



# **Construction Specification for Civil Works**

## **C221 – Pipe Drainage**

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This document was originally based on AUS-SPEC - Development Construction Specification C221 – Pipe Drainage. Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Tamworth Regional Council Specification for Civil Works. The parts of the AUS-SPEC document that remain are still subject to the original copyright.

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**REVISIONS: C221 - Pipe Drainage**

REVISIONS	CLAUSES AMENDED	AMENDMENT DETAILS	DATE
1		Original Issue	20/05/2019

## GENERAL

### C221.01 SCOPE

This Specification covers the supply and installation of pipe culverts for stormwater drainage.

**Scope**

This Specification is to be read in conjunction with *C220 - Stormwater Drainage*.

**Associated Specifications**

The work to be executed under this Specification consists of supply of pipes, bedding, installation and backfilling.

**Extent of Work**

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements Sub-Annexure B2*.

**Quality**

### C221.02 DEFINITIONS

**The Works** – Defined as follows:

**The Works**

- **Developer Infrastructure Works** - work includes subdivisions and any public infrastructure work associated with an approved Development in the TRC local government area requiring a construction certificate.
- **Contracted Works** – infrastructure work undertaken by a Principal Contractor or subcontractor formally appointed by TRC and supervised by TRC.
- **Internal Works** - infrastructure work undertaken by TRC's day labour workforce.

**Constructor** – Defined as the organisation responsible for construction of the Works and the Principal Contractor as defined in the *Work Health and Safety Act 2011*.

**Constructor**

**TRC Representative** – Defined as follows:

**TRC Representative**

- **Developer Infrastructure Works** – Nominated TRC officer(s) for the approved Development.
- **For Contracted Works** – the Superintendent.
- **For Internal Works** – TRC Asset Owner

**Constructor's Representative** – Defined as follows:

**Constructor's Representative**

- **Contracted Works** – the Principal Contractor's nominated representative as per the relevant contract.
- **Internal Works** – TRC officer responsible for delivery.

**Developer's Representative**– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of **Developer Infrastructure Works**.

**Developer's Representative**

### C221.03 REFERENCE DOCUMENTS

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents Standards Test Methods**

Where not otherwise specified in the relevant Tamworth Regional Council (TRC) Construction Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the TRC Construction Specifications at the time of the Works approval.

**Currency**

**(a) Tamworth Regional Council (TRC) Specifications**

*C220 - Stormwater Drainage.*

*C230 - Subsurface Drainage.*

*C241 – Stabilisation.*

*CQC - Quality Control Requirements.*

**(b) Australian Standards**

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

- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1141.51 - Unconfined compressive strength of compacted materials.
- AS 1254 - Unplasticized PVC (UPVC) pipes and fittings for storm or surface water applications.
- AS 1289.3.3.1 - Calculation of the plasticity index of a soil.
- AS 1289.5.4.1 - Compaction control test - Dry density ratio, moisture variation and moisture ratio.
- AS 1289.4.3.1 - Determination of the pH value of a soil - Electrometric method.
- AS 1289.4.4.1 - Determination of the electrical resistivity of a soil - Sands and granular materials.
- AS 1289.E6.1 - Compaction control test - Density index method for a cohesionless material.
- AS 1397 - Steel sheet and strip - Hot dipped zinc coated or aluminium/zinc coated.
- AS 1646 - Elastomeric seals for waterworks purposes.
- AS 3725 - Loads on buried concrete pipes.
- AS 4058 - Precast concrete pipes (pressure and non-pressure).
- AS 4139 - Fibre-reinforced concrete pipes and fittings.
- AS 5065 - Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.
- AS/NZS ISO 9002 - Quality systems - Model for quality assurance in production, installation and servicing.

**(c) TRC Standard Drawings Applicable to this Specification**

SW007 - Junction Pit and Grated Inlet Pit.

SW008 - Surface Inlet Pit and Surcharge Pit.

SW009 – Inter Allotment Drainage Pit.

SW012 - Pipe Bedding.

SW013 - Pipe to Box Culvert Connection.

TRC Standard Drawings shall take precedence over ALL other drawings related to the Works. **Precedence**

Where any TRC Standard Drawings conflicts with this Specification, the requirements of this Specification shall take precedence. Proposals to deviate from this Specification shall constitute a **HOLD POINT**.

**HOLD POINT**

All proposed deviations from the approved design drawings, TRC Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the TRC Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

**PROCESS HELD:** The lot or element affected by the proposed deviation.

**Hold Point**

**C221.04 GENERAL**

Pipes shall not be placed in position until the Constructor has produced documentary evidence to the TRC Representative that the manufacture of the products to be used in the Works has complied with the Manufacturer's Quality Plan developed in accordance AS/NZS ISO 9002.

**Compliance with Quality Plan**

Documentation shall comprise a conformance certificate to AS 4058 or AS 4139 as appropriate for each batch of pipes to be included in the Works. Conformance certificates are to be supplied at least 24 hours in advance of dispatch to the Works site.

**Certification**

**HOLD POINT**

A conformance certificate, accompanied by quality records, detailing that all pipes and associated structures (eg: headwalls) are manufactured in accordance with C221.04, shall be submitted to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least five (5) working days prior to the proposed installation of pipes.

**PROCESS HELD:** Installation of Pipes.

**Hold Point**

Each unit shall be marked at time of manufacture with:

**Marking**

- (a) Class and size.
- (b) Manufacturer's name.
- (c) Date of casting.

The Constructor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction.

**Excavation Drainage**

Culverts shall be installed within 10mm of the grade line and within 10mm of the horizontal alignment specified on the approved design drawings. The Constructor shall relay any culvert which is not within these tolerances.

**Tolerances**

At the discharge end of culverts terminating at pits and headwalls, a 3m length of 100mm diameter subsurface drain shall be laid in the trench 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100mm above the invert level of the culvert or headwall.

**Subsurface Drain**

The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with C230 - *Subsurface Drainage*.

Where the Constructor proposes to travel construction plant in excess of 5 tonnes gross mass over pipes and culverts, the Constructor shall design and provide adequate protective measures at the crossing point for the pipes and culverts and shall submit the proposals to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) for approval.

**Construction Plant Movement**

## **C221.05 PIPES**

Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the approved design drawings.

***Precast  
Reinforced  
Concrete Pipes***

Fibre-reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the approved design drawings.

***Fibre-  
Reinforced  
Concrete Pipes***

Unless specified otherwise, joints shall be of the flexible type and the pipes shall have special sockets incorporating rubber ring joints complying with AS 1646 and as recommended by the manufacturer.

***Joints***

Polyvinyl Chloride (PVC) pipes shall comply with AS 1254 and shall be of the class and size shown on the approved design drawings.

***PVC Pipes***

Polypropylene pipes and fittings shall comply with AS 5065 and shall be of the class and size shown on the approved design drawings.

***Polypropylene  
Pipes***

## **C221.06 EXCAVATION**

Unless otherwise indicated on the approved design drawings or approved by the TRC Representative, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

***Formation to  
Subgrade Level***

In undertaking trench excavation, the Constructor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements including the NSW Workcover Excavation Work Code of Practice. Records documenting compliance with this Code, and other Statutory requirements shall be kept on the Works site.

***Safety***

Excavation dimensions for pipe installation shall be in accordance with Table 2 on TRC Standard Drawing SW012.

***Excavation  
Width***

## **C221.07 BEDDING, HAUNCH, SIDE ZONE AND OVERLAY MATERIALS**

The materials surrounding the pipe shall be in accordance with this Specification, TRC Standard Drawing SW012 or AS 3725 (including AS 3725 Supplement 1) where proposed deviations from this Specification are deemed appropriate.

***Material  
Conformance***

TRC Standard Drawing SW012 shows the location of each material zone for both embankment and trench applications.

***Bedding  
Dimensions***

Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table C221.1, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6. Select fill material in the side and overlay zones, for pipe support type HS, shall also comply with Table C221.1.

***Material  
Requirements***

Sieve size (mm)	Weight passing %	
	Bed and Haunch Zones	Select Fill in Side & Overlay Zones
75.0	—	100
19.0	100	—
9.5	—	50 - 100
2.36	50 -100	30 – 100
0.60	20 - 90	15 – 50
0.30	10 - 60	—
0.15	0 - 25	—
0.075	0 - 10	0 – 25

**Table C221.1 - Bedding Material Grading Limits**

Backfill material, obtained either from the excavation or another source, shall contain less than 20% (by mass) of stones sized between 75mm and 150mm and none larger than 150mm.

All material shall be compacted in layers not exceeding 150mm compacted thickness for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

**Source**

**HOLD POINT**

The Constructor shall nominate all materials for each zone and shall provide suitable evidence of compliance to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least five (5) working days prior to placement.

**PROCESS HELD:** Placement of Nominated Material(s)

**Hold Point**

**C221.08 COMPACTION**

At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the TRC Representative, is neither less than 60% nor more than 90% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

**Layers**

Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table C221.2 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

**Moisture Content**

Compaction shall be undertaken in a manner that minimises the risk of damage to the pipe structure(s). Vibratory rollers exceeding 1 tonne in weight shall not be used within 2m of the pipe structure(s). The Constructor shall be responsible for rectifying any damaged pipes, or related infrastructure, resulting from the use of unsuitable compaction methods or devices.

**Compaction Requirements**



		Pipe Support Type						
		U	H1	H2	H3	HS1	HS2	HS3
Minimum Relative Compaction %	Bed and Haunch Zones	—	50	60	Concrete	50	60	70
AS 1289.5.4.1 (Standard Compaction)	Side Zones:							
	Cohesionless	—	—	—	—	50	60	70
	Cohesive	—	—	—	—	85	90	95

**Table C221.2 - Bedding Material Compaction Requirements**

The top 0.1Dmm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is probable the bedding material shall be stabilised in accordance with *C241 - Stabilisation*.

***Cementitious Stabilisation***

**C221.09 INSTALLATION**

**(a) General**

All pipes and other structures shall be stored, handled and installed in accordance with the manufacturer's recommendations.

***Manufacturer's Recommendations***

Pipes shall be laid with the socket end placed upstream. Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings. Unless specified, no individual length of pipe shall be shorter than 1.2m.

***Positioning of Pipes***

In the case of pipes 1200mm or more in diameter, laid in situations where embankments are to be more than 3m high, measured above the invert of the pipe, pipes shall be stiffened temporarily by the Constructor by interior timber struts, erected before filling is placed. Struts shall be of hardwood measuring at least 100mm by 100mm or 125mm diameter. One strut shall be placed in a vertical position at each pipe joint, then at a spacing not greater than 1200mm. Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe. Both the sill and the cap shall be continuous throughout the length of the pipe and they shall be of sawn hardwood, of cross section not less than 100mm by 100mm. Struts shall be made to bear tightly by the use of wedges between the top of the struts and the cap. Struts, sills and caps shall be removed on completion of the embankment.

***Stiffening of Culverts***

***Removal of Struts***

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the TRC Representative or a 3:1 sand:cement mortar before the commencement of backfilling.

***Seal Lifting Holes***

Bulkheads shall be constructed in accordance with the approved design drawings on all lines where the pipe gradient exceeds 6% at 15m spacings. Anchor blocks shall be installed at 3m spacings, or at bends or junctions, where the pipe gradient exceeds 20%.

***Bulkheads***

**WITNESS POINT**

The Constructor shall notify the TRC Representative at least two (2) days prior to the placement of concrete for concrete bulkheads and anchor blocks for inspection and approval by the TRC Representative.

**Process Held:** Placement of Concrete.

**Witness Point**

The Constructor shall present the laid and jointed pipes for inspection by the TRC Representative prior to commencement of trench backfilling.

**Inspection**

**WITNESS POINT**

Inspection of laid and jointed pipes by the TRC Representative at least three (3) days prior to the placement of backfill. Evidence that the pipes have been laid within the specified tolerances shall be made available to the TRC Representative on request.

**PROCESS HELD:** Commencement of backfilling.

**Witness Point**

**(b) Joints in Reinforced Concrete Pipes**

**(i) Rubber Ringed Joints**

Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

**Clean and Dry Material**

The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted. The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it. The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by the TRC Representative.

**Procedure for Rolling Rubber Rings**

The joint shall be tested to ensure the rubber ring has rolled evenly into place.

**Joint Test**

Where wedge shaped "skid" rubber rings are prescribed the Manufacturer's instructions, which include the use of lubricants, shall be followed.

**"Skid" Rings**

**(c) Joints in Fibre-Reinforced Cement Pipes**

**(i) New Pipes**

Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in Clause C221.08(b). Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions.

**Procedure**

**(ii) Direct Side Connections to Other Pipes**

Direct side connections to other pipes shall be as detailed on the approved design drawings.

**C221.10 BACKFILL**

The remainder of the trench to the underside of pavement, or topsoil, shall be classified as backfill. Where excavation is approved through the selected material zone (SMZ), the section of trench within the SMZ shall be backfilled with selected material.

**Trench Backfill**

All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

**Layers**

At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which is neither less than 60% nor more than 90% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

**Moisture Content**

When compacted adjacent to other infrastructure, the Constructor shall adopt compaction methods which will not cause damage or misalignment. Any damage caused shall be rectified, and all costs of such rectification shall be borne by the Constructor. Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

**Precautions**

**Constructor's Cost**

## LIMITS AND TOLERANCES

### C221.11 SUMMARY OF LIMITS AND TOLERANCES

The limits and tolerances for materials and product performance related to the various clauses in this Specification are summarised in Table C221.3 below.

Item	Activity	Limits/Tolerances	Spec Clause
<b>1</b>	<b>Culvert Position</b>		
	(a) Grade Line	± 10mm	C221.04
	(b) Horizontal Alignment	± 10mm	C221.04
<b>2</b>	<b>Bedding</b>		
	(a) Material Requirements	Table C221.1	C221.07
	(b) Bed and Haunch Zone Compaction	Table C221.2	C221.08
<b>3</b>	<b>Backfill - Concrete Pipes</b>		
	(a) Side and Overlay Zone Compaction	Table C221.2	C221.10
	(b) Layer Thickness	< 150mm	C221.10

**Table C221.3 - Summary of Limits and Tolerances**

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