket of the pipe, and its grading shall generally fall within the following limits shown in Table 3.4. (WSA 02 Part 3, Sections 16.1, 16.2).

Table 3.4 Grading of bedding material for pipes other than PVC and PE

Sieve size aperture width (AS 1152)	Equivalent BS sieve size (BS 410)	Percentage passing
22.4 mm	1 inch	100
6.7 mm	¼ inch	90–100
425 µm	No. 36	40–90
75 µm	No. 200	0–10

Rising mains—Pipes other than PVC/PE

Pipes for rising mains (excluding PVC/PE pipes) may be laid directly on other than rock foundation.

The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 75 mm below the barrel and socket of the pipe, where rock or other hard material occurs in the bottom of the trench or where specified or directed by the Superintendent.

The bedding material shall be either loose clean sand and/or medium dense clean sand or as directed by the Superintendent.

Rising mains—PVC/PE Pipes

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding as shown in Figure 4.1 in AS/NZS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within limits shown in Table 3.4.

Where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in Pipe Bedding provided also that the material meets the requirements for passing sieve sizes 9.5 mm and 6.7 mm as shown in Table 3.5.

Underlay a minimum of 75 mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150 mm above the top of the pipe.

Table 3.5 Grading of bedding material for PVC and PE pipes

Sieve size aperture width (AS 1152)	Equivalent BS sieve size (BS 410)	Percentage passing
9.5 mm	3/8 inch	100
6.7 mm	1/4 inch	90–100
425 µm	No. 36	40–90
150 µm	No. 100	0–10

Pipeline grades 15-50%

The Contractor shall bed all gravitation sewers laid on grades of 15% to 50% on 20 MPa concrete complying with 0310 *Minor concrete work*.

Such concrete bedding shall have a thickness of at least 75 mm 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 and a width across the trench not less than the minimum width shown in Table 3.1.

Pipelines grades greater than 50%

The Contractor shall encase all gravitation pipelines and rising mains, laid on grades steeper than 50%, in concrete as detailed on the Drawings.

3.11 LAYING AND JOINTING OF PIPES

Installation

Unless detailed otherwise in this worksection, the Contractor shall install pipes in accordance with AS/NZS 2032, AS 2033, AS/NZS 2566.1, AS/NZS 2566.2 or AS 3690 as appropriate (WSAA 02 Part 3, Section 17).

Cleaning and examination of components

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the Superintendent to inspect it.

If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions.

Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

Flotation

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing.

The Contractor shall remove any temporary supports prior to completion of backfilling.

Joint type

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be elastomeric seal joints (either roll-on rubber ring or skid type) or, where shown on the Drawings, mechanical joints shall be fixed flange, bolted gland type, or a PE pipe system specific joint type. (WSAA 02 Part 3, Section 17.1.2).

Roll-on rubber ring

For pipes with roll-on rubber ring joints, spigots and sockets shall be clean and dry.

The Contractor, after making the joint, shall check that the rubber ring has rolled in evenly, and, if not, the Contractor shall withdraw the pipe and remake the joint.

Skid rubber ring

For pipes with skid type elastomeric seal joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint.

The Contractor shall make the joint such that the witness mark shall, at no point, be more than 3 mm from the end of the socket.

Cut pipes

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

Field cuts shall be undertaken in accordance with WSAA 02.

For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made.

If the Contractor proposes to use a petrol-engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by the Superintendent.

Witness mark on cut pipes

Except for PE pipes to be butt welded, where pipes are cut in the field, the Contractor shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe.

The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Different Joints

Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows:

- For jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, a PVC/PE adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS 1646.
- For jointing PVC to ductile iron, the Contractor shall use a rubber ring (elastomeric) joint with an adaptor coupling.
- For jointing PE to ductile iron, the Contractor shall use a restrained joint (flange or coupler).

(Note: the compatibility of the PVC/PE pipe, joint seal and DI socket should be confirmed)

Ductile iron spigots shall not be inserted into PVC/PE sockets.

Alternatively, multi-fit mechanical couplings or flanged adaptor couplings, but not stainless steel leak/repair clamps, may be used to join pipes of different materials. Where PE pipes are being joined with mechanical couplings, joint restraint shall be provided.

Existing AC pipe

The Contractor shall conform with the relevant Statutory and OH&S requirements when cutting and disposing of asbestos cement pipes.

Tolerances

Gravitation pipelines shall be constructed to the following tolerances (WSAA 02 Part 3, Section 23):

The maximum horizontal deviations to either side from the design axis of a pipeline shall be 20 mm for all sizes of pipes.

The invert level shall not deviate from the design grade line by more than 10 mm.

Joint deflection

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made.

The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

Rising main grade

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes for rising mains on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Rising main identification

Detectable identification tape to AS/NZS 2648.1 shall be laid along the line of the rising main within 150 mm of the finished surface or as otherwise directed by the Superintendent. (WSAA 02 Part 3, Section 17.11)

Ovality testing

Prior to backfilling and compaction operations, the Contractor shall undertake ovality tests of all pipelines for any abnormalities in pipe shape and rectify any unsatisfactory sections found to the satisfaction of the Superintendent.

The test results of such tests shall be made available to the Superintendent.

This action constitutes a WITNESS POINT.

The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the test results is required.

3.12 BACKFILL AND COMPACTION

Approval of pipe laying prior to backfilling

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling. (WSAA 02 Part 3, Section 21).

This action constitutes a HOLD POINT.

The Superintendent's approval to the laid and jointed pipes is required prior to the release of the hold point.

Commencement

Backfill shall not be placed until the Superintendent has given approval.

Side support and overlay

Material for the side support and overlay of the pipe shall be as for pipe bedding specified in Pipe Bedding.

The material shall be compacted in layers of not more than 150 mm to 95% of the standard maximum dry density of the material used when determined in accordance with AS 1289.5.7.1.

Remainder of excavation

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150 mm thick as follows:

- Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be: (WSA 02 Part 3, Section 21.1.2).
 - . Backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table 3.4, and compacted to Density Index of 70 when determined in accordance with AS 1289.5.4.1 for cohesionless materials:
 - * Below 0.5 m of the road surface
 - * In the road reserve, but excluding the road pavement
 - . Backfilled with excavated material, and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.7.1, to within 0.5 m of the road surface, but excluding the pavement layers.
 - . Backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.7.1.
- Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.4.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.7.1 for cohesive materials.

Prevention of damage

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

Compaction tests

The contractor shall carry out compaction tests 75 mm to 100 mm below the level being tested. (WSA 02 Part 3, Section 22.3)

Flood compaction

The Contractor may compact backfill by trench flooding only where:

- The ground and backfill material is cohesionless sand.
- Water for flooding has been sourced at the site.
- The process will not create mud which would be moved off site by vehicles or construction plant.
- Additives are not used.

3.13 CONNECTIONS TO MAINTENANCE HOLES AND STRUCTURES

Flexible Joints

The Contractor shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600 mm long pipes such that two flexible joints are provided, the first joint being at or within 150 mm of the face of the structure.

Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300 mm of the position shown on the drawings (WSA 02 Part 3, Section 18.10, SEW-1302, 1303, 1313).

Maintenance hole location

The Contractor may vary slightly the positions of maintenance holes shown on the Drawings, subject to final approval by the Superintendent immediately prior to construction, to suit changes, such as erection of structures, growth of flora and installation of services.

The positioning of a maintenance hole shall be such as to comply with occupational health and safety requirements for access by maintenance staff, providing a proper working area around the top and access into the hole.

Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:

- For deviations from the design levels of maintenance holes as shown on the Drawings or as directed by the Superintendent during construction, the following tolerances shall apply: (WSA 02 Part 3, Section 23).
 - . Where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100 mm or less:

Pipe	Tolerance
. Inlet	-nil; +10 mm
. Outlet	-10 mm; + nil
 - . Where the difference in levels, as above, is greater than 100 mm:

Pipe	Tolerance
. Inlet	-10 mm; +10 mm
. Outlet	-10 mm; +10 mm
- Allowable lateral deviations from the final design position of maintenance holes shall be ± 300 mm.

Work on live maintenance holes

The Contractor shall complete all necessary Works on 'live' maintenance holes (that is, accesses to sewer system that is currently in service) unless shown otherwise on the Drawings or advised by the Superintendent.

Where shown on the Drawings that work on 'live' maintenance holes shall be performed by others, the Contractor's attention is drawn to the Conditions of Contract regarding the obligation of the Contractor to co-ordinate the Works with any simultaneous and/or adjacent work by others.

The Contractor shall liaise with these Contractors and Authorities to avoid disruption, delays and possible conflict.

All Works undertaken by the Contractor at 'live' maintenance holes in delivering the Works under the Contract shall be a cost to the Contractor (WSAA 02 Part 3, Section 24).

3.14 JUNCTIONS AND PROPERTY CONNECTION SEWERS

Location

The Contractor shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this worksection and the Drawings.

Such junctions shall be inserted along pipelines in locations shown on the Drawings or directed by the Superintendent, with the service connection, where not shown on the Drawings, provided at a depth

no deeper than 1.5 m provided the property still has service to the sewer, as follows (WSA 02 Part 3, Section 17.7):

- For existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies.
- For vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.

Long property connection sewers

Where the sewer is intended to serve a large block and/or where the sewer line is located more than 75 m from the premises, the Contractor shall extend the property connection sewer onto that block such that the maximum horizontal measurement in a straight line between the sewer connection point and the premises on the block is not more than 75 m.

Concrete encasement

Junctions for risers shall be encased in 20 MPa concrete complying with 0310 *Minor concrete work*.

Backfill

Except where concrete encasement is ordered by the Superintendent, the Contractor shall sand compact backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500 mm upstream and downstream of the riser. Compaction density shall be as for the requirements for the trench pipeline.

Property connection sewer caps

All property connection sewers and junctions shall have a minimum diameter of 150 mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10 m. (WSA 02 Part 3, Sections 17.7, 17.8).

3.15 MARKING OF JUNCTIONS AND PROPERTY CONNECTION SEWERS

Location

The Contractor shall clearly mark the position of each riser, junction or end of a property connection sewer on completion of backfilling.

The marking shall be made by one of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by the Sewer Authority and to the approval of the Superintendent. (WSA 02 Part 3, Section 17.9).

Adjacent to fence

Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter 'J' 50 mm high shall be painted thereon.

An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.

Peg

Elsewhere, the Contractor shall drive into the ground, a peg, 75 mm × 50 mm × 600 mm long at that position, and left flush with the surface of the surrounding ground.

The Contractor shall connect the peg to an underground identification tape as specified hereafter.

Tape position

The Contractor shall tie the identification tape to the junction or end of the property connection sewer and hold the tape in a vertical position during backfilling.

The Contractor shall spike the top end of the tape by the junction peg immediately upon completion of backfilling. (WSAA 02 Part 3, Section 17.11)

Identification tape

The identification tape shall be 75 mm wide red coloured polyethylene tape with the inscription 'Caution—buried sewer line', printed in heavy black letters every 200 mm.

3.16 TRENCH STOPS

Sewer or rising main grade 5% to 14%

Where a sewer or rising main is laid on bedding at a grade of 5% to 14%, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed (WSA 02 Part 3, Section 17.5, SEW-1206, SEW-1207):

- At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100 mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls to a level 300 mm above the top of the pipe.
- The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

Spacing

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

$$D=100/G$$

where

D = Distance between stops in m,

G = Grade of pipe expressed in percentum.

3.17 CONCRETE BULKHEADS

Gravitation sewer or rising main grade 15% to 29% and 30% to 50%

Where a gravitation sewer or rising main is installed at a grade of 15% to 29%, the Contractor shall construct concrete bulkheads.

Where a gravitation sewer or rising main is installed at a grade 30% to 50%, the Contractor shall construct concrete bulkheads integral with concrete encasement.

Bulkheads shall be of 20 MPa concrete complying with 0310 *Minor concrete work* and of 150 mm minimum thickness as follows (WSAA 02 Part 3, Section 17.5, SEW 1206, SEW 1207):

- Where concrete bedding or encasement to pipe is required, the 150 mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm.

The bulkhead shall extend to 150 mm below finished surface level or such other level as directed by the Superintendent.

- Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150 mm for the full width of trench.
- A 75 mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter.

The gravel shall be 10 to 20 mm in size within 150 mm in all directions upstream and above the invert of the drain hole beyond which another 150 mm thick surround of gravel 2 to 10 mm in size shall be placed.

Spacing

The distance between concrete bulkheads shall be determined by the following formulas (WSA 02 Part 1, Table 8.1):

Concrete bulkhead

$$D=L/G$$

Concrete encasement (continuous) and concrete bulkhead

$$D=100/G$$

where

L = 80 × pipe length (in metres) with 450 m maximum

D = Distance between bulkheads in m

G = Grade of pipe expressed in percentum

If L > 100 m use intermediate trenchstops at spacing < 100/G

3.18 THRUST AND ANCHOR BLOCKS FOR RISING MAINS

Location

The Contractor shall construct thrust and anchor blocks where shown on the Drawings to the dimensions depicted therein or as otherwise directed by the Superintendent.

The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

Thrust blocks

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with 0310 *Minor concrete works* such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

Anchor blocks

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with 0310 *Minor concrete works* of a volume not less than that directed by the Superintendent.

Temporary anchorage

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test.

The cost of providing such anchorages shall be deemed to be included in the rates tendered for laying and jointing rising mains.

Restrained joints

The Contractor shall obtain the consent of the Sewer Authority for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

3.19 RISING MAIN FITTINGS

Location

The Contractor shall install rising mains, air release valves and inspection pipes where shown on the Drawings or directed by the Superintendent.

All rising mains shall be topped with an appropriate identification tape.

Marking plates

The Contractor shall provide marking plates bearing the letters 'DAV' for double air valves, 'SCOUR' for scour pipes and 'SRM' for sewage rising main at changes of direction and at such chainages that the location of the main is marked, at least once each 100 metres, as specified hereinafter.

In urban areas, the kerb adjacent to each fitting is to be painted with two (2) coats of non-slip paint coloured black.

Marking posts

Where, in the opinion of the Superintendent, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting.

The distance to the fitting in metres, to an accuracy of 0.1 m, shall be permanently marked on the plate with legible numbers a minimum 80 mm high.

Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

- The post shall conform to the following requirements:
- The post shall be of sufficient length to be set firmly in place under saturated ground conditions.
- When installed, the post shall project 1000 mm above the ground, provided that where tall grass or crops are likely to obscure the post, or where directed by the Superintendent, its height above the ground shall be increased to 1500 mm.
- The post shall be painted with 2 coats of white enamel for exterior use.

3.20 CONCRETE ENCASEMENT

Location

The Contractor shall encase in concrete, pipes in gravity sewers or rising mains (as shown on the Drawings) with less than the specified cover above the top of the pipe barrel, or where directed by the Superintendent.

Concrete shall be 20 MPa complying with 0310 *Minor concrete works* and have the following minimum dimensions (WSA 02 Part 3, Section 16, SEW-1205):

- For trenches in other than rock—150 mm minimum under, on both sides and on top of the pipe barrel.

- For trenches in rock—100 mm minimum under the pipe barrel, 150 mm on top of the pipe barrel and for the full width of trench excavated.

Contraction joint

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12 mm thick shall be formed in the concrete encasement at the face of each socket or at one face of each coupling.

Reinforcement

Reinforcement in concrete encasement shall be as shown on the Drawings.

3.21 WRAPPING OF DUCTILE IRON PIPELINES

Location

Where shown on the Drawings or directed by the Superintendent, the Contractor shall enclose a ductile iron pipeline or a section thereof, in layflat polyethylene sleeving (WSAA 02 Part 3, Section 17.10).

Material

The materials to be used shall be high impact resistance polyethylene sleeving complying with AS 3681 and 50 mm wide plastic adhesive tape.

Width

The width of the sleeving when flat shall be in accordance with the pipe manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Colour

Where necessary to distinguish pipes within close proximity, pipelines shall be identified by Cream sleeving for Sewer Gravity and Rising mains, Lilac sleeving for Sewer Reuse mains and Blue sleeving for Potable Water mains or an appropriate identification tape approved by the Superintendent.

Application

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent.

The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench.

Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250 mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape.

As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately one-metre intervals.

Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes.

The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal.

The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

Damage to wrapping

The Contractor shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench.

3.22 CORROSION PROTECTION OF STEEL BOLTS AND NUTS

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations.

Bolts and nuts shall be dry, clean and free from rust immediately before wrapping.

3.23 CAST-IN-SITU MAINTENANCE HOLES

Concrete

For all maintenance holes concrete work, the Contractor shall comply with 0310 *Minor concrete work* for the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as follows (WSAA 02 Part 3, Section 18):

- Cement used in all concrete shall be Type SR to AS 3972. The Contractor may use fly ash additive to a maximum 20%. Cement used shall be no older than three months since manufacture.
- The minimum cement content shall be 360 kg/m³ of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

3.24 COVERS AND FRAMES

Manufacture

Covers and frames shall comply with AS 3996. On-site filling of recessed covers shall comply with AS 3996 and any manufacturers instructions.

Shape and surfaces

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3 mm.

Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4 mm radius. (WSAA 02 Part 3, Section 18.9).

Approval

Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

This action constitutes a HOLD POINT.

The Superintendent's approval to the quality test documentation is required prior to the release of the hold point.

Tolerances

Tolerances for the dimensions on the COVER shall be -3 mm +NIL.

Tolerances for the dimensions on the FRAME shall be -3 mm +3 mm.

Cover seating

Maintenance hole covers shall be seated on a layer of bitumen impregnated fibre board, having a cross-section of 25 × 25 mm.

Alternatively another seating material of a cross-section and composition approved by the Superintendent may be used.

Cover levels

Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type.

Elsewhere, covers shall be finished 25 mm above the surface of the ground where not shown otherwise on the Drawings, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water. The Contractor shall also ensure that the access chamber cover is not a tripping hazard. Where these requirements conflict, the level shall be as directed by the Superintendent.

Cast iron cover and frame

In locations where shown on the Drawings or directed by the Superintendent, the Contractor shall install a cast iron cover and frame instead of the standard concrete maintenance hole cover.

Where it is evident, or otherwise shown on the Drawings, the Contractor shall install bolt down frames and covers in areas subjected to 1 in 100 year flooding.

3.25 STEP IRONS

Step irons shall be as detailed on the Drawings.

The Contractor shall fix step irons in formwork prior to placing concrete, ensuring step hold, alignment and spacing is positioned for safe access (WSAA 02 SEW 1307).

3.26 PREFORMED MAINTENANCE HOLE AND MAINTENANCE SHAFT SYSTEMS

Specification

If approved by the Superintendent, preformed systems, complying with the Drawings, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of cast in-situ systems (WSAA 02 Part 3, Section 18.4).

Approval

Preformed system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

This action constitutes a HOLD POINT.

The Superintendent's approval to the quality test documentation is required prior to the release of the hold point.

Watertight components

The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Maintenance holes

Generally, preformed maintenance holes shall be made up in accordance with the Drawings, with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, a cone section, cover and frame.

Make-up Rings may be used between cone sections and frames to make up height differentials.

The wall thickness of any reinforced component below the frame shall not be less than 84 mm.

The vertical distance from the top of the surround and the first step is to be in the range of 600 mm to 900 mm.

Maintenance shafts

Generally, preformed maintenance shafts shall be made up in accordance with the Drawings, with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, cover and frame (WSAA SEW 1314).

Installation

The installation of all preformed components shall be in accordance with the manufacturers' recommended procedures and requirements.

Backfill

Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to a level 300 mm above the top of the highest incoming pipe and for the full width of the excavation.

If necessary, the Contractor shall import and compact non-cohesive granular material.

3.27 RESTORATION OF SURFACES

Original condition

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works.

The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with imported turf from a source approved by the Superintendent (WSA 02 Part 3, Section 22).

Carriageway pavements and pathways shall be restored in a continuous manner to a condition equivalent to that existing at the commencement of the Works as determined by the Superintendent.

Maintenance

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period.

The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

Temporary pavement restoration

Immediately the backfilling of a trench excavated through a pavement has been completed, the Contractor shall temporarily restore the pavement.

Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration.

The Contractor shall maintain the temporary restoration until final restoration is carried out.

Final pavement restoration

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 Superintendent, the removal of temporary restoration.

Backfill

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform with the adjacent surface.

Surplus material shall be removed and disposed of to areas arranged by the Contractor.

Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

Disposal of surplus material

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces.

The Contractor shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period.

Settlement

Where, within public or private property, the reasonable convenience of persons will require such, the Superintendent may order the Contractor to level trenches at the time of backfilling.

The Contractor shall make good any subsequent settlement, as required by placing additional fill.

Restoration of damaged or disturbed private property and services.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Tunnelling

Should the Contractor elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced.

The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period.

Property owner advice of any impending works

The Contractor shall provide notice to affected property owners of any pending works.

4 PIPELINE TESTING

4.1 GENERAL

Initial test before backfill

The Contractor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and before backfilling is commenced.

An acceptance test shall be carried out before the issue of the Certificate of Practical Completion and not earlier than one month after completion of construction of all sewers and maintenance holes in a section.

Sewers or maintenance holes failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained (WSAA 02 Part 3, Section 22).

Cleaning

All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.

Vacuum system

Where a vacuum system has been specified, the Contractor shall test the system in accordance with the testing schedule as shown on the Drawings.

4.2 INITIAL TEST OF GRAVITATION SEWERS

Compressed Air

The Contractor shall make the initial testing of gravitation sewers with compressed air.

Before the initial test is performed, all pipelaying on the section shall be completed, and backfill shall be compacted to the level of the centre of the pipe barrel and the Superintendent notified.

This action constitutes a WITNESS POINT.

The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the initial testing is required.

Risers and property connection sewers

The initial test may be carried out before risers and/or property connection sewers are constructed so that the main line can be backfilled.

However, the Contractor shall carry out an initial test on the risers and property connection sewers as soon as they are completed.

Other than full lengths

Where the Superintendent approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.

Rectification

The Contractor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

Ovality testing

- Visual inspection for Ovality, during CCTV survey may be used to identify non conforming pipework.
- Where problems are identified by the CCTV Survey, the Contractor shall undertake ovality testing as directed by the Superintendent.

Proving Tool

- All sewers to DN 300 shall be tested to determine any excessive ovality using a proving tool approved by the Council. Ovality testing shall be undertaken after all earthworks on the subdivision are complete and no sooner than 28 days after backfill of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested.
- The proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as given in Table 4.1.
- The proving tool shall be fabricated from steel and have pulling rings at each end. The prover shall be marked to indicate the nominal pipe size and the prover outside diameter.
- Maximum Allowable Deflection = 3% of Mean Outside Diameter.
- The testing shall require a 'prover' to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded.

Alternatively, compliance with the requirement of Maximum Allowable Deflection = 3% of Mean Outside Diameter may be determined using a laser profiler and method approved by the Superintendent.

Table 4.1 Minimum diameter of proving tool

Nominal size (DN)	Minimum prover diameter (mm)
	PVC PIPE
100	99.7
150	142.6
225	213.9

300	280.8
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4.3 INITIAL TEST OF MAINTENANCE HOLES

Timing of test

The Contractor shall test each maintenance hole for leakage, as soon as practicable after the maintenance hole is constructed and the maintenance hole cover surround fitted (WSA 02 Part 3, Section 22.4.4).

Method

Apply an initial test vacuum pressure (negative pressure) of approximately 37 kPa to the top of the MH. Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilise for at least 3 minutes to identify any initial leakage.

When the pressure has stabilised and is at or below the starting test vacuum of 33.8 kPa of mercury, commence the test by allowing the gauge pressure to drop to 33.8 kPa, at which point the initiate time recording. Record the time for the vacuum to drop to 30.4 kPa.

Accept the MH under test if the time for the vacuum reading to drop from 33.8 kPa to 30.4 kPa meets or exceeds the relevant time. (Refer WSAA 02 Part 3, section 22.4.4)

Alternative tests

Alternatively, the maintenance hole may be tested in conjunction with the downstream section of main or undertaken using the vacuum method or use of compressed air.

In either case, the Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

4.4 ACCEPTANCE TEST OF GRAVITATION SEWERS AND MAINTENANCE HOLES

Method

The Contractor shall make the acceptance test on all components in the section of the sewer in the same manner as the initial test.

The section of the sewer system to be tested in each test shall be approved by the Superintendent. The Contractor is responsible for the conduct of the test and for arranging inspection by the Superintendent.

The Contractor shall give the Superintendent three (3) working days notice of his intention to undertake testing. This notice must be in writing and specify the pipeline and/or access chambers to be tested as well as the time, date and location of the test equipment.

Approval

The submission, to the Superintendent, of satisfactory test results constitutes a HOLD POINT.

The approval of the Superintendent is required prior to the release of the hold point.

Alternative

The Superintendent may permit hydrostatic testing as an alternative to compressed air testing for acceptance of gravitation pipelines.

The Superintendent may reject any pipeline or maintenance hole in which there is visible or detectable leakage.

4.5 TESTING WITH COMPRESSED AIR

Equipment

The Contractor shall supply and keep all necessary equipment in a condition acceptable to the Superintendent.

Pressure gauges

The Contractor shall test (calibrate) pressure gauges prior to use by static water column.

Compressed air supply equipment

Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m³/minute at 35 kPa.

The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 28 kPa ± 4 kPa.

The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50 kPa, a pressure relief valve that shall be set to blow off at 28kPa \pm 4 kPa and a gate valve to the pipeline to be tested.

Method

The method of setting up and carrying out the test shall be as follows (WSAA 02 Part 3, Section 22.4):

- Insert a blank plug at one end and a disc with air-hose connection at the other end of the line.

Care shall 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 kPa to 28 kPa (over one minute approximately).
- Hold air pressure at 28 kPa for three minutes for stabilising temperature.
- Close gate valve to shut off air supply to test equipment.
- Measure the time it takes for the pressure to drop from 25k Pa to 18 kPa. If this time is less than that permitted or if the line cannot be pressurised to 28 kPa, then the test is unsatisfactory and the pipeline shall be checked for leaks.
- To check pipelines for leaks:
 - . Open the gate valve from the air supply sufficiently to maintain a pressure of 14 kPa to 23 kPa in the pipeline.
 - . 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.
- If leaks are detected, they shall be repaired to the satisfaction of the Superintendent.
- Re-test as above until the time taken for the pressure to drop is greater than that shown below.

Allowable pressure drop times

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

- 100 mm pipe—1 minute
- 150 mm pipe—2 minutes
- 225 mm pipe—4 minutes
- 300 mm pipe—6 minutes
- 375 mm pipe—8 minutes
- 400 mm pipe—11 minutes
- 525 mm pipe—14 minutes
- 600 mm pipe—17 minutes

Possible leakage or excessive air permeability

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 shall be thoroughly saturated with water before testing or a hydrostatic test applied.

Hydrostatic test

In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Contractor shall apply a hydrostatic test.

4.6 HYDROSTATIC TESTING

Pipe connection

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

Water

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

Test container

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

- For initial test:
 - . when no property connection sewers or risers are constructed—a minimum head of 2 metres above the pipe invert at the upstream end of the line under test, or
 - . where property connection sewers and/or risers are constructed—a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers.
- For acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers, or above the free standing level of ground-water in the vicinity whichever is the higher.
- Such other lesser head as the Superintendent, at the Superintendent's discretion, may direct.

Ground-water

The Contractor shall determine, at the Contractor's expense, the free standing level of groundwater, by a method acceptable to the Superintendent.

Extra water

After allowing an interval for absorption, to be determined by the Superintendent, any fall of the free water surface shall be made good by adding extra water to the container. The Contractor shall measure the fall in water level during ten minutes thereafter.

Results

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

Test length

A standard test length in metres is defined as 1370 m divided by the effective diameter of the pipeline in millimetres.

Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline.

Where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.

4.7 VISUAL INSPECTION AND MEASUREMENT OF INFILTRATION

Head of groundwater

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e., 1500 mm or more above the soffit of the sewer main provided that groundwater is at least 150 mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration.

Method

In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured.

Rate of infiltration

If the Superintendent, at the Superintendent's discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Superintendent shall determine, the duration over which infiltration is to be measured.

The rate of infiltration shall not exceed that determined by the following formula:

$$Q.I. = 0.65 (L_1d_1h_1 + L_2d_2h_2 + \dots\dots\dots L_nd_nh_n) + H_a$$

where:

Q.I. = rate of infiltration in litres/hour

L = length of pipe in metres

d = nominal size of pipe in metres

h = average head of groundwater over the invert level of the pipe in the section under test

H_a = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test.

Determination of the head of groundwater

The Contractor shall determine the head of groundwater, at the Contractor's expense, by a method approved by the Superintendent.

4.8 TESTING OF RISING MAINS

Test to detect leakage and defects

The Contractor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks.

The submission, to the Superintendent, of satisfactory test results constitutes a HOLD POINT.

The approval of the Superintendent is required prior to the release of the hold point.

Timing

Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled, provided that:

- If so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and
- The pressure testing shall not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.

Section definition

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

Wet weather

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

Field joints

During pressure testing, all field joints which have not been backfilled shall be clean, dry and accessible.

Stop valves

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Cleaning and filling with water

Before testing a pipeline section, the Contractor shall clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled.

Purging of air from rising mains shall be promoted by opening air valves.

In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

Test pressure

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to the pressure rating of the pipe specified.

Duration of test

The Contractor shall maintain the specified test pressure for as long as required by the Superintendent, while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 8 hours.

Test records

For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

Pass/fail criteria

The pressure testing of a section shall be considered to be satisfactory if:

- There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

- There is no visible leakage; and
- The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

$$Q1 = (0.000532 + C/L_p) \times D \times L \times (H)^{0.5}$$

where:

Q1 = permissible leakage rate (litres per hour)

C = a coefficient as specified hereunder for the particular pipe material and type of joint

D = nominal diameter of pipe (mm)

L = length of section tested (km)

H = average test head (m)

L_p = average pipe length – L/n (m) where 'n' is the total number of pipes and fittings in the section tested.

- the measured leakage rate does not exceed that rate calculated by the simplified formula for the type of pipe given in Table 4.2, in which event determination of the permissible leakage rate on the basis of the formula specified in c) above shall not be necessary.

The simplified formulae are based on the coefficient 'C' and average pipe lengths contained in that tabulation.

Table 4.2 Simplified formula

Pipe type	Simplified formula	Coefficient 'C'	Average pipe length (m)
D.I.	$Q1 = 0.0105D \times L \times (H)^{0.5}$	0.0548	5.5
PVC	$Q1 = 0.01D \times L \times (H)^{0.5}$	0.0568	6.0

Rectification

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be rectified by the Contractor at the Contractor's expense.

Where a thrust block or an anchor block fails, and such thrust block or anchor block has been constructed in accordance with the Drawings, and the failure is not, in the opinion of the Superintendent, the fault of the Contractor, the thrust or anchor block shall be strengthened or reconstructed as directed by the Superintendent.

The cost of strengthening or reconstruction of such thrust or anchor block and the cost of retesting shall be paid as a Variation to the Contract, at such rates as are determined in accordance with the provisions of the General Conditions of Contract.

Alternative tests

Alternatively, the rising main may be tested by the use of compressed air.

In this case, the Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

5 PUMP STATIONS

5.1 PUMPS

Materials

Pump construction materials for centrifugal end suction pumps shall comply with Table 5.1.

Table 5.1 Materials for centrifugal end suction pumps

DESCRIPTION	MATERIAL
PUMP	
Casing and suction bend	Cast iron AS 1830 Gr T200
Wear rings	Cast iron AS 1830 Gr T200
Impeller	316 Stainless steel/AS 1444
Impeller nut	Gunmetal AS 1565-905C

DESCRIPTION	MATERIAL
Shaft	316 Stainless steel/AS 2837
Shaft sleeve	Phosphor bronze AS 1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS 1565-9060
Gland	Cast Iron AS 1830 Gr T200
Gland studs	316 Stainless steel/AS 2837
PUMP (continued)	
Gland nuts	316 Stainless steel/AS 2837
Fixing nuts and bolts handhole	316 Stainless steel/AS 2837
Covers	316 Stainless steel/AS 1444
Fitted bolts and nuts, casing and dowels	316 Stainless steel/AS 2837
Forcing screws	316 Stainless steel/AS 2837
Water thrower and drip tray	316 Stainless steel/AS 1444
Pump set base plate	Cast iron AS 1830 Gr T2000/Fabricated steel
MOTOR	
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Cast iron/Mild steel
Motor fan cover	Mild steel
Motor fan	Metal
HOLDING DOWN BOLTS	316 Stainless steel/AS 2837
MECHANICAL SEALS	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

Manufacturer’s warranty

The Contractor shall provide a written warranty from the Manufacturer of the equipment.

This action constitutes a HOLD POINT.

The Superintendent’s approval of the warranty is required prior to the release of the hold point.

The Manufacturer’s warranty shall require the Manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within two (2) years after the date of delivery of any piece of equipment used in Work under the Contract.

Nuts and bolts

All nuts and bolts shall be manufactured in accordance with AS 1111 and AS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts:

- All bolts, nuts and washers shall be stainless steel to AS 1444 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated.
- All threads are to be rolled.
- All bolt heads and nuts shall be hexagonal.
- All bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528.
- All nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts.
- All concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16 mm.
- Concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on flanges

Bolts on all flanges will protrude no more than 10 mm past the nut when tightened.

Anti-galling, anti-seize

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluoroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

5.2 PREFORMED PUMP STATIONS AND PACKAGE PUMP STATIONS

Alternate wet well

Prefomed components or systems, complying with the Drawings, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of in-situ construction provided:

- Prefomed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units.
- Joints shall be internal flush.
- The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Package pump stations

Package pump stations may be supplied and installed provided:

- All components comply with the requirements of this worksection.
- The units are at least equivalent to the requirements of this worksection and the Drawings.

5.3 ELECTRICAL COMPLIANCE

Standards

The works shall be in accordance with the Electrical Services Minimum Requirements contained in MEW E101 except where this worksection or the Drawings indicate otherwise.

The technical requirements detailed on the Drawings shall take precedence over the requirements of this worksection should clauses be in disagreement.

MEW E101 covers the general requirements for materials, workmanship, and methods of installation as follows:

- General
- Reticulation and wiring
- Switchboards and associated equipment
- Accessories
- Luminaries—Supply and installation
- Electric motors
- Painting, colour coding and labelling

Except where MEW E101 requires a higher standard, Works shall be carried out in accordance with AS 3000, the Service Rules of the Supply Authority, "Service and Installation Rules of NSW" produced by Department of Water and Energy and all relevant Statutory Authorities.

Proof of compliance

The Contractor shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

Approval of designs and material

The Contractor shall submit all designs and material, to each Authority having jurisdiction for approval.

The Contractor shall arrange for each Authority having jurisdiction to inspect the Works.

The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority.

This action constitutes a WITNESS POINT.

The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

5.4 SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA), CONTROLS

Approved manufacturer

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Water Authority. The Water Authority is to be Contacted for the Specifications, Supply and Installation of all SCA.

5.5 ELECTRICAL INSTALLATION

Liaison

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

Contractor's responsibility

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

All works are to comply with the Current Versions of

- "Service and Installation Rules of NSW" produced by Department of Water and Energy
- AS/NZ 3000 Wiring Rules, 2007

5.6 PRESSURE GAUGES

Compliance

The Contractor shall install one (1) diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349/rifugal pump installation.

Cases shall be fabricated from stainless steel complying with AS 1444 or bronze.

The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

Calibration

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Inclusions

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Installation

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150 mm and larger. In pipework less than 150 mm, gauges and fittings shall be screwed into a tapping band.

On rising mains, where shown on the Drawings, the Contractor shall install a ball valve to allow removal of the gauge.

Gauge range

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

5.7 VALVES

Compatibility with pipework

The Contractor shall ensure that the valves supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve.

The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

Installation

The Contractor shall ensure that valves are installed so as to facilitate maintenance.

The Contractor shall take into account the manufacturer's recommendations, the requirements shown on the Drawings, the type of connection, and lubrication of connecting bolts.

Flanges

Flanges shall comply with AS 2129 to the class shown on the Drawings.

Clockwise closing

Unless shown otherwise on the Drawings, all valves shall be clockwise closing.

Valve key operators and hand wheels

The Contractor shall size 'Tee' Key valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels shall display an embossed or engraved arrow, together with 'open' and/or 'close' corresponding to the valve operation.

Provision of 'Tee' Key

One 'Tee' key operator per pump station, of suitable length for operating the respective valve from the surface level, shall be provided for each size of valve installed in each pump station.

Non return valves

Non return valves shall be of the swing check type to AS 3578 or AS 4794 of cast iron or steel body, cover and disc with bronze body and disc seat rings.

The leaf shall swing clear and provide an unobstructed waterway.

Arrangement

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve.

Inclusions

Each non-return valve shall have an extended spindle, minimum grade 316 stainless steel, fitted with an adjustable counterweight, together with a proximity switch to indicate a no-flow condition.

No flow switches

The no flow switches shall have the following features:

- Be of the eccentric cam operated limit switch type.
- Have a minimum rating of 10 amps, 240 V AC, 50- Hz.
- Be oil tight and dust proof to IP 65.
- Be suitable for 25 mm conduit entry.
- Be mounted on rigid stainless steel complying with AS 1444 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.

Knife gate valve

The knife gate valve shall be constructed in accordance with the following:

- The design shall include an enclosed bonnet.
- The spindle shall be of the non-rising type.
- Valves shall be clockwise closing.
- The gland around the spindle shall be adjustable or formed by a double O-ring.
- Flange jointing shall be rubber O-rings.
- Seating shall be achieved by flexible seats which shall be designed in a manner that will allow easy replacement. The material of the seat is to be nominated.

Isolating washers

All assembly bolts and nuts shall be fitted with fibre or nylon isolating washers to prevent bimetallic corrosion where required.

Spindle guard

Each valve spindle shall be fitted with a cast steel or forged steel spindle guard secured to the valve spindle with a gun metal set screw or a handwheel secured to the spindle with gun metal set screw and washer.

Drilled and threaded

Valves shall be drilled and threaded, where required, in accordance with AS 2129.

5.8 TESTING AND COMMISSIONING OF PUMP STATION

Compliance

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the Specification requirements.

The submission to the Superintendent of satisfactory test results constitutes a HOLD POINT.

The approval of the Superintendent is required prior to the release of the hold point.

Testing and inspections

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the program prepared by the Contractor and approved by the Superintendent.

Prepare pre-commissioning record sheets

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning

Specific requirements for pre-commissioning shall include, but are not limited to:

- Initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for 'running in'.
- Physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc, depending on the type of equipment.
- Electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary.
- Tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms.
- Equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

Carry out pre-commissioning tests

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Submission of completed pre-commissioning record sheets

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent five (5) working days notice of the Contractor's intention to undertake commissioning.

The Contractor shall supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

This action constitutes a WITNESS POINT.

The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the commissioning is to be exercised.

Approved commissioning program

The Contractor shall conduct commissioning in a logical sequence in accordance with a program prepared by the Contractor and approved by the Superintendent.

Responsibility for test program

Throughout commissioning the Contractor shall be responsible for the test program.

Supervision during the commissioning tests

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

Documentation approval prior to each stage

The Contractor shall prepare schedules, test record sheets and programs for approval by the Superintendent prior to each stage of the overall commissioning.

Final testing and commissioning

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment in accordance with MEW E101.

Qualified personnel for all testing, commissioning and any adjustments

The Contractor shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel.

5.9 PRACTICAL COMPLETION OF PUMP STATION

The Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued:

- Receipt by the Superintendent of a certificate of approval from the relevant statutory authorities.
- Pump station is in working order as demonstrated by the testing and commissioning.
- Approval by the Superintendent of operating and maintenance manuals.
- Receipt by the Superintendent of as-built drawings of the pump station.

5.10 TELEMETRY

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by the Sewer Authority at the Contractor's expense.

The pump station shall be capable of being operated automatically by control signals from the existing or proposed telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

5.11 OPERATION AND MAINTENANCE MANUALS

General information

Manuals shall contain the following information:

- Contractor's name, address and telephone number.
- Client's Contract number, job name.
- Pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

Test curves

Manuals shall contain the following test curves:

- Pump witnessed test curves.
- Motor test curves.
- Motor torque/speed/efficiency characteristic curves.

Pumps

Manuals for pumps shall contain the following information:

- Manufacture.
- Type and model number.
- Serial number.
- Dimensioned general arrangement drawing of pump and motor.
- Sectional arrangement drawing with parts and list.
- Dimensioned sectional arrangements detailing:
 - . Maximum and minimum shaft/bearing clearance (radial)
 - . Maximum and minimum impeller/bowl clearance (radial)

- . Maximum and minimum impeller/bowl clearance (axial)
- . Impeller/bowl wear rings.
- . Motor/pump coupling—type, make and model number.
- . Mechanical seals where applicable.

Motors

Manual for motors shall contain the following information:

- Manufacture.
- Type and model number.
- Serial number.
- Dimensioned general arrangement drawing.
- Sectional arrangement drawing for submersible motor power cabling where applicable.
- Gland sealing arrangement drawing for submersible motor power cabling where applicable.
- Cables where applicable.
- Terminal block arrangement drawing where applicable.

Valves

Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

Operation and maintenance

The operating and maintenance manual shall include:

- Safe working procedures—For switching and isolating the supply and distribution system.
- Comprehensive description of operation, including flow charts detailing each operational activity (e.g. manual pump operation, routine test procedures).
- Maintenance procedures—Recommended maintenance periods and procedures.
- Tools—Particulars of maintenance equipment and tools provided, with instructions for their use.
- Equipment—A technical description of the equipment supplied, with diagrams and illustrations where appropriate.
- Dismantling—Where necessary, procedures for dismantling and reassembling equipment.
- Spare parts—A list of the spare parts provided.

Trouble shooting

Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

Replacement procedures

Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

6 CONSTRUCTION COMPLIANCE

6.1 WORK-AS-EXECUTED DETAILS

Main requirements

The Contractor shall submit to the Superintendent work-as-executed Drawings showing the actual location and alignment of pipelines, maintenance holes and junctions, all pump station details together with operating and maintenance manuals. (WSAA 02 Part 3, Section 26).

Additional detailed requirements

Details shall include the size, type, levels, grade of pipelines, maintenance hole, and maintenance shaft location, types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.

Future special precautions

The Contractor shall record on work-as-executed Drawings the area of side fill which should not be disturbed in future without special precautionary measures where side fill construction is part of the structural integrity of a constructed pipeline of a diameter more than 225 mm.

Survey

The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment.

Asset register

The Contractor shall provide records, for the Sewer Authority's Asset Register, to the Superintendent at the time of practical completion of the Contract.

The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

Video record of internal condition

Unless advised otherwise by the Superintendent, the Contractor shall provide a video recording of the internal condition of all mains in accordance with the Conduit Inspection Reporting Code of Australia WSA 05 - 2008 2.2 Appendix F.

The video recording shall be undertaken at the time of practical completion of the Contract. (WSAA 02 Part 3, Section 22.7).

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection in accordance with Pay Items 1361.1 to 1361.11 inclusive.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Concrete for bedding, junctions for risers, bulkheads, thrust and anchor blocks, concrete encasement, cast-in-situ maintenance holes and pump stations is measured and paid in accordance with this worksection and not 0310 *Minor concrete work*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete work*.

7.2 PAY ITEMS

1361.1 Excavation and backfill for sewers

The unit of measurement shall be cubic metre.

The schedule rate for this Pay Item shall be an average rate to cover all types of material encountered during excavation. Separate rates shall not be included for earth and rock.

The rate is deemed to include:

- Setting out and associated survey.
- Excavation, including excavation and replacement of unsuitable material.
- Backfilling and compaction, other than selected backfill, of sewers.
- Restoration of surface.
- Replacement for over-excavation for any reason.
- Control of stormwater runoff, temporary drainage and erosion and sedimentation control.

The volumes of excavation for payment shall be computed as follows:

- Trench width—Minimum width in Table 3.2 +200 mm.
- Trench depth—Average actual depth to underside of specified bedding.
- Trench length—Actual excavation length, centre to centre of maintenance holes or centre of maintenance holes to face of structure.

1361.2 Sewer pipe

The unit of measurement shall be the linear metre measured along the centreline of each particular type of sewer pipe and shall be the plan length between centres of maintenance hole or centre of maintenance hole to face of structure.

The schedule rate shall include:

- Supply of pipe and fittings

- Wrapping pipeline or other protective measures
- Survey and setting out
- Bedding (including concrete bedding)
- Junctions and property connection sewers
- Bulkheads
- Thrust and anchor blocks
- Jointing (including connections)
- Temporary bracing and strutting of excavation
- Selected backfilling
- Quality compliance

1361.3 Maintenance holes and maintenance shafts

The unit of measurement shall be per 'each' installed.

The schedule of rate for preformed maintenance holes shall include for the supply, setting out, excavation, installation including step irons and benching, backfilling and disposal of spoil off site. It shall also include for temporary stockpiling prior to backfilling, control of stormwater run off and erosion and sedimentation control.

The schedule of rate for preformed maintenance shafts shall include for the supply, setting out, excavation, installation including benching, backfilling and disposal of spoil off site. It shall also include for temporary stockpiling prior to backfilling, control of stormwater run off and erosion and sedimentation control

The schedule rate for cast in situ maintenance holes and maintenance shafts shall include for the setting out, excavation, formwork, supply and placing concrete, supply and fixing step irons, placing benching, backfilling, disposal of spoil off site and making live connections where necessary. It shall also include for temporary stockpiling prior to backfilling, control of stormwater run off and erosion and sedimentation control.

A separate unit rate shall be included in the Schedule of Rates for each type and size of maintenance hole and maintenance shaft.

1361.4 Covers and surrounds

The unit of measurement shall be per 'each' installed.

The schedule rate for covers and surrounds shall include for the supply, installation and grouting.

A separate unit rate shall be included in the Schedule of Rates for each size and type of surround and cover.

1361.5 Connection to existing

The unit of measurement shall be per 'each' connection to existing maintenance hole or structure.

The schedule rate for connection to existing shall include for all the necessary works to blank off, sand fill, cut into or otherwise modify and finish the system as shown on the Drawings.

1361.6 Trench timbering left in place

The unit of measurement shall be a lump sum for timber directed to be left in place by the Superintendent.

No extra payment shall be made where the Contractor uses more timber than anticipated or the timber used exceeds the size of timber required as determined by the Superintendent.

1361.7 Concrete encasement

The unit of measurement shall be the linear metre measured along the centreline of each particular type of concrete encasement.

The schedule rate shall include for additional excavation, formwork, reinforcement, concrete and contraction joints.

1361.8 Pump station

The item shall be a Lump Sum for each Pump Station.

The Lump Sum for:

- In situ pump stations shall include for the setting out, excavation, preparation of foundation, formwork, reinforcement, concreting, curing concrete, backfilling, disposal of spoil off site, supply and installation of pipework, valves, fittings, access cover, ladder and cleaning up. It shall also

include for temporary stockpiling prior to backfilling, control of stormwater run off and erosion and sedimentation control.

- Preformed pump stations shall include for the, setting out, excavation, preparation of foundation, any formwork, reinforcement, concreting, and curing concrete, supply and installation of preformed sections, pipework, valves, fittings, access cover, ladder, backfilling and disposal of spoil off site and cleaning up. It shall also include for temporary stockpiling prior to backfilling, control of stormwater run off and erosion and sedimentation control.
- Packaged pump stations shall include for the setting out, excavation, preparation of foundation, any formwork, reinforcement, concreting, and curing concrete, supply and installation of package pump station including pumps, suction and discharge pipework, valves, fittings, control panel and cabinet, power and control wiring and testing, backfilling and disposal of spoil off site and cleaning up. It shall also include for temporary stockpiling prior to backfilling, control of stormwater run off and erosion and sedimentation control.

1361.9 Sewer pumps

The item shall be a Lump Sum for each Sewer Pump, not including pumps supplied with package pump stations as costed in Pay Item 1361.8.

The Lump Sum shall include for the supply and installation of the system as specified and as detailed on the Drawings including suction and discharge pipework, valves, fittings, control panel and cabinet, power and control wiring and testing.

1361.10 Commissioning

The item shall be a Lump Sum.

The Lump Sum for Commissioning shall include for all labour, test equipment and consumables to undertake and record the full commissioning procedure for all equipment and systems, and to carry out all necessary modifications and adjustments to the system so that it operates in accordance with the Specification requirements.

1361.11 Manuals

The item shall be a Lump Sum.

The Lump Sum for Manuals shall include for the preparation and printing of the operating and maintenance manuals in accordance with the Specification. 'Work-as-executed' drawings shall be included.