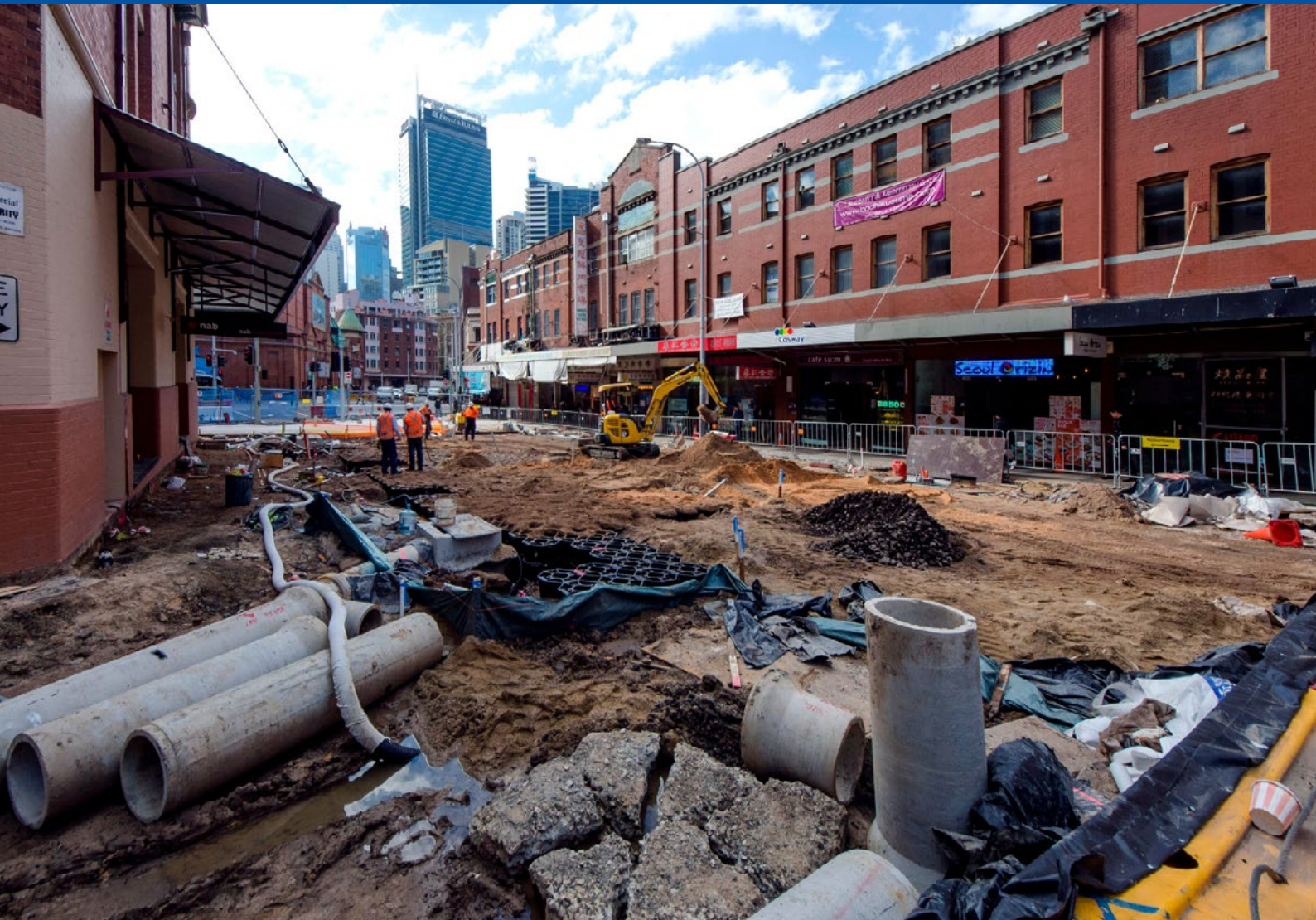


# B10 Stormwater Drainage Construction



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## 10.1 SCOPE

This Technical Specification covers the requirements for the supply, delivery, transport and installation of all precast underground stormwater drains and culverts, together with the construction of drainage pits, manholes, inlet and outlet structures and drainage connections, all as shown on the drawings as specified. This Technical Specification also covers the installation of Water Sensitive Urban Design (WSUD) devices such as raingardens and Stormwater Quality Improvement Devices (SQIDS).

The general terms 'underground stormwater drains' and 'pipes' shall be taken to also refer to culverts for the purpose of this Technical Specification.

## 10.2 STANDARD AND GUIDELINES

Unless stated otherwise in the Technical Specification, the approved drawings or elsewhere in the construction documents, the Works shall comply with the current and relevant Australian Standards and/or RMS Standards.

Any variations or ambiguity between the Technical Specification, other construction documents and Australian Standards shall be referred to the City's Representative for direction before proceeding with the Works.

The following list indicates the Australian Standards and/or RMS Standards applicable to this Technical Specification. This list is not exhaustive and may not include all standards that may apply to the Works to be undertaken. It is the responsibility of the Service Provider to ensure that all relevant standards are met.

- AS 1210 Pressure vessels
- AS 1214 Hot dip galvanised coatings on threaded fasteners (ISO metric coarse thread series)
- AS 1254 Unplasticised PVC (uPVC) pipes and fittings for storm or surface water applications
- AS 1260 PVC pipes and fittings for drain, waste and vent applications
- AS 1289 Methods of testing soils for engineering purposes
- AS 1302 Steel reinforcing bars for concrete
- AS 1303 Hard drawn steel reinforcing wire for concrete
- AS 1304 Welded wire reinforcing fabric for concrete
- AS 1463 Polyethylene pipe extrusion compounds
- AS 1579 Arc-welded steel pipes and fittings for water and waste-water
- AS 1597 Precast reinforced concrete box culverts
- AS 1646 Rubber joint rings for water supply, sewerage and drainage purposes
- AS 1741 Vitrified clay pipes and fittings with flexible joints – Sewer quality
- AS 1831 Ductile cast iron
- AS 2032 Code of practice for installation of uPVC pipe systems
- AS 2033 Installation of polyethylene pipe systems
- AS 2439 Perforated plastics drainage and effluent pipe and fittings
- AS 2566.1 Buried flexible pipelines – Structural design
- AS 2701.4 Methods of sampling and testing mortar for masonry constructions – Method for determination of compressive strength
- AS 2865 Safe working in confined space
- AS 3500 National plumbing and drainage code – Compendium
- AS 3500.3 Stormwater drainage – Plumbing and drainage – Stormwater drainage
- AS 3600 Concrete structures
- AS 3680 Polyethylene sleeving for ductile iron pipelines
- AS 3705 Geotextiles – Identification, marking and general data

- AS 3706 Geotextiles – Methods of test
- AS 3725 Loads on buried concrete pipes
- AS 3972 Portland and blended cements
- AS 3996 Metal access covers, road grates and frames
- AS 4041 Pressure piping
- AS 4058 Precast concrete pipes (pressure and non-pressure)
- AS 4060 Loads on buried vitrified clay pipes
- AS 4139 Fibre reinforced concrete pipes and fittings
- CPAA – The Foreman’s Guide to Laying Concrete Pipes (Abridged Version).

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### 10.3 STORMWATER DRAINAGE DESIGN

The design and analysis of the City’s stormwater system and drainage systems proposed as part of development and subdivision within the local area shall comply with the requirements of the following documents:

- City of Sydney Council – Sydney Streets Technical Specifications – Technical Specification A4: Stormwater Drainage Design
- Australian Rainfall and Runoff
- Managing Urban Stormwater (MUS): Soils and Construction – (Blue Book)
- FAWB (2009). Adoption Guidelines for Stormwater Biofiltration Systems, Facility for Advancing Water Biofiltration, Monash University.

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## 10.4 MATERIALS

### 10.4.1 PIPES

All pipes shall be of first quality manufacture, free from damage and/or distortion and capable of withstanding the prescribed proof loadings. All fittings shall be of similar manufacture and of suitable quality.

#### 10.4.1.1 REINFORCED CONCRETE PIPES (RCP)

Precast concrete drainage pipes shall be manufactured and factory tested for quality to AS 4058. *Precast concrete pipes (pressure and non-pressure).*

Rubber ring jointed pipes shall be used for construction of all pipelines up to and including 1800mm diameter. All pipes shall have socket ends with rubber ring joints in accordance with AS 1646. *Elastomeric seals for waterworks purposes.*

All pipes shall be a minimum Class 4.

#### 10.4.1.2 FIBRE REINFORCED CONCRETE (FRC) PIPES

Where permitted to be used by the City’s Representative, fibre-reinforced concrete (FRC) drainage pipes shall be manufactured in accordance with AS 4139 *Fibre-reinforced concrete pipes and fittings.*

#### 10.4.1.3 PLASTIC PIPES

Recycled plastic pipes and other plastic pipes may be used as substitutes to reinforced concrete pipes (RCP) where approved by the City’s Representative in non-trafficable areas or areas difficult to access for construction purposes. Plastic pipes shall conform as follows:

- UPVC Pipe conforming to *AS 1260 PVCU pipes and fittings*, section on sewer quality
- HDPE Pipe conforming to *AS 1463 Polyethylene pipe extrusion compounds*
- Polyethylene (PE) Pipe conforming to *AS 1463 Polyethylene pipe extrusion compounds*

#### 10.4.1.4 SUBSOIL DRAINAGE AND AGRICULTURAL PIPES

Unless otherwise detailed, pipes for subsoil drains shall be 90mm diameter corrugated perforated plastic drainage pipe, Class 1000 complying with the requirements of *AS 2439 Perforated plastics drainage and effluent pipe and fittings*.

##### 10.4.1.4.1 SLOTTED UPVC FOR RAINGARDENS

Perforated or slotted pipes of other material including uPVC and FRC may be accepted as an alternative, subject to compliance with the relevant sections of *AS 2439 Perforated plastics drainage and effluent pipe and fittings*.

Slotted pipes without geofabric shall be used in raingardens.

#### 10.4.1.5 SPECIAL PIPES

##### 10.4.1.5.1 PERMEABLE CONCRETE PIPES

Porous concrete pipes may be considered as a substitute to RCP for WSUD purposes where ground conditions permit. Geotechnical investigation and approval shall be required. Pipes shall be installed as per the supplier's specifications and as detailed in the City's Representative approved plans.

##### 10.4.1.5.2 PREFABRICATED FITTINGS

Fabricated fittings such as Lobster Back elbows and pipe end configurations shall be manufactured to *AS 1579 - Arc-welded steel pipes and fittings for water and wastewater*, *AS 1210 Pressure vessels* and *AS 4041 Pressure Piping standards*.

Concrete Lobster Back pipes are to be used where specified and approved by the City's Representative. Bends shall be bandaged for waterproofing and concrete encased during construction.

#### 10.4.1.6 BOX CULVERTS

##### 10.4.1.6.1 PRECAST REINFORCED CONCRETE

Small precast reinforced concrete box culverts up to 1200mm x 1200mm shall comply with the requirements of *AS 1597.1 Precast reinforced concrete box culverts*. Each batch of culvert sections shall be subjected to the proof loading test as prescribed in Section 3.2 of *AS 1597.1. Precast reinforced concrete box culverts*.

Large precast reinforced box culverts from 1500mm to 4200mm span and 4200mm height shall comply with the requirements of *AS 1597.2 Precast reinforced concrete box culverts* and be manufactured to conform to *RMS Specification R16*.

Box culvert sections of a size equal to or larger than 600mm x 450mm shall be fitted with suitable lifting lugs to allow for installation.

Cast in situ base slabs shall be used unless specified otherwise.

Culverts shall be manufactured under an approved quality assurance system. Culverts shall only be used if they have the necessary information clearly marked on them to identify the manufacturer, date of manufacture, batch number, culvert dimensions and inspection status.

#### 10.4.1.6.2 CAST IN SITU CONCRETE

Cast in situ concrete box culverts shall be permitted in situations where site conditions do not allow the practical installation of precast units. Concrete and reinforcement shall be supplied, formed and placed as per B3: Concrete Works Construction and as detailed in the design drawings.

#### 10.4.1.6.3 JOINTING MATERIAL

A self-adhesive aluminium tape with a bitumen/rubber adhesive shall be used to adhere to concrete and positively weatherproof all joints.

#### 10.4.1.7 CONCRETE, REINFORCEMENT AND EPOXY GROUT

Concrete, reinforcement and formwork for drainage structures shall comply with the requirements of B3: Concrete Works Construction.

Concrete shall be a minimum strength of 32 MPa for drainage pits, covers and similar structures and 20 MPa for scour stops, concrete bedding and encasement.

Non-shrinkage epoxy grout shall be approved by the City's Representative.

Cement mortar shall comply with the requirements of AS 2701. *Methods of sampling and testing mortar.*

#### 10.4.2 FILL AND PIPE SUPPORT MATERIAL

##### 10.4.2.1 NATURAL MATERIAL

Material for fill and pipe support including bedding, haunch and side zones, pipe overlay and backfill shall be select fill consisting of free-draining granular material having a particle size distribution determined in accordance with AS 1289.3.6.1. *Methods of testing soils for engineering purposes.*

Unless shown on the drawings, the pipe support type shall be Type HS3 under roads, paths and driveways, and HS2 elsewhere. Grading limits for select fill shall be in accordance with AS 3725 *Design for installation of buried concrete pipes* as found below.

The Service Provider shall obtain a copy of the supplier's grading tests that is indicative of the material supplied. A copy of this test certificate shall be provided to the City's Representative upon request.

**Table 1:  
Grading limits for select fill in bed and haunch zones**

Sieve Size (mm)	Weight Passing (%)
19.0	100
2.36	100–50
0.60	90–20
0.30	60–10
0.15	25–0
0.075	10–0

**Table 2:  
Grading limits for select fill in side zones**

Sieve Size (mm)	Weight Passing (%)
75.0	100
9.5	100–50
2.36	100–30
0.60	50–15
0.075	25–0



#### 10.4.2.2 RECYCLED MATERIAL

The City prefers and encourages the use of recycled products to replace natural products where possible. Crushed recycled building materials such as Recycled Crushed Glass (RCG) may be used as bedding and pipe support material, provided that it comprises of well-graded, angular, hard, durable inert particles which allow for excellent compaction and drainage characteristics. The recycled product shall meet the requirements of select fill as above.

The Service Provider, when requested, shall obtain samples from the supplier which is representative of the material to be used on site and submit them to the City's Representative for approval prior to use.

Refer to:

- [Specification for Recycled Crushed Glass as an Engineering Material](#)
- [Recycled Glass as Pipe Embedment Material](#)

#### 10.4.3 STORMWATER PITS

Stormwater pits shall be cast in situ unless specified otherwise. The concrete shall be supplied, formed and placed as per B3: Concrete Works Construction.

##### 10.4.3.1 ALTERATION AND MODIFICATION TO EXISTING STORMWATER PITS

All brick pits shall be replaced and any modification or alteration to the brick pits is not acceptable.

The City's approvals for any alteration or modification shall be obtained prior to commencement of the Works on site. All components of the altered pit including but not limited to grates, lintels, walls, bases, suspended lids and all of the materials used for alteration shall comply with relevant sections of A4: Stormwater Drainage Design and B10: Stormwater Drainage Constructions.

#### 10.4.4 PRECAST STRUCTURES

All precast structures such as lintels and lid surrounds shall be manufactured, supplied and installed in accordance with the requirements of *AS3600 – Concrete Structures*.

#### 10.4.5 STONE LINTELS

Stone shall be granite, bluestone, sandstone or trachyte as specified on the drawings. Refer to B4: Kerb and Gutter Construction for stone property requirements. Refer to the standard drawings for dimensions.

#### 10.4.6 STORMWATER GRATES, FRAMES AND COVERS

Stormwater grates, frames and covers shall be ductile cast-iron products in accordance with *AS 1831 Ductile Cast Iron* unless approved otherwise.

All products shall be bicycle-safe or pedestrian-safe for roadways and footways respectively and as specified by the City's Representative. Heel-safe grates shall be required only where specified.

Load requirements shall be Class C for footpaths and Class D for roads or areas with trafficable loadings.

#### 10.4.7 WATERPROOFING

Waterproofing products shall be either water-based bituminous paint or polyurethane membrane as specified. The waterproofing shall be installed as per the manufacturer's recommendations and have a minimum of two (2) coats applied.

All waterproofing products shall have a minimum 10-year guarantee and conform to *AS 4020 Products for use in contact with drinking water*.

A geo-fabric or other form of suitable protection is to be added to the surface of the waterproofing during backfilling or general works immediately adjacent to the waterproofing layer to prevent any punctures occurring.

## 10.4.8 RAINGARDENS

### 10.4.8.1 LINING MATERIALS

#### 10.4.8.1.1 UNREINFORCED POLYPROPYLENE

Unreinforced polypropylene lining shall be a minimum thickness of 0.5mm and be supplied free of defects. The liner shall be generally supplied in large enough sheets/rolls to suit the raingarden area and minimise joints.

All joints and seams shall be joined using plastic welding methods, in accordance with the polypropylene supplier’s recommendations.

The liner shall be transported and stored on site in a manner to ensure that the liner is not damaged prior to installation.

#### 10.4.8.1.2 SHOTCRETE

Shotcrete lining shall be pre-mixed sprayed concrete placed using high-pressure equipment.

Sprayed concrete shall be supplied and placed as per B3: Concrete Works Construction.

### 10.4.8.2 DRAINAGE LAYER

The drainage layer shall comprise a no fines drainage gravel and be in accordance with the following particle distribution:

Particle size	% Retained
> 7mm	0
4mm–7mm	> 70%
2mm–4mm	< 20%
< 2mm	0

### 10.4.8.3 TRANSITION LAYER

The transition layer shall comprise coarse washed river sand or recycled crushed glass equivalent and be in accordance with the following:

- 90 per cent of particles retained above 0.25mm
- Saturated hydraulic conductivity > 250mm/hr

#### 10.4.8.4 BIO FILTRATION LAYER

The bio-filtration layer shall comprise a sandy loam mix in accordance with the FAWB guidelines and the following:

- Saturated hydraulic conductivity between 100mm/hr and 250mm/hr
- Particle distribution:

Description	Proportion	Grading
Clay and Silt	< 3%	< 0.05mm
Very Fine Sand	5%–30%	0.05mm–0.15mm
Fine Sand	10%–30%	0.15mm–0.25mm
Medium to Coarse Sand	40%–60%	0.25mm–1.0mm
Coarse Sand	7%–10%	1.0mm–2.0mm
Fine Gravel	< 3%	2.0mm–3.4mm

- Total clay and silt content  $\leq$  3%
- Organic content shall be < 5%
- pH (1:5) in water 5.5–7.5
- Electrical conductivity (EC) < 1.2dS/m
- Total nitrogen < 1000mg/kg
- Orthophosphate ( $\text{PO}_4^{-3}$ ) < 80mg/kg.

#### 10.4.8.5 GRAVEL MULCH

The gravel mulch shall be a washed aggregate between 10mm and 20mm in diameter as specified in the drawings or by the City’s Representative.

#### 10.4.8.6 SUBMERGED ZONE LAYER

Refer to FAWB guidelines on submerged zones, noting that permanent submerged zones have been found to be more effective and benefit plants in dry periods. Refer also to the table below.

The submerged zone shall comprise a mix of the following:

- No fines drainage gravel
- 5% organic mulch (sugar cane mulch)
- 5% hardwood chips (not treated).

The gravel within the submerged layer shall be in accordance with the following particle distribution:

Particle size	% Retained
> 7mm	0
4mm–7mm	> 70%
2mm–4mm	< 20%
< 2mm	0

---

## 10.5 SUPPLY

### 10.5.1 QUALITY

The Service Provider shall provide evidence satisfactory to the City's Representative that the pipes, box culvert sections and other drainage and filtration products supplied under the contract conform with the appropriate Australian Standard.

The Service Provider shall obtain copies of test certificates for the products from the manufacturer which are readily identifiable with the batch they represent. A copy of the test certificates shall be provided to the City's Representative upon request.

### 10.5.2 UNLOADING, HANDLING AND STORAGE

All pipes, box culverts and other drainage products shall be supplied and delivered by the Service Provider. Where the products are not immediately laid, they are to be placed and stored in a position and in a manner that will safeguard the public against personal or property injury, in the event of which, the Service Provider will be held entirely responsible.

The Service Provider shall employ adequate means in handling the products and shall be responsible for all damage done to these in unloading from delivery vehicles, cartage to the site and laying in position.

All products damaged in these operations will be replaced or repaired, as directed by the City's Representative, at the Service Provider's expense. No product shall be laid which is cracked, spalled or damaged, and all such products shall be removed by the Service Provider from the site of the works.

---

## 10.6 DRAINAGE CONSTRUCTION

### 10.6.1 TRENCH FOR DRAINAGE

#### 10.6.1.1 GENERAL

The Service Provider shall set out the trench alignment, clearly marking the specified end points of the trench. The City's Representative will inspect the set out of the trench prior to the commencement of excavation.

The Service Provider shall be responsible for obtaining current underground location plans to locate all existing services and obtain clearances for potholing and construction. The Service provider is strongly advised use the Dial Before You Dig service to obtain this information prior to commencing Works.

Before commencing excavation, the Service Provider shall expose all crossings and connection points on existing services along the proposed drainage system alignment. The levels of each crossing and connection point shall be surveyed and any variations to the levels given or any difficulties in being able to achieve the required grades of the proposed pipeline shall be reported to the City's Representative.

Refer to *Sections 1.3.6 Existing Services and Relocation* and *1.3.7 Abandonment of Services* in *Section 1.3 Site Requirements* of B1: Preliminaries and General Construction.

### 10.6.1.2 WIDTH OF EXCAVATION

Trench excavation generally shall comply with the principles prescribed in the following Codes of Practice for the various types of pipe:

- AS 3725 Concrete Pipes
- AS 4060 Vitrified Clay Pipes
- AS 2032 uPVC Pipes
- AS 2566 Flexible Pipelines

Trenching for pipes shall be to trench conditions in accordance with AS 3725 – *Concrete Pipes* and AS 2566 *Flexible Pipelines* unless otherwise specified.

Trench widths for concrete pipes shall be 1.4 times the external pipe diameter or the external pipe diameter plus 600mm measured at the level of the crown of the pipe, whichever is greater.

The standard width of trenches for subsoil drains shall be 200mm.

In trenches where shoring is necessary, the width shall be increased sufficiently to maintain the clearances specified above between the face of the shoring and pipes.

### 10.6.1.3 ALLOWANCE FOR BEDDING

Trenches shall be excavated to the pipe design levels shown on the drawings plus the required bedding depth. Allowance shall be made in the depth of the trench for the bedding type specified.

For concrete pipes, the depth of bedding shall be a minimum of 100mm for pipes up to and including 1500mm diameter and 150mm depth for all mains larger than a 1500mm diameter.

Bedding for subsoil drains shall be a 50mm minimum.

### 10.6.1.4 PIPE COVER

The minimum pipe cover, measured from the top of the pipe to the finished surface, shall be as per the table below:

Location	Required Cover
Roads	600mm
Footpaths	400mm
Parks	400mm

Where the new pipe is located in a planned future road alignment, then the cover shall be in accordance with the cover requirements for a road and be based on the future design levels.

## 10.6.2 PIPE BEDDING AND SIDE SUPPORT

Unless otherwise shown on the drawings, the pipes shall be laid in trench conditions. The support type and bedding and side support material shall be in accordance with Table 1 in *Section 10.4.2.1 Natural Material*.

If not shown on the drawings, the pipe support for reinforced concrete pipes shall be Type HS3 under roads, paths and driveways, and HS2 elsewhere.



### 10.6.3 LAYING AND JOINTING

#### 10.6.3.1 PIPES

All pipes shall be spigot and socket, rubber-ringed, steel-reinforced concrete pipes unless approved otherwise by the City's Representative.

Pipe laying shall begin at the downstream end of the line with the socket end of the pipe facing upstream. When the pipes are laid, the barrel of each pipe shall be in contact with the bedding material along its full length exclusive of the socket. Pipe sockets shall not bear on the bottom of the trench. Handling of pipes shall be in accordance with the manufacturer's recommendation.

All rubber rings used shall be the same rings supplied by the pipe manufacturer, to match the pipe to be installed. Installation of the rubber ring shall be done in accordance with the manufacturer's recommendation.

Lifting holes, where provided, shall be sealed with the plug provided by the manufacturer.

#### 10.6.3.2 BOX CULVERTS

Box culverts shall be either wholly cast in situ or precast units with a continuous cast in situ reinforced concrete base. Precast bases shall not be used unless approved otherwise by the City's Representative.

Precast sections of box culverts shall be firmly butted together and the joints sealed in accordance with the manufacturer's recommendation.

The contact areas between the culvert sections and the base slab shall be mortared.

Unless otherwise specified or shown on the drawing, multi-row box culverts shall be laid with the sections in each row in contact with the sections in the adjacent rows.

Cast in situ culverts shall be constructed in accordance with the construction drawings. All concrete shall be constructed in accordance with B3: Concrete Works Construction.

#### 10.6.4 SUBSOIL PIPES IN TRENCH

Where subsoil pipes are specified on construction plans, they are to be installed in accordance with the manufacturer's recommendation.

The subsoil drains shall have a rodding point installed on the upstream end of the drain to provide for future cleaning. The rodding point shall be fitted with an appropriate cap and finish flush with the finished surface.

#### 10.6.5 BACKFILLING

Backfilling under this Technical Specification is the remainder of filling in the trench above the bedding and pipe support material. It shall include the pipe overlay zone and the backfilling of the remainder of the trench.

Backfilling of concrete pipes shall be in accordance with *AS 3725. Design for installation of buried concrete pipes*.

The City prefers and encourages the use of recycled products to replace natural products in backfilling.

Prior to backfilling, the pipes shall be inspected to confirm that the joints have been driven home correctly, and that the rubber rings have not slipped out of the joints.

Trenches are to be backfilled promptly after laying of pipelines. Any damage caused to pipes by floating or the like due to delay in backfilling or inadequate protective measures will be the Service Provider's responsibility and will not be the subject of an extension of time. Backfilling shall comply with the following requirements:

### 10.6.5.1 PIPE OVERLAY ZONE

The Service Provider shall fill above the side zone to a level of 150mm above the top of the pipe with select material in accordance with Table 2 above in Section 10.4.2.1 Natural Material. Fill material shall be obtained which is free from stones greater than 100mm and with not more than 20 per cent of stones between 75mm and 100mm in size.

The material shall be compacted to a minimum of 95 per cent standard maximum dry density and compacted in layers not exceeding 150mm loose thickness.

### 10.6.5.2 PIPE BACKFILL ABOVE OVERLAY ZONE

The remainder of the trench above the pipe overlay zone up to the sub-base level shall be backfilled with selected material in accordance with Table 2 above, which is free from stones greater than 100mm and with not more than 20 per cent of stones between 75mm and 100mm in size.

Material lower than 600mm below sub-base level shall be compacted to at least 90 per cent of standard maximum dry density. The top 600mm below the road sub-base levels shall be compacted to at least 95 per cent of the standard maximum dry density.

### 10.6.5.3 SUPPORT TO PIPES AND STRUCTURES

Where an existing pipe or other structure crosses a trench, it shall be supported in accordance with the relevant Utility's requirements.

Where a service crosses an existing City-owned pipe or structure, they are to be adequately supported in accordance with the directions given by the City's Representative.

### 10.6.6 CONCRETE ENCASUREMENT

Drainage pipes are only to be concrete-encased where the appropriate cover cannot be achieved due to service conflicts or other unforeseen obstructions. Pipes shall only be encased as a last resort and with prior approval from the City's Representative.

All concrete encasement shall be 32 MPa concrete and supplied and installed in accordance with B3: Concrete Works Construction. Generally, the concrete encasement shall be 150mm thick and shall finish a minimum of 100mm below the finished ground surface level.

### 10.6.7 CONCRETE BULKHEADS

Concrete bulkheads shall be installed on pipe lines where the grade exceeds 10 per cent or where specified on the construction plans. The spacing of bulkheads shall be as shown on the plans, with a maximum distance of 10m between the centres of bulkheads.

Bulkheads shall be constructed as detailed in the approved construction plans.

### 10.6.8 BANDAGE JOINTS

Bandage joints shall only be constructed with the approval from the City's Representative.

The ends of the pipes that are to be joined shall be cut smooth. The pipes shall then be cleaned of all loose material.

The joint shall be bandaged with waterproof jointing material, a minimum 200mm wide lapped by at least 100mm, then tied with wire and concrete encased in accordance with the standard drawing.

### 10.6.9 CONNECTIONS AND JUNCTIONS

All stormwater drainage connections to pits, drains, and the like shall be neatly made, and where necessary, the ends of all drains shall be trimmed off and finished with non-shrinkage epoxy grout.

New pipework inlets connecting to existing stormwater pits shall be located between 90° and 270° to the pit outlet. Connections outside this range are unacceptable.

Where directed, the Service Provider shall provide an entry into pits for future stormwater drainage pipes by the provision of a suitably sized pipe stub as directed by the City's Representative.

Holes for subsoil drains shall be 90mm diameter, unless otherwise specified or shown on the drawings.

Direct pipe-to-pipe connections (pipe junctions) shall not be accepted.

### 10.6.10 DRAINAGE PITS

Drainage pits shall be cast in situ, reinforced and benched internally with mass concrete as detailed on the standard drawing.

Where drainage pits exceed 1m in depth, approved climbing irons must be installed as shown on the standard drawings.

Pit walls shall be formed on the inside faces.

The walls and base shall be reinforced as specified on the standard drawings.

Benching shall be constructed in accordance with the standard drawings.

Brick stormwater pits shall be fully removed and replaced with new concrete pits as per City of Sydney's standard drawings.

All pipes shall connect into the wall of the drainage pit. The pipe shall not connect at the corner of the pit (birdsmouth). Birdsmouth shall only be accepted with prior approval from the City's Representative and only if it can be proved that all other options are not viable. The pipe shall extend into the drainage pit to the inside wall and be cut smooth to suit.

#### 10.6.10.1 REMOVAL OF TRAP GULLY

Trapped gully pits shall be reconstructed by removing the buffer wall and constructing structural supports where required to the satisfaction of the City's Representative.

The base of the pit shall be raised and benched with mass concrete to the invert level of the outlet pipe.

### 10.6.11 INSTALLATION OF LINTELS

Drainage lintels shall be as specified on the construction drawings and installed in accordance with the standard drawings.

The ramp under the lintel shall be installed as detailed in the standard drawings.

Lintels for sag and on-grade pits shall be installed centrally and skewed upstream respectively to the pit. Precast concrete lintels shall have a minimum 3m extended kerb inlet (EKI) opening where possible.

### 10.6.12 SUBSOIL PIPES

100mm diameter subsoil pipes, with socks, shall be installed at the base of all new pipe line trenches and have a minimum length of 3m. The ag lines (agricultural drains) shall be installed along the pipe line trench upstream of each drainage pit.

Subsoil drainage pipes shall extend through any mass concrete benching, sleeved with 100mm diameter uPVC pipes to provide a free outlet.

### 10.6.13 BACKFILLING AROUND PITS

Backfilling around pits shall be placed in layers not exceeding 300mm loose thickness and compacted to refusal using handheld mechanical equipment.

### 10.6.14 PROPERTY DOWNPIPE CONNECTIONS

All property downpipe connections shall be connected to the kerb and gutter or directly into the City's drainage system. Property downpipes shall not be discharged directly onto footways.

Where property connections are directly connected to the drainage pipe, the location of the connection shall be recorded prior to backfilling around the connection.

All downpipe crossings shall be laid to a minimum fall of 1 per cent. This may require the installation of the drains at an angle rather than perpendicular to the boundary/kerb.

Crossing shall be rectangular RHS. No pipes will be permitted.

#### 10.6.14.1 DIRECT CONNECTIONS

Pipes used for direct house downpipe connections shall be of spigot and socket, rubber-ring, joint-reinforced concrete or uPVC Class SN6, solid-walled, solvent-welded pipes.

Direct connected pipes shall be installed into the nearest drainage pit only. Direct connection into pipes is not acceptable unless approved by the City's Representative.

All connections shall be core drilled and sealed with a non-shrink grout.

#### 10.6.14.2 CONNECTIONS TO KERBS

Connections to the kerb from house downpipes shall be made with either solid-walled, solvent-welded pipes or 100mm x 150mm galvanised rectangular hollow sections. The kerb connections shall be in accordance with the standard drawings.

Downpipe crossings shall take the shortest route to the kerb and shall be generally straight grade with minimal bends. All bends shall be manufactured with a maximum of 45° bend. Downpipe crossings shall not cross the frontage of another property without the approval of the City's Representative.

No pressure lines shall be connected to the kerb. All connections to the kerb shall be conveyed by gravity only.

## 10.7 RAINGARDENS

There are three main types of raingardens: lined, lined with submerged zone, and unlined. Each of these raingardens are built with various layers as shown in the standard drawings. Each layer of the raingardens is described below.

The layers and depth of the raingarden are critical to achieve the desired water quality outcomes and shall only be modified with approval from the City's Representative. Hold and witness points are required as outlined in *Section 10.12.1.1*.

### 10.7.1 LINING METHOD

The liner shall be either plastic welded unreinforced polypropylene or shotcrete as detailed on the design drawings.

A plastic liner shall not be used where a utility service crosses the raingarden, unless it can be demonstrated that an adequate seal can be provided where the service penetrates the raingarden wall.

### 10.7.2 SUBMERGED ZONE

The submerged zone shall be installed as per the standard drawings.

Waterproofing is only required for shotcrete liners within the submerged zone and shall be installed as per the manufacturer's recommendation.

Where practical, the submerged zone can be constructed using a PP liner with welded joints.

Reference the FAWB guidelines on submerged zones as they can be done in two different ways.

### 10.7.3 SUBSOIL DRAINAGE

Subsoil drainage shall be 90mm slotted PVC pipes laid within the drainage layer, with a minimum of 50mm cover. The layout of the subsoil drainage shall be in accordance with the drawings.

Roding points shall be installed at the end of each subsoil drain and be brought to the top of the ponded water depth (generally 150mm) to allow for future cleaning.

### 10.7.4 DRAINAGE LAYER

The drainage layer shall be installed horizontally and flat and be a minimum of 150mm thick in accordance with the standard drawings.

### 10.7.5 TRANSITION LAYER

The transition layer shall be installed horizontally and flat and be a minimum of 100mm thick in accordance with the standard drawings.

### 10.7.6 BIO-FILTRATION LAYER

The bio-filtration layer shall be installed to suit the finished surface levels and be a minimum of 400mm thick in accordance with the standard drawings.

The bio-filtration layer shall also be lightly compacted to avoid settlement.

### 10.7.7 VEGETATION

Vegetation shall be planted as shown on the construction drawings.

### 10.7.8 MULCH

Mulch shall be installed immediately after planting in a single continuous layer, generally 50mm thick.

### 10.7.9 ENERGY DISSIPATERS

Energy dissipation rocks of 100mm to 200mm diameter shall be set 50mm proud within a 100mm thick concrete base and in accordance with the standard drawings.



### 10.7.10 OVERFLOW PITS

Overflow drainage pits shall be cast in situ, reinforced and benched internally with mass concrete as detailed on the standard drawing.

Concrete shall be supplied, formed and placed as per B3 Concrete Works Construction.

### 10.7.11 KERBING AROUND RAINGARDENS

Refer to B4: Kerb and Gutter Construction.

### 10.7.12 GUTTER BRIDGES

Gutter bridges are only to be installed in conjunction with raingardens.

The galvanised steel cover shall be manufactured off site and installed as per the standard drawings.

Concrete shall be supplied, formed and placed as per B3 Concrete Works Construction.

## 10.8 PERMEABLE PAVING

Permeable paving shall be installed on a 100mm thick base in 5mm gravel over either the sandy soil substrate or a manufactured drainage cell as noted on the construction drawings.

The paver type, colour and laying pattern shall be specified on the construction drawings.

## 10.9 SQID

Stormwater quality improvement devices (SQID) shall consist of an underground unit with a continuous deflective separation system to effectively screen, separate and trap debris, sediment, and oil and grease from stormwater runoff. Installations shall comply with this Technical Specification, the approved plans and the manufacturer's instructions.

## 10.10 CLEANING OF DRAINAGE STRUCTURES

Prior to final sign-off and site handover, all drainage pits and pipes shall be cleaned using high-pressure jetting. Note that in line with current EPA legislation, discharge to waterways shall be under licence only.

Handheld gurneys are only acceptable for cleaning drainage pits. All pipes shall be cleaned with a specialised jetting truck and the appropriate nozzle attachment.

## 10.11 CCTV INSPECTION OF DRAINAGE STRUCTURE

Closed circuit television (CCTV) inspections of pipelines shall be conducted to check for any construction defects prior to backfilling sections of pipeline or culvert as requested by the City's Representative. A visual inspection shall be conducted for short sections of pipeline prior to backfilling if and when requested by the City's Representative.

CCTV inspection of conduits shall be conducted in accordance with the *Conduit Inspection Reporting Code of Australia WSA 05*.

## 10.12 QUALITY

### 10.12.1 INSPECTIONS

At least two working days' notice shall be given for all inspections.

#### 10.12.1.1 HOLD AND WITNESS POINTS

Construct Drainage Pipe	
1. Process Held:	Pipe Setout (Section 10.6.1.1)
Submission Details:	At least two (2) working days before the new pipe is setout on site
Release of Hold Point:	The City's Representative will inspect the proposed layout, prior to authorising the release of the Hold Point
2. Process Held:	Excavation of Trench (Section 10.6.1.1)
Submission Details:	At least two (2) working days prior to excavation of trench
Release of Witness Point:	The City's Representative will inspect the trench prior to authorising the release of the Witness Point unless advised otherwise
3. Process Held:	Placement and Compaction of Bedding (Section 10.6.1.3)
Submission Details:	At least two (2) working days prior to placement and compaction of bedding
Release of Witness Point:	The City's Representative will inspect the compacted bedding, prior to authorising the release of the Witness Point unless advised otherwise
4. Process Held:	Laying Pipe, Including Downpipe Crossings (Section 10.6.3.1)
Submission Details:	At least two (2) working days prior to laying the pipe
Release of Hold Point:	The City's Representative will inspect installed pipe, prior to authorising the release of the Hold Point
5. Process Held:	Placement and Compaction of Side Support (Section 10.6.2)
Submission Details:	At least two (2) working days prior to placing and compaction of side support
Release of Witness Point:	The City's Representative will inspect the compacted side support, prior to authorising the release of the Witness Point unless advised otherwise
6. Process Held:	Placement and Compaction of Overlay Zone (Section 10.6.5.1)
Submission Details:	At least two (2) working days prior to placement and compaction overlay zone
Release of Witness Point:	The City's Representative will inspect the compacted overlay zone, prior to authorising the release of the Witness Point unless advised otherwise
7. Process Held:	Placement and Compaction of Backfill (Section 10.6.5)
Submission Details:	At least two (2) working days prior to placement and compaction of backfill
Release of Witness Point:	The City's Representative will inspect the compacted backfill, prior to authorising the release of the Witness Point unless advised otherwise

Construct Precast Culvert	
1. Process Held:	Culvert Setout (Section 10.6.3.2)
Submission Details:	At least two (2) working days before the new culvert is setout on site
Release of Hold Point:	The City's Representative will inspect the proposed layout, prior to authorising the release of the Hold Point
2. Process Held:	Excavation of Trench (Section 10.6.1.1)
Submission Details:	At least two (2) working days prior to excavation of trench
Release of Witness Point:	The City's Representative will inspect the trench, prior to authorising the release of the Witness Point unless advised otherwise
3. Process Held:	Placement and Compaction of Bedding (Section 10.6.1.3)
Submission Details:	At least two (2) working days prior to placement and compaction of bedding
Release of Witness Point:	The City's Representative will inspect the compacted bedding, prior to authorising the release of the Witness Point unless advised otherwise
4. Process Held:	Pouring Culvert Base (Section 10.6.3.2)
Submission Details:	At least two (2) working days prior to pouring the culvert base
Release of Hold Point:	The City's Representative will inspect installed formwork and reinforcement, prior to authorising the release of the Hold Point
5. Process Held:	Installation of Precast Culvert (Section 10.6.3.2)
Submission Details:	At least two (2) working days prior to installation of precast culvert
Release of Hold Point:	The City's Representative will inspect the installed culvert, prior to authorising the release of the Hold Point
6. Process Held:	Placement and Compaction of Side Support (Section 10.6.2)
Submission Details:	At least two (2) working days prior to placing and compaction of side support
Release of Witness Point:	The City's Representative will inspect the compacted side support, prior to authorising the release of the Witness Point unless advised otherwise
7. Process Held:	Placement and Compaction of Overlay Zone (Section 10.6.5.1)
Submission Details:	At least two (2) working days prior to placement and compaction overlay zone
Release of Witness Point:	The City's Representative will inspect the compacted overlay zone, prior to authorising the release of the Witness Point unless advised otherwise
8. Process Held:	Placement and Compaction of Backfill (Section 10.6.5)
Submission Details:	At least two (2) working days prior to placement and compaction of backfill
Release of Witness Point:	The City's Representative will inspect the compacted backfill, prior to authorising the release of the Witness Point unless advised otherwise

## Construct Cast In Situ Culvert

1. Process Held:	Culvert Setout (Section 10.6.3.2)
Submission Details:	At least two (2) working days before the new culvert is setout on site
Release of Hold Point:	The City's Representative will inspect the proposed layout, prior to authorising the release of the Hold Point
2. Process Held:	Excavation of Trench (Section 10.6.1.1)
Submission Details:	At least two (2) working days prior to excavation of the trench
Release of Witness Point:	The City's Representative will inspect the trench, prior to authorising the release of the Witness Point unless advised otherwise.
3. Process Held:	Placement and Compaction of Bedding (Section 10.6.1.3)
Submission Details:	At least two (2) working days prior to placement and compaction of bedding
Release of Witness Point:	The City's Representative will inspect the compacted bedding, prior to authorising the release of the Witness Point unless advised otherwise
4. Process Held:	Pouting Culvert Base (Section 10.6.3.2)
Submission Details:	At least two (2) working days prior to pouring culvert base
Release of Hold Point:	The City's Representative will inspect installed formwork and reinforcement, prior to authorising the release of the Hold Point
5. Process Held:	Pouring of Cast In situ Culvert (Section 10.6.3.2)
Submission Details:	At least two (2) working days prior to pouring of cast in situ culvert
Release of Hold Point:	The City's Representative will inspect formwork and reinforcement, prior to authorising the release of the Hold Point
6. Process Held:	Placement and Compaction of Side Support (Section 10.6.2)
Submission Details:	At least two (2) working days prior to placing and compaction of side support
Release of Witness Point:	The City's Representative will inspect the compacted side support, prior to authorising the release of the Witness Point unless advised otherwise
7. Process Held:	Placement and Compaction of Overlay Zone (Section 10.6.5.1)
Submission Details:	At least two (2) working days prior to placement and compaction overlay zone
Release of Witness Point:	The City's Representative will inspect the compacted overlay zone, prior to authorising the release of the Witness Point unless advised otherwise
8. Process Held:	Placement and Compaction of Backfill (Section 10.6.5)
Submission Details:	At least two (2) working days prior to placement and compaction of backfill
Release of Witness Point:	The City's Representative will inspect the compacted backfill, prior to authorising the release of the Witness Point unless advised otherwise

## Construct Drainage Pit

1. Process Held:	Drainage Pit Setout (Section 10.6.10)
Submission Details:	At least two (2) working days before the new drainage pit is setout on site
Release of Hold Point:	The City's Representative will inspect the proposed layout, prior to authorising the release of the Hold Point
2. Process Held:	Excavation for Pit (Section 10.6.10)
Submission Details:	At least two (2) working days prior to excavation for pit
Release of Witness Point:	The City's Representative will inspect the excavation, prior to authorising the release of the Witness Point unless advised otherwise
3. Process Held:	Placement and Compaction of Bedding (Section 10.6.1.3)
Submission Details:	At least two (2) working days prior to placement and compaction of bedding
Release of Witness Point:	The City's Representative will inspect the compacted bedding, prior to authorising the release of the Witness Point unless advised otherwise
4. Process Held:	Pouring Drainage Pit (Section 10.6.10)
Submission Details:	At least two (2) working days prior to pouring the drainage pit
Release of Hold Point:	The City's Representative will inspect installed formwork and reinforcement, prior to authorising the release of the Hold Point
5. Process Held:	Placement and Compaction of Backfill (Section 10.6.5)
Submission Details:	At least two (2) working days prior to placement and compaction of backfill
Release of Witness Point:	The City's Representative will inspect the compacted backfill, prior to authorising the release of the Witness Point unless advised otherwise
6. Process Held:	Installation of Grate/Lid (Section 10.6.10)
Submission Details:	At least two (2) working days prior to installation of grate/lid
Release of Hold Point:	The City's Representative will inspect the installed grate/lid, prior to authorising the release of the Hold Point
7. Process Held:	Installation of Lintel (Section 10.6.11)
Submission Details:	At least two (2) working days prior to installation of the lintel
Release of Hold Point:	The City's Representative will inspect the installed lintel, prior to authorising the release of the Hold Point



## Construct Raingarden

1. Process Held:	Excavation for Raingarden (Section 10.7) Note a Hold Point here to check the level at this point. Levels are crucial to raingarden success. The City's Representative will inspect the levels, prior to authorising the release of the Hold Point.
Submission Details:	At least two (2) working days prior to excavation for the raingarden
Release of Witness Point:	The City's Representative will inspect the excavation, prior to authorising the release of the Witness Point unless advised otherwise
2. Process Held:	Placement of Liner (Section 10.7.1)
Submission Details:	At least two (2) working days prior to placement of liner
Release of Hold Point:	The City's Representative will inspect the installed liner, prior to authorising the release of the Hold Point
3. Process Held:	Placement of Slotted Drains (Section 10.7.3)
Submission Details:	At least two (2) working days prior to placement of slotted drains
Release of Hold Point:	The City's Representative will inspect the slotted drains, prior to authorising the release of the Hold Point
4. Process Held:	Placement of Drainage Layer (Section 10.7.4) Note a Hold Point here for submerged zones. The City's Representative will inspect the submerged zones, prior to authorising the release of the Hold Point.
Submission Details:	At least two (2) working days prior to placement of drainage layer
Release of Hold Point:	The City's Representative will inspect the finished levels of the drainage layer, prior to authorising the release of the Hold Point
5. Process Held:	Placement of Transition Layer (Section 10.7.5)
Submission Details:	At least two (2) working days prior to placement of the transition layer
Release of Hold Point:	The City's Representative will inspect the finished levels of the transition layer, prior to authorising the release of the Hold Point
6. Process Held:	Placement of Bio-filtration Layer (Section 10.7.6)
Submission Details:	At least two (2) working days prior to placement of the bio-filtration layer
Release of Hold Point:	The City's Representative will inspect the finished levels of the bio-filtration layer, prior to authorising the release of the Hold Point
7. Process Held:	Installation of Dissipation Rocks (Section 10.7.9)
Submission Details:	At least two (2) working days prior to installation of dissipation rocks
Release of Hold Point:	The City's Representative will inspect installed dissipation rocks, prior to authorising the release of the Hold Point
8. Process Held:	Installation of Plants (Section 10.7.7)
Submission Details:	At least two (2) working days prior to installation of plants
Release of Hold Point:	The City's Representative will inspect installed plants, prior to authorising the release of the Hold Point

9. Process Held: Placement of Gravel Mulch (Section 10.7.8)

Submission Details: At least two (2) working days prior to placement of gravel mulch

Release of Hold Point: The City’s Representative will inspect the finished levels of the gravel mulch, prior to authorising the release of the Hold Point

### 10.12.2 TOLERANCES

The contractor shall construct the Works within the following tolerances:

Item	Activity	Tolerances
1.	Pipework	<ul style="list-style-type: none"> <li>Finished horizontal position +/- 50mm from design drawings</li> <li>Finished vertical position +/- 25mm from design levels</li> <li>Finished grade +/- 0.5% from design grades greater than 3% and +/- 0.2% from design grades less than or equal to 3%</li> </ul>
2.	Manhole, Field Inlet, Property Pit, IO Structure and GPT	<ul style="list-style-type: none"> <li>Finished horizontal position +/- 50mm laterally and +/- 100mm longitudinally from the design drawings</li> <li>Finished vertical position +/- 25mm from both the surface and invert design levels</li> </ul>
3.	Inlet Gully	<ul style="list-style-type: none"> <li>Finished position of an inlet gully to match the adjacent kerb and gutter both horizontally and vertically</li> </ul>