

TWEED SHIRE COUNCIL

DEVELOPMENT
CONSTRUCTION
SPECIFICATION

C402

SEWERAGE SYSTEM

VERSION 1.11

SPECIFICATION C402 - SEWERAGE SYSTEM

CLAUSE	CONTENTS	PAGE
CITATION		5
ORIGIN OF DOCUMENT, COPYRIGHT		5
VERSIONS, C402 SEWERAGE SYSTEM.....		5
GENERAL		8
C402.01 SCOPE.....		8
C402.02 REFERENCE DOCUMENTS.....		8
MATERIALS.....		12
C402.03 GENERAL		12
C402.04 UNPLASTICISED AND MODIFIED PVC (uPVC and PVC-M) PIPE AND FITTINGS.....		12
C402.05 POLYETHYLENE (PE) PIPE AND FITTINGS		13
C402.06 GLASS REINFORCED PLASTIC (GRP) PIPE AND FITTINGS		13
C402.07 DUCTILE IRON (DI) PIPE AND FITTINGS		13
C402.08 STEEL PIPELINE.....		13
C402.09 VITRIFIED CLAY		14
C402.10 PREFORMED/PRE-CAST MAINTENANCE HOLES (MH)		14
C402.11 PREFORMED MAINTENANCE SHAFTS (MS) AND TERMINAL MAINTENANCE SHAFTS (TMS) INCLUDING COVER		14
C402.12 MAINTENANCE HOLE COVERS AND FRAMES		14
C402.13 STEELWORK.....		14
PIPELINE CONSTRUCTION.....		14
C402.14 GENERAL		14
C402.15 LOCATION.....		14
C402.16 COVER OVER PIPELINES.....		15
C402.17 CROSSINGS.....		15
C402.18 EARTHWORKS		16

C402.19	MINIMUM TRENCH WIDTH FOR PIPELINES.....	16
C402.20	MAXIMUM TRENCH WIDTH.....	17
C402.21	EXCAVATION DEPTH.....	17
C402.22	SUPPORT OF EXCAVATION	18
C402.23	PIPE BEDDING.....	18
C402.24	LAYING AND JOINTING OF PIPES.....	19
C402.25	CONNECTIONS TO MAINTENANCE HOLES AND STRUCTURES	21
C402.26	JUNCTIONS AND PROPERTY CONNECTION SEWERS.....	22
C402.27	MARKING OF JUNCTIONS AND PROPERTY CONNECTION SEWERS.....	22
C402.28	TRENCH STOPS.....	23
C402.29	CONCRETE BULKHEADS	23
C402.30	THRUST AND ANCHOR BLOCKS FOR RISING MAINS.....	24
C402.31	RISING MAIN FITTINGS	24
C402.32	CONCRETE ENCASEMENT.....	25
C402.33	WRAPPING OF PIPELINES.....	25
C402.34	CORROSION PROTECTION OF STEEL BOLTS AND NUTS	26
C402.35	CAST-IN-SITU MAINTENANCE HOLES.....	26
C402.36	COVERS AND FRAMES	27
C402.37	STEP IRONS (DELETED).....	27
C402.38	PREFORMED/PRE-CAST MAINTENANCE HOLE AND MAINTENANCE SHAFT SYSTEMS	27
PIPELINE TESTING AND RESTORATION		28
C402.39	GENERAL	28
C402.40	INITIAL TEST OF GRAVITATION SEWERS	28
C402.41	INITIAL TEST OF MAINTENANCE HOLES.....	29
C402.42	ACCEPTANCE TEST OF GRAVITATION SEWERS AND MAINTENANCE HOLES	30
C402.43	TESTING GRAVITY MAINS WITH COMPRESSED AIR	31
C402.44	ALLOWABLE PRESSURE DROP TIMES.....	32
C402.45	HYDROSTATIC TESTING OF GRAVITY MAINS	32
C402.46	VISUAL INSPECTION AND MEASUREMENT OF INFILTRATION.....	33

SEWERAGE SYSTEM

C402.47	TESTING OF RISING MAINS.....	33
C402.48	BACKFILL AND COMPACTION	35
C402.49	RESTORATION OF SURFACES	36

PUMP STATIONS37

C402.50	PUMPS.....	37
C402.51	PREFORMED PUMP STATIONS AND PACKAGE PUMP STATIONS.....	39
C402.52	ELECTRICAL COMPLIANCE	39
C402.53	SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA), CONTROLS	40
C402.54	ELECTRICAL INSTALLATION	41
C402.55	PRESSURE TEST POINTS.....	43
C402.56	VALVES	43
C402.57	TESTING AND COMMISSIONING OF PUMP STATION.....	44
C402.58	PRACTICAL COMPLETION OF PUMP STATION.....	45
C402.59	TELEMETRY.....	45

CONSTRUCTION COMPLIANCE46

C402.61	WORK-AS-EXECUTED DETAILS.....	46
C402.62	OPERATION AND MAINTENANCE MANUALS	46

SPECIAL REQUIREMENTS46

C402.64	CCTV INSPECTION	46
C402.65	WHAT IS TO BE INSPECTED.....	47
C402.66	PRE INSPECTION CRITERIA.....	47
C402.67	INSPECTION CRITERIA	47
C402.68	ACCEPTANCE CRITERIA.....	48
C402.69	CCTV SUBMISSION.....	48
C402.70	IF REMEDIATION WORKS ARE REQUIRED.....	49
C402.71	RESERVED	49




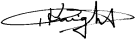

CITATION

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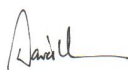

ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on AUS-SPEC - Development Construction Specification C402 - Sewerage System, March 2002 (Copyright SWR-TM). Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Tweed Shire Council Development Specification. The parts of the AUS-SPEC document that remain are still subject to the original copyright.



VERSIONS, C402 SEWERAGE SYSTEM

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering and Operations
1.1	Original Version		1 July 2003	
1.2	Update references to WSA, Australian Standards, TSC specifications and standard drawings Marking tape for mains/rising mains Marking plates for rising mains and fittings O&M manual handover requirements Update pipeline testing requirements to match field practices	C402.02 and all references C402.24-18; C402.27-5 C402.31 C402.60-9 C402.43-47	23 June 2006	
1.3	Expanded CCTV inspection criteria and reporting Renumbered clauses	C402.64-70, C402.63 deleted C402.71-72	12 January 2007	
1.4	Clarify maintenance hole cover frame sizing	C402.12.1	11 April 2007	
1.5	Updated references to Standard Drawings and WSAA Water Supply Code. Reference new Mechanical and Electrical Specifications to replace MEW E101 Trench stops of cement stabilised sand bags or concrete bulkheads required for grades 5% to 14%. Clarify height requirements for trench stops. Delete step iron clause Pipeline testing not to commence until all utility services installed in the area. Reduce test duration from 8 to 4 hours. Adopt WASA formula	Various C402.28.1 C402.37 C402.47	18 August 2010	

SEWERAGE SYSTEM

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering and Operations
	for allowable leakage and specify 1000m max test length. Specify CD/DVD contents and format for CCTV inspections	C402.69		
1.6	Amend minimum trench widths, to provide minimum 450mm Clarify height requirements for bulkheads, in line with trench stops	Table C402.1 C402.29	19 March 2013	
1.7	Addition of revised/new standard drawings Delete compressed air rising main testing alternative	C402.02.2(d) C402.47.12	28 August 2014	
1.8	Amend/Addition to reference documents Expanded CCTV reporting requirements Replace all references to SWAC with "Certifying Engineer" Remove references to AS1289.5.7.1	C402.02 C402.69 Various C402.01, C402.48	5 February 2016	
1.9	Amend/Addition to reference documents Inclusion of Covers & MH's Deletion of Steps & ladders in manholes Inclusion of Minimum Cover Table Removal of Maximum trench width detail Amend from detectable to traceable wire Inclusion of cast-in-situ Inclusion of pre-cast Inclusion of visual inspection testing Inclusion of Test Pressure Delete Hold Point Inclusion of AS3000 reference Delete SCA requirements (various) Additions to Electrical Installation Delete Pressure Gauges	C402.02 & Various C402.12 C402.13 & C402.38 C402.19 C402.20 C402.24 & 27 C402.35 C402.38 C402.40 C402.47 C402.50 C402.52 C402.53 C402.54 C402.55	22 February 2017	

SEWERAGE SYSTEM

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering and Operations
	requirements (various) Delete Valves (various) Additions and Deletions Testing and Commissioning of Pump Station (various) Additions and Deletions Practical Completion of Pump Station Additions and Deletions Operation and Maintenance Manuals (various)	C402.56 C402.57 C402.58 C402.60		
1.10	Addition of Standard Design plans Amendments to Thrust and Anchor Blocks for Rising Mains Update testing of rising mains	C402.02 C402.30 C402.47	18 January 2022	
1.11	Addition of Standard Design plans	C402.02	24 May 2022	

DEVELOPMENT CONSTRUCTION SPECIFICATION C402

SEWERAGE SYSTEM

GENERAL

C402.01 SCOPE

1. This specification is for construction of: ***Suitable Works***
 - (a) Gravitation sewers up to DN600 nominal size;
 - (b) Common Effluent sewers, both gravity and pressurised;
 - (c) Vacuum Sewerage Systems;
 - (d) Rising mains up to DN600 nominal size;
 - (e) Standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers;
 - (f) Small pump stations, usually limited to single wells with submersible pumps.

2. This Specification excludes the construction activities for: ***Exclusions***
 - (a) Treatment plants;
 - (b) Headworks;
 - (c) Dosing plant;
 - (d) Larger pump stations;
 - (e) Works controlled by others, including overflow management

3. The Subdivider 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 Services Association of Australia's publication GRAVITY SEWERAGE CODE OF AUSTRALIA, SEWERAGE PUMPING STATION CODE OF AUSTRALIA and PRESSURE SEWERAGE CODE OF AUSTRALIA, except as otherwise specified herein. Sewerage works should be designed in accordance with the DEVELOPMENT DESIGN SPECIFICATION D12 – SEWERAGE SYSTEM. ***Compliance***

4. For the purposes of this Specification, 'access chambers' are referred to as 'maintenance holes'. ***Terminology***

C402.02 REFERENCE DOCUMENTS

1. Documents referenced in this Specification are listed below whilst being cited in the text in the abbreviated form or code indicated. The Subdivider shall possess, or have access to, the documents required to comply with this Specification. ***Documents***

2. Where parallel sections or equivalent clauses to the reference SEWERAGE CODE OF AUSTRALIA is called up as part of this Specification, these references are identified by part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section). **Sewerage Code**

(a) Council Specifications

- | | | |
|-----------|---|---|
| C271 | - | Development Construction Specification "Minor Concrete Works" |
| C201 | - | Development Construction Specification "Control of Traffic" |
| C211 | - | Development Construction Specification "Control of Erosion and Sedimentation" |
| D12 | - | Development Design Specification "Sewerage System" |
| D13 | - | Development Design Specification "Engineering Plans (Subdivisions)" |
| EL01-EL19 | - | Electrical Specifications |
| ME01-ME04 | - | Mechanical Specifications |

(b) Australian Standards

References in this Specification or on the design plans to Australian Standards are noted by their prefix AS or AS/NZS. **Australian Standards**

Where not otherwise specified in this Specification or the design plans, the Subdivider shall use the latest Australian Standard, including amendments and supplements, available within two (2) weeks of close of tenders. **Currency**

- | | | |
|---------------|---|---|
| AS/NZS 1111 | - | ISO metric hexagon commercial bolts and screws |
| AS/NZS 1112 | - | ISO metric hexagon nuts, including thin nuts, slotted nuts, and castle nuts |
| AS 1152 | - | Specification for test sieves |
| AS/NZS 1260 | - | PVC pipes and fittings for drain, waste and vent applications |
| AS 1272 | - | Unsintered PTFE tape for thread sealing applications |
| AS 1289.5.4.1 | - | Compaction control test – Dry density ratio, moisture variation and moisture ratio |
| 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/NZS 1477 | - | PVC pipes and fittings for pressure applications |
| AS 1565 | - | Copper and copper alloys – Ingots and castings |
| AS 1579 | - | Arc welded steel pipes and fittings for water and wastewater |
| AS/NZS 1594 | - | Hot-rolled steel flat products |
| AS 1627.4 | - | Metal finishing – Preparation and pre-treatment of surfaces- 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 for electrical equipment |
| AS 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/NZS 2280 | - | Ductile iron pressure pipes and fittings |
| AS 2528 | - | Bolts, studbolts and nuts for flanges and other high and low temperature applications |

SEWERAGE SYSTEM

- AS/NZS 2566.1 - Buried flexible pipelines – Structural design
- AS 2837 - Wrought alloy steels – Stainless steel bars and semi-finished products
- AS/NZS 3000 - Electrical installations (Wiring Rules)
- AS/NZS 3008 - Electrical installations – Selection of cables
- AS 3439 - Low-voltage switchgear and control gear assemblies
- AS 3518 - Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications
- 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
- 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 - Metal access covers, road grates and frames
- AS 4058 - Precast concrete pipes (pressure and non-pressure)
- AS 4060 - Loads on buried vitrified clay pipes
- AS 4087 - Metallic flanges for waterworks purposes
- AS/NZS 4129 - Fittings for polyethylene (PE) pipes for pressure applications
- AS/NZS 4130 - Polyethylene (PE) pipes for pressure applications
- AS 4198 - Precast concrete access chambers for sewerage applications (Read ‘maintenance hole’ for ‘access chamber’)
- AS/NZS 4321 - Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
- AS/NZS 4680 - Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
- AS/NZS 4765(Int) Modified PVC (PVC-M) pipes for pressure applications
- AS 4794 - Non return valves – Swing check and tilting disc

(c) Other

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)

PWD - Safety Guidelines for fixed ladders, stairways, platforms and walkways for use in sewerage treatment works, pumping stations and maintenance holes.

Building Codes Board of Australia

- Building Code of Australia - PART E1, Fire Fighting Equipment.

Plumbing Code of Australia (PCA)

European Standard.

BS EN 1091 - Vacuum Sewerage Systems

NSW Department of Commerce

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

Water Services Association of Australia (WSAA)

WSA 02–2014 - GRAVITY SEWERAGE CODE OF AUSTRALIA

WSA 04–2005 - SEWERAGE PUMPING STATION CODE OF AUSTRALIA

WSA 06-2008 - VACUUM SEWERAGE CODE OF AUSTRALIA

WSA 07-2007 - PRESSURE SEWERAGE CODE OF AUSTRALIA
 WSA 2007- Product and Material Information and Guidance
 WSA 02-2002 - SEWERAGE CODE OF AUSTRALIA (STANDARD DRAWINGS)
 WSA PRODUCT SPECIFICATIONS FOR PRODUCTS AND MATERIALS –
 WSA PS 200 TO 404 (Where Relevant)

(d) Standard Design plans that apply to this section;

Tweed Shire Council (TSC) Standard Drawings

S.D.110	Interallotment Drainage/Sewerage Location Diagram
S.D.220/01	2.0m diameter Pump Station - Site Layout
S.D.220/02	2.0m diameter Pump Station - Standard Notes
S.D.220/03	2.0m diameter Pump Station - General Arrangement
S.D.220/04	2.0m diameter Pump Station - Sectional Plan and Section 'A'
S.D.220/05	2.0m diameter Pump Station - Concrete Reinforcing
S.D.220/06	2.0m diameter Pump Station - Details
S.D.221/01	Pump Station Access Covers Drawing Index, Notes and Legend
S.D.221/02	Wet-Well Access covers Opening Options
S.D.221/03	Valve Chamber Access Covers Opening Options
S.D.221/04	Wet-Well Handrails Arrangement Options
S.D.221/05	Wet-Well Access Covers with Handrails General Arrangement Plans
S.D.221/06	Wet-Well Access Covers with Handrails Details
S.D.221/07	Wet-Well Access Covers Supported by Safety Grate Details
S.D.221/08	Valve Chamber Access Covers General Arrangement Plans
S.D.221/09	Valve Chamber Access Covers and Safety Grate Details
S.D.221/10	Handrails and Toeboards Details
S.D.221/11	Miscellaneous Details – 1 of 2
S.D.221/12	Miscellaneous Details – 2 of 2
S.D.230	Horizontal Thrust Blocks Sewer Mains – Test Pressure 800kPa
S.D.231	Thrust and Anchor Blocks for Vertical Bends Sewer Mains – Test Pressure 800kPa
S.D.232	Thrust Blocks for Valves and Inline Thrust Sewer Mains – Test Pressure 800kPa
S.D.240	Sluice Valve Installation Details
S.D.242	Automatic Air Valve Installation Details
S.D.243	Manual Air Valve Installation Details
S.D.244	Sewerage Rising Main Discharge Chamber
S.D.250	Property Connection Details - Type A and Type B
S.D.251	Property Connection Details - Type C1 and Type C2
S.D.252	Property Drain Connection to Council Sewer
S.D.260	Pressure Sewerage Systems Property Service Layout
S.D.261	Pressure Sewerage Systems Typical Details
S.D.262	Pressure Sewerage Systems House Drain Connection Details

SEWERAGE SYSTEM

S.D.263	Pressure Sewer Rising Main Connection of Single Household Pump to Council Gravity Sewer
S.D.272	Control Building for Sewage Pumps Up To 80kW - Tilt-Up Panel Construction (Sheets 01-09)
S.D.273	Control Building for Sewage Pumps Up To 80kW - Blockwork Construction (Sheets 01-09)
S.D.276	Trench Drainage Bulk Heads and Trench Stops
S.D.277	10m Vent Stack
S.D.278	Maintenance Holes for Sewers <= 300mm Diameter
S.D.820	Sewage Pump Stations 0.1-22.5kW Electrical Standard Drawings SCADA Pack 350 Controller (Sheets 00-17)

Sewerage Code of Australia drawings are to be used in preference to DPWS Standard Drawings WSA 02-2002,4, Standard Drawings SEW-1100 to 1500 Series)

Sewerage Pumping Station Code of Australia (WSA 04-2005 Standard Drawings)

Tweed Shire Council Drawings shall take precedence over Sewerage Code of Australia Drawings. **Precedence**

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

MATERIALS

C402.03 GENERAL

1. The Subdivider shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this Specification. **Due Diligence**
2. The Subdivider shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits. **Rejection**
3. All gravity reticulation pipes shall be rubber ring (elastomeric), complying with AS 1646, jointed to the type, size and class as shown on the design plans. **Pipes**

C402.04 UNPLASTICISED AND MODIFIED PVC (uPVC and PVC-M) PIPE AND FITTINGS

1. Unplasticised PVC (uPVC) 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 design plans. (WSA 02-2014, 1, 4) **Non-pressure Pipe PVC**
2. Unplasticised PVC (uPVC) pipes and fittings for rising mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints shall be of the class and size as shown on the design plans. Modified PVC (PVC-M) pipes and fittings shall comply with AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design plans. **Pressure Pipe PVC**
3. PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS 2032 and AS/NZS 2566.1. **Installation**

4. Pipes and fittings are to be handled and stored protected from sunlight. The Subdivider shall provide protection for the pipes and fittings from ultra violet light and damage. The Subdivider shall take account of the time for storage and type of shelter. **Protection**

C402.05 POLYETHYLENE (PE) PIPE AND FITTINGS

1. Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the design plans and installed in accordance with AS 2033. (WSA 02-2014, 1, 4) **Standard**
2. Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings. **Jointing**
3. The Subdivider shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design plans. **Internal Diameter**

C402.06 GLASS REINFORCED PLASTIC (GRP) PIPE AND FITTINGS

1. Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571 and shall be of the class and size as shown on the design plans and installed in accordance with AS/NZS 2566.1. (WSA 02-2014, 1, 4) **Standard**
2. Pipes and fittings are to be handled and stored protected from sunlight. The Subdivider shall provide protection for the pipes and fittings from ultra violet light and damage. The Subdivider shall take account of the time for storage and type of cover. **Protection**

C402.07 DUCTILE IRON (DI) PIPE AND FITTINGS

1. 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 design plans, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric) to the class and type as shown on the design plans. (WSA 02-2014, 1, 4) **Standard**
2. Flanges shall be to the table shown on the design plans. Bolts and nuts for flanged joints shall be stainless steel, unless shown otherwise on the design plans. **Flanges**
3. All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS 4321, or wrapped. The Subdivider shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Certifying Engineer. **Corrosion Protection**

C402.08 STEEL PIPELINE

1. Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the design plans. (WSA 02-2014, 1, 4) **Standard**
2. The Subdivider shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Certifying Engineer. **Corrosion Protection**
3. The jointing system shall be rubber ring (elastomeric) unless shown otherwise on the design plans. **Joints**

SEWERAGE SYSTEM

C402.09 VITRIFIED CLAY

1. 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 design plans and suitable for rubber ring (elastomeric) joints. (WSA 02-2014, 1, 4) **Standard**

C402.10 PREFORMED/PRE-CAST MAINTENANCE HOLES (MH)

1. Preformed/Pre-CAST maintenance hole components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete. (WSA 02-2014, 1, 5 & 2, 17) **Standard**

C402.11 PREFORMED MAINTENANCE SHAFTS (MS) AND TERMINAL MAINTENANCE SHAFTS (TMS) INCLUDING COVER

1. Where approved by TSC, preformed/pre-cast maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete. (WSA 02-2014, 1, 5 & 3, 18, SEW-1314, SEW-1316) **Standard**

C402.12 MAINTENANCE HOLE COVERS AND FRAMES

1. Maintenance hole covers and frames shall comply with AS 3996 and shall be solid top, marked with SAN-SEW, size and class as shown on the design plans. Frames shall be standard width of 600mm diameter or 600mm x 900mm opening and shall be ductile iron Grade 600/B in accordance with AS 1831. Covers shall be lightweight ductile iron hinged with a rubber watertight seal and be the appropriate class for the traffic loading. (EJ Maestro Access Covers or similar) **Ductile Iron**
2. Concrete covers and frames shall comply with AS 4198 and shall be of the size and, either Heavy or Light, class as shown on the design plans. **Concrete**

C402.13 STEELWORK

1. Structural steelwork, including 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. **Corrosion Protection**

PIPELINE CONSTRUCTION

C402.14 GENERAL

1. The Subdivider shall not change the pipeline alignment without the prior concurrence of TSC. The Subdivider shall provide full details, of any proposed changes to the pipeline alignment, to the Certifying Engineer for submission to TSC. This action constitutes a **HOLD POINT**. The Certifying Engineer shall obtain the decision of TSC prior to the release of the hold point.

HP

C402.15 LOCATION

1. 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 **Pipe Laying Method**

design plans. The Subdivider shall commence laying of pipelines at the lower end of the line unless directed otherwise by the Certifying Engineer. The Subdivider shall lay pipelines to grades and locations shown on the design plans unless directed otherwise by the Certifying Engineer. (WSA 02-2014, 2, 12.1 & 12.2).

C402.16 COVER OVER PIPELINES

1. The minimum depth of cover to be provided over pipelines shall be as follows: **Minimum Cover**

LOCATION	MINIMUM COVER (mm)
Private property non vehicular (New & Existing Developments)	600
Private property vehicular	750
Footpaths, sealed roads (non Arterial)	900
Unsealed roads	1200
Arterial roads	1200

Table C402.1 - Minimum Cover over Sewer

2. Lesser covers may be permitted where special protection of the pipelines has been shown on the design plans or directed by the Certifying Engineer. **Special Protection**

C402.17 CROSSINGS

1. Where a pipeline crosses a Main or State road, creek or involves features shown on the design plans, under the control of any Authority, the Subdivider shall carry out the work in accordance with the requirements of that Authority. The Subdivider shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees (WSA 02-2014, 2, 16.13). The Subdivider shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Certifying Engineer if requested. This action constitutes a **WITNESS POINT**. The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to request the written approval is to be exercised. **Subdivider's Responsibility**

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2. Where shown on the design plans, the Subdivider 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. (WSA 02-2014, 2, 12.5.2 & 16.12). **Existing Road Crossings**

3. The Subdivider shall address, in its Method Statement for trenchless conduit installation, the following:- **Trenchless Installation Methodology**
- (a) General description of method and sequence of operation.
 - (b) Size, depth and position of temporary pits required.
 - (c) Encasement pipe and carrier pipe material and size.
 - (d) Use of specialist subcontractors.
 - (e) Specialist equipment to be used.
 - (f) Grout type and method of injection.

4. The encasement pipe shall be as detailed on the design plans. The encasement **Encasement**

SEWERAGE SYSTEM

- pipe shall extend 1.0m behind the back of the kerb on either side of the carriageway. **Pipe**
5. The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe. **Support Cradles**
6. After installation and pressure testing of the carrier pipe, the Subdivider shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler. (WSA 02-2014, 23, 16.12) **Grouting**
7. The carrier pipe must have white internal pipe wall surface. 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 tubing.

C402.18 EARTHWORKS

1. The Subdivider shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design plans, or as directed by the Certifying Engineer, within the specified tolerances. The Subdivider 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. (WSA 02-2014, 2, 14). **Subdivider's Responsibility**
2. The Subdivider shall leave a clear space of 600mm 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. (WSA 02-2014, 2, 13.3 & 14). **Excavated Material**
3. At the completion of work each day, the Subdivider shall install safety fencing to Statutory requirements along the edges of open excavations to isolate them from the public. The Subdivider 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. (WSA 02-2014, 2, 14) **Public Safety**
Access to Property
4. The Subdivider shall locate, protect and repair, as necessary, all services affected by the Works at the Subdivider's expense. (WSA 02-2014, 2,14) **Existing Services**
5. The Subdivider shall carry out erosion and sedimentation control at all construction sites in accordance with TSC C211 – Control of Erosion and Sedimentation. **Erosion Control**
6. The Subdivider shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 02-2014, 2, 14) **Limiting Excavations**

C402.19 MINIMUM TRENCH WIDTH FOR PIPELINES

1. The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table C402.2. (WSA 02-2014, 2, 14.2).

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	450	450
100	450	450
150	450	450
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

Table C402.2 - Minimum Trench Widths

2. Where the design plans 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 Certifying Engineer, so as to provide a neat straight line free from broken ragged edges. (WSA 02-2014, 2, 14) **Minimum Disturbance**
3. The Subdivider shall widen the trench where necessary for the installation of valves and fittings and protective coating systems. **Widen For Fittings**

C402.20 MAXIMUM TRENCH WIDTH

1. 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. The Certifying Engineer may, however, restrict the width of trench due to local conditions. **Width Restrictions**
2. For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580mm plus the outside diameter of the pipe barrel. **PVC/PE Pipe**
3. The Subdivider shall supply a method statement of any special construction control, where shown on the design plans, to the Certifying Engineer's approval. **Special Controls**

C402.21 EXCAVATION DEPTH

1. The Subdivider shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for rising mains to be laid on other than rock foundations or as otherwise shown on the design plans. (WSA 02-2014, 2, 14.10) **75mm Below**
2. 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 **Pipe Support**

SEWERAGE SYSTEM

and wrapping.

C402.22 SUPPORT OF EXCAVATION

- 1. The Subdivider shall adequately support all excavations to Statutory requirements as the Works proceed. When withdrawing supports, the Subdivider shall exercise every precaution against slips or falls. (WSA 02-2014, 2, 14.5). **Precaution Against Slips or Falls**
- 2. The Subdivider shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation. **Timber Left in Place**

C402.23 PIPE BEDDING

- 1. When excavation of the trench has been completed the Subdivider shall obtain the Certifying Engineer's approval prior to commencing pipe laying, jointing and bedding. This action constitutes a **HOLD POINT**. The Certifying Engineer's approval of the excavated trench is required prior to the release of the hold point. **Approval**

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- 2. Crusher screenings may only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Subdivider can demonstrate that its use will not impede repair operations. (WSA 02-2014, 2, 15). **Crusher Screenings**
- 3. 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 75mm below the barrel and socket of the pipe, and its grading shall generally fall within the following limits shown in Table C402.3. **Gravity Sewers Pipes other than PVC/PE**

Sieve Size Aperture Width (AS1152)	Equivalent BS Sieve Size (BS410)	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

Table C402.3 - Grading of Bedding Material for Pipes Other Than PVC and PE

- 4. Pipes for rising mains (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Subdivider shall provide non-cohesive granular bedding, having a minimum thickness of 75mm 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 Certifying Engineer. The bedding material shall be either loose clean sand and /or medium dense clean sand or as directed by the Certifying Engineer. **Rising Mains Pipes other than PVC/PE**
- 5. For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 75mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150mm above the top of the pipe) 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 C402.4, except that where the materials cannot be reasonably sourced from within the vicinity, the Subdivider may use materials satisfying the classification in paragraph 2 above provided also that the material meets the requirements for passing sieve sizes 9.5mm and 6.7mm as shown in Table C402.3. **PVC/PE Pipes**

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

Table C402.4 - Grading of Bedding Material for PVC and PE Pipes

6. Use embedment materials that:

Embedment Materials

- (a) Comply with the maximum particle sizes in Table C402.5
- (b) Comply with the Purchase Specification for embedment materials as nominated in the Design drawings or Specification

Pipe Diameter (DN)	Maximum Particle Size (mm)	Bedding Materials
≤ 160	10	Sand or Crusher screenings
>160	20	Aggregate, Sand or Crusher screenings

Table C402.5 – Maximum Particle Size

7. The Subdivider shall bed all gravitation sewers laid on grades of 15 per cent to 50 per cent on 20MPa concrete complying with C271 – Minor Concrete Works. Such concrete bedding shall have a thickness of at least 75mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe and a width across the trench not less than the minimum width shown in Table C402.2. **15-50% Grades**
8. The Subdivider shall encase all gravitation pipelines and rising mains, laid on grades steeper than 50 per cent, in concrete as detailed on the design plans. **Grades Greater Than 50%**

C402.24 LAYING AND JOINTING OF PIPES

1. Unless detailed otherwise in this Specification, the Subdivider shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate. (WSA 02-2014, 2, 16). **Installation**
2. Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Subdivider and, if required by the Certifying Engineer, the Subdivider shall suspend each one in a sling to enable the Certifying Engineer to inspect it. If directed by the Certifying Engineer, the Subdivider shall oil valves and repack valve glands. **Examination**
3. The Subdivider 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. **Cleaning**
4. The Subdivider shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Subdivider shall remove any temporary supports prior to completion of backfilling. **Flotation**
5. Except where solvent cement joints are needed to make up or install fittings, **Joint Type**

SEWERAGE SYSTEM

joints in pipelines shall be flexible, rubber ring (elastomeric) joints (either roll-on rubber ring (elastomeric) or skid type) or, where shown on the design plans, mechanical joints (either fixed flange or bolted gland type). (WSA 02-2014, 2,16.1)

6. For pipes with roll-on rubber ring (elastomeric) joints, spigots and sockets shall be clean and dry. The Subdivider, after making the joint, shall check that the rubber ring (elastomeric) has rolled in evenly, and, if not, the Subdivider shall withdraw the pipe and remake the joint. **Roll-on Rubber Ring**
7. For pipes with skid type rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Subdivider shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket. **Skid Rubber Ring**
8. Pipes may be cut as needed, or directed by the Certifying Engineer, to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting. **Cut Pipes**
9. For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Subdivider shall ensure that fire-fighting equipment, in working order, is on the site prior to the field cuts being made. If the Subdivider proposes to use a petrol-engine pipe cutter in an excavation, the Subdivider shall ensure that a safe atmosphere is maintained in the excavation at all times. **Pipe Cutting**
10. The Subdivider shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by the Certifying Engineer. **End Preparation**
11. Where pipes are cut in the field, the Subdivider shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe. The Subdivider shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Subdivider shall refer to the socket manufacturer for the correct marking depth. **Witness Mark**
12. Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows: **Different Joints**
 - (a) For jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, the Subdivider shall use a PVC/PE adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS 1646.
 - (b) For jointing PVC/PE to ductile iron, the Subdivider shall use a rubber ring (elastomeric) joint with an adaptor coupling.
13. The Subdivider shall conform with the relevant Statutory and OH&S requirements when cutting and disposing of asbestos cement pipes. **Existing AC Pipe**
14. Gravitation pipelines shall be constructed to the following tolerances: **Tolerances**
 - (a) The maximum horizontal deviations to either side from the design axis of a pipeline shall be 20mm for all sizes of pipes. (WSA 02-2014, 2, 22.1)
 - (b) The invert level shall not deviate from the design grade line by more than 10mm. (WSA 02-2014, 2, 22.2)
15. Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Subdivider shall comply **Joint Deflection**

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.

16. The maximum angle of deflection between adjacent pipes shall be limited to 2° or 0.035 radian in areas subject to mine subsidence or slippage. **Limit of Joint Deflection**
17. Unless otherwise directed by the Certifying Engineer, the Subdivider 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 Grade**
18. Cream traceable (stainless steel wire) warning tape shall be laid along the line of the rising main, positioned at either the interface between the bedding material and the backfill material, or 300mm above the top of the service when the backfill material is the same as the bedding material. (WSA 02-2014, 2, 16.11.2) **Rising Main Identification**
19. Prior to backfilling and compaction operations, the Subdivider shall undertake ovality tests of all pipelines for any abnormalities in pipe shape and rectify any unsatisfactory sections found to the satisfaction of the Certifying Engineer. The test results of such tests shall be made available to the Certifying Engineer. This action constitutes a **WITNESS POINT**. The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to inspect the test results is required. **Ovality Testing**

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C402.25 CONNECTIONS TO MAINTENANCE HOLES AND STRUCTURES

1. The Subdivider shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600mm long pipes such that two (2) flexible joints are provided, the first joint being at or within 150mm of the face of the structure. Where flexible joints cannot be made with cut pipes, the Subdivider shall select pipes from the various lengths provided in order to make the second joint within 300mm of the position shown on the design plans. (WSA 02-2014, 2, 17.8). **Flexible Joints**
2. The Subdivider may vary slightly the positions of maintenance holes shown on the design plans, subject to final approval by the Certifying Engineer 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: **Maintenance Hole Location**
- (a) For deviations from the design levels of maintenance holes as shown on the design plans or as directed by the Certifying Engineer during construction, the following tolerances shall apply: (WSA 02-2014, 2, 22). **Tolerances**
- (i) Where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100mm or less:

Pipe	Tolerance
Inlet	- nil; + 10mm
Outlet	- 10mm; + nil

- (ii) Where the difference in levels, as above, is greater than 100mm:

Pipe	Tolerance
Inlet	- 10mm; + 10mm

SEWERAGE SYSTEM

Outlet - 10mm; + 10mm

- (b) Allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.

3. The Subdivider 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 design plans or advised by the Certifying Engineer. Where shown on the design plans that work on “live” maintenance holes shall be performed by others, the Subdivider must co-ordinate the Works with any simultaneous and/or adjacent work by others. The Subdivider shall liaise with these Subdividers and Authorities to avoid disruption, delays and possible conflict. All Works undertaken by the Subdivider at “live” maintenance holes in completing the subdivision works shall be under supervision of TSC and at the cost to the Subdivider. (WSA 02-2014, 2, 23).

**Work on Live
Maintenance
Holes**

C402.26 JUNCTIONS AND PROPERTY CONNECTION SEWERS

The Subdivider shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this Specification and the design plans. Such junctions shall be inserted along pipelines in locations shown on the design plans or directed by the Certifying Engineer, with the service connection, where not shown on the design plans, provided at a depth no deeper than 1.5m provided the property still has service to the sewer, as follows: (WSA 02-2014, 2, 16.7 & 16.8)

Location

- (a) 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.
- (b) 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.

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

**Long Property
Connection
Sewers**

3. Junctions for risers shall be encased in 20MPa concrete complying with the Specification C271 MINOR CONCRETE WORKS.

**Concrete
Encasement**

4. Except where concrete encasement is ordered by the Certifying Engineer, the Subdivider 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 500mm upstream and downstream of the riser. Compaction density shall be as for the requirements for the trench pipeline.

Backfill

5. All property connection sewers and junctions shall have a minimum diameter of 150mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10m.

**Property
Connection
Sewer Caps**

C402.27 MARKING OF JUNCTIONS AND PROPERTY CONNECTION SEWERS

1. The Subdivider 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 (1) of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by TSC and to the approval of the

Location

Certifying Engineer. (WSA 02-2014, 2, 16.9).

- | | | |
|----|--|--------------------------|
| 2. | Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50mm high shall be painted thereon. An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible. | Adjacent to Fence |
| 3. | Elsewhere, the Subdivider shall drive into the ground, a peg, 75mm x 50mm x 600mm long at that position, and left flush with the surface of the surrounding ground. The Subdivider shall connect the peg to an underground identification tape as specified hereafter. | Peg |
| 4. | The Subdivider shall tie the identification tape to the junction or end of the property connection sewer and hold the tape in a vertical position during backfilling. The Subdivider shall spike the top end of the tape by the junction peg immediately upon completion of backfilling. (WSA 02-2014, 2, 16.11) | Tape Position |
| 5. | Cream traceable (stainless steel) warning tape shall be laid along the line of all mains. The tape is to be positioned at either the interface between the bedding material and the backfill material, or 300mm above the top of the service when the backfill material is the same as the bedding material. | Traceable Tape |

C402.28 TRENCH STOPS

- | | | |
|----|---|------------------------|
| 1. | Where a sewer or rising main is laid on bedding at a grade of 5 per cent to 14 per cent, the Subdivider shall construct, as below, trench stops consisting of bags filled with cement stabilised sand and sealed, or concrete bulk heads. Refer standard drawing S.D.276. | Grade 5% to 14% |
| | (a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm 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 extend to within 300mm below finished surface level, or up to a maximum 1 metre above the pipe obvert (whichever is the lesser). | |
| | (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. | |
| 2. | The distance between trench stops shall be determined by the following formula: | Spacing |

$$D = \frac{100}{G}, \text{ whereby}$$

D = Distance between stops in m,
G = Grade of pipe expressed in percentum.

C402.29 CONCRETE BULKHEADS

- | | | |
|----|---|---|
| 1. | Where a gravitation sewer or rising main is installed at a grade of 15 per cent to 29 per cent, the Subdivider shall construct concrete bulkheads. Where a gravitation sewer or rising main is installed at a grade 30 per cent to 50 per cent, the Subdivider shall construct concrete bulkheads integral with concrete encasement. Where a pipe is installed at a grade of 50 per cent and over, the Subdivider shall provide a site specific design. Bulkheads shall be of 20MPa concrete complying with the standard drawing (WSA02-2002, 4, SEW-1206), | Grade 15% to 29% and 30% to 50% and over 50% |
|----|---|---|

SEWERAGE SYSTEM

TSC C271 – Minor Concrete Works, and 150mm minimum thickness as follows:
(WSA 02-2014, 1, 9.10 & 2, 16.6)

- (a) Where concrete bedding or encasement to pipe is required, the 150mm 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 150mm. The bulkhead shall extend to within 300mm below finished surface level, or up to a minimum 1 metre above the pipe invert (whichever is the lesser).
- (b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.
- (c) A 75mm 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 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel 2 to 10mm in size shall be placed.

2. The distance between concrete bulkheads shall be determined as outlined in Table 9.1 of WSA02-2014. **Spacing**

C402.30 THRUST AND ANCHOR BLOCKS FOR RISING MAINS

1. The Subdivider shall construct thrust and anchor blocks where shown on the design drawings to the dimensions depicted in TSC Standard Drawings S.D.230 to 232 or as otherwise directed by the Certifying Engineer. 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. **Location**
2. The Subdivider shall provide permanent thrust blocks of minimum 20MPa concrete, complying with TSC C271 – 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 specified in S.D.230 and 232 or as directed by the Certifying Engineer. **Thrust Blocks**
3. The Subdivider shall provide permanent anchor blocks of minimum 20MPa concrete, complying with TSC C271 – Minor Concrete Works, of a volume not less than that specified in S.D.231 or as directed by the Certifying Engineer. **Anchor Blocks**
4. The Subdivider shall provide temporary anchorages adequate to restrain the pipe when under test. **Temporary Anchorage**
5. The Subdivider shall obtain the consent of TSC for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning. **Restrained Joints**

C402.31 RISING MAIN FITTINGS

1. The Subdivider shall install rising mains, air release valves and inspection pipes where shown on the design plans or directed by the Certifying Engineer. All rising mains shall be topped with an appropriate identification tape. **Location**
2. The Subdivider shall provide marking plates bearing the letters "AV" for air valves, "SCOUR" for scour pipes and "SRM" for sewage rising main at changes **Marking Plates**

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, white background with red lettering.

3. Where, in the opinion of the Certifying Engineer, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Subdivider shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1m, shall be permanently marked on the plate with legible numbers a minimum 80mm high. Wooden posts shall not be used. **Marking Posts**
4. The post shall conform to the following requirements: **Post Details**
 - (a) The post shall be of sufficient length to be set firmly in place under saturated ground conditions.
 - (b) When installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, or where directed by the Certifying Engineer, its height above the ground shall be increased to 1500mm.
 - (c) The post shall be painted with 2 coats of white enamel for exterior use.

C402.32 CONCRETE ENCASEMENT

1. The Subdivider shall encase in concrete pipes in gravity sewers or rising mains, where approved by TSC, as shown on the design plans, with less than the specified cover above the top of the pipe barrel, or where directed by the Certifying Engineer. Concrete shall be 20MPa complying with WSA 02-2002, 4, SEW-1205 and TSC C271 – Minor Concrete Works and have the following minimum dimensions: **Location**
 - (a) For trenches in other than rock: 150mm minimum under, on both sides and on top of the pipe barrel.
 - (b) For trenches in rock: 100mm minimum under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.
2. In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12mm thick shall be formed in the concrete encasement at the face of each socket or at one (1) face of each coupling. **Contraction Joint**
3. Reinforcement in concrete encasement shall be as shown on the design plans. **Reinforcement**

C402.33 WRAPPING OF PIPELINES

1. Where shown on the design plans or directed by the Certifying Engineer, the Subdivider shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving. (WSA 02-2014, 2, 16.10).
2. The materials to be used shall be high impact resistance polyethylene sleeving of minimum thickness 0.2mm polyethylene film, approved by the Certifying Engineer, and 50mm wide plastic adhesive tape. **Material Type**
3. 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 **Width**

SEWERAGE SYSTEM

sunlight does not exceed 48 hours.

4. Where necessary to distinguish pipes within close proximity, pipelines shall be identified by colour sleeving, green in colour, or an appropriate identification tape. **Colour**
5. 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 Certifying Engineer. The Subdivider 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 250mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three (3) 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 (1) metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Subdivider 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. **Application**
6. The Subdivider shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench. **Damage**

C402.34 CORROSION PROTECTION OF STEEL BOLTS AND NUTS

1. The Subdivider shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Certifying Engineer consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping. **Wrapping**

C402.35 CAST-IN-SITU MAINTENANCE HOLES

1. For all maintenance holes concrete work, the Subdivider shall comply with TSC C271 – Minor Concrete Works in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below. (WSA 02-2014, 2, 17.2). **Concrete**
2. Cement used in all concrete shall be Type SR to AS 3972. The Subdivider may use fly ash additive to a maximum 20 per cent. Cement used shall be no older than three (3) months since manufacture. **Cement Type**
3. The minimum cement content shall be 360 kg/m³ of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass. **Minimum Cement Content**
4. Reinforcement shall be provided within all cast-in situ maintenance holes
5. Dowels shall be located at each individual manhole lift (WSA 02 2014, 2, 17.2.3)

C402.36 COVERS AND FRAMES

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|----|---|-------------------------------|-----------|
| 1. | 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 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius. (WSA 02-2014, 2, 17.1 & 18.7 & 18.3). Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Certifying Engineer that quality tests have been carried out. This action constitutes a HOLD POINT . The Certifying Engineer's approval to the quality test documentation is required prior to the release of the hold point. | Standard | HP |
| 2. | Tolerances for the dimensions on the COVER shall be - 3mm + NIL. | Cover
Tolerance | |
| 3. | Tolerances for the dimensions on the FRAME shall be -3mm +3mm. | Frame
Tolerance | |
| 4. | Maintenance hole covers shall be seated on a layer of bitumen-impregnated fibreboard, having a cross-section of 25 x 25mm. Alternatively another seating material of a cross-section and composition approved by the Certifying Engineer may be used. | Cover Seating | |
| 5. | Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type. Elsewhere, covers shall be finished 25mm above the surface of the ground where not shown otherwise on the design plans, or such other level as directed by the Certifying Engineer, in a manner designed to avoid as far as possible, the entry of surface water. | Cover Levels | |
| 6. | In locations where shown on the design plans or directed by the Certifying Engineer, the Subdivider shall install a ductile iron cover and frame instead of the standard concrete maintenance hole cover. Where shown on the design plans, the Subdivider shall install bolt down frames and covers in areas subjected to 1 in 100 year flooding. Ductile iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed as necessary, in accordance with the manufacturer's written requirements. | Ductile Iron
Cover | |

C402.37 STEP IRONS (DELETED)**C402.38 PREFORMED/PRE-CAST MAINTENANCE HOLE AND MAINTENANCE SHAFT SYSTEMS**

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|----|---|----------------------------------|-----------|
| 1. | If approved by the Certifying Engineer, preformed systems, complying with the design plans, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of cast in-situ systems. (WSA 02-2014, 2, 17). Preformed/pre-cast system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Certifying Engineer that quality tests have been carried out. This action constitutes a HOLD POINT . The Certifying Engineer's approval to the quality test documentation is required prior to the release of the hold point. | Approval | HP |
| 2. | The Subdivider shall supply components that make a watertight system and have a satisfactory surface finish. | Watertight
Components | |

SEWERAGE SYSTEM

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| 3. | Generally, preformed/ pre-cast maintenance holes shall be made up in accordance with the design plans, 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 84mm.. (also refer to S.D.278 for standard manholes) | Component Assembly |
| 4. | Where approved, preformed maintenance shafts shall be made up in accordance with the design plans, with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, cover and frame. (WSA 02-2002, 4, SEW-1314) | Maintenance Shafts |
| 5. | The installation of all preformed components shall be in accordance with the manufacturers' recommended procedures and requirements. | Manufacturers' Procedures |
| 6. | Backfill for all preformed/pre-cast maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to a level 300mm above the top of the highest incoming pipe and for the full width of the excavation. If necessary, the Subdivider shall import and compact non-cohesive granular material. | Backfill |
| 7. | Smartpit PE maintenance holes may be used at sewerage rising main discharge manholes. | Discharge Manholes |

PIPELINE TESTING AND RESTORATION

C402.39 GENERAL

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|----|--|-------------------------------------|
| 1. | The Subdivider 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 (1) 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. (WSA 02-2014, 2, 21). | Initial Test Before Backfill |
| 2. | All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing. | Cleaning |
| 3. | Where a vacuum system has been specified, the Subdivider shall test the system in accordance with the testing schedule as shown on the design plans. | Vacuum System |

C402.40 INITIAL TEST OF GRAVITATION SEWERS

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|----|---|-----------------------|
| 1. | The Subdivider 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 Certifying Engineer notified. This action constitutes a WITNESS POINT . The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to inspect the initial testing is required. | Compressed Air |
|----|---|-----------------------|

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- 2. 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 Subdivider shall carry out an initial test on the risers and property connection sewers as soon as they are completed.

Risers and Property Connection Sewers
- 3. Where the Certifying Engineer 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.

Other Than Full Lengths
- 4. The Subdivider shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

Rectification
- 5. The Subdivider shall undertake ovality testing as follows:

 - (a) All sewers to DN 300 shall be tested to determine any excessive ovality using a proving tool approved by the Certifying Engineer. 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.
 - (b) 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 specified in Table C402.6:

Ovality Testing

NOMINAL SIZE (DN)	MINIMUM PROVER DIAMETER (mm)
	UPVC PIPE
100	99.7
150	142.6
225	222.9
300	280.8

Table C402.6 – Ovality Testing

- (c) 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.
 - (d) Maximum Allowable Deflection = 3% of Mean Outside Diameter.
 - (e) 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.

Visual Inspection Testing
- 6. The Subdivider shall undertake visual inspection testing using a torch and extended mirror between manholes to inspect that the pipe is laid straight without any bends.

 - (a) The mirror should show the light from the torch if the pipework is laid straight.
 - (b) The pipeline shall be clean.
 - (c) There shall be no high or low spots. (ensure line has been laid at the same grade)

Visual Inspection Testing

C402.41 INITIAL TEST OF MAINTENANCE HOLES

- 1. After the maintenance holes have been constructed (including benching, fitting of

Leakage

SEWERAGE SYSTEM

the converter slab, surround frame and cover) and all backfill operations are complete, they shall be tested as a minimum number as hereafter specified in Table C402.7. (WSA 02-2014, 2, 21.4.5)

Number of Sewer Maintenance Holes in Subdivision Works	Percentage Tested Initially (see Item 2)
≤ 5	100%
6 to 10	50%
11 to 20	33%
> 20	25%

Table C402.7

2. Where projects contain both precast and in-situ concrete Maintenance Holes, each type shall be viewed as separate populations, with the above criteria applying to each population separately within the project. If any of the sample holes fail the initial test, then all Maintenance Holes within the project shall be tested.

3. The test shall be made by plugging all pipe openings in the walls, the vacuum test head shall be placed in the top of the Maintenance Hole and the seal inflated. Draw a vacuum of 33.5Kpa on the Maintenance Hole then close the valve on the vacuum line and turn the pump off.

Method

4. The Maintenance Hole shall have passed the vacuum test if the time taken for the reading to drop to 30 KPa meets or exceeds the time specified in Table C402.8

Duration

Maintenance Hole Depth (mm)	Time in Seconds
<2400	17
3000	21
4000	28
5000	35
6000	42

Table C402.8

5. Alternatively, the Maintenance Holes may be tested by alternative methods, in which case the subdivider shall provide details of the alternative method proposed, for approval by the Certifying Engineer, prior to its use.

Alternative Tests

C402.42 ACCEPTANCE TEST OF GRAVITATION SEWERS AND MAINTENANCE HOLES

1. The Subdivider shall make the acceptance test on all components in the section of the sewer in the same manner as the initial test. The submission, to the

As for Initial Test

Certifying Engineer, of satisfactory test results constitutes a **HOLD POINT**. The approval of the Certifying Engineer is required prior to the release of the hold point.

HP

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| 2. | The Certifying Engineer may permit hydrostatic testing as an alternative to compressed air testing for acceptance of gravitation pipelines. | Alternative |
| 3. | The Certifying Engineer may reject any pipeline or maintenance hole in which there is visible or detectable leakage. | Rejection |

C402.43 TESTING GRAVITY MAINS WITH COMPRESSED AIR

- | | | |
|----|---|------------------------|
| 1. | The Subdivider shall supply and keep all necessary equipment in a condition acceptable to the Certifying Engineer. | Equipment |
| 2. | The Subdivider shall test pressure gauges prior to use by static water column. | Pressure Gauges |
| 3. | Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m ³ /minute at 35kPa. The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 35kPa ± 4kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50kPa, a pressure relief valve that shall be set to blow off at 35kPa ± 4kPa and a gate valve to the pipeline to be tested. | Compressed Air |
| 4. | The method of setting up and carrying out the test shall be as follows:
(WSA 02-2014, 2, 21.4): | Method |
| | (a) 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. Test lengths shall be limited to single pipe runs between MHs and/or MSs. | |
| | (b) Couple test equipment to line under test and compressor or airline. | |
| | (c) Slowly increase the air pressure in the line from 0 to 35kPa (over one (1) minute approximately). | |
| | (d) Hold air pressure at 35kPa for three (3) minutes for stabilising temperature. | |
| | (e) Close gate valve to shut off air supply to test equipment. | |
| | (f) Measure the time it takes for the pressure to drop from 35kPa to 28kPa. If this time is less than that permitted or if the line cannot be pressurised to 35kPa, then the test is unsatisfactory and the pipeline shall be checked for leaks. | |
| | (g) To check pipelines for leaks: | |
| | a. Open the gate valve from the air supply sufficiently to maintain a pressure of 14 to 23kPa in the pipeline. | |
| | b. 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. | |
| | (h) If leaks are detected, they shall be repaired to the satisfaction of the Certifying Engineer. | |
| | (i) Re-test as above until the time taken for the pressure to drop is greater than that shown below. | |

C402.44 ALLOWABLE PRESSURE DROP TIMES

1. The time taken for the pressure to drop from 35kPa to 28kPa shall be greater than:
Time
 - 225mm pipe or smaller – 3 minutes
 - 300mm pipe – 6 minutes
 - 375mm pipe – 8 minutes
 - 400mm pipe – 11 minutes
 - 525mm pipe – 14 minutes
 - 600mm pipe – 17 minutes
2. 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.
Saturation with Water
3. In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Subdivider shall apply a hydrostatic test.
Hydrostatic Test

C402.45 HYDROSTATIC TESTING OF GRAVITY MAINS

1. The Subdivider shall carry out the hydrostatic test by connecting to the pipeline or section thereof under test, a pipe or hose terminating in a 150mm diameter container not less than 100mm deep. All other open ends of the pipeline shall be plugged.
Pipe Connection
2. 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.
Water
3. The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:
Test Container
 - (a)
 - (i) 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
 - (ii) For initial test 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.
 - (b) 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.
 - (c) Such other lesser head as the Certifying Engineer, at the Certifying Engineer's discretion, may direct.
4. The Subdivider shall determine, at the Subdivider's expense, the free standing level of groundwater, by a method acceptable to the Certifying Engineer.
Ground-Water

5. After allowing an interval for absorption, to be determined by the Certifying Engineer, any fall of the free water surface shall be made good by adding extra water to the container. The Subdivider shall measure the fall in water level during ten (10) minutes thereafter. **Extra Water**
6. The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25mm for each standard test length of the pipeline under test including property connection sewers and/or risers. **Results**
7. A standard test length in metres is defined as 1370m 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. **Test Length**

C402.46 VISUAL INSPECTION AND MEASUREMENT OF INFILTRATION

1. Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500mm or more above the soffit of the sewer main provided that groundwater is at least 150mm 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. **Head of Groundwater**
2. In such circumstances, the Subdivider shall propose full details of the method by which the infiltration is to be measured. **Method**
3. If the Certifying Engineer, at the Certifying Engineer's discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Certifying Engineer shall determine, the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:- **Rate of Infiltration**

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

Where:

- Q.I. = rate of infiltration in litres/hour
 L = length of pipe in metres
 d = nominal size of pipe in metres
 h = average head of groundwater over the invert level of the pipe in the section under test
 H_a = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test.

4. The Subdivider shall determine the head of groundwater, at the Subdivider's expense, by a method approved by the Certifying Engineer. **Subdivider's Cost**

C402.47 TESTING OF RISING MAINS

1. The Subdivider shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. No testing should be commenced until all utility services (e.g. electricity, telecommunications, gas) have been installed in the area. The submission, to the Certifying Engineer, of satisfactory test results constitutes a **HOLD POINT**. The approval of the Certifying Engineer is required prior to the release of the hold point.

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SEWERAGE SYSTEM

2. Pipelines shall be tested in sections approved by the Certifying Engineer as soon as practicable after each section has been laid, jointed and backfilled, provided that:
- Timing**
- (a) If so specified or if the Subdivider 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 Certifying Engineer; and
- (b) The pressure testing shall not be commenced earlier than seven (7) days after the last concrete thrust or anchor block in the section has been cast.
3. For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, eg by means of main stop valves.
- Section Definition**
4. Pressure testing shall not be carried out during wet weather unless otherwise approved by the Certifying Engineer.
- Wet Weather**
5. During pressure testing, all field joints which have not been backfilled shall be clean, dry and accessible.
- Field Joints**
6. During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one (1) side of the valve in closed position with no pressure on the other side for at least 15 minutes.
- Stop Valves**
7. Before testing a pipeline section, the Subdivider shall clean it to the satisfaction of the Certifying Engineer 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.
- Filling with Water**
8. The hydrostatic test pressure which shall be applied to each section of the pipeline shall be 800 kPa for sewer rising main pipes. For mains where working pressure exceeds 650kPa, the hydrostatic test pressure shall be specified by the water authority.
- Test Pressure**
9. The Subdivider shall maintain the specified test pressure for as long as required by the Certifying Engineer, while the Subdivider examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Subdivider shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing. A Council approved and supplied water meter shall be fitted to measure leakage from the rising main.
- Duration of Test**
10. The pressure testing of a section shall be considered to be satisfactory if:
- Results**
- (a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- (b) There is no visible leakage; and
- (c) The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

$$Q_1 = (0.14xDxLxH)/1000$$

where:

Q_1 = permissible leakage rate (litres per hour)

D = internal diameter of pipe (mm)

L = length of main tested (km)

H = average test head (m)

- (d) Unless otherwise permitted by the superintendent, adopt a maximum test length of 1km.

11. 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 Subdivider at the Subdivider's expense.

Rectification

C402.48 BACKFILL AND COMPACTION

1. After laying and jointing of a pipeline has been completed the Subdivider shall present the laid and jointed pipes for inspection by the Certifying Engineer prior to commencement of trench backfilling (WSA 02-2014, 2, 20). This action constitutes a **WITNESS POINT**.

Notification

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2. Backfill shall not be placed until the Certifying Engineer has given approval.

Approval

3. Material for the side support and overlay of the pipe shall be as for pipe bedding specified in Clause C402.23. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS 1289.5.4.1.

**Side Support
and Overlay**

4. The Subdivider shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows: (WSA 02-2014, 2, 20).

**Remainder of
Trench**

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

- (i) Backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table C402.3, and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials

**Backfill to
Subgrade
Level With
Non-Cohesive
Granular**

1. Below 0.5m of the road surface

2. In the road reserve, but excluding the road pavement

- (ii) Backfilled with excavated material, and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to within 0.5m of the road surface, but excluding the pavement layers.

**Backfill to
Subgrade
Level with
Excavated
Material**

- (iii) Backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1

**Backfill of
Pavement
Layers**

SEWERAGE SYSTEM

- (b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.
5. The Subdivider shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe. **Care**
6. The Subdivider shall carry out compaction tests 75mm to 100mm below the level being tested. (WSA 02-2014, 2, 21.3) **Compaction Tests**
7. The Subdivider may compact backfill by trench flooding only where: **Flood Compaction**
- (a) The ground and backfill material is cohesionless sand.
- (b) Water for flooding has been sourced at the site.
- (c) The process will not create mud which would be moved off site by vehicles or construction plant.
- (d) Additives are not used.

C402.49 RESTORATION OF SURFACES

1. The Subdivider 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 Subdivider 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 Certifying Engineer. (WSA 02-2014, 2, 24). **Original Condition**
2. The Subdivider shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period. The Subdivider 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. **Maintenance**
3. Immediately the backfilling of a trench excavated through a pavement has been completed, the Subdivider 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 Subdivider shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Certifying Engineer, the removal of temporary restoration. **Temporary Pavement Restoration**

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|----|---|--|
| 4. | In other than roadways, the Subdivider 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 Subdivider. Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period, the Subdivider shall take all necessary steps to consolidate the trench before removing surplus materials from the site. | <i>Backfill</i> |
| 5. | In locations where, in the opinion of the Certifying Engineer, 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 Certifying Engineer in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Subdivider shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period. | <i>Disposal of Surplus Material</i> |
| 6. | Where, within public or private property, the reasonable convenience of persons will require such, the Certifying Engineer may order the Subdivider to level trenches at the time of backfilling. The Subdivider shall make good any subsequent settlement, as required by placing additional fill. | <i>Settlement</i> |
| 7. | The Subdivider shall immediately restore any damaged or disturbed private property and services. | <i>Restoration</i> |
| 8. | Should the Subdivider elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces. The Subdivider 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. | <i>Tunnelling</i> |
| 9. | The Subdivider shall provide notice to affected property owners of any pending works. | <i>Property Owner Advice</i> |

PUMP STATIONS

C402.50 PUMPS

- | | | |
|----|--|-------------------------|
| 1. | Pumps shall be submersible sewage pumps. Council's preferred submersible pumps are: Flygt, Mono, Forrers and Grundfos. | <i>Materials</i> |
| 2. | Pump construction materials for centrifugal end suction pumps shall comply with the following: | |

SEWERAGE SYSTEM

DESCRIPTION	MATERIAL
PUMP	
Casing and suction bend	Cast iron AS 1830 Gr T200
Wear rings	Cast iron AS 1830 Gr T200
Impeller	316 Stainless steel/AS 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 AS1830 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 T2000/Fabricated steel
MOTOR	
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Cast iron/Mild steel
Motor fan cover	Mild steel
Motor fan	Metal
HOLDING DOWN BOLTS	316 Stainless steel/AS 2837
MECHANICAL SEALS	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

3. 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 the subdivision works. **Manufacturer's Liability**
4. All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts. **Nuts and Bolts**
 - (a) 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.

- (b) All threads are to be rolled.
 - (c) All bolt heads and nuts shall be hexagonal.
 - (d) All bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528.
 - (e) All nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts.
 - (f) 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 16mm.
 - (g) Concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.
5. Bolts on all flanges will protrude no more than 10mm past the nut when tightened. ***Bolts on Flanges***
6. The Subdivider shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluorethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide. ***Anti-Galling, Anti-Seize***

C402.51 PREFORMED PUMP STATIONS AND PACKAGE PUMP STATIONS

1. Where approved by TSC, preformed components or systems, complying with the design plans, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of in-situ construction provided: ***Alternate Wet Well***
- (a) Preformed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units.
 - (b) Joints shall be internal flush
 - (c) The Subdivider shall supply components that make a watertight system and have a satisfactory surface finish. ***Component Quality***
2. Where approved by TSC, Package pump stations may be supplied and installed provided:
- (a) All components comply with the requirements of this Specification
 - (b) The units are at least equivalent to the requirements of this Specification and the design plans. ***Package Units***

C402.52 ELECTRICAL COMPLIANCE

1. The Works shall be in accordance with the Electrical Services Minimum Requirements contained in EL01-EL019 except where this Specification or the design plans indicate otherwise. The technical requirements detailed on the design plans shall take precedence over the requirements of this Specification should clauses be in disagreement. ***Standards***
2. EL01-EL019 covers the general requirements for materials, workmanship, and methods of installation as follows: ***DPWS Requirements***

SEWERAGE SYSTEM

- (a) General
- (b) Reticulation and wiring
- (c) Switchboards and Associated Equipment
- (d) Accessories
- (e) Luminaries – Supply and Installation
- (f) Electric Motors
- (g) Painting, Colour Coding and Labelling

- | | |
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| 3. Except where EL01-EL019 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. | Compliance |
| 4. Where AS 3000 requires, the Subdivider shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority. | Proof of Compliance |
| 5. The Subdivider shall submit all designs and material, to each Authority having jurisdiction for approval. The Subdivider shall arrange for each Authority having jurisdiction to inspect the Works. The Certifying Engineer 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 Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to attend the inspections is to be exercised. | Approval |

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C402.53 SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA), CONTROLS

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| 1. The Subdivider shall supply and install the SCA designed and assembled by a manufacturer approved by the Certifying Engineer. | Approved Manufacturer |
| 2. Where the SCA is outdoor it shall be stationary, free standing, aluminium-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 1939. | Type |
| 3. The Subdivider shall provide an effective barrier to prevent gases from the wet well entering the SCA. | Barrier to Gases |
| 4. Starter contactors shall have appropriate ratings for the proposed pumps to AC3. | Starter Contactors |
| 5. All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design plans. | Terminals |
| 6. The Subdivider shall liaise with the electricity supply authority to supply a lock barrel for the metering equipment, at the Subdivider's expense. The Certifying Engineer shall supply standard lock barrels for use on the SCA at no cost to the Subdivider. | Lock Barrels |
| 7. 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 & 24 V, A.C. | Characteristics |

Prospective short-circuit current: 14kA for 1 second.
 Peak Factor: 2.2
 Power Factor Correction (Determined in consultation with the Certifying Engineer)
 Earthing (M.E.N. system)

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| 8. | All cables shall enter the SCA from below. | <i>Cable Entry</i> |
| 9. | The Subdivider shall supply data from the switchgear supplier confirming Type “2” co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Certifying Engineer. | <i>Switchgear Data</i> |
| 11. | 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. | <i>Operation</i> |
| 11. | The Subdivider shall carry out Factory Acceptance Testing (FAT) in conjunction with a Council’s Representative and in accordance with TSC EL01-EL019 and the results shall comprise all routine Tests specified in AS 3439. The Certifying Engineer and Council’s Representative shall be given seven (7) days notice of the proposed date of such tests. The test shall fulfil all of the requirements listed on checklist E.1.001.1 to the Council representative’s satisfaction. All faults and failures must be fixed to the satisfaction of the representative before FAT is accepted. | <i>Factory Acceptance Testing (FAT)</i> |
| 12. | The Subdivider shall pack the equipment for transport after satisfactory FAT, and after approval has been given by the Certifying Engineer. The Subdivider 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. Where equipment has been removed, cover plates shall be provided. | <i>Packing</i> |
| 13. | The Subdivider shall be responsible for any damage that may occur during transit and unloading at site. | <i>Damage</i> |
| 14. | The Subdivider shall ensure that spare parts, tools etc, are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc, as applicable. | <i>Tools</i> |
| 15. | The Certifying Engineer or representative will be responsible for setup of automatic control system for the pumps during commissioning. | <i>Levels</i> |
| 16. | The Subdivider shall supply and install control equipment as shown on TSC Standard Drawing. Sets SD820/00 to SD820/17 . | <i>Pump Control</i> |

C402.54 ELECTRICAL INSTALLATION

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| 1. | The Subdivider shall liaise with the Supply Authority for the electricity supply to the pump station site. | <i>Liaison</i> |
| 2. | The Subdivider 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. | <i>Subdivider’s Responsibility</i> |
| 3. | The Subdivider shall supply and install all cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits. | <i>Cabling</i> |

SEWERAGE SYSTEM

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| 4. | The Subdivider shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500mm below the finished ground level in non-trafficable areas and 600mm 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. | Conduits |
| 5. | The Subdivider shall run electrical marker tape 150mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150mm wide and stamped with the words "DANGER – ELECTRIC CABLES BELOW" or similar. | Marker Tape |
| 6. | The Subdivider shall route all underground cabling with the approval of the Certifying Engineer. 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 Certifying Engineer's approval of the route of all underground cabling is required prior to the release of the hold point. | Route |
| | | HP |
| 7. | The Subdivider shall determine the Points of Attachment on site and the Subdivider shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority. | Point of Attachment |
| 8. | 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. | Consumer Mains |
| 9. | The minimum size of the consumers mains shall be sized to satisfy the following requirements: | Size |
| | (a) Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30 per cent minimum. | |
| | (b) Be sized for a voltage drop less than 1.5 per cent to the maximum demand as calculated. | |
| | (c) Be single core PVC/PVC cables. XLPE insulated cable may also be used. | |
| | (d) Comply with the requirements of the Supply Authority. | |
| | (e) Pole termination method shall be as shown on the design plans. | |
| | (f) AS 3000 and AS 3008 | |
| 10. | In addition to the requirements of the Supply Authority and EL01-EL019, the Subdivider 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 50mm ² cable and a Type 4 pit for larger cable. | Earthing Conductor |
| 11. | Where required by the Certifying Engineer, the Subdivider 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. | Surge Diverters |
| 12. | The Subdivider shall bond the pump station main earth via an independent suitable sized copper stake. | Pipework |
| 13. | The Subdivider 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. | Meters |

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| 14. | The Subdivider shall supply and install the following metering equipment: | <i>Metering
Equipment</i> |
| | (a) Plug-in meter bases or all electricity meters (tariffs) supplied by the Supply Authority, as may be required by the Supply Authority. | |
| | (b) Service potential fuses. | |
| | (c) Current transformers metering equipment (if required). | |
| | (d) All necessary wiring and other accessories as required by the Supply Authority. | |
| | (e) Key locking facilities for Supply Authority access. | |
| 15. | The Subdivider 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. | <i>Cable Entry</i> |
| 16. | The Subdivider 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. | <i>Sealing</i> |
| 17. | Flow meters must be installed in accordance with the manufacturer's specifications. If no manufacturer specifications are available, you must be able to provide evidence that the device is performing accurately, in accordance with Australian Standard AS3565.1 (for water meters). The flow meter test shall fulfil all of the requirements listed on checklist F.1.01 to the Council representative's satisfaction. All faults and failures must be fixed to the satisfaction of the representative before flow meter is accepted. | <i>Flow meters</i> |

C402.55 PRESSURE TEST POINTS

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| 1. | A 20mm tapping shall be installed into the pipe wall of ductile iron pipes inside the valve pit for each discharge pipe. This tapping shall have a compatible, non-corrosive ball valve installed.. | <i>Installation</i> |
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C402.56 VALVES

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| 1. | The Subdivider shall ensure that the valves supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. | <i>Compatibility
with Pipework</i> |
| 2. | The Subdivider shall ensure that valves are installed so as to facilitate maintenance. The Subdivider shall take into account the manufacturer's recommendations, the requirements shown on the design plans and standard drawings, the type of connection, and lubrication of connecting bolts. | <i>Installation</i> |
| 3. | Flanges shall comply with AS 4087 Figure B5. | <i>Flanges</i> |
| 4. | Unless shown otherwise on the design plans, all valves shall be clockwise closing. | <i>Clockwise
Closing</i> |
| 5. | All sluice valves shall be resilient seated fully FBN coated. | |

SEWERAGE SYSTEM

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| 6. | Non return valves shall be of the swing check type to AS 3578 or AS 4794 of cast iron or steel body. The leaf shall swing clear and provide an unobstructed waterway. Non return valves shall be FBN coated. | Non Return Valves |
| 7. | 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. | Arrangement |
| 8. | The inlet knife gate valve shall be constructed in accordance with the following:

(a) The design shall include an enclosed bonnet.

(b) The spindle shall be of the non-rising type.

(c) Valves shall be clockwise closing.

(d) The gland around the spindle shall be adjustable or formed by a double O-ring.

(e) Flange jointing shall be rubber O-rings.

(f) 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.

(g) The valve shall be unidirectional fully stainless steel construction. | Knife Gate Valve |
| 9. | All assembly bolts and nuts shall be fitted with fibre or nylon isolating washers to prevent bimetallic corrosion where required. | Isolating Washers |
| 10. | 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.. | Spindle Guard |
| 11. | Valves shall be drilled and threaded, where required, in accordance with AS 4087. | Drilled and Threaded |

C402.57 TESTING AND COMMISSIONING OF PUMP STATION

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| 1. | Testing and commissioning will generally be conducted in the following stages and these actions constitutes a HOLD POINT :

(a) Switchboard Factory Acceptance Testing (FAT)

(b) Pre-commissioning checks

(c) On-site commissioning and testing | Compliance

<div style="border: 1px solid black; padding: 2px; text-align: center;">HP's</div> |
| 2. | Application shall be made to Council for commissioning of a site. The application includes a checklist with the minimum requirements to be achieved before making application. Once Council receives an application a site visit shall be conducted to verify that the site is ready for commissioning. The pre-commissioning checklist C1.001 will be used to determine whether a site is deemed ready for commissioning by a Council Representative. This action constitutes a WITNESS POINT . | <div style="border: 1px solid black; padding: 2px; text-align: center;">WP</div> |
| 3. | Council will be responsible for commissioning of the site. A commissioning plan including relevant Inspection Test Plans (ITP's) will be provided to the Subdivider outlining the commissioning process and testing. The site must be made available, the well filled with sufficient water to allow 10 minutes operation of the | <div style="border: 1px solid black; padding: 2px; text-align: center;">WP</div> |

largest installed pump and any associated rising mains must be tested and filled prior to the commissioning date. After commissioning a list of defects will be provided to the Subdivider and must be completed before commissioning is successful and the site is allowed to be brought onto the live system. This action constitutes a **WITNESS POINT**. The Certifying Engineer or representative and a representative of the Subdivider may be present to witness the commissioning.

4. The Council shall furnish the Certifying Engineer and Subdivider with one (1) signed copy of the completed Commissioning Plan Record Sheet countersigned by the Certifying Engineer's Representative who witnessed the test. **Submission**

C402.58 PRACTICAL COMPLETION OF PUMP STATION

1. The Subdivider shall fulfil the following requirements before the Certificate of Practical Completion is issued: **Certificate**
- (a) Receipt by the Certifying Engineer of a certificate of approval from the relevant statutory authorities.
 - (b) Pump station is in working order as demonstrated by the testing and commissioning.
 - (c) Receipt by the Certifying Engineer of as-built design plans of the pump station and all operations and maintenance manuals.

C402.59 TELEMETRY

1. The Subdivider shall make provision for equipment to link the pump station to the clear SCADA telemetry network as shown on TSC Standard Drawing Sets SD820/00 to SD820/17. **Subdivider's Cost**
2. The pump station shall be capable of being operated automatically by control signals from the existing or proposed telemetry system. In addition, either one (1) or any combination of pumps may operate at any one (1) time by control signals from the telemetry system. **Operation**

C402.60 OPERATION AND MAINTENANCE MANUALS

1. Manufacturers Operations and Maintenance Manual's shall be supplied for each piece of equipment in the station.
2. Each Manual shall contains the following information:
- (a) Subdivider's name, address and telephone number.
 - (b) Client's Contract number, job name
 - (c) Quick reference guide in Section 1 outlining the main pumping station details such as Pumping Station name, number, location, wet well dimensions, pump model and serial numbers, pump duties, power and voltage, and pipework inlet & outlet details.
 - (d) Pump station general arrangement drawings showing pumps, motors, valves, pipework, switchboard and electrical installation and all manufacturers supplied details. The make and model shall be identified for the equipment installed
 - (e) Pump details including design pump curve, factory tested pump curve, motor test curve, motor torque/speed/ efficiency characteristic curves,

SEWERAGE SYSTEM

copy of stamped plate/tag for each pump,

3. The operation and maintenance manual shall also include:
- (a) Safe working procedures: For switching and isolating the supply and distribution system;
 - (b) Comprehensive description of operation, including flow charts detailing each operational activity (e.g. manual pump operation, routine test procedures);
 - (c) Maintenance procedures: Recommended maintenance periods and procedures;
 - (d) Tools: Particulars of maintenance equipment and tools provided, with instructions for their use.
 - (e) Equipment: A technical description of the equipment supplied, with diagrams and illustrations where appropriate;
 - (f) Dismantling: Where necessary, procedures for dismantling and reassembling equipment;
 - (g) Spare parts: A list of the spare parts provided.
4. For equipment that does not have a Manufacturer's manual, a manual shall be created to the satisfaction of Council.

Operation and Maintenance

5. The Certifying Engineer shall supply Council with three hard copy printout of the operation and maintenance manual. The manual shall be compiled in a folder indexed and labelled with the Pump Station number, location, on the front and spine. A CD containing the word-processor file(s) (Microsoft Windows compatible format) for the document and a copy of the document in PDF format shall also be provided. One spare set of pump and motor tags shall be provided with the O&M manuals.

O&M Manual Handover

CONSTRUCTION COMPLIANCE

C402.61 WORK-AS-EXECUTED DETAILS

See Development Design Specification D13

D13

C402.62 OPERATION AND MAINTENANCE MANUALS

The Subdivider shall submit to the Certifying Engineer all operation and maintenance manuals at the time of commissioning or when handed over for Council's operation. All operation and maintenance manuals must be included in the subdivision works compliance certificate attachments.

SPECIAL REQUIREMENTS

C402.64 CCTV INSPECTION

1. When a CCTV Inspection is Required:
- (a) Unless advised otherwise by the Certifying Engineer, a CCTV inspection to verify the internal condition of all sewer pipe infrastructure is required to be undertaken

CCTV

after backfilling and after completion of all subdivision works and passage of construction equipment above the mains (normally around the time of practical completion of the subdivision works).

Inspections

(b) A CCTV inspection of all sewer pipe infrastructure is required to be undertaken on or immediately after the expiration of the defects liability (maintenance) period.

(c) Additional CCTV inspections are required of any remediation / repair works undertaken to the sewer infrastructure, or as directed by the Certifying Engineer and/or Council to demonstrate that the standard of the infrastructure is acceptable.

Other CCTV Inspections (as required)

(d) The CCTV assessment shall also include any existing sewer infrastructure that is to be utilised within the design. Council will advise if any repair / upgrades to the existing system are required.

Use of existing infrastructure

C402.65 WHAT IS TO BE INSPECTED

1. All sewer networks are to be CCTV inspected.
2. Pipes shall be inspected and reported on the following:
 - (a) Horizontal alignment
 - (b) Vertical alignment
 - (c) Cracks and defects
 - (d) Pipe joints
 - (e) Joints to manholes and other pipes
 - (f) Ovality

Assessment Criteria

C402.66 PRE INSPECTION CRITERIA

1. All pipes are to be inspected upon delivery. A "No cracks policy" is to be adopted, giving the site supervisor the authority to reject any pipe with a crack when delivered.

No cracks policy

C402.67 INSPECTION CRITERIA

1. CCTV surveys are to be undertaken using a camera with the ability to capture footage in colour and pan and tilt 360°.
2. All pipes must be free of debris and silt at the time of inspection.
3. The pipeline shall be assessed at the following speeds

Speed

Conduit Diameter	Allowable Camera Speed
Dia. < 200mm	0.1m/s *

SEWERAGE SYSTEM

Conduit Diameter	Allowable Camera Speed
200mm ≤ Dia. < 300mm	0.15m/s *
Dia. ≥ 300mm	0.2m/s *
* - Or as agreed by Council	

4. The camera must stop perpendicular at all joints but does not need to pan 360°. However, particular attention should be paid to any infiltration at joints and connections. **Stop at joints**
5. The camera must stop perpendicular to all cracks, defects, junctions and manholes, and pan 360°. **Stop and Pan**

C402.68 ACCEPTANCE CRITERIA

1. The pipeline will be acceptable if the Certifying Engineer is satisfied that the CCTV inspection does not reveal any defects that would constitute a departure from this specification or any other relevant Tweed Shire Council Development Specification. **Acceptance of CCTV Inspection**
2. Sections of the pipeline that fail the ovality test are to be excavated and the trench and embedment replaced. Pipes that are crushed or creased are to be replaced.
3. Pipes that are crushed, split or creased are to be replaced.

C402.69 CCTV SUBMISSION

1. The Applicant must submit both a hardcopy report and an electronic report (submitted in USB portable medium in a format suitable to Council - as outlined below) of the CCTV inspection. The CCTV Inspection Report is a pre-requisite for issue of an *Off Defects Liability Compliance Certificate*.

USB portable drive contents and format:

- a. Individual video files representing each section of pipe from node to node. (e.g. from MH 5A to MH 6A)
 - b. Each video file is to be named appropriately to enable easy identification, utilising names as shown on the as-constructed or approved design drawings. (e.g. *MH5A-MH6A*)
 - c. Video file format is to be MPG format.
 - d. Copy of pipe survey report in PDF format.
2. The reports must include
 - a. Name of asset owner.
 - b. Name of the company performing the inspection and name of the operator.
 - c. Operator's job reference.
 - d. Coding system employed (i.e. WSA 2013)
 - e. Method of inspection.

- f. Details of equipment used.
- g. Specify the date of the inspection
- h. Time of commencement of inspection.
- i. Specify location (including Street Name and number)
- j. Specify details of the reach being inspected (including line and structure numbers)
- k. Provide footage in colour
- l. Whether the maintenance structure was pre-cleaned.
- m. Precipitation at the time of inspection.
- n. Description of any measures taken to control flow during the inspection.
- o. Cover details.
- p. Type of node.
- q. The vertical reference point, if recording vertical location.
- r. The circumferential reference point.
- s. Video or digital image storage details.
- t. Identify all faults, features and connections in the pipeline.
- u. Clearly show chainage along the pipeline
- v. Suggest appropriate remediation measures, as required.

C402.70 IF REMEDIATION WORKS ARE REQUIRED

- 1. Any defects identified by the inspection must be repaired or replaced in accordance with the provisions of this Specification, or as directed by the Certifying Engineer / Council.
- 2. All costs associated with the CCTV inspection and rectification works shall be borne by the Applicant. **Costs**
- 3. A follow-up CCTV assessment is required of any repaired or replaced infrastructure, to demonstrate that the remediation measures undertaken are satisfactory to Council.

C402.71 RESERVED