



# Snowy Valleys Council

## Water and Sewerage Construction Specification

Adopted – 27 September 2019

Revision	Date	Approved by

<b>0071 Reticulation and pump stations (Design)</b>	<b>3</b>
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**0071 RETICULATION AND PUMP STATIONS (DESIGN)**

**1 SCOPE AND GENERAL**

**Scope**

This worksection contains procedures for the design of a water reticulation system, including pump stations, either as a stand-alone project or part of a development.

Note: See Annexure A for incorporation of local requirements into this worksection.

**1.1 OBJECTIVE**

The objective of a water supply system is to provide to the consumer a reticulated (either potable or dual potable/raw) water supply to meet the demands imposed upon it by both the consumers and fire fighting requirements. Consumer requirements shall be met by providing a water main and allowing an appropriate point of connection for each individual property.

**1.2 COMPLIANCE**

The design of reticulation and pump station components shall comply with the Water Services Association of Australia's publication Water Supply Code of Australia unless specified otherwise herein and should be constructed in accordance with 1341 *Water – reticulation and pump stations (Construction)*.

**1.3 SUBSIDISED SCHEMES**

Where the Specification forms part of a contract attracting Government Grant funds, the Principal shall identify:

- Items which are not of the least cost option, that:
  - . Are intended to have a much longer design life than the normal asset service life detailed in the Asset Management Guidelines of the International Infrastructure Management Manual.
  - . Do not meet the project objectives and the requirements of the various Authorities for the least Net Present Value (NPV) but may become the preferred option for construction.
- Particular equipment which is procured without relevant competition through tendering
- Duplication of equipment or unit processes in a system configuration

**1.4 WORKSECTIONS TO BE USED BY THE DESIGNER**

In designing a water reticulation system it is assumed that the Designer shall possess, or have access to, the documents required to comply with this worksection.

The Designer shall include the requirements of 1341 *Water – reticulation and pump stations (Construction)*

The Designer shall use the latest edition of the Australian Standards, including amendments and supplements, unless specified otherwise.

References to the Water Supply Code of Australia (WSAA 03-2002 Version 2.3) are identified by part and section numbers and enclosed in brackets thus (WSAA Part, Section).

Water Supply Code of Australia drawings shall be used in preference to DPWS standard drawings (WSAA 03 Part 4).

**1.5 REFERENCED DOCUMENTS**

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

**Worksection**

1341 *Water – reticulation and pump stations (Construction)*

**Standards**

- AS 1102 series Graphical symbols for electrotechnical documentation (various)
- AS 1111 series ISO metric hexagon bolts and screws
- AS 1112 series ISO metric hexagon nuts

AS 1214	Hot-dipped galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 1281	Cement mortar lining of steel pipes and fittings
AS 1432	Copper tubes for plumbing, gasfitting and drainage applications
AS 1579	Arc-welded steel pipes and fittings for water and waste-water
AS 1646 series	Elastomeric seals for waterworks purposes
AS 1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation
AS 2129	Flanges for pipes, valves and fittings
AS 2200	Design charts for water supply and sewerage
AS 2634	Chemical plant equipment made from glass-fibre reinforced plastics (GRP) based on thermosetting resins
AS 2837	Wrought alloy steels—Stainless steel bars and semi-finished products
AS 3571	Glass filament reinforced thermosetting plastics (GRP) pipes—Polyester based—Water supply, sewerage and drainage applications
AS 3688	Water supply—Metallic fittings and end connectors
AS 3996	Access covers and grates
AS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4087	Metallic flanges for Waterworks purposes.
AS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 1594	Hot rolled steel flat products
AS/NZS 2280	Ductile iron pipe and fittings
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 3500	Plumbing and drainage
AS/NZS 3500.1	Water services
AS/NZS 3862	External fusion-bonded epoxy coating for steel pipes
AS/NZS 4129	Fittings for polyethylene (PE) pipes for pressure applications.
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications.
AS/NZS 4131	Polyethylene (PE) compounds for pressure pipes and fittings.
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 4765	Modified PVC (PVC-M) pipes for pressure applications

**Other publications**

*NSW Department of Commerce*

MEW E101 Electrical Services Minimum Requirements

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

*Water Services Association of Australia (WSAA)*

WSAA 03 Water Supply Code of Australia

*Australian Building Codes Board*

BCA Vol 1—PART E1, Fire fighting equipment.

**1.6 BIBLIOGRAPHY****Standards**

AS 1444	Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS 2638 series	Gate Valves for waterworks purposes

AS 3578	Cast iron non-return valves for general purposes
AS 3579	Cast iron wedge gate valves for general purposes
AS 3680	Polyethylene sleeving for ductile iron pipelines
AS 3735	Concrete structures for retaining liquids
AS 3952	Water supply—Spring hydrant valve for waterworks purposes
AS 4020	Testing of products for use in contact with drinking water
AS 4041	Pressure piping
AS 4100	Steel structures
SAA HB 48	Steel structures design handbook
AS/NZS 1260	PVC-U pipes and fittings for drain, waste and vent application

**Other publications**

*Institute of Public Works Engineering Australia (IPWEA)*

Guide to Codes and Practices for Streets Opening - Streets Opening Conference 2007 (Sections 5 and 6 detailing locations and depths of other services and preferred location for water reticulation pipes)

*NSW Department of Commerce*

PWD-WSIM Water Supply Investigation Manual

PWD Safety Guidelines for fixed ladders, stairways, platforms and walkways

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## 2 DESIGN CRITERIA

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### 2.1 GENERAL

#### Responsibility for design

Except where specified otherwise, the division of responsibilities between the Water Authority and the Designer shall be in accordance with WSAA 03 Part 1, Section 1.5.

#### Dual supplies

The Designer shall take into account the special requirements for dual water supplies where required by the Water Authority, including but not limited to, demand, size and location for each pipe system. Dual services shall not be installed unless part of a dual supply.

#### Valve type and location

The Designer shall take into account the location and type of valve required considering maintenance and repair requirements, the need for double air valves with integral isolating valve on mains or single air valve with isolating valve on reticulation mains, and scour points.

### 2.2 RETICULATION PRESSURE

#### Minimum static head

Reticulation systems shall be designed to supply peak instantaneous demand by gravity while maintaining a minimum static head of 200 kPa (20 m). (WSAA 03 Part 1, Section 2.4.3).

#### Water demand

A peak instantaneous demand of 0.15 L/s/tenement shall be used except that when supplying more than 1000 tenements, a demand of 0.10 L/s/tenement shall be used. Water demands for other industries shall be as detailed in the WSAA 03 Part 1, Section 2.2).

#### Maximum pressure

The maximum pressure applied to a component of a pipeline shall in-service not exceed the safe working pressure of the component. The effect of water hammer shall be taken into account for the maximum pressure.

The maximum pressure applied to a component for field testing, including water hammer, shall not exceed the field test pressure recommended by the component manufacturer.

The maximum pressure during field testing or in-service along a pipeline shall take into account the permitted forces that can be applied to pipeline support structures such as trust blocks.

#### Desirable maximum pressure

The desirable maximum pressure is 600 kPa. Zoning of the reticulation system by means of pressure reducing valves (PRV's) may be necessary to achieve these pressures across the development.

### **Fire fighting**

Water mains required for fire-fighting purposes in the development shall be designed in accordance with the Building Code of Australia.

### **Network analysis**

The Designer shall provide a network analysis of the reticulation system detailing the pressure and velocity distribution after consultation with the Water Authority. To fully assess the impact of a development on water infrastructure, the Council will carry out a network analysis at the Developer's expense.

## **2.3 PIPELINE**

### **Trunk mains**

Trunk mains directly supplying reticulation systems shall be designed as part of the reticulation system to carry peak instantaneous demands. (WSAA 03 Part 1, Sections 2.2 and 2.3)

### **Peak daily demand**

Mains feeding service reservoirs shall be designed to carry peak daily demands over 24 hours in the case of gravity mains and 22 hours in the case of rising mains.

### **Looped mains**

Reticulation mains shall be looped to eliminate dead ends unless permitted otherwise by the Water Authority.

### **Staged development**

Where a dead end is permitted to provide for future extension from staged development, the end shall be fitted with a stop valve, hydrant bend and hydrant.

### **Loss of supply**

Wherever possible, the development shall be serviced from two or more trunk mains to avoid the loss of supply in the event of maintenance or breakage.

### **Individual service**

Each dwelling shall have an individual service tapped from the main and extending 300 mm inside the lot boundary unless otherwise permitted by the Water Authority.

### **Valve chambers**

The Designer shall confirm with the Water Authority if valves are to be buried or housed in valve chambers.

The Designer shall show on the Drawings the type of cover and how the covers shall be seated. Where buried, the design shall be to WSAA 03 Part 1 Section 6, WAT-1301 to WAT 1306.

### **Access covers**

Access covers shall be manufactured in accordance with AS 3996.

The Designer shall ensure that air valve covers have adequate openings for air exchange.

### **Valve closing**

Stop valves shall be anti-clockwise closing.

### **Valve maintenance**

The Designer shall provide for ease of valve maintenance within valve chambers, where provided, and select valve types such that servicing of the valve can be effected without removal from service, wherever possible.

## **2.4 LOCATION**

In designing the reticulation system, standard locations shall be followed, as detailed below:

- Reticulation mains shall be laid in compliance with the Water Authority's standard footpath allocation for public utilities, or in the absence thereof, in conformity with the Streets Opening Conferences' protocols.
- Valves shall be located to avoid conflict with driveways, telephone house service pits and underground electrical boxes. Stop valves shall be located so that approximately 20 dwellings can be isolated for shutdowns.
- Hydrants shall be located on all reticulation mains at all high points and low points of the main and at dead ends. The interval between hydrants shall not exceed 60 metres.

Water mains shall not be located on private property.

## 2.5 MINE SUBSIDENCE AREAS AND AREAS OF SLIPPAGE

### Ground strain

The Designer shall accommodate the movement associated with the ground strain for the area, as advised by the Mine Subsidence Board for water reticulation jointing systems in proclaimed Mine Subsidence Areas, or in a known or expected area of subsidence or slippage.

The design ground strain for the development shall be detailed on the Drawings. (WSAA 03 Part 1, Section 5.5.4)

### Pipe jointing system

The pipe jointing system selected shall be capable of accepting ground movements, without impairing the water tightness of the joint, for the ground strain as advised by the Mine Subsidence Board.

For non welded pipe systems in areas with high ground strains, a pipe jointing system using shorter effective length pipes and/or deep socket fittings shall be used.

The following action constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

Where the Mines Subsidence Board does not cover an area of known, or suspected, subsidence or slippage, the above requirements shall still apply.

## 3 MATERIALS

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### 3.1 GENERAL

#### Working pressure

The working pressure of pipes, fittings, valves and hydrants shall be fit for the purpose in accordance with the relevant Australian Standard for the material and shall be at least 1600 kPa (160 m) unless otherwise specified by the water supply authority.

#### Class and standard

The Designer shall select pipe type, class and standard based on pumping design and in accordance with AS 2200 and site conditions.

All pipes shall be a minimum Class 16 unless otherwise determined by the Supply Authority (WSAA 03 Part 1, Section 3.7).

#### Type

Pipes and fittings for water reticulation shall be of unplasticised PVC (PVC-U), modified PVC (PVC-M), oriented PVC (PVC-O), ductile iron, steel, polyethylene, glass reinforced plastic (GRP), or copper. The material specifications for each pipe type are provided in the following Clauses 3.2 to 3.7 below.

#### Colour coding

Where water pipes are to be located in close proximity to other service pipes and in dual systems, or where there is the likelihood of the pipes not being recognised as water pipes, the Designer shall provide for the pipes to be colour coded in accordance with WSAA 03 and shown on the Drawings accordingly.

#### External protection

The Designer shall show on the Drawings the extent of external protection required. External protection shall be shown to comply with WSAA 03 Part 1 Section 4.12.

#### Piers

Piers for any above ground water main shall be in accordance with WSAA 03 Drawing WAT-1310.

#### Special allowances

The Designer shall allow for adequate working area, waste removal and transport arrangements where scouring points or pipe inspection locations are nominated (WSAA 03 Part 1, Sections 6.6 and 6.7).

#### Gauge locations

The Designer shall indicate the location of connections for gauges required on mains.

#### Diameter

The minimum diameter of all pipes shall be DN 100 unless otherwise specified by the Supply Authority. In areas zoned by the relevant planning authority for commercial, industrial or high-rise buildings the minimum diameter shall be DN 150, unless otherwise specified by the Supply Authority.

In all cases pipe sizes and residual pressures shall be designed to cater for fire fighting flows (WSAA 03 Part 1, Section 3.2 and particularly 3.2.2).

#### **Limits of use**

The Designer shall take regard of the limits of use for the pipeline system materials under consideration (WSAA 03 Part 1, Sections 3.5, 3.6, 3.7 Table 3.1, Part 2 Section 8.6, Table 8.2).

#### **Valves**

Where valves are specified and shown on the Drawings, they shall comply with the valve details in the Development construction specification—Water reticulation (WSAA 03 Part 1, Section 6).

#### **Thrust blocks**

The Designer shall design thrust blocks to resist maximum allowable operating pressure (MAOP) of the pipe and the designated field test pressure.

#### **Surge control**

The pipe material and class selection shall be appropriate for surge control.

### **3.2 PVC PIPES AND FITTINGS**

#### **Pipe and fittings**

PVC (PVC-U) pipe shall comply with AS/NZS 1477 Series 2, blue in colour and with elastomeric seal spigot and socket joints.

Modified PVC (PVC-M) and oriented PVC (PVC-O) pipes and fittings shall comply with AS/NZS 4765 Series 2 and AS 4441 Series 2 respectively, and shall be blue in colour and with elastomeric seal spigot and socket joints. (WSAA 03 Part 2, Table 8.2).

#### **Ductile iron compatible**

Where Series 1 PVC-U pipe complying with AS/NZS 1477 or Series 1 PVC-M pipe complying with AS/NZS 4765 is used in conjunction with ductile iron fittings ensure elastomeric seals appropriate to the application are used.

#### **Pre-curved for cul-de-sac**

Where radii exceed allowable radii for bending on site, PVC pipes shall be pre-curved to suit the radius of any cul-de-sac road pavement in which they are to be installed.

#### **Fittings**

Fittings for use with PVC pipe shall be elastomeric seal jointed. Valves shall comply with **Materials (General)**.

### **3.3 DI PIPES AND FITTINGS**

#### **Pipes and fittings**

Ductile iron (DI) pipes and fittings shall be manufactured in accordance with AS/NZS 2280 and shall be minimum Class PN 20 for elastomeric seal joints.

Where ductile iron pipes are to be flanged, AS/NZS 2280 Flange Class shall be specified. (WSAA 03 Part 2, Table 8.2)

#### **Corrosion protection**

The Designer shall specify cement mortar lining in accordance with AS/NZS 2280, or fusion-bonded medium density polyethylene to AS/NZS 4158.

External protection shall be epoxy coating to AS/NZS 3862 where not otherwise specified as sleeved or wrapped, taking into account the type of corrosion protection required.

#### **Joints**

Generally, pipe and fitting joints shall be specified to be spigot and socket type using a elastomeric seal push in seal made of natural rubber, ethylene propylene rubber or nitrile rubber with compounds complying with AS 1646.

#### **Restrained joints**

The Designer shall take account of congested service corridors, poor soil conditions and the need for additional security for strategic mains with regard to the provision of restrained joints.

No restrained joint repair couplings were available at the time of publication of this worksection. A repair using couplings may require independent anchoring.

#### **Flanges**

Flanges shall be specified to be manufactured in accordance with AS 4087 and AS 2129.



The Designer shall specify bolts and nuts for flanged joints in accordance with AS 2129, of stainless steel in accordance with AS 2837 as for pumps specified in 1341 *Water – reticulation and pump stations (Construction)*.

### 3.4 STEEL PIPES AND FITTINGS

#### Pipes and fittings

Steel pipes and fittings shall be manufactured in accordance with AS 1579 and designed to AS/NZS 2566.1. (WSAA 03 Part 2, Table 8.2).

#### Joints

The Designer shall specify the jointing system where long-term corrosion resistance, ease of construction or special circumstances dictate the need.

The pipe jointing shall be either:

- Elastomeric seal jointed with seals complying with AS 1646, or
- Butt welded, welded spigot and socket, or welded using a welding collar and with the application of a polyethylene heat shrunk sleeve over the weld, or wrapped, or
- Flanged to comply with AS 4087 to the table specified on the Drawings. Bolts and nuts for flanged joints shall be in accordance with AS 2129 and galvanised in accordance with AS 1214, or stainless steel in accordance with AS 2837 as for pumps specified in 1341 *Water – reticulation and pump stations (Construction)*.

#### Position under power lines

Where the routes of continuously welded steel pipelines run in parallel with high voltage power lines sufficiently close to induce significant electrical currents in the pipeline, the Designer shall seek an alternate route or specify measures to prevent corrosion due o induced currents (WSAA 03 Part 1, Section 4.3.11 and Part 2, Table 8.2).

### 3.5 PE PIPES AND FITTINGS

#### Pipes

Unless otherwise approved by the Superintendent, all domestic property service pipes shall be of Class 16, PE. Meter riser pipes shall be in accordance with AS 3500. All service pipes shall be provided with trace wires.

Polyethylene (PE) pipe shall be manufactured in accordance with AS/NZS 4130 and designed to AS/NZS 2566.1. (WSAA 03 Part 2, Table 8.2)

#### Fittings

PE Fittings shall comply with AS/NZS 4129.

### 3.6 GRP PIPES, COLLARS AND FITTINGS

#### Pipes and collars

Glass reinforced thermosetting plastics (GRP) pipes and collars shall be manufactured to AS 3571 and designed to AS/NZS 2566.1. (WSAA 03 Part 2, Table 8.2).

The Designer shall take into account surge cycles and refer to the manufacturer when the temperatures are likely to exceed 35°C.

#### Fittings

GRP fittings shall comply with AS 2634. Ductile iron fittings complying with AS/NZS 2280 with appropriate elastomeric seals complying with AS 1646 may also be used.

### 3.7 COPPER PIPE AND FITTINGS

#### Pipes

Copper tube shall be manufactured in accordance with AS 1432 in the range of DN 6 to DN 200 for Type A or Type B. The Designer shall take into account the requirements of AS/NZS 3500.1.

#### Fittings

Capillary and compression fittings shall be specified to comply with AS 3688 and de-zincification resistant. Capillary fittings shall have silver brazed joints or solder insert capillary joints.

## 4 PUMP STATIONS

### 4.1 GENERAL

#### Location

The Designer shall take into account site access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves or on private property.

The following action constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to confer on the locations is required.

#### Pump building

Pump units shall be secured under a purpose-designed building which shall be subject to the Development Approval (DA) of the Council.

The building shall match the aesthetics of the surrounding land use and shall accommodate any need for climate and/or acoustic control.

Occupational Health and Safety requirements shall be met especially with regard to clearance for maintenance, and avoidance of trip hazards.

#### Substructure

Where pumps are to be installed below ground level, the Designer shall provide for the pumps to be mounted on plinths and housed in a single pump well.

#### Conditions

The Designer shall provide for the construction of the pump well after taking into consideration the ground and site conditions.

#### Preformed components

Preformed components or systems, complying with the Drawings, if any, may be used in lieu of in-situ construction provided:

- Preformed concrete wall units are to be manufactured to AS 4058. The Designer shall take into account the cover requirements for the reinforcing steel.
- Joints shall be internal flush
- The Designer shall ensure components make a watertight system and have a satisfactory surface finish.

#### Protection against flooding

Where the pump station site is exposed to possible flooding, the Designer shall provide for the floor of the pump station or top of pump well, as appropriate, to be one (1) metre above the 1 in 100 year flood level or to such other level as provided by Council's planning instruments, whichever is the higher.

#### Protection against flotation

The Designer shall provide for the design of pump wells against flotation both during the construction/installation stage and whilst operating under flood conditions designed as above.

#### Pump capacity

Capacities of the pump unit shall be calculated from the intersection of the pump performance curve and the pipeline characteristic curve calculated at mid water level of the service reservoir involved with this duty point.

The pump station shall deliver the required transfer capacity over a period of 22 hours.

Standby pumping capacity shall be provided such that if one (1) pump is out of service, the pump station will remain able to supply the required transfer capacity.

The pump unit shall be capable of operating near optimal efficiency within the range of operating conditions.

#### Pump pipework

All pipework and fittings shall be in accordance with this worksection. In addition, all steel bolts, nuts and washers shall comply with AS 1111 and AS 1112 and shall be stainless steel complying with AS 2837 Grade 316.

#### Pump prime

Where there is negative suction head at the pump inlet, provision shall be made to facilitate priming of each pump.

### **Alarms and signals**

The Designer shall provide for alarms and signals systems with the concurrence of the Water Authority.

### **Auxiliary Power Connection**

The Designer shall provide for an auxiliary power connection at each pump station consisting of:

- changeover switch; and
- connection lead and plug

## **4.2 PUMPS**

### **Pump type**

Pumps shall comply with the WS-SPEC. The Designer shall take account of dismantling joints and valves provided in the pipework to facilitate removal of the pumps for maintenance and the need for surge control devices.

### **Inter-changeable**

Pump sets are to be interchangeable within each pump station where standby pumps are installed.

### **Structural steelwork**

The Designer shall design structural steelwork in accordance with HB 48.

## **4.3 ELECTRICAL**

### **Specification**

The works shall be designed in accordance with and subject to the provisions of MEW E101, except where modified by this worksection.

### **Design responsibility**

The Designer shall be responsible for the design of the equipment as suitable for the purpose. Equipment design shall comply with the requirements of the relevant standard specification.

### **SCA and electrical**

The Designer shall provide for Switchgear Control Assembly (SCA), SCA housing and electrical requirements as detailed in 1341 *Water – reticulation and pump stations (Construction)*.

### **Inter-changeability**

Where more than one (1) item of equipment is designed to form a particular function, all such items of equipment shall be identical and completely interchangeable (e.g. pilot lights, pushbuttons, relays, etc).

### **Switchboard**

The switchboard shall be installed visibly and physically accessible above all areas at risk of flooding.

### **Ambient conditions**

Ambient conditions shall be within the normally accepted limits of 0°C to 45°C.

The switchboard shall be connected to the local electricity supply system.

### **Connection to local supply**

Nominal system parameters:

415 volt, 3-phase, 4-wire, 50 Hz, solidly earthed neutral system.

Prospective Fault Current: As specified by the Local Supply Authority.

### **Automatic operation**

The pump station shall be designed for fully automatic operation in the unmanned condition.

## **4.4 POWER SUPPLY**

### **Consumer mains**

The consumer electrical mains shall be run underground where possible and commence at the point of attachment on a steel consumers pole (if applicable) installed near the property boundary and run in conduit to the switchboard.

The minimum size of the consumers mains shall be sized to satisfy the following requirements:

- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.
- Be sized for a voltage drop less than 1.5% of the maximum demand as calculated.
- Be single core PVC/PVC cables. XLPE insulated cable may also be used.

- Comply with the requirements of the Local Supply Authority.
- Pole termination method shall be determined in consultation with the Local Supply Authority.

#### 4.5 TELEMETRY

##### **Schedule**

The Designer shall provide for telemetry requirements in accordance with the schedule supplied by the Water Authority.

##### **Compatibility**

The telemetry system is to be compatible with the existing Radtel system.

#### 4.6 OTHER APPURTENANCES

##### **Lifting equipment**

The Designer shall provide for machinery lifting equipment including pump chains as necessary.

##### **Gauges**

The Designer shall provide pressure tapping and gauges for all valves, including isolation and non-return valves as detailed in 1341 *Water – Reticulation and pump stations (Construction)*.

##### **Covers**

The Designer shall take account of the possibility of site flooding ingress and overflow, and Occupational Health and Safety requirements in providing for access and inspection covers.

### 5 DOCUMENTATION

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#### 5.1 RETICULATION

##### **Approval**

The Principal shall submit, to the relevant Water Authority for approval, four (4) copies of the proposed water main design, including calculations and network analysis, if appropriate, prior to commencement of construction. (WSAA 03 Part 1, Section 7).

The following action constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to direct the submission to the Water Authority is taken.

##### **Drawings**

The Drawings shall show to scale:

- Plan showing:
  - . Lot boundaries and lot numbers.
  - . Location and size of all mains, appurtenances and pump stations.
  - . Existing mains.
  - . Existing and proposed features and services.
  - . North point and scale bar.
  - . Easement locations.
  - . Arrangement of other utilities.
- Longitudinal section showing:
  - . Reduced levels for natural surface and design surfaces at all changes in grade.
  - . Mains, appurtenances and pump stations.
  - . Appurtenances numbered in accordance with the relevant Water Authority's Asset Register.
  - . Invert levels where necessary.
  - . Size, type and class and grade of pipe. Also, pipe grade where appropriate.
  - . Location, invert level and size of all drainage lines, sewer mains, and other utility services crossing the main.
  - . Notation regarding all joining lines.
  - . Property ownership.
  - . Note 'In road' trench details.

- Pump stations—Drawings showing general arrangement of pump stations with site plan; concrete outlines; number, make, model and details of pumps; inlet and outlet pipework details and levels; pump cut in; cut out and alarm levels; switchboard location; pump station access details; design starts per hour.
- Corrosion protection—Drawings showing details of corrosion protection required for pipes and fittings.
- Trenchless installation—Drawings showing areas designated for trenchless pipe installation.

#### **Drawing scale, size and format**

Detail plans shall be drawn to a scale of 1:500 and longitudinal sections to a horizontal scale of 1:1000 and a vertical scale of 1:100.

Drawings shall be 'A3' and/or 'A1' size after consultation with the relevant Water Authority.

Drawings shall also be provided in electronic format after consultation with the relevant Water Authority.

#### **Location of fittings and fixtures**

The Designer shall show locations of hydrants, stop valves, non-return valves, air valves and scour valves, tees, tapers, creek crossings, trench dimensions and backfill, thrust blocks, and other existing and proposed services and installations including chambers and covers and items of construction which are project specific.

## **5.2 PUMP STATION**

### **Approval**

The Principal shall submit, to the relevant Water Authority for approval, prior to commencement of the manufacture of any pumps and control equipment, four (4) copies of the following:

- Switch and Control Gear Assemblies (SCA)—Proposed fully dimensioned manufacturing details, general arrangement (showing internal/external details) and foundation/gland plate details.
- Common Control—Complete circuit diagram and description of operation.
- Schedule of Equipment—Completed as to the equipment to be provided.
- Other Engineering drawings as required fully describing the proposed equipment.

The submission of the documents constitutes a WITNESS POINT (WP):

The Principal shall advise at the time of notification by the Designer whether the option to direct the submission to the relevant Water Authority is taken.

### **Chlorination and access hazards**

The Designer shall take into consideration the technical requirements to minimise all risks associated with chlorination, and entry into confined space.

### **Drawing size and format**

Drawings shall be on 'A3' and/or 'A1' size after consultation with the relevant Water Authority. All symbols used shall conform to AS 1102 and all wires and terminals shall be numbered.

Drawings shall be provided in electronic form after consultation with the Water Authority.

### **Asset register**

The Designer shall provide asset schedules and Drawings in an electronic form consistent with the existing or proposed Asset Register after consultation with the relevant Water Authority (WSAA 03 Part 1, Section 7.3).

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## **6 ANNEXURE A**

### **6.1 INSTRUCTION FOR SPECIFICATION PREPARATION**

#### **Incorporation of local requirements for water reticulation design**

- This worksection recognises that each Council may need to vary the Specifications to meet local requirements. The items below may be taken into account in varying this design specification and 1341 *Water – reticulation and pump stations (Construction)* (Reticulation and pump stations).
- The Water Directorate, a close partner of the Institute of Public Works Engineering Australia (IPWEA) may provide additional information regarding the following:
  - . A complete list of Australian Standards relevant to Water Reticulation compiled as a result of a survey of Standards in use.

- . A schedule of training organisations available to provide accreditation to Contractors and Superintendents.
- . A schedule of organisations or Councils available to undertake disinfection of water mains together with guidelines for disinfection.
- . A schedule of products in use compiled as a result of a survey of users.
- . Advice on handling different requirements between the Council and any subsidising Authority. Differences identified include:
  - \* Provision of more expensive materials, fittings and pumps.
  - \* Water supply storage heads (20 m is called up compared to a minimum requirement of 12 m).
- The grading requirements called up for sand bedding may need to be checked where Council wishes to facilitate local acquisition 1341 *Water – reticulation and pump stations (Construction)* (**Pump bedding** and Table 4.2).
- Valve opening direction varies within and between Water Authorities. The requirements of the specifications may need to be checked against existing installations (**Pipeline** of this worksection).
- Working pressures vary, especially between the inland and the coast. The requirements of the specifications may need to be checked against existing conditions (**Reticulation pressure and Materials** of this worksection).
- Materials for PVC and PE fittings may be different for different size pipes. The requirements of the specifications may need to be checked against existing installations 1341 *Water – reticulation and pump stations (Construction)* (**PVC pipes and fittings and Polyethylene**).
- The requirement for the location of property services varies between Councils. The requirements of the specifications may need to be checked against existing installations (**Pipeline** of this worksection).
- Each Council may wish to consider any special requirements for the installation of long length water service connections. (Expand on **Pipeline** of this worksection).
- The method of marking access to fittings varies between Councils. The requirements of the worksections may need to be checked against existing requirements (1341 *Water – reticulation and pump stations (Construction)* **Marking Plates**).
- The number and timing for receipt of documents called up varies between Councils. The requirements of the specifications may need to be checked against existing requirements.
- Councils require varying lead times for notices to be given. The requirements of the specifications may need to be checked against existing requirements.
- Council may wish to consider the option for installation of curved pipes (e.g. in cul-de-sacs) (**PVC Pipes and Fittings** of this worksection).

**0076 SEWERAGE SYSTEMS - RETICULATION AND PUMP STATIONS (DESIGN)**

**1 SCOPE AND GENERAL**

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**1.1 SCOPE**

The work to be executed under this worksection consists of the design of a sewerage system either as a stand-alone project or part of a development.

The worksection contains procedures for the design of the following elements of the sewerage system:

- Gravity sewers including junctions and property connection sewers.
- Common effluent sewers both gravity and pressurised.
- Vacuum sewer system.
- Maintenance holes and other structures.
- Rising mains.
- Pump stations.

**1.2 OBJECTIVE**

The objective of the sewerage system is to transport sewage or effluent from domestic properties to the treatment plant in accordance with all current relevant legislation. Consumer requirements shall be met by providing a sewer main and allowing an appropriate point of connection for each individual property.

**1.3 COMPLIANCE**

The design of gravity sewer systems and pump station components shall comply with the Water Services Association of Australia's publication Sewerage Code of Australia unless specified otherwise herein and should be constructed in accordance with 1361 *Sewerage - reticulation and pump stations (Construction)*.

**1.4 SUBSIDISED SCHEMES**

Where the Specification forms part of a contract attracting Government Grant funds, the Principal shall identify

- Items which are not of the least cost option, that:
  - . Are intended to have a much longer design life than the normal asset service life detailed in the Asset Management Guidelines of the International Infrastructure Management Manual.
  - . Do not meet the project objectives and the requirements of the various Authorities for the least Net Present Value (NPV) but may become the preferred option for construction.
- Particular equipment which is procured without relevant competition through tendering.
- Duplication of equipment or unit processes in a system configuration.

**1.5 SPECIFICATIONS TO BE USED BY THE DESIGNER**

In designing a sewerage system it is assumed that the Designer shall possess, or have access to, the documents required to comply with this worksection.

The Designer shall include the requirements of the 1361 *Sewerage - reticulation and pump stations (Construction)*.

The Designer shall use the latest edition of the Australian Standards, including amendments and supplements, unless specified otherwise.

References to the Sewerage Code of Australia are identified by part and section numbers and enclosed in brackets thus (WSAA Part, Section).

Sewerage Code of Australia drawings are to be used in preference to DPWS Standard Drawings (WSAA 02 Part 4).

## 1.6 REFERENCED DOCUMENTS

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

### Worksection

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

### Standards

AS 1102 series	Graphical symbols for electrotechnical documentation (Various)
AS 1214	Hot dipped galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 1281	Cement mortar lining of steel pipes and fittings
AS 1444	Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS 1579	Arc welded steel pipes and fittings for water and waste-water
AS 1646 series	Elastomeric seals for waterworks purposes (Series)
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 2129	Flanges for pipes, valves and fittings
AS 2200	Design charts for water supply and sewerage
AS 2634	Chemical plant equipment made from glass-fibre reinforced plastics (GRP) based on thermosetting resins
AS 2837	Wrought alloy steels—Stainless steel bars and semi-finished products
AS 3571	Glass filament reinforced thermosetting plastics (GRP) pipes—Polyester based—Water supply, sewerage and drainage applications
AS/NZS 3735	Concrete structures retaining liquids
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 4087	Metallic flanges for waterworks purposes
AS 4100	Steel structures
AS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 1260	PVC pipes and fittings for drain, waste and vent application
AS/NZS 1477	PVC pipes and fittings for pressure applications
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 3500	Plumbing and drainage
AS/NZS 3500.2	Sewerage
AS/NZS 3518	Acrylonitrile Butadiene Styrene (ABS) pipes and fittings for pressure applications
AS/NZS 3862	External fusion-bonded epoxy coating for steel pipes
AS/NZS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications
AS/NZS 4131	Polyethylene (PE) compounds for pressure pipes and fittings
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 4765(Int)	Modified PVC (PVC-M) pipes for pressure applications
AS/NZS 5065	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications



### Other publications

*NSW Department of Commerce*

MEW E101	Electrical Services Minimum Requirements
PWD-SD	Public Works Department Manual of Practice—Sewage Design
PWD-PSD	Public Works Department Manual of Practice—Sewage Pumping Station Design (May 1986)

*Water Services Association of Australia (WSAA)*

WSAA 02	Sewerage Code of Australia, 2nd Edition Ver. 2.3
WSAA 04	Sewerage Pumping Station Code
WSAA 07	The Pressure Sewerage Code of Australia

## 1.7 BIBLIOGRAPHY

### Standards

AS 1631	Cast grey and ductile iron non-pressure pipe and fittings
AS 3680	Polyethylene sleeving for ductile iron pipelines
SAA HB 48	Steel structures design handbook
BS EN 1091	Vacuum sewerage systems

### Other publications

*Institute of Public Works Engineering Australia (IPWEA)*

Guide to Codes and Practices for Streets Opening - Streets Opening Conference 2007 (Sections 5 and 6 detailing locations and depths of other services and preferred location for water reticulation pipes)

*NSW Department of Commerce*

WS-SPEC	Technical Requirements (TRs) and Strategic products Specifications
PWD	Safety Guidelines for fixed ladders, stairways, platforms and walkways for use in sewage treatment Works, pumping stations and maintenance holes

*Water Services Association of Australia (WSAA)*

WSAA 04	Sewerage Pumping Station Code
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*Australian Building Codes Board*

Building Code of Australia—PART E1, Fire Fighting Equipment

## 2 DESIGN CRITERIA

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### 2.1 GENERAL

#### Standard

The design shall be in accordance with the Sewerage code of Australia, or PWD-SD and PWD-PSD unless specified otherwise herein (WSAA 02 Part 1).

#### Responsibility

Except where specified otherwise, the division of responsibilities between the Sewer Authority and the Designer shall be in accordance with the Sewerage code of Australia (WSAA 02 Part 1, Section 1.3).

#### Gravity system

The Designer shall confirm the design criteria with the Sewer Authority and shall design a gravity pipeline collection system with pump stations and rising mains, where necessary to comply with the requirements of this worksection, to transport fresh sewage, or common effluent, for treatment.

#### Pressurised or vacuum system

Pressurised common effluent or vacuum systems shall only be considered after consultation with the Sewer Authority.

#### Discharges to gravity sewers

The Designer shall not provide for common effluent or vacuum discharges to gravity sewers or conventional sewerage treatment plants without the concurrence of the Sewer Authority.

## 2.2 DETERMINATION OF AREA TO BE SERVED

### PWD-SD and upstream provision

The area to be served shall be determined in accordance with PWD-SD except that the Sewer Authority may require provision for an upstream sewer.

In the design brief the Sewer Authority will indicate the level and size of existing pipe as well as anticipated flows to be allowed for in the design (WSAA 02 Part 1, Section 2.3.2).

Alternatively, the Authority may require the designer to determine the future and ultimate upstream sewer loading and provide adequate allowance for such loadings to the satisfaction of the approving authority.

### Depth

The depth of sewer shall be sufficient to allow a minimum of 90% of each lot to be serviced.

### Provision of sewerage

All lots shall be able to be served by gravity sewers wherever possible.

## 2.3 DESIGN LOADING

### Flows

The Designer shall obtain the concurrence of the Sewer Authority for the flow to be used for the design of sewers serving industrial areas and developments not specifically listed in the Sewerage Code of Australia or PWD-SD (WSAA 02 Part 1, Section 3).

### Design codes

The design shall take account of AS 2200, AS/NZS 2566.1, AS/NZS 3500.2, AS/NZS 3735, the Sewerage Code of Australia and, where design elements are not covered elsewhere in these codes, PWD-SD and PWD-PSD.

## 2.4 SEWER ALIGNMENT (WSAA 02 PART 1, SECTION 4.3)

### Consent of owner

Where it is necessary for sewers to be located outside the development, the Designer shall obtain written approval from the affected property owner.

Preparation of any application for approval from an affected property owner shall constitute a WITNESS POINT (WP).

The Principal shall advise whether the option to review and direct on the application is taken at the time of notification by the Designer.

### Road reserve

Where sewers are proposed to be located within existing road reserves, the Designer shall check that the sewers do not conflict with other utility services and locate the sewers in accordance with established protocols (WSAA 02 Part 1, Section 4.4).

### Easement

Sewers located on private property must be located in an easement of minimum width three (3) metres. Unless there are compelling reasons to the contrary the sewer shall be located in the centre of the easement.

A Registered Surveyor shall survey easements and pipelines (WSAA 02 Part 1, Section 4.5).

### Trench width

Where control of the trench width is practical or effective, the design may be based on wide trench condition.

The Designer shall call up the need, in the Construction Specification, for the Contractor to supply special construction control with a method statement when there is economic justification to design to narrow trench condition.

## 2.5 MAINTENANCE HOLES (MHS) (WSAA 02 PART 1, SECTION 6.6)

### Spacing

Maintenance holes shall generally be placed on gravity sewers as specified in PWD-SD Clause 6.1, except that the maximum spacing shall be 70 m (WSAA 02 Part 1, section 6.3).

### Terminal maintenance hole

All upstream ends of sewers shall terminate in a maintenance hole if the upstream end is more than 30 m from the downstream maintenance hole. Only in exceptional circumstances may maintenance holes be replaced with maintenance shafts.

### **Venting**

The Designer shall provide for the venting of maintenance holes which accept pumped discharges.

### **Connections to existing systems**

Connections to existing maintenance holes or sewers of the existing sewerage system is to be based on the Sewer Authority's sewerage master plan.

### **Access covers**

Access covers shall be manufactured in accordance with AS 3996.

## **2.6 MAINTENANCE SHAFTS (MSS) AND TERMINAL MAINTENANCE SHAFTS (TMSS)**

### **As required by sewer authority**

Maintenance shafts and terminal maintenance shafts configuration shall provide adequate access for multiple directional cleaning. These shafts shall be provided as required by the Sewer Authority.

### **MH Layout**

The provision of maintenance shafts and terminal maintenance shafts shall not affect the layout of maintenance holes or terminal maintenance holes unless directed by the Sewer Authority.

### **Maximum spacing**

Where used, a terminal maintenance shaft shall be no further than 70 m from the nearest maintenance hole.

### **Conditions limiting use**

The Designer shall take account of conditions limiting the use of maintenance shafts (WSAA 02 Part 1, Section 6.7).

## **2.7 PIPELINES (WSAA 02 PART 2)**

### **Type**

Pipes and fittings for sewerage systems shall be of unplasticised PVC, modified PVC, ductile iron, vitrified clay, steel, polyethylene, polypropylene or glass reinforced plastic. The material specifications for each pipe type are provided in Section 3.

### **Witness Point**

The choice of pipe type constitutes a WITNESS POINT (WP). The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

### **Fibre cement pipes and fittings**

Fibre cement pipe and fittings shall not be used.

### **Concrete pipes**

Concrete pipes shall not be used.

### **Buried pipes**

Pipelines shall be buried. Above ground sewers may be designed in a gravity system only where other options are less practical (WSAA 02 Part 1, Section 8.7).

The action to provide for above ground sewers constitutes a WITNESS POINT.

The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

### **External protection**

The Designer shall show on the Drawings the extent of external protection required to be undertaken by the Contractor.

External protection shall be shown to comply with 1361 *Sewerage - reticulation and pump stations (Construction)*.

### **Colour coding**

Where sewer pipes or rising mains are to be located in close proximity to other services pipes or where there is the likelihood of the pipes not being recognised as sewerage pipes, the Designer shall provide for the pipes to be colour coded and shown on the Drawings accordingly.

### **Piers**

Piers for any above ground sewer pipeline shall be in accordance with the Sewerage code of Australia Drawing SEW-1404.

### **Property connection**

The pipeline alignment shall be such that no property connection sewer is to be more than 10 m in length.

#### **Connection depth**

The Designer shall ensure that connections to the pipeline shall be extended to service level and capped off.

#### **Special allowances**

The Designer shall allow for adequate working area, waste removal and transport arrangements where scouring points or inspection pipe locations are nominated.

#### **Thrust blocks**

The Designer shall design thrust blocks to resist maximum pressure of the pipe, not the estimated surge pressure.

#### **Surge control method**

The Designer shall provide for surge control by specifying an appropriate rising main material and class selection.

### **2.8 JOINTS**

#### **Elastomeric seal or butt welded**

Gravity sewers and rising mains shall generally be spigot and socket joints with elastomeric seals complying with AS 1646, or butt welded in the case of polyethylene pipe.

#### **Flanges**

Flanged joints connecting pipes, fittings, valves and pumps shall comply with AS 2129 (Flanges shall be Table C) or AS 4087, Class 16, as appropriate.

The concurrence of the Sewer Authority shall be obtained for the type of joint to be used (WSAA 02 Part 2, Section 10.3.2).

### **2.9 MINE SUBSIDENCE AREAS AND AREAS OF SLIPPAGE**

#### **Ground strain**

The Designer shall accommodate the movement associated with the ground strain for the area, as advised by the Mine Subsidence Board for sewerage jointing systems in proclaimed Mine Subsidence Areas, or in a known or expected area of subsidence or slippage.

The design ground strain for the development shall be detailed on the Drawings.

#### **Pipe jointing system**

The pipe jointing system selected shall be capable of accepting ground movements, without impairing the water tightness of the joint, for the ground strain as advised by the Mine Subsidence Board. For areas with high ground strains a pipe jointing system using shorter effective length pipes and/or deep socket fittings shall be used.

This action constitutes a WITNESS POINT.

The Principal shall advise at the time of notification by the Designer whether the option to confer is required.

#### **Areas applicable**

Where the Mines Subsidence Board does not cover an area of known, or suspected, subsidence or slippage, the above requirements shall still apply.

## **3 MATERIALS**

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### **3.1 PVC GRAVITY PIPE**

#### **Standard**

PVC pipe shall be specified to be manufactured in accordance with AS/NZS 1260, designed in accordance with AS/NZS 2566.1 and with elastomeric seal spigot and socket joints (WSAA 02 Part 2, Table 10.1). The pipe shall be not less than Class SN 6.

#### **Ductile iron pipe compatibility**

Where PVC pipe is used in conjunction with DI fittings, the Designer shall ensure the jointing system is appropriate.

#### **Fittings**

Fittings for use with PVC pipe shall be elastomeric seal jointed.

### 3.2 PVC PRESSURE PIPE

#### Standard

PVC pressure pipe shall be specified to be manufactured in accordance with AS/NZS 1477, AS 4441 or AS/NZS 4765, designed in accordance with AS/NZS 2566.1, and with elastomeric seal spigot and socket joints (WSAA 02 Part 2, Table 10.3). The pipe class shall be selected based on pumping design and site conditions.

#### Ductile iron pipe compatibility

Where PVC pipe is used in conjunction with DI fittings, the Designer shall ensure the jointing system is appropriate.

#### Fittings

Fittings for use with PVC pressure pipe shall be elastomeric seal jointed.

### 3.3 DUCTILE IRON PIPE AND FITTINGS

#### Standard

Ductile iron pipes and fittings shall be specified to be manufactured and cement mortar lined in accordance with AS/NZS 2280 (Sulphur Resistant), with minimum Class PN 20 for elastomeric seal joints. Where pipes are flanged, AS/NZS 2280 Flange Class pipe shall be specified (WSAA 02 Part 2, Table 10.1).

#### Corrosion protection

The Designer shall specify cement mortar lining in accordance with AS/NZS 2280, or fusion-bonded medium density polyethylene to AS/NZS 4158.

External protection shall be epoxy coating to AS 3862 where not otherwise specified as sleeved or wrapped, taking into account the type of corrosion protection required.

#### Joints

Generally, pipe and fitting joints shall be specified to be spigot and socket type using an elastomeric seal made of natural rubber, or ethylene propylene rubber with compounds complying with AS 1646.

#### Flanges

Flanges shall be specified to be manufactured in accordance with AS 2129 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129 and galvanised in accordance with AS 1214 or stainless steel in accordance with AS 2837 as for pumps specified in 1361 *Sewerage - reticulation and pump stations (Construction)*.

### 3.4 VITRIFIED CLAY (VC) PIPES AND FITTINGS

#### Standard

Vitrified Clay pipes and fittings shall be specified to be manufactured in accordance with AS 1741 and designed in accordance with AS 4060 (WSAA 02 Part 2, Table 10.2).

#### Joints

Pipe and fitting shall be spigot and socket type using an elastomeric seal joints. Natural rubber shall not be used.

### 3.5 STEEL PIPE AND FITTINGS

#### Standard

Steel pipes and fittings shall be specified to be manufactured in accordance with AS 1579 and designed to AS/NZS 2566.1.

#### Joints

The Designer shall specify the jointing system where long-term corrosion resistance, ease of construction or special circumstances dictate the need. The pipe jointing shall be either:

- Elastomeric seal jointed with seals complying with AS 1646, or
- Butt welded, welded spigot and socket, or welding using a welding collar, and with the application of a polyethylene heat shrunk sleeve over the weld, or wrapped, or
- Flanged to comply with AS 4087 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129 and galvanised in accordance with AS 1214, or stainless steel in accordance with AS 1444 as for pumps specified in 1361 *Sewerage - reticulation and pump stations (Construction)*.

### 3.6 POLYETHYLENE PIPE AND FITTINGS

Polyethylene pressure pipe and fittings shall be manufactured to comply with AS/NZS 4129 and AS/NZS 4130 and designed to AS/NZS 2566.1 (WSAA 02 Part 2, Table 10.2).

### 3.7 GLASS REINFORCED PLASTIC (GRP) PIPE AND FITTINGS

Glass reinforced thermosetting plastics (GRP) pipes and collars shall be manufactured to comply with AS 3571 and designed to AS/NZS 2566.1 (WSAA 02 Part 2, Table 10.2).

Fittings shall comply with AS 2634. Ductile iron fittings complying with AS/NZS 2280 with appropriate elastomeric seals to AS 1646 may also be used.

### 3.8 POLYPROPYLENE PIPE AND FITTINGS

#### Standard

Polypropylene pipes and fittings shall be specified to be manufactured to AS 5065 and designed to AS/NZS 2566.1 (WSAA 02 Part 2, Table 10.2).

## 4 PUMP STATIONS

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### 4.1 GENERAL

#### Location

The Designer shall take into account access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves.

This action constitutes a **WITNESS POINT**.

The Principal shall advise at the time of notification by the Designer whether the option to confer on the locations is required.

#### Type

Where not provided as a vacuum sewerage system, the Designer shall provide for all pump stations to be of the single wet well submersible pump style with self contained freestanding switchboards suitable for external use. The Designer may be required to design an attached storm storage well in accordance with the requirements of the Sewer Authority.

#### Conditions

The Designer shall provide for the construction of the pump well after taking into consideration the ground and site conditions.

#### Preformed components

Preformed components or systems, complying with the Drawings, if any, may be used in lieu of in-situ construction provided:

- Preformed concrete cylindrical wall units are to be manufactured to AS/NZS 4058. The Designer shall take into account the cover requirements for reinforcing steel and cement types.
- Joints shall be internal flush
- The Designer shall ensure selected components make a watertight system and have a satisfactory surface finish.

#### Protection against flooding

Where the pump station site is exposed to possible flooding, the Designer shall provide for the top of pump well to be one (1) metre above the 1 in 100 year flood level or to such other level as provided by Council's planning instruments, whichever is the higher.

#### Protection against flotation

The Designer shall provide for the design of pump wells against flotation both during the construction/installation stage and whilst operating under flood conditions designed as above.

#### Package units

Package pump station units may be designed, with the prior concurrence of the Sewer Authority, where the area being serviced is small and/or their inclusion contributes to an overall lesser depth of excavation in the system.

### **Surfaces**

The Designer shall provide for internal surfaces of wet wells to be prepared and coated with an epoxy paint system approved by the Superintendent. All bolted connections within wet wells shall be stainless steel complying with AS 2837 Grade 316.

### **Surcharges and overflows**

The Designer shall size pipes and pump station capacity to avoid surcharges under design flow conditions. The Designer shall provide for overflows in strict accordance with the conditions of the licence, if any, permitting sewage overflow.

### **Alarms and signals**

The Designer shall provide for alarms and signals systems with the concurrence of the Sewer Authority.

### **Auxiliary Power Connection**

The Designer shall provide for an auxiliary power connection at each pump station consisting of:

- changeover switch; and
- connection lead and plug

## **4.2 PUMPS**

### **Special requirements**

The Designer shall specify special requirements, if any, for materials to be used in the pump station, taking into consideration the nature and composition of the sewage to be pumped. Each pump shall be fitted with a flushing valve installed in accordance with the manufacturer's recommendations.

### **Size**

The Designer shall provide for pump stations to be fitted with suitably sized pumps, consistent with other pumps in service, in conventional duty pump/standby pump arrangement.

### **Impeller clearance**

Each pump shall be capable of passing solids of not less than 75 mm diameter unless grinding equipment is incorporated

### **Removal**

Each pump shall be capable of being removed with the aid of fixed guide rails.

### **Inter-changeable**

Pump sets are to be interchangeable within each pump station.

### **Structural steelwork**

The Designer shall design structural steelwork in accordance with AS 4100 or HB 48.

## **4.3 ELECTRICAL**

### **Design responsibility**

Notwithstanding other clauses mentioned herein, the Designer shall be responsible for the design of the equipment as suitable for the purpose.

Equipment design shall comply with the requirements of the relevant standard specification.

### **SCA and electrical**

The Designer shall provide for Switchgear Control Assembly (SCA), SCA housing and electrical requirements as detailed in 1361 *Sewerage - reticulation and pump stations (Construction)*.

### **Inter-changeability**

Where more than one (1) item of equipment is designed to form a particular function, all such items of equipment shall be identical and completely interchangeable (eg. pilot lights, pushbuttons, relays, etc.).

### **Switchboard**

The switchboard shall be installed visibly and physically accessible above areas at risk of flooding.

### **Ambient conditions**

Ambient conditions shall be within the normally accepted limits of 0°C to 45°C.

### **Connection to local supply**

The switchboard shall be connected to the local electricity supply system.

Nominal system parameters:

- 415 volt, 3-phase, 4-wire, 50 Hz, solidly earthed neutral system.
- Prospective Fault Current: as specified by the local supply Authority.

#### **Standards**

The works shall be designed in accordance with and subject to the provisions of MEW E101, except where modified by this worksection.

#### **Automatic operation**

The pump station shall be designed for fully automatic operation in the unmanned condition.

### **4.4 WATER SUPPLY**

#### **Cleaning**

The Designer shall provide for automatic well washers and flush valves to be installed at each pump station and controlled so that they operate when the duty pump is operating.

#### **Contamination protection**

The Designer shall provide at all pump stations for an adequate water supply for cleaning purposes. This supply shall be protected from contamination due to backflow by the installation of a registered break tank or reduced pressure zone device in accordance with AS 3500.2.

### **4.5 TELEMETRY**

#### **Schedule**

The Designer shall provide for telemetry requirements in accordance with the schedule supplied by the Sewer Authority.

#### **Compatibility**

The telemetry system is to be compatible with the existing Radtel system.

### **4.6 OTHER APPURTENANCES**

#### **Venting**

The Designer shall provide for venting of each pump station, and in built up areas, after consultation with the local Council.

#### **Lifting equipment**

The Designer shall provide for machinery lifting equipment including pump chains.

#### **Gauges**

The Designer shall provide pressure tapping and gauges for all valves, including isolation and non-return valves and as detailed in 1361 *Sewerage - reticulation and pump stations (Construction)*.

#### **Covers**

The Designer shall take account of the possibility of site flooding ingress and overflow, and occupational health and safety requirements in providing for access and inspection covers.

#### **Lighting and Access**

The Designer shall make provision for adequate overhead lighting and all weather access to the pump station site.

## **5 DOCUMENTATION**

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### **5.1 SEWERAGE SYSTEM**

#### **Approval**

The Principal shall submit, to the Sewer Authority for approval, four (4) copies of the proposed sewerage system design, including calculations prior to commencement of construction (WSAA 02 Part 1, Section 9).

This action constitutes a WITNESS POINT.

The Principal shall advise at the time of notification by the Designer whether the option to direct the submission to the Sewer Authority is taken..

#### **Drawings**

The Drawings shall show to scale:

- Plan showing:
  - . Lot boundaries and lot numbers.



- . Location and chainage of all maintenance holes, junctions and dead ends.
- . Maintenance hole types.
- . Location and size of all gravity and rising mains and pump stations.
- . Location of vents.
- . Sewer main number and maintenance hole number.
- . Existing sewer mains, junctions and maintenance holes.
- . For level lots, spot levels at the lot extremities to show that at least 90% of the area of the lot can be connected to the sewer by gravity.
- . Hatching shall show the area of any lot not serviced.
- . Site contours.
- . Existing and proposed features and services.
- . North point and scale bar.
- . Easement location.
- . Arrangement of other utilities.
- Longitudinal section showing:
  - . Reduced levels for natural surface and design surfaces at all changes in grade.
  - . Maintenance hole locations and type.
  - . Maintenance holes numbered in accordance with the Sewer Authority's Asset Register.
  - . Invert levels for maintenance holes inlet and outlet.
  - . Size, type, class and grade of pipe.
  - . Location, invert level and size of all drainage lines, water mains, and other utility services crossing the main.
  - . Notation regarding all joining lines.
  - . Property ownership.
  - . Note upstream ET's at each maintenance hole.
  - . Note 'In road' trench conditions.
- Pump stations—General arrangement of pump stations with site plan; concrete outlines; number, make, model and details of pumps; inlet and outlet pipework details and levels; pump cut in; cut out and alarm levels; switchboard location; pump station access details; design starts per hour.
- Pipe protection—Details of corrosion protection required for pipes and fittings.
- Trenchless installation—Areas designated for trenchless pipe installation.

#### **Drawing scale, size and format**

Detail plans shall be drawn to a scale of 1:500 and longitudinal sections to a horizontal scale of 1:1000 and a vertical scale of 1:100.

Drawings shall be 'A3' size and/or 'A1' after consultation with the Sewer Authority.

Drawings shall be provided also in electronic form after consultation with the Sewer Authority.

## **5.2 PUMP STATION**

### **Approval**

The Principal shall submit, to the Sewer Authority for approval, prior to commencement of the manufacture of any pumps and control equipment, four (4) copies of the following:

- Switch and Control Gear Assemblies—Proposed fully dimensioned manufacturing details, general arrangement (showing internal/external details) and foundation/gland plate details.
- Common Control—Complete circuit diagram and description of operation.
- Schedule of Equipment—Completed as to the equipment to be provided.
- Other Engineering drawings as required to fully describe the proposed equipment.

The submission of the documents constitutes a WITNESS POINT.

The Principal Shall advise at the time of notification by the Designer whether the option to direct the submission to the Sewer Authority is taken.

### **Confined space risks**

The Designer shall take into consideration the technical requirements to minimise all risks associated with entry into confined space.

### **Drawing Size and format**

Drawings shall be on 'A3' size. All symbols used shall conform to AS 1102 and all wires and terminals shall be numbered.

Drawings shall also be provided in electronic form after consultation with the Sewer Authority.

### **Asset register**

The Designer shall provide asset schedules and Drawings in a form consistent with the existing or proposed Asset Register after consultation with the Sewer Authority. (WSAA 02 Part 1, Section 9.3.2).

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## **6 ANNEXURE A**

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### **6.1 INSTRUCTION FOR SPECIFICATION PREPARATION**

#### **Incorporation of Local Requirements for Sewerage System Design**

This worksection recognises that each Council may need to vary the Specifications to meet local requirements. The items below may be taken into account in varying this design specification and 1361 *Sewerage - reticulation and pump stations (Construction)*.

The Water Directorate, a close partner of the Institute of Public Works Engineering Australia (IPWEA), may provide additional information regarding the following:

- A complete list of Australian Standards relevant to Sewerage System compiled as a result of a survey of Standards in use.
- A schedule of training organisations available to provide accreditation to Contractors and Superintendents.
- A schedule of products in use compiled as a result of a survey of users.
- Advice on handling different requirements between the Council and any subsidising Authority. Differences identified include:
  - . Provision of more expensive materials, fittings and pumps.
  - . Automation (eg Sewerage pump station well washers and flushing valves **Pumps**).
  - . Depth of gravity sewers versus increased number of pump stations.
  - . Dimensional variations, including:
    - \* Sewer maintenance hole spacing **Maintenance Holes**.
    - \* Length of sewer dead ends **Maintenance Holes**.
    - \* Length of sewer service connections **Pipelines**.
    - \* Cover requirements to 1361 *Sewerage - reticulation and pump stations (Construction)*.
    - \* Depth to sewer connections **Determination of area to be served** and **Pipelines**.

The grading requirements called up for sand bedding may need to be checked where Council wishes to facilitate local acquisition. See 1361 *Sewerage - reticulation and pump stations (Construction)*, **Pipe bedding** and Table 3.4).

Valve opening direction varies within and between Water Authorities. The requirements of the specifications may need to be checked against existing installations. See 1361 *Sewerage - reticulation and pump stations (Construction)* **Valves**.

The requirement for the location of property services varies between Councils. The requirements of the specifications may need to be checked against existing installations. See 1361 *Sewerage - reticulation and pump stations (Construction)* **Junction and property connection sewers**.

The number and timing for receipt of documents called up varies between Councils. The requirements of the worksection may need to be checked against existing requirements.

Councils require varying lead times for notices to be given. The requirements of the worksection may need to be checked against existing requirements.

Council may wish to consider the option for installation of curved pipes (eg in cul-de-sacs).

Council may wish to include provision for inverted syphons and associated venting.

**1341 WATER – RETICULATION AND PUMP STATIONS (CONSTRUCTION)**

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**1 SCOPE AND GENERAL**

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**1.1 SCOPE**

The is to be constructed under this worksection consists of the construction of Mains up to DN 600 nominal size and small pump stations.

This worksection excludes the construction activities for:

- Reservoirs, including repainting of reservoirs.
- Treatment plants.
- Dams.
- Headworks, including bores and weirs.
- Dosing plant.
- Larger pump stations.

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 water supply 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.

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 requirements of the Water Supply Code of Australia except as otherwise specified herein.

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

**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 QUALITY**

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

**1.5 REFERENCED DOCUMENTS**

References to the *Water Supply Code of Australia* 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).

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

**Worksections**

0161 *Quality (Construction)*

0310 Minor concrete works

1101 Control of traffic

1102 Control of erosion and sedimentation

**Standards**

AS 1111	ISO metric hexagon bolts and screws—Product grade C
AS 1111.1	Bolts
AS 1111.2	Screws
AS 1112	ISO metric hexagon nuts – Style 1 – Product grades A + 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
AS 1289.5.4.1	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 1432	Copper tubes for plumbing, gasfitting and drainage applications
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 1830	Grey cast iron
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 2419	Fire hydrant installations
AS 2419.2	Fire hydrant valves
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2638	Gate valves for waterworks purposes
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 3952	Water supply—Spring hydrant valve for waterworks purposes
AS 3996	Access covers and grates
AS 4087	Metallic flanges for waterworks purposes
AS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS 4441(Int)	Oriented PVC (PVC-O) pipes for pressure applications
AS 4794	Non-return valves—Swing check and tilting disc
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 1594	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	Structural 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 3862	External fusion-bonded epoxy coating for steel pipes
AS/NZS 3879	Solvent cements and priming fluids for use with unplasticized PVC (PVC-U and PVC-M) and ABS pipes and fittings
AS/NZS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4680	Hot-dipped galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS4765(Int)	Modified PVC (PVC-M) pipes for pressure applications
AS 60529	Degrees of protection provided by enclosures (IP Code)
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 Commerce*

MEW E101 Electrical Services Minimum Requirements

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

*Water Services Association of Australia (WSAA)*

WSAA 03 Water Supply Code of Australia

WSAA 01 Polyethylene Pipeline Code Standard Drawings

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## **2 MATERIALS**

### **2.1 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.

### **2.2 PVC PIPES AND FITTINGS**

#### **Standard**

PVC pipes and fittings for mains and suction pipes shall comply with AS/NZS 1477, AS 4441(Int) or AS/NZS 4765, shall be suitable for use with elastomeric seals complying with AS 1646 and shall be of the class and size as shown on the Drawings. (WSAA 03 Part 3, Section 12.1)

#### **Installation**

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032, AS/NZS 2566.1 and WSAA 03.

### **Protection**

Pipes and fittings shall be handled and stored in accordance with WSAA 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 ACRYLONITRILE BUTADIENE STYRENE (ABS)**

### **Standard**

ABS pipes and fittings shall comply with AS/NZS 3518 to the class, size, use, shape and colour as shown on the Drawings and installed in accordance with AS/NZS 2566.1 and AS 3690.

Where storage beyond the times specified in WSA 03 is required, the Contractor shall provide protection for the pipes and fittings from ultra violet light and damage.

### **Jointing**

ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement to AS/NZS 3897

## **2.4 GLASS REINFORCED PLASTIC (GRP)**

### **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 (WSA 03 Part 3, Section 12.1.).

### **Protection**

Where storage beyond the times specified in WSA 03 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.

Jointing shall be with elastomeric seals complying with AS 1646 series, to the class and type as shown 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 the requirements of 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 AND FITTINGS**

### **Standard**

Steel pipelines and fittings shall comply with AS 1579 and shall be of the class, size, lining and coating as shown on the Drawings. (WSA 03 Part 3, section 12.1.)

### **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 series or butt-welded, unless shown otherwise on the Drawings.

### **High voltage powerlines**

The Contractor shall comply with WSA 03 where continuously welded steel pipelines run parallel to, when in close proximity, high voltage power lines.

## **2.7 COPPER PIPE AND FITTINGS**

### **Standard**

Copper tube and fittings shall comply with AS 1432 and shall be of the size and type as shown on the Drawings.

### **Insulated**

The Contractor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the Drawings. (WSAA 03 Part 3, section 12.1.)

## **2.8 POLYETHYLENE (PE)**

### **Standard**

Polyethylene pipe shall comply with AS/NZS 4130 and shall be of the class and size as shown on the Drawings and installed in accordance with AS 2033. (WSAA 03 Part 3, section 12.1.)

### **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.

## **2.9 STEELWORK**

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 galvanised to AS/NZS 4680. (WSAA 03 Part 3, section 12.1.)

## **3 VALVES AND HYDRANTS**

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### **3.1 GENERAL**

#### **Compatibility with pipework**

The Contractor shall ensure that the valves and hydrants 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 the valves and hydrants 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, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSAA 03 Part 3, Section 15.11.1.)

#### **Corrosion protection**

The type of external corrosion protection of buried valves and hydrants shall be fusion-bonded medium density polyethylene coating to AS 3862 and AS 4321 or thermal-bonded polymeric coating to AS/NZS 4158.

#### **Flanges**

Flanges shall comply with AS 2129 and AS 4087 and shall be of the class and size shown on the Drawings.

### **3.2 STOP VALVES**

#### **Sluice valves**

Sluice valves shall be resilient seated valves manufactured in accordance with AS 2638 series.

The valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings.

#### **Ball valves**

Ball valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings.

#### **Butterfly valves**

Butterfly valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings

#### **Knife gate valves**

Knife gate valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings

#### **Scour valves**

Scour valves shall connect to pipelines with a flanged joint. Scour valve assemblies shall be as shown on the Drawings.

#### **Operation**

Valves shall be operated by a removable key.

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. Underground valves shall be anticlockwise closing (ACC) whilst above ground valves shall be clockwise closing (CC).

#### **Hand wheel arrow**

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

#### **Gaskets for valves**

Gasket for the valves shall be fabricated from 3mm thick insertion rubber.

### **3.3 AIR VALVES**

#### **Standard**

Air valves shall be of the double orifice type with integral isolating valve of minimum size DN 80, and shall be installed as shown in the Drawings.

#### **Isolation**

Air valves shall be installed such that they can be maintained without affecting supply.

#### **Alternate type**

The Contractor shall obtain the consent of the Water Authority for the use of other types of air valves.

### **3.4 NON-RETURN VALVES**

#### **Standard**

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 or with bronze body and disc seat rings.

The leaf shall swing clear and provide an unobstructed waterway. Wafer style non-return valves shall not be used.

#### **Maintenance**

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 body.

#### **No flow switch**

Where shown on the Drawings, non-return valves shall have an extended spindle, minimum grade 316 stainless steel complying with AS 1449, fitted with an adjustable counterweight, together with a proximity switch to indicate a no-flow condition.

#### **Switch features**

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 1449 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.



### 3.5 SPRING HYDRANTS

#### Standard

Spring hydrant bodies shall be manufactured in accordance with AS 3952 and installed in accordance with AS 2419.2 except as varied below.

#### Access

The top of spring hydrants shall be between 100 mm and 200 mm below finished surface level as detailed in WSAA 03 Part 4, WAT-1104.

If necessary, this shall be achieved by the use of hydrant risers of various heights.

### 3.6 PRESSURE REDUCING VALVES

Pressure reducing valves shall be of the type as shown on the Drawings.

Pressure reducing valves shall be installed with isolating valves to facilitate maintenance.

## 4 PIPELINE CONSTRUCTION

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### 4.1 ACCREDITATION

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, shall 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.

### 4.2 ALIGNMENT CHANGES

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

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

This action constitutes a **HOLD POINT**.

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

### 4.3 LOCATION

The location of the mains and pump stations, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the Drawings.

The pipelines shall be laid to grades and locations shown on the Drawings and to tolerances in the WATER SUPPLY CODE unless directed otherwise by the Superintendent (WSAA 03 Part 3, section 21).

The Contractor shall confirm the locations immediately prior to construction. (WSAA 03 Part 3, Section 11).

### 4.4 COVER OVER PIPELINES

#### Minimum cover

The minimum depth of cover to be provided for mains, measured vertically from the finished ground level to the top of any socket, shall be as follows (WSAA 03 Part 3, Sections 13, 17, 21, WAT-1201):

- 750 mm in embankments
- 600 mm in roadways and commercial areas
- 450 mm elsewhere

#### Special protection

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

#### Special needs

Greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

**Maximum cover**

The maximum cover shall be 1000 mm, unless otherwise directed.

**4.5 CROSSINGS**

**Authority approvals for road and creek crossings and other features**

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 03 Part 3, Section 1.6 Affected Party Notifications).

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 mains.

The installation of the main by open trenching shall not be permitted over the lengths designated for trenchless installation. (WSAA 03 Part 3, Section 15.13.)

**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.

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.

**4.6 EARTHWORKS**

**Location**

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 03 Part 3, Section 13).

**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.

**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.

All installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

**Access to properties**

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

All installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

**Existing services**

The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor’s expense.

**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 03 Part 3, Section 13.2.)

**4.7 MINIMUM TRENCH WIDTH FOR PIPELINES**

**Timbering or sheet piling**

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 shown in Table 4.1.

**Table 4.1 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
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
525	850	800
600	950	900

**Minimum disturbances**

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.

**Widen for fittings**

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

**4.8 EXCAVATION DEPTH**

**75 mm below**

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.

**Pipe support**

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

**4.9 SUPPORT OF EXCAVATION****Precautions 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 03 Part 3, Section 13.6).

**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.

**4.10 PIPE BEDDING****Approval to bedding installation**

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.

**Crusher screenings**

Crusher screenings shall 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. (WSAA 03 Part 3, Section 14.)

**Pipes other than PVC/PE**

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

The bedding material shall conform to the sands classification described in WSAA 03 Part 4 WAT-1200 Soil Classification Guidelines, either loose clean sand and/or medium dense clean sand.

**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 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits in Grading of Bedding Material for PVC and PE Pipes table.

**Grades greater than 50%**

All mains laid on grades steeper than 50 per cent shall be encased in concrete as detailed on the Drawings.

**Table 4.2 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	¼ inch	90–100
425 µm	No. 36	40–90
150 µm	No. 100	0–10

**4.11 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 03 Part 3 Section 15, WAT-1102 to 1105).

**Examination**

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.

#### **Cleaning**

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.

Any temporary supports shall be removed prior to completion of backfilling.

#### **Joints**

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be elastomeric seal joints, either roll-on 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.

For pipes with rubber ring (elastomeric) 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 03.

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 engined 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 clearly identifiable 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/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket.

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

Ductile iron spigots shall not be inserted to 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 OHS requirements when cutting and disposing of asbestos cement pipes.

#### **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.

#### **Limit of joint deflection**

The maximum angle of deflection between adjacent pipes shall comply with manufacturers recommendations.

### **Grade**

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

### **Detectable tape**

Detectable identification tape shall be laid along the line of non-metallic mains within 150 mm of the finished surface. (WSAA 03 Part 3, Section 15.10.)

## **4.12 WRAPPING OF DUCTILE IRON PIPELINES**

### **Location**

Where shown on the Drawings, the Contractor shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving. (WSAA 03 Part 3, Section 15.9.)

### **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 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**

Pipelines shall be identified by colour sleeving, blue stripe for potable water and purple for recycled water, 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 sleeving 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 sleeving**

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

## **4.13 CORROSION PROTECTION OF STEEL BOLTS AND NUTS**

The Contractor shall wrap all 316 grade stainless 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 or as directed by the Superintendent.

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

## **4.14 BACKFILL AND COMPACTION**

### **Notification of pipeline laid and jointed**

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 the commencement of trench backfilling. (WSAA 03 Part 3, Section 17).

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.

#### **Approval**

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 comply with the requirements 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 trench**

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

#### **Roadway areas**

- Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be backfilled in accordance with the requirements of Section 1151 Road Openings and Restoration.

#### **Prevention of damage to pipes, coating and wrapping**

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.

#### **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.

### **4.15 TRENCH STOPS**

#### **Grade 5% to 14%**

Where a pipe 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 (WSAA 03 Part 4 WAT-1209 and Part 3, Sections 15.7, 15.8):

- a) 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 and to a level 300 mm above the top of the pipe.
- b) 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 metres

G = grade of pipe expressed in percentum

### **4.16 CONCRETE BULKHEADS**

Where a pipe is installed at a grade of 15% to 29%, the Contractor shall construct concrete bulkheads.

Where a pipe 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 works*.

150 mm minimum thickness as follows (WSAA 03 Part 4 WAT-1209 and Part 3, Sections 15.7, 15.8):

- 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 formula:

Concrete bulkhead

$$D=L/G$$

Concrete encasement (continuous) and concrete bulkhead

$$D=100/G$$

where

L = 80 × Pipe length, m with a 450 m max  
if L > 100 m use intermediate trenchstops at spacing < 100/G

D = distance between bulkheads in m

G = grade of pipe expressed in percentum

## 4.17 VALVE AND HYDRANT CHAMBERS

### Type

The Contractor shall construct around each valve and hydrant a chamber of the type and to the details shown on the Drawings (WSA 03 Part 3, Section 15.11.12).

### Concrete

The concrete shall comply with 0310 Minor concrete work.

### Colour designation

Valve chamber covers shall be painted with white pavement marking paint while hydrant chamber covers shall be painted with yellow pavement marking paint.

## 4.18 CHAMBER COVERS AND FRAMES

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

### Finish

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.

### Tolerance

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.

### Covers

Frames shall be seated as shown on the Drawings or as directed by the Superintendent.

Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces.



Elsewhere, covers shall be finished 25 mm above the surface of the ground, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

#### **Plastic covers**

The Contractor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

### **4.19 SERVICE CONNECTIONS**

The Contractor shall provide service connections in accordance with the Water reticulation code (WSAA 03 Part 4 WAT-1108 and WAT-1109). For Batlow, or any other area identified as having aggressive ground or water conditions service connections shall be in polyethylene or other approved material. In these conditions copper will not be permitted.

### **4.20 THRUST AND ANCHOR BLOCKS**

#### **Location**

Thrust and anchor blocks shall be constructed 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 resultant forces resulting from internal pressures will occur. (WSAA 03 Part 4 WAT-1205 to 1208 and Part 3, Section 15.5).

#### **Thrust blocks**

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with 0310 Minor concrete work (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 Water 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.

“Tyton Lok” joint restraint units may be used where shown on the drawings.

### **4.21 CONCRETE ENCASUREMENT**

#### **Location**

Where pipes have less than 450 mm of cover above the top of the pipe barrel, or where directed by the Superintendent, they shall be encased in concrete.

#### **Specification**

Concrete shall be 20 MPa complying with 0310 Minor concrete work and have the following minimum dimensions (WSAA 03 Part 4 WAT-1203, WAT-1204 and Part 3, Sections 12.5.5.1, 14.4, 16.6):

- For trenches in other than rock—150 mm minimum under, on both sides and on top of the pipe barrel.
- For trenches in rock—75 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.

## 4.22 MARKING PLATES

### Valve and hydrant

The Contractor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position as approved by the Superintendent.

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 Water Authority. (WSAA 03 Part 3, Section 15.16.)

### Marker posts

The Contractor shall provide and set in the ground a Marker Post with the relevant marking, SV, HP or HR at the top of the post, facing the valve or fitting.

The post shall be made of recycled plastic material, complying with approved standard drawings and 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, its height above the ground shall be increased to 1500 mm.

### Pavement markers

In addition to the marking plates, the Contractor shall affix two-way reflective raised pavement markers to the road pavement and kerb, where available, in accordance with the Water reticulation code (WSAA 03 Part 4 WAT-1300, WAT-1106 and WAT-1107).

## 4.23 RESTORATION OF SURFACES

### Original condition

Carriageway pavements, pathways lawns and other improved areas shall be restored in a continuous manner to a condition equivalent to that existing 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 turf imported from a source approved by the Superintendent. (WSAA 03 Part 3, Section 23.)

### 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.

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

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.

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

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 to 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. Cross reference clause 4.14 Backfill and Compaction.

### 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 Contractor shall level trenches at the time of backfilling or otherwise as directed by the Superintendent.

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

### **Restoration**

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

### **Directional Drilling**

Should the Contractor elect to drill 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**

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

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## **5 PIPELINE TESTING AND COMMISSIONING**

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### **5.1 PRESSURE TESTING**

#### **Mains**

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

#### **Notification**

The Contractor shall notify the timing of pressure tests 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 testing is required.

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.

#### **Polyethylene and other pipelines**

Testing of Polyethylene pipelines shall be carried out in accordance with WSAA 01.

All other pipelines shall be tested in accordance with Pressure Testing.

#### **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 for inspection.

#### **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 shall be as shown on the drawings. The test pressure shall not exceed the manufacturer's recommended test pressure for the lowest rated component taking into account the components location in the pipeline.

### **Duration of test**

The Contractor shall maintain the specified test pressure for a minimum period of 6 hours.

### **Determining actual leakage losses**

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.

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:

$$Q1 = 0.0105 D.L. (H)^{0.5}$$

where:

Q1 = permissible leakage rate (litres per hour)

D = nominal diameter of pipe (mm)

L = length of section tested (km)

H = average test head (m)

### **Rectification**

Any failure, defect, or visible leakage which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the Contractor at the Contractor's expense, provided that 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 cost of strengthening or reconstruction of such thrust block 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*.

### **Compressed air test**

The pipeline shall not be tested using compressed air.

WARNING: Air testing stores significant quantities of energy in the form of compressed air, which if released by the failure of a pipe, temporary end plate, joint or block, can cause pipeline components, equipment, temporary blocks and fill materials to travel at high speed and become life threatening hazards.

### **Connection to existing network**

Connections to existing Council controlled pipes will be made by Council at the Contractor's expense.

The Contractor shall make arrangements with the Water Authority or other Authority concerned for the timing of the work including the need to isolate the existing mains and notification of affected dwelling occupants.

The Superintendent shall be given five (5) working days notice of such arrangements (WSAA 03 Part 3, Section 22).

### **Disinfection of pipelines**

The Contractor shall disinfect all water mains after satisfactory testing in accordance with this worksection (WSAA 03 Part 3, Section 20).

The Contractor shall adopt procedures for the disinfection of the mains with the concurrence of the Water Authority.

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## **6 PUMP STATIONS**

### **6.1 PUMPS**

#### **Materials**

Pump construction materials for centrifugal end suction pumps shall comply with Table 6.1.

### 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 as follows:

- All bolts, nuts and washers shall be stainless steel to AS 1449 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated.
- All threads shall 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 and 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.

**Table 6.1 Construction materials for pumps**

DESCRIPTION	MATERIAL
<b>PUMP</b>	
Casing and suction bend	Cast iron AS 1830 Gr T200
Wear rings	Cast iron AS 1830 Gr T200
Impeller	316 Stainless steel AS 1449
Impeller nut	Gunmetal AS 1565-905C
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
Gland nuts	316 Stainless steel AS 2837
Fixing nuts and bolts handhole	316 Stainless steel AS 2837
Covers	316 Stainless steel AS 1449
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 1449
Pump set base plate	Cast iron AS 1830 Gr T200/Fabricated steel
<b>MOTOR</b>	

DESCRIPTION	MATERIAL
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
<b>MECHANICAL SEALS</b>	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

## 6.2 PRESSURE GAUGES

### Compliance

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

Cases shall be fabricated from stainless steel complying with AS 1449 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. 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.

## 6.3 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.

### DPWS requirements

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.

### **Compliance**

Except where MEW E101 requires a higher standard, Works shall be carried out in accordance with AS/NZS 3000, the Service Rules of the Supply Authority 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 electrical designs and materials**

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.

## **6.4 SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA)**

### **Approved manufacturer**

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

### **Type**

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

### **Construction**

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A steel galvanised channel base shall be provided.

### **Starter contactors**

Starter contactors shall have the appropriate rating for the proposed pumps to AC3.

### **Terminals**

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the Drawings.

### **Lock barrels**

The Contractor shall liaise with the electricity supply authority to supply a lock barrel for the metering equipment, at the Contractor's expense. The Superintendent shall supply standard lock barrels for use on the SCA at no cost to the Contractor.

### **Characteristics**

The electrical characteristics of the SCA shall be:

- Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
- Motor Control Circuit: 240 V, 50 Hz.
- Common Control Circuit: 240 and 24 V, A.C.
- Prospective short-circuit current: 14 kA for 1 second.
- Peak Factor: 2.2
- Power Factor Correction (Determined in consultation with the Water Authority)
- Earthing (M.E.N. system)

### **Cable entry**

All cables shall enter the SCA from below.

### **Switchgear data**

The Contractor shall supply data from the switchgear supplier confirming Type '2' co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

### **Operation**

The 'AUTO' mode shall be capable of being overridden by turning the starter selector switch to the 'ON' position.

Manual operation would normally be used in the event of failure of the telemetry system or for function testing.

A warning label (R/W/R) advising selector switches to be left in the 'AUTO' mode shall be fitted to common control cover.

#### **Factory tests**

The Contractor shall carry out factory tests in the presence of the Superintendent's Representative and in accordance with Schedule MEW E101 and the results shall comprise all routine Tests specified in AS/NZS 3439.

#### **Functional tests**

Functional tests referred to in Schedule MEW E101 shall include electrical function tests as defined in AS/NZS 3439.

#### **Packing**

The Contractor shall ensure, after approval has been given by the Superintendent, that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

#### **Damage**

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

#### **Tools**

The Contractor shall ensure that spare parts, tools etc, are packed separately from the main plant and shall be marked 'Spare Parts', 'Tools' etc, as applicable.

#### **Spare parts**

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

#### **Pump control**

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

### **6.5 ELECTRICAL INSTALLATION**

#### **Liaison**

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

#### **Facilities for revenue metering equipment**

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.

#### **Cabling**

The Contractor shall supply and install all cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits.

#### **Conduits**

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas.

The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

#### **Marker tape**

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits.

Marker tape shall be orange in colour, 150 mm wide and stamped with the words 'DANGER—ELECTRIC CABLES BELOW' or similar.

#### **Cabling route approval**

The Contractor shall route all underground cabling with the approval of the Superintendent.

Brass marking plates shall be positioned on any concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read 'Danger – Electrical Cables Below'.

This action constitutes a **HOLD POINT**.

The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.



### **Point of attachment**

The Contractor shall determine the Points of Attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

### **Consumer mains**

The consumer mains shall be generally run underground and commence at the Point of Attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

The minimum size of the consumers mains shall be sized to satisfy the following requirements:

The size shall be based on:

- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.
- Be sized for a voltage drop less than 1.5% to the maximum demand as calculated.
- Be single core PVC/PVC cables. XLPE insulated cable may also be used.
- Comply with the requirements of the Supply Authority.
- Pole termination method shall be as shown on the Drawings.
- AS/NZS 3000 and AS/NZS 3008.1.1.

### **Earthing conductor**

In addition to the requirements of the Supply Authority and MEW E101 the main earthing conductor shall be run in conduit to the main earthing electrode.

The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm<sup>2</sup> cable and a Type 4 pit for larger cable.

Surge diverters

The Contractor shall provide a separate earthing conductor and electrode for the surge diverters.

Each electrode shall be bonded and suitably labelled with an engraved brass label.

### **Pipework**

The Contractor shall bond the pump station metallic pipework to the main earth.

### **Meters**

The Contractor shall install metering facilities within the SCA.

The metering facilities and panel shall be Energy Authority approved and suitable for the installation of the metering equipment required by the Supply Authority.

### **Metering equipment**

The Contractor shall supply and install the following metering equipment:

- Plug-in meter bases or all electricity meters (tariffs) supplied by the Supply Authority, as may be required by the Supply Authority.
- Service potential fuses.
- Current transformers metering equipment (if required).
- All necessary wiring and other accessories as required by the Supply Authority.
- Key locking facilities for Supply Authority access.

### **Cable entry**

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals.

Cables shall not be jointed.

### **Sealing**

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

## **6.6 TESTING AND COMMISSIONING OF PUMP STATION**

### **Materials, equipment, installation and workmanship 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.

## **Standards**

Tests and inspections shall comply with relevant Australian Standards.

## **Testing**

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.

## **Sequence**

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

## **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.

## **Testing and recording of test results**

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 to Superintendent**

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.

## **Notification of commissioning**

The Contractor shall give five (5) working days notice of the Contractor's intention to undertake commissioning and 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 programme**

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

## **Responsibility**

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

### **Supervision**

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**

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**

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**

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

## **6.7 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.

## **6.8 TELEMETRY**

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

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

## **6.9 OPERATION AND MAINTENANCE MANUALS**

### **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.

### **Pump and motor 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;
- Description of operation;
- 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.

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## **7 CONSTRUCTION COMPLIANCE**

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### **7.1 WORK-AS-EXECUTED DETAILS**

The Contractor shall submit to the Superintendent work-as-executed Drawings showing the actual location and alignment of pipelines, and all pump station details together with operating and maintenance manuals (WSAA 03 Part 3, Section 24).

Details shall include the size, type, levels of pipelines, valve and hydrant chamber types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.

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

### **7.2 ASSET REGISTER**

The Contractor shall provide records, for the Water 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.

## 8 MEASUREMENT AND PAYMENT

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### 8.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed in this worksection in accordance with Pay Items 1341.1 to 1341.11 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 valve chambers, bulkheads, thrust and anchor blocks, concrete encasement 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.

### 8.2 PAY ITEMS

#### 1341.1 Excavation and backfill for water reticulation

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 pipes
- 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 4.1 + 200 mm.
- Trench Depth: Average actual depth to underside of specified bedding.
- Trench Length: Actual excavation length.

#### 1341.2 Supply and lay pipe and fittings

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

The schedule rate shall include:

- Supply of pipe and fittings
- Wrapping pipeline
- Survey and setting out
- Bedding
- Bulkheads
- Thrust and anchor blocks
- Jointing (including connections)
- Temporary bracing and strutting of excavation
- Selected backfilling
- Quality compliance

#### 1341.3 Supply and install valves

The unit of measurement shall be per 'each' stop, air or scour valve and associated chamber or box installed.

The schedule of rate for supply and install valves shall include for setting out, excavation, formwork, supply and placing concrete, supply and installation of valves, supply and installation of covers and frames, supply and installation of marker plates, 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.

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

**1341.4 Supply and install hydrants**

The unit of measurement shall be per 'each' hydrant and associated box installed.

The schedule of rate for supply and install hydrants shall include for setting out, excavation, formwork, supply and placing concrete, supply and installation of hydrants, supply and installation of covers and frames, supply and installation of marker plates, 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.

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

**1341.5 Connection to existing**

The unit of measurement shall be per 'each' connection to existing pipe.

The schedule rate for connection to existing shall include for all the necessary works to arrange and liaise with the appropriate Authority, cut into or otherwise modify and finish the system as shown on the Drawings.

**1341.6 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.

**1341.7 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.

**1341.8 Pump station**

The item shall be a Lump Sum for each pump station.

The Lump Sum 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.

**1341.9 Water pumps**

The item shall be a Lump Sum for each water pump.

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.

**1341.10 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.

**1341.11 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. Necessary and appropriate 'work-as-executed' drawings shall be included.

**1361 SEWERAGE – RETICULATION AND PUMP STATIONS (CONSTRUCTION)**

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**9 SCOPE AND GENERAL**

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**9.1 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;
- Low pressure grinder
- 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.

**9.2 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.

**9.3 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.

**9.4 TERMINOLOGY**

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

## 9.5 QUALITY

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

## 9.6 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

WSA 07 The Pressure Sewerage Code of Australia

Standard Drawings

## 10 MATERIALS

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### 10.1 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.

### 10.2 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.

### 10.3 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.

### 10.4 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.

## 10.5 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.

## 10.6 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.

## 10.7 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)

## 10.8 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).

## 10.9 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.

## 10.10 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.

**10.11 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).

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**11 PIPELINE CONSTRUCTION**

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**11.1 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.

**11.2 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.

**11.3 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**

<b>Location</b>	<b>Minimum cover (mm)</b>
Private property non vehicular – New developments	600

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

## 11.4 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.

## 11.5 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).

**11.6 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.

### 11.7 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.

## 11.8 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.

## 11.9 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.

## 11.10 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	¼ 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.

**11.11 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.

## **11.12 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 in accordance with Section 1151 Road Openings and Restoration.

- Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be:

### **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.

## **11.13 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  $\pm 300$  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).

### **11.14 JUNCTIONS AND PROPERTY CONNECTION SEWERS**

#### **Location**

The Contractor shall provide property connection sewers or risers to properties to serve existing and future dwellings in accordance with this worksection and the Drawings. Inspection shafts and/or maintenance holes shall be provided at all sewer ends. Property risers shall terminate with a screwed cap, a minimum of 100mm above surface level.

Junctions shall be inserted along pipelines in locations shown on the Drawings or directed by the Superintendent. The service connection, where not shown on the Drawings shall be provided as follows:

- 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.

#### **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 and if applicable, risers, shall have a minimum diameter of 150 mm and both the riser and connection shall 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).

## 11.15 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).

## 11.16 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.

## 11.17 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

$L = 80 \times$  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  $< 100/G$

### 11.18 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.

### 11.19 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.

#### Marker posts

The Contractor shall provide and set in the ground a Marker Post with the relevant marking, SV, HP or HR at the top of the post, facing the valve or fitting.

The post shall be made of recycled plastic material, complying with approved standard drawings and 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, its height above the ground shall be increased to 1500 mm.

## 11.20 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.

## 11.21 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 green sleeving, 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.

## 11.22 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/m<sup>3</sup> of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

## 11.23 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.

## 11.24 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).



## 11.25 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.

## 11.26 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.

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.

**Directional Drilling**

Should the Contractor elect to drill 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.

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## 12 PIPELINE TESTING

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### 12.1 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.

## 12.2 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

The Contractor shall undertake ovality testing as follows:

- 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

## 12.3 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

The test shall be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround.

The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole.

After allowing an interval for absorption, to be determined by the Superintendent, the Contractor shall refill the maintenance hole and measure the loss of water during the following 30 minutes.

The test on the maintenance hole will be considered satisfactory provided the water lost is less than 3 mm depth in the top section of the maintenance hole for each 1 m depth of maintenance hole.

The depth of maintenance hole is to be taken from the bottom of the maintenance hole cover recess in the cover surround to the invert of the outlet from the maintenance hole.

The plug of the outlet shall be fitted with a suitable release for emptying the maintenance hole on satisfactory completion of the test.

#### **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.

### **12.4 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.

### **12.5 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 m<sup>3</sup>/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 ±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.

## **12.6 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.

### **12.7 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<sub>a</sub> = 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.

## 12.8 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.

### 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 1.5 times the design dynamic head of the pipe.

### Duration of test

The Contractor shall maintain the specified test pressure 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.

**13 PUMP STATIONS**

**13.1 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
<b>PUMP</b>	
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
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
<b>PUMP (continued)</b>	
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



DESCRIPTION	MATERIAL
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
<b>MOTOR</b>	
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
<b>MECHANICAL SEALS</b>	
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.

## 13.2 PREFORMED PUMP STATIONS AND PACKAGE PUMP STATIONS

### Alternate wet well

Preformed 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:

- Preformed 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.

### **13.3 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 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.

### **13.4 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 Superintendent.

#### **Type**

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 1939.

#### **Construction**

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A steel galvanised channel base shall be provided.

#### **Barrier to gases**

The Contractor shall provide an effective barrier to prevent gases from the wet well entering the SCA.

#### **Starter contactors**

Starter contactors shall have appropriate ratings for the proposed pumps to AC3.

#### **Terminals**

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the Drawings.

### **Lock barrels**

The Contractor shall liaise with the electricity supply authority to supply a lock barrel for the metering equipment, at the Contractor's expense.

The Superintendent shall supply standard lock barrels for use on the SCA at no cost to the Contractor.

### **Characteristics**

The electrical characteristics of the SCA shall be:

- Main Circuit—415/240 V, 50 Hz, 3-phase, 4-wire.
- Motor Control Circuit—240 V, 50 Hz.
- Common Control Circuit—240 V and 24 V, A.C.
- Prospective short-circuit current—14 kA for 1 second.
- Peak Factor—2.2
- Power Factor Correction (Determined in consultation with the Superintendent)
- Earthing (M.E.N. system)

### **Cable entry**

All cables shall enter the SCA from below.

### **Switchgear data**

The Contractor shall supply data from the switchgear supplier confirming Type '2' co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

### **Operation**

The 'AUTO' mode shall be capable of being overridden by turning the starter selector switch to the 'ON' position.

Manual operation would normally be used in the event of failure of the telemetry system or for function testing. A warning label (R/W/R) advising selector switches to be left in the 'AUTO' mode shall be fitted to common control cover.

### **Factory tests**

The Contractor shall carry out of factory tests in the presence of the Superintendent's Representative and in accordance with Schedule MEW E101 and the results shall comprise all routine Tests specified in AS 3439.

The Superintendent shall be given seven (7) days notice of the proposed date of such tests.

### **Functional tests**

Functional tests referred to in Schedule MEW E101 shall include electrical function tests as defined in AS 3439.

### **Packing**

The Contractor shall pack the equipment for transport after satisfactory final factory inspection and tests, and after approval has been given by the Superintendent.

The Contractor shall ensure that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers.

The Contractor shall ensure that spare parts, tools etc, are packed separately from the main plant and shall be marked 'Spare Parts', 'Tools' etc, as applicable.

### **Voids due to removed equipment**

Where equipment has been removed, cover plates shall be provided.

### **Damage during transit and unloading**

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

### **Spare parts**

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

### **Automatic control**

Automatic control of the pump station pumping equipment shall be by way of float switches/probes providing single pump duty operation unless shown otherwise on the drawings.

The switches/probes will be compatible with those in use, if any, in the system.

### **Levels**

The following wet well levels shall be used in the automatic control of the pump operation system:

- Bottom water level (BWL)
- Top water level (TWL)
- Maximum top water level (MTWL)
- Flood alarm level (FAL)

### **Pump operation**

In the event of a rise in water level to Maximum Top Water Level, the pumps will operate in accordance with the operating procedures for the pump station.

The Superintendent shall advise the Contractor as to whether:

- The duty pump will cut out and the standby pump will operate, or
- The duty pump will continue to operate and the standby pump will cut in parallel.

### **Pump control**

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

## **13.5 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.

### **Cabling**

The Contractor shall supply and install all cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits.

### **Conduits**

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas.

The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

### **Marker tape**

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150 mm wide and stamped with the words 'DANGER—ELECTRIC CABLES BELOW' or similar.

### **Route**

The Contractor shall route all underground cabling with the approval of the Superintendent.

This action constitutes a **HOLD POINT**.

The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.

### **Brass marking plates**

Brass marking plates shall be positioned on any concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read 'Danger—Electrical Cables Below'.

### **Point of attachment**

The Contractor shall determine the Points of Attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

### **Consumer mains**

The consumer mains shall be generally run underground and commence at the Point of Attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

The minimum size of the consumers mains shall be sized to satisfy the following requirements:

- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.

- Be sized for a voltage drop less than 1.5% to the maximum demand as calculated.
- Be single core PVC/PVC cables. XLPE insulated cable may also be used.
- Comply with the requirements of the Supply Authority.
- Pole termination method shall be as shown on the Drawings.
- AS/NZS 3000 and AS/NZS 3008.1.1.

#### **Earthing conductor**

In addition to the requirements of the Supply Authority and MEW E101, the Contractor shall run the main earthing conductor in conduit to the main earthing electrode.

The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm<sup>2</sup> cable and a Type 4 pit for larger cable.

#### **Surge diverters**

The Contractor shall provide a separate earthing conductor and electrode for the surge diverters.

Each electrode shall be bonded and suitably labelled with an engraved brass label.

#### **Pipework**

The Contractor shall bond the pump station metallic pipework to the main earth.

#### **Meters**

The Contractor shall install metering facilities within the SCA.

The metering facilities and panel shall be Energy Authority approved and suitable for the installation of the metering equipment required by the Supply Authority.

#### **Metering equipment**

The Contractor shall supply and install the following metering equipment:

- Plug-in meter bases or all electricity meters (tariffs) supplied by the Supply Authority, as may be required by the Supply Authority.
- Service potential fuses.
- Current transformers metering equipment (if required).
- All necessary wiring and other accessories as required by the Supply Authority.
- Key locking facilities for Supply Authority access.

#### **Cable entry**

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals.

Cables shall not be jointed.

#### **Sealing**

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

### **13.6 PRESSURE GAUGES**

#### **Compliance**

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

### **13.7 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.

### **13.8 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 and 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.

## **13.9 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.

## **13.10 TELEMETRY**

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network (Radtel) 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.

## **13.11 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.

## 14 CONSTRUCTION COMPLIANCE

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### 14.1 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 electronic transfer 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.

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

## 15 MEASUREMENT AND PAYMENT

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### 15.1 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*.

### 15.2 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.

<b>1391 SERVICE CONDUITS</b>
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## 1 SCOPE AND GENERAL

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### 1.1 SCOPE

The work to be executed under this worksection includes the supply of materials and the installation of electrical and telephone conduits, pits and footings for streetlighting columns in accordance with the Worksection and Drawings.

The Worksection excludes the installation of wiring, equipment and streetlighting columns

### 1.2 QUALITY

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

### 1.3 REFERENCED DOCUMENTS

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

#### Worksections

0161 *Quality (Construction)*

0310 *Minor concrete works*

#### Standards

AS 1289 Methods for testing soils for engineering purposes

AS 1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

AS/NZS 1477 PVC pipes and fittings for pressure applications

AS/NZS 2053 series Conduits and fittings for electrical installations

AS/NZS 3000 Wiring Rules

Australian Telecommunications Authority (AUSTEL) Standards

Customer Premises Cabling Manual

### 1.4 ELECTRICITY

Electrical conduits and pits shall be installed in accordance with AS/NZS 3000 and the Service and Installation Rules of the local electricity supply Authority.

### 1.5 TELEPHONE

Telephone conduits and pits shall be installed in accordance with the AUSTEL Customer Premises Cabling Manual.

The Contractor shall complete all necessary notices, pay all fees and charges and arrange for all inspections and tests required by the relevant Authority.

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## 2 MATERIALS

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### 2.1 GENERAL

All pipes, fittings and pits shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent that the components conform to the requirements of this Worksection.

This action constitutes a **HOLD POINT**.

The Superintendent's approval of the documentary evidence is required prior to the release of the hold point.

## 2.2 CONDUITS

### Electrical

Conduits and conduit fittings for all electrical cabling shall be category 'A' orange coloured heavy duty rigid UPVC manufactured in accordance with AS/NZS 2053 series and with solvent welded joints.

All conduits shall be of the sizes shown on the Drawings.

### Telephone

Conduits and conduit fittings for all telephone cabling shall be Class 12 white coloured UPVC manufactured in accordance with AS/NZS 1477 and with solvent welded joints.

All conduits shall be of the sizes shown on the Drawings.

## 2.3 JUNCTION PITS

### Electrical

Electrical junction pits shall be precast in polymer concrete with 'Electricity' impressed in the lid, or equivalent approved by the Superintendent, to the requirements of the local Electricity Authority.

### Telephone

Telephone pits shall be precast in glass reinforced concrete with the relevant telephone Company's symbol impressed in the lid, or equivalent approved by the Superintendent, to the requirements of the relevant telephone Company.

## 2.4 CONCRETE FOOTINGS

### Concrete

Concrete footings for street lighting columns shall be 20 MPa compressive strength in accordance with the requirements of 0310 *Minor concrete works*.

## 2.5 ANCHOR BOLTS

Anchor bolt assemblies to be cast into street lighting column footings shall be supplied as a Principal supplied (TBS) item.

## 3 CONSTRUCTION

### 3.1 LAYOUT OF CONDUIT

#### Roadway crossings

Layout of conduit at railway crossings shall comply with the following:

- Minimum cover—The conduits shall be installed where shown on the Drawings or as directed by the Superintendent after construction of earthworks to subgrade level.  
The grade of the conduit shall be such as to provide a minimum cover over the conduit of 400 mm to the top of select subgrade level under pavement and shoulders.
- Laying conditions—The conduit shall be laid on a straight grade and line, in a trench not more than 300 mm wide and on a bed of compacted sand of 50 mm minimum thickness.  
Backfill over the conduit shall be compacted so that the relative compaction as determined by AS 1289.5.4.1 is not less than 100%.
- Draw wire—Draw wire shall be provided in all conduits.
- Marks in kerb—A mark shall be made in the face of kerb on both sides of the road indicating the location of the conduit crossing. The mark shall consist of the letter 'E' for electrical or 'T' for telephone, as appropriate, routed into the concrete and at minimum 75 mm high.
- Temporary markers—Where kerb and gutter construction has not yet commenced, temporary timber post markers shall be installed at the conduit crossings so that markings in the face of kerb can be made at the correct locations at the time of kerb and gutter construction.

#### Other locations

Layout of conduit at other locations shall comply with the following:

- Laying conditions—The conduit shall be laid on a straight grade and line and in normal trench conditions on a bed of compacted sand 50 mm minimum thickness. The width of trench shall not exceed 300 mm and the minimum cover over the conduit to finished surface level shall be 300 mm.

Backfill over the conduit shall be compacted so that the relative compaction as determined by AS 1289.5.4.1 is not less than 95%.

- Draw wire—Draw wire shall be provided in all conduits.

### 3.2 JUNCTION PITS

#### Location

Junction pits shall be installed at locations shown on the Drawings or as directed by the Superintendent.

#### Installation method

All junction pits shall be installed firmly in the ground on a drainage bed of 5 mm nominal size screened aggregate of minimum thickness 150 mm.

All conduit connections to junction pits shall be made waterproof by bitumastic sealant or other method approved by the Superintendent.

#### Drain

A 50 mm diameter UPVC drain shall be provided in each junction pit.

The drain shall be graded to a stormwater drainage pit or discharge through an embankment batter.

### 3.3 FOOTINGS FOR STREET LIGHTING COLUMNS

#### Location

The Contractor shall construct concrete footings at the locations for street lighting columns shown on the Drawings or as directed by the Superintendent.

#### Excavation

Excavation for footings shall be neatly cut from solid material. Excavated material shall be disposed of at locations approved by the Superintendent.

#### Dimensions

Footings shall be constructed to the dimensions and details as shown on the Drawings.

#### Anchor bolt assembly

The anchor bolt assembly shall be accurately located and firmly supported.

#### Concrete specification

Concrete and reinforcement shall be supplied and placed in accordance with the requirements of 0310 *Minor concrete work*.

Concrete shall not be placed until the formwork and anchor bolt assembly location have been approved by the Superintendent.

This action constitutes a **HOLD POINT**.

The Superintendent's approval of the formwork and anchor bolt assembly is required prior to the release of the hold point.

## 4 MEASUREMENT AND PAYMENT

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### 4.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work scheduled in this Specification on a schedule of rates basis in accordance with Pay Items 1391.1 to 1391.3 inclusive.

A lump sum price for any of these items shall not be accepted.

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 and reinforcement for footings is measured and paid in accordance with this specification and not in 0310 *Minor concrete works*.

### 4.2 PAY ITEMS

#### 1391.1 Supply and lay UPVC conduit

The unit of measurement shall be the linear metre of conduit installed.

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

The schedule rate shall be inclusive of the supply of conduit and bends, excavation, laying of conduit in trench or structure, backfilling, the provision of draw wire and connection to junction pits.

**1391.2 Junction pits**

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

A separate unit rate shall be included in the Schedule of Rates for each type of junction pit.

The schedule rate shall be inclusive of the supply of the junction pits, excavation, installation, backfilling and drain from pit.

**1391.3 Concrete footing for street lighting columns**

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

A separate unit rate shall be included in the Schedule of Rates for each type of footing.

The schedule rate shall be inclusive of all work and materials required for the construction of the footing including excavation, formwork, concrete reinforcement and installation of the supplied anchor bolt assembly.



<b>1392 TRENCHLESS CONDUIT INSTALLATION</b>
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## **1 SCOPE AND GENERAL**

### **1.1 SCOPE**

This worksection covers the installation of any type of drainage or service conduit where it is a requirement of the Contract that trenchless techniques are to be used. Trenchless techniques minimise interference with existing features, facilities or traffic. These techniques may be by either jacking, ramming, bursting, thrust or auger boring, micro-tunnelling, directional drilling or other suitable technique as appropriate for the particular installation.

The work to be executed under this worksection consists of supply of the conduit, installation and all necessary ancillary work, whether such work is temporary or permanent, as shown on the Drawings.

This worksection should be read in conjunction with 1351 *Stormwater drainage (Construction)*, 1352 *Pipe drainage*, 1353 *Precast box culverts*, and 1354 *Drainage structures* 1391 *Service conduits*, as appropriate.

### **1.2 QUALITY**

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

### **1.3 REFERENCED DOCUMENTS**

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

#### **Worksections**

0161 *Quality (Construction)*  
 0179 *General requirements (Construction)*  
 0310 *Minor concrete works*  
 1151 *Road openings and restoration*  
 1351 *Stormwater drainage (Construction)*  
 1352 *Pipe drainage*  
 1353 *Precast box culverts*  
 1354 *Drainage structures*  
 1391 *Service conduits*

#### **Standards**

AS/NZS 3725 Loads on buried concrete pipes  
 AS/NZS 4058 Precast concrete pipes (pressure and non-pressure)

#### **Other publications**

Concrete Pipe Association of Australia (CPAA)  
 Concrete pipe jacking, Technical brief  
 International Society for Trenchless Technology (ISTT)  
 (Represented in Australia by the Australasia Society for Trenchless Technology)  
 Glossary of trenchless terms

### **1.4 TERMINOLOGY**

Some of the trenchless techniques available are described below in accordance with the ISTT Glossary of trenchless terms:

- Jacking: A system of directly installing pipes behind a shield machine by hydraulic jacking from a drive shaft such that the pipes form a continuous string in the ground.
- Ramming: A non-steerable system of forming a bore by driving a steel casing, usually open-ended, using a percussive hammer from a drive pit.



- Strategy for dealing with noise pollution problems.
- Traffic management.
- Dewatering.

General requirements and design guidelines for jacking precast concrete and other rigid pipes are given in the CPAA publications, Pipe jacking—Design guidelines and concrete pipe jacking—Technical Bulletin.

#### **Location of services**

The 'Dial Before You Dig' Service, telephone 1100, shall be contacted to obtain locations of water, sewer, stormwater, gas, electricity and telephone services, during the preparation of the Method Statement.

#### **Services verification**

The Utility Authorities' contact names listed in 0179 *General requirements (Construction)* shall also be contacted to verify the location of services, during the preparation of the Method Statement.

## **2 CONSTRUCTION**

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### **2.1 CONDUIT**

#### **Concrete pipe strength**

For precast concrete pipes, the strength of the conduit shall be verified by the Contractor as adequate for the purpose utilising the methodology set out in AS 3725 with reference to AS 4058, for cracking load test parameters, and the Contractor's own determination of appropriate soil parameters.

The ultimate load for the conduit is to exceed cracking load by a factor of safety of 50%.

#### **Other pipe strengths**

The Contractor shall provide similar and equivalent verification if the conduit does not comprise precast reinforced concrete pipe.

#### **Load testing**

The conduit shall not be installed until the Contractor has produced documentary evidence to the Superintendent that appropriate load testing as required by Australian Standards and this worksection has been carried out and the representative specimens have satisfied the appropriate requirements.

This action constitutes a **HOLD POINT**.

The Superintendent's approval of the documentary evidence is required prior to the release of the hold point.

### **2.2 INSTALLATION**

The installation shall provide for the following performance requirements:

- The installation of the conduit by open trenching shall not be permitted over the length designated for trenchless techniques.
- Where appropriate, voiding around the conduit shall be eliminated by grouting prior to completion of works, with material and methodology of grouting described in the Method Statement.
- The line and grade of the conduit shall comply with the Drawings within the tolerances indicated on the Drawings or stated in **Tolerances** when not explicitly shown on the Drawings.
- After installation all joints shall be flush to the internal conduit walls and watertight.
- After installation of the conduit laid by trenchless techniques and prior to any grouting procedures, bulkhead walls shall be established at locations shown on the Drawings. Such bulkheads shall comply with **Bulkheads**.
- The installation of the conduit shall not affect any adjacent building foundations and shall provide for consistent support prior to, during and after installation.
- The installation of the conduit shall not endanger the stability or health of the root systems of trees to be retained as designated by the Superintendent in conjunction with Council's Tree Preservation Officer.

### **2.3 TOLERANCES**

The conduit shall be installed in accordance with the horizontal and vertical alignment as shown on the Drawings subject to the following definition of tolerances:

- The position of both the inlet and outlet of the conduit shall be determined by a registered Surveyor and shall comply with the Drawings for horizontal position to a tolerance of  $\pm 30$  mm.
- Vertical tolerance at the inlet/outlet of the conduit where installation commences shall be  $\pm 10$  mm.
- The average grade of the conduit shall comply with the grade as shown on the Drawings  $\pm 0.05\%$ .
- The conduit alignment at all joints will be true with a tolerance of  $\pm 5$  mm deflection in any direction at 1.5 m from the joint.

## 2.4 PERMANENT AND TEMPORARY PITS

### Excavation

Any permanent and/or temporary pits established for purposes of installation shall be constructed in accordance with 1351 *Stormwater drainage (Construction)*.

### Temporary pits

Backfilling of temporary pits shall comply with the backfilling and compaction requirements of 1351 *Stormwater drainage (Construction)*.

The surface of temporary pits, after backfilling, shall be restored to pre-construction condition as in accordance with 1151 *Road openings and restoration*.

### Permanent pit construction

Permanent pits or access chambers, located at the pits used for trenchless conduit installations, shall be constructed to the details as shown on the Drawings and in accordance with the appropriate Specification following demobilisation of the trenchless conduit installation equipment.

Backfill and compaction around permanent pits or access chambers shall be in accordance with 1351 *Stormwater drainage (Construction)*.

## 2.5 BULKHEADS

### Grout loss

Bulkheads shall be constructed in accordance with the Drawings or as nominated in the Method Statement submitted.

They shall be built in reinforced concrete as detailed in the Drawings, and fabricated to bond to the conduit so as to exclude direct grout pressure loss at the conduit/soil interface.

### Installation sequence

Bulkheads shall be constructed, and any grouting undertaken, prior to construction of adjacent conduits installed under conventional trench techniques so as to prevent undermining of the previously installed trenchless conduit.

## 2.6 CONCRETE WORK

For all concrete work, the Contractor shall comply with 0310 *Minor concrete work* in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

Measurement and payment

## 2.7 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed in this worksection on a schedule of rates basis, in accordance with the Pay Items 1392.1 to 1392.5.

A lump sum price for any of these items, except item (a), shall not be accepted.

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

Excavation for permanent pits or access chambers is measured and paid in accordance with 1351 *Stormwater drainage (Construction)*.

Excavation and backfilling for temporary pits, including additional excavation and backfill at permanent pits sites, is measured and paid in this worksection and not 1351 *Stormwater drainage (Construction)*.

Restoration for temporary pits is measured and paid in accordance with this worksection and not 1151 *Road openings and restoration*.

Construction of, and backfilling for, permanent pits or access chambers is measured and paid in accordance with the appropriate conjunctive Specifications.

Bulkheads are measured and paid in accordance with this worksection and not 0310 *Minor concrete work*.

## 2.8 PAY ITEMS

### 1392.1 Mobilisation, establishment and demobilisation

The unit of measurement shall be an item.

The sum shall include all activities involved in the mobilisation, establishment and demobilisation of the trenchless conduit installation equipment and facilities.

The sum shall be all inclusive.

### 1392.2 Trenchless installation of conduit

The unit of measurement shall be the plan linear metre measured in the plane including access pits along the centreline of each particular type, class and size of conduit installed by trenchless techniques.

The schedule rate shall include:

- Survey and setting out.
- Supply of conduit.
- Installation.
- Jointing.
- Lining.
- Grouting.
- Excavation, removal and disposal.
- Temporary pits, excavation, backfill and restoration.

### 1392.3 Bulkheads

The unit of measurement shall be 'each' bulkhead completed.

The rate shall include all activities and materials required to complete the bulkhead structures as shown on the Drawings.

### 1392.4 Excavation for temporary pits

The unit of measurement shall be the cubic metre measured as bank volume of excavation.

The schedule rate 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 plan area for payment shall be the area calculated from the outside dimensions of the pit as shown on the Drawings. The depth shall be determined from the actual site measurement of the distance from the surface at the time of excavation to the base of the pit.

### 1392.5 Backfill for temporary pits

The unit of measurement shall be the cubic metre of compacted material.

The schedule of rate shall include backfill and compaction in layers as specified and restoration of surface to pre-construction condition.