



Stormwater Drainage Design

Guidelines

2019

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1. Purpose

The purpose of this document is to outline the stormwater drainage design requirements for developments within the City of Melbourne.

2. Background

The City of Melbourne manages an extensive network of stormwater drainage assets, made up of approximately 365 kilometres of underground drain and 15,000 drainage pits. There are a number of significant challenges in managing this network, such as the effects of climate change, aging infrastructure, increased development and greater community expectations in terms of reducing flood risk and responding to reports of flooding.

The effects of [climate change](#)¹ are predicted to result in a 19.5 % increase in rainfall intensity as well as a 0.8 metre rise in sea level by the year 2100. These effects, in combination with the highly impervious nature in some of the municipality's lower lying areas (Southbank, CBD South, Docklands and Fishermans Bend) result in a likely increase in flood risk. The City of Melbourne is mitigating this flood risk through the following means:

- A proactive annual program of drainage upgrades and renewal works
- Increasing catchment permeability through Council's Total Watermark and Urban Forest Strategies
- Restricting the flow rates discharged from new development sites
- Promoting the use of Integrated Water Cycle Management in Council's capital works program and through planning permit requirements on developments
- Drainage data collection program to facilitate flood modelling of the Council drainage network
- Progressively increasing the capacity of drains and pump stations to a 5% Annual Exceedance Probability (AEP) standard

Flood risk is a product of both the likelihood of a flood event, and the consequences of such an event occurring. It stands therefore that flood risk can be reduced by either reducing the likelihood of flooding (through increased drainage capacity, or reducing runoff for example), reducing the consequences of flooding (through increased awareness and preparedness at flooding 'hot spots'), or a combination of both.

3. Design Requirements

For the purposes of these guidelines, the municipality is broken into three distinct regions, each of which has its own specific drainage design requirements for new developments. The drainage design requirements for development in each area are outlined below.

3.1 On Site Detention

The primary purpose of On-Site Detention (OSD) Systems within the City of Melbourne is to limit the rate of discharge from a site to the legal point of discharge, freeing up capacity in the Council drainage network to reduce flooding during more extreme rainfall events. This is achieved by controlling post development flow rates to a pre-determined level, and temporarily storing excess runoff in storage tanks or pipes within a site boundary. The key elements of an OSD System are:

- A runoff collection system consisting of gutters, downpipes, pits and pipes.
- A runoff storage area (Oversized Pipe, Tank, etc.)

¹ <http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/>

- A flow control device (Multicell, Orifice Pit or Pump) to allow discharge to the Legal Point of Stormwater Discharge at the predetermined rate

3.2 Region 1 - CBD and Growth Areas

This region includes the Melbourne Central Business District as well as the Southbank, Arden-Macaulay, Docklands and CBD North growth areas. With the exception of residential extensions and single dwelling development, all developments within this region will be subject to the following drainage design requirements:

3.2.1 OSD Design Parameters – Region 1

The two key calculations required for the design of an OSD System are:

Permissible Site Discharge (PSD)

The purpose of the PSD is to limit the site discharge to a pre-determined rate. Within Region 1 (CBD and Growth Areas), the PSD is calculated as the runoff generated from the pre-developed site during a 20%² AEP design storm event of 5 minute duration.

The PSD is calculated using the Rational Method Formula:

$$\text{PSD (litres/s)} = \frac{C_{20} \times I_{20}^5 \times A}{3600}$$

Where,

$$C_{20} = 20\% \text{ AEP Runoff Coefficient}$$

$$= 0.95 \times [F_{\text{imp}} \times 0.9 + (1-F_{\text{imp}}) \times 0.143]$$

$$F_{\text{imp}} = \text{Fraction Impervious for Pre-Developed Site}$$

$$I_{20}^5 = \text{Rainfall Intensity for 20\% AEP event of 5 minute duration (mm/hr)}$$

$$A = \text{Site Area (m}^2\text{)}$$

Site Storage Requirement (SSR)

The SSR in Region 1 (CBD and Growth Area) is calculated from the post development runoff generated from a 100 year ARI rainfall event. A range of storm durations needs to be considered when calculating the SSR. Typically storm durations ranging from 5 minutes to approximately 2 hours will need to be considered to determine the maximum SSR which is to be adopted for the drainage design. The calculations may be undertaken either by applying Boyd's Method for peak flood estimation (Outlined in Australian Rainfall & Runoff Section 7.5.6, 1987) for a suitable range of storm durations or by using a computer program such as OSD4. Where OSD4 is being used to calculate the required SSR, City of Melbourne's Drainage Engineer should be contacted to provide Tc (catchment time of concentration) and Tso (travel time taken from site to outlet).

$$\text{SSR} = [\text{DQ1} - \text{PSD}] \times 60 \times D \times 1.195$$

Where:

$$D = \text{Storm Duration (Ranging from 5 minutes to 120 minutes)}$$

$$\text{DQ1} = 1\% \text{ AEP runoff for storm duration 'D minutes'}$$

PSD = Permissible Site Discharge (Outlined above)

1.195 = Factor to account for 19.5% increased rainfall intensity due to climate change

3.2.2 Integrated Water Cycle Management – Region 1

The City of Melbourne, through its town planning approval process, requires all new developments with an increase in floor area in excess of 50 m² to incorporate Integrated Water Cycle Management (IWCM) principles into stormwater drainage design. This approach can serve the dual purpose of providing temporary flood storage on a lot scale, while also reducing the demand for potable water supply.

Where a rainwater tank is proposed within a development to comply with these IWCM requirements, and a daily justifiable demand for harvested rainwater reuse on site is identified, this regular drawdown in water level from the tank may offer the opportunity for on-site detention storage to be incorporated within the IWCM design. The volume of detention storage that can be offset within a rainwater tank is site specific, and dependent on variables such as roof area, daily demand and tank size.

3.3 Region 2 - Non Growth Areas

This region includes the more established suburbs of Kensington, North Melbourne, Parkville, Carlton North, East Melbourne, Jolimont and South Yarra. With the exception of residential extensions and single dwelling development, all developments within this region will be subject to the following drainage design requirements:

3.3.1 OSD Design Parameters – Region 2

The two key calculations required for the design of an OSD System are:

Permissible Site Discharge (PSD)

The purpose of the PSD is to limit the site discharge to a pre-determined rate. Within Region 2 (Non Growth Areas), the PSD is calculated as the runoff generated from the pre-developed site during a 20% AEP design storm event of 5 minute duration.

The PSD is calculated using the Rational Method Formula:

The PSD is calculated using the Rational Method Formula:

$$\text{PSD (litres/s)} = \frac{C_{20} \times I_{20}^5 \times A}{3600}$$

Where,

C_{20} = 20% AEP Runoff Coefficient

$$= 0.95 \times [F_{\text{imp}} \times 0.9 + (1 - F_{\text{imp}}) \times 0.143]$$

F_{imp} = Fraction Impervious for Pre-Developed Site

I_{20}^5 = Rainfall Intensity for 20% AEP event of 5 minute duration (mm/hr)

A = Site Area (m²)

Site Storage Requirement (SSR)

The SSR in Region 2 (Non Growth Area) is calculated from the post development runoff generated from a 10% AEP rainfall event. A range of storm durations needs to be considered when calculating the SSR. Typically storm durations ranging from 5 minutes to approximately 2 hours will need to be considered to

determine the maximum SSR which is to be adopted for the drainage design. The calculations may be undertaken either by applying Boyd's Method for peak flood estimation (Outlined in Australian Rainfall & Runoff Section 7.5.6, 1987) for a suitable range of storm durations or by using a computer program such as OSD4. Where OSD4 is being used to calculate the required SSR, City of Melbourne's Drainage Engineer should be contacted to provide Tc (catchment time of concentration) and Tso (travel time taken from site to outlet).

$$\text{SSR} = [\text{DQ}_{10} - \text{PSD}] \times 60 \times D \times 1.195$$

Where,

D = Storm Duration (Ranging from 5 minutes to 120 minutes)

DQ10 = 10% AEP runoff for storm duration 'D minutes'

PSD = Permissible Site Discharge (Outlined above)

1.195 = Factor to account for 19.5% increased rainfall intensity due to climate change

3.3.2 Integrated Water Cycle Management – Region 2

The City of Melbourne, through its town planning approval process, requires all new developments in excess of 50m² to incorporate Integrated Water Cycle Management (IWCM) principles into stormwater drainage design. This approach can serve the dual purpose of providing temporary flood storage on a lot scale, while also reducing the demand for potable water supply.

Where a rainwater tank is proposed within a development to comply with these IWCM requirements, and a daily justifiable demand for harvested rainwater reuse on site is identified, this regular draw down in water level from the tank may offer the opportunity for on-site detention storage to be incorporated within the IWCM design. The volume of detention storage that can be offset within a rainwater tank is site specific, and dependent on variables such as roof area, daily demand and tank size.

3.4 Region 3 – Fishermans Bend

Development within the Fishermans bend precinct must generally accord with The Fishermans Bend Strategic Framework Plan. Objective 7.2 of this Plan contains the following requirements relative to stormwater drainage:

- **Guideline 1**

New buildings must install a third pipe to supply non potable uses within the development, including for toilet flushing, fire services, irrigation and cooling, unless otherwise agreed by South East Water. Installing third pipe during building construction is more cost effective than retrofitting in the future.

- **Guideline 4**

Storage, such as rainwater tanks with a capacity of 0.5 cubic metre per 10 square metres of roof area and equipped with power and water management telecommunications will be required. Such roof top runoff should be stored independently of runoff from other impervious surfaces such as car parks.

The City of Melbourne's drainage requirements for developments within this precinct align with the above guidelines.

4. Construction of a Council Drain

In circumstances where an existing Council drain does not extend beyond the frontage of a proposed development site, developers may be required to construct a suitable drainage outfall, in the road reserve or through an easement, to an approved point of discharge nominated by the City of Melbourne.

Designs are to be prepared by a suitably qualified Civil Engineer, in accordance with the [Engineering Service Branch Design and Drafting Guidelines](#)² (link below) and should be submitted to Council's Drainage Engineer for approval. Once approved, the construction of the new drain is to be undertaken in accordance with the approved design and under the supervision of Council's Drainage Engineer.

Once constructed to the satisfaction of Council, the drain will become a Council asset for the purposes of ongoing management and maintenance, and may be used as a Legal Point of Discharge for future developments as deemed appropriate by Council.

4.1 Design Requirements

The following design requirements should be implemented for all submissions of new Council drain designs:

- New Council drains constructed within high density or growth areas (CBD, Southbank, Docklands, Arden Macaulay and Fishermans Bend) are to be designed for a 5% AEP capacity with an additional 19.5% allowance for increased rainfall intensity due to climate change
- Council drains constructed in all other areas are to be designed for a 10% AEP capacity with an additional 19.5% allowance for increased rainfall intensity due to climate change
- Any Council drain constructed within a road reserve should be a minimum of 300mm diameter RCP-RRJ Class 4 pipe with 600mm cover
- Easement drains are to be a minimum of 300mm in diameter and constructed of RCP, FRC or UPVC with a minimum of 400mm cover.
- The minimum gradient of any Council drain is to be 1 in 250
- A feature and level survey is to be undertaken over the area of the proposed drainage line.
- The location of all services in the proximity of the proposed drainage line should be included on plan with potentially conflicting services accurately proved to Quality Level A and plotted on long section drawings.
- Suitably scaled PDF Plans and Long Sections of the proposed drainage line overlaying a feature and level survey should be submitted to Council's Engineering Department for approval.
- Plans should include a Pit Schedule showing pit dimensions, depths, surface level, floor levels, pit type, lid type, inlet and outlet dimensions, invert levels and depths, for all proposed and existing pits along the length of the proposed drain.
- Long Sections should specify pipe dimensions, gradients, material and capacity, existing ground level, upstream and downstream invert levels, and chainage along the length of the proposed drain.
- Drains are to be laid and backfilled in accordance with City of Melbourne's Drainage Specification 2012 (Appendix 1)
- Junction Pits are to be cast in-situ and are to be constructed in accordance with City of Melbourne's Drainage Specification 2012 and Standard Drawing 1P50318
- Grated Drainage Pits are to be constructed in accordance with City of Melbourne's Drainage Specification 2012 and Standard Drawing 1P50302
- Grated Drainage Pits with Overflow Kerbs are to be constructed in accordance with City of Melbourne's Drainage Specification 2012 and Standard Drawing 1P50301

² <http://www.melbourne.vic.gov.au/SiteCollectionDocuments/engineering-services-design-drafting-guidelines.pdf>

4.2 Ownership and Maintenance

Once constructed and inspected by Council Engineers, the drain and associated pits within the road reserve or easement will become Council assets and will be added to Council's Drainage Asset Database for ongoing maintenance. Property connections to the newly constructed drain shall remain private assets to be maintained by the property owner or Owners' Corporation.

4.3 As Constructed Drawings

Upon completion, the developer's engineer is to prepare and submit "As-Constructed" drawings of the newly constructed drain, in accordance with City of Melbourne's [As-Built Spatial Standards 2015](#)³.

5. Legal Point of Discharge Process

For any works requiring a building permit, Section 610 (2) of the Building Regulations 2006 requires a report from the relevant Council identifying the point of discharge from the site. In determining an appropriate Legal Point of Discharge for a site within the City of Melbourne, the following site specific characteristics are considered:

Location of Council Drainage Assets Servicing Development Site

The discharge point from the site must be one of the following Council owned drainage assets:

- Council Drain
- Council Drainage Pit
- Kerb and Channel, or
- Council Laneway Surface

The location of the discharge point will be provided by the City of Melbourne.

Fall of Land

Where available, Council will nominate the Legal Point of Discharge at the low side of the development site, to facilitate site drainage by gravity. In practice, a Legal Point of Discharge may not always be available on the low side of the site. Engineered systems such as pumps or charged drainage may need to be implemented to reach the nominated discharge point.

Legal point of discharge information can be obtained from the City of Melbourne by completing an [online application](#)⁴.

6. Groundwater Management

Increasing development and pressure for space within the City of Melbourne has seen the demand for basement constructions within private development increase significantly in recent years. The interaction of basement structures with the groundwater table presents engineers with two primary design options; either designing a 'Tanked' basement to withstand the additional pressure of groundwater, or a 'Wet' basement, that allows groundwater to penetrate the basement wall, where it is collected and discharged from the site.

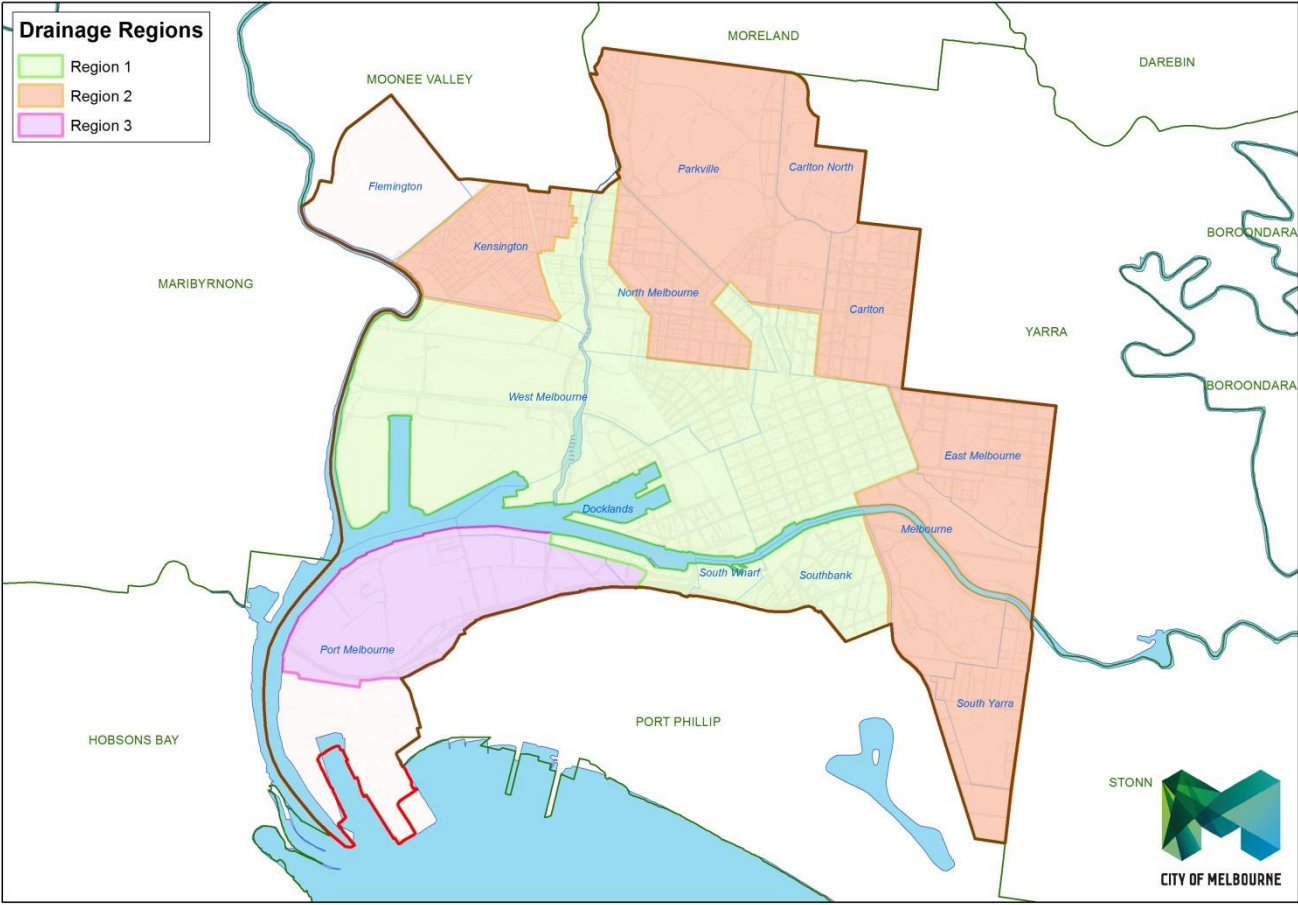
Council have requirements on the quality and quantity of groundwater that may be discharged to the drainage network. Developers should contact Council's Engineering Department at the time of application to discuss whether discharge will be permitted and, if so, what the quality and quantity requirements for discharge are.

³ <http://www.melbourne.vic.gov.au/SiteCollectionDocuments/as-built-spatial-standards.pdf>

⁴ <https://eservices.melbourne.vic.gov.au/ePathway/Production/Web/default.aspx?js=255856214>

Appendix 1

Map of City of Melbourne drainage regions



Appendix 2

City of Melbourne Drainage Specification January 2012

Engineering services

1.0 General

All stormwater designs must be carried out in accordance with the requirements of Australian Rainfall and Runoff 4th Edition 1994/1998, this Specification and the relevant Australian Standards.

2.0 Water

Only clean water from the Melbourne Water mains shall be used for mixing concrete, mortar or grout.

The Contractor is held responsible for the maintenance and repair of all water taps and hose connections used by him.

3.0 Storage of Materials

All materials which are required for the work must be stored, if it is necessary to do so, only on the land of which the Contractor has possession for the execution of the contract.

Any site selected for such purpose is subject to the approval of the Manager – Engineering Services or **Principal Engineer - Infrastructure who may direct it to another location.**

4.0 Provision for Ingress And Egress Of Property Occupiers

The Contractor shall make suitable and satisfactory arrangements during the period of the contract for the ingress and egress of vehicles, materials and workmen with the respective property owners or occupiers.

Forty-eight (48) hours' notice to owners or occupiers will be required if access to property is unavoidably hindered.

5.0 Provision for Pedestrians

The Contractor shall make suitable and satisfactory arrangements for a continuous, uninterrupted discernable path of travel for all pedestrians.

6.0 Protection of Site

Proper provision is to be made for lighting and for guarding the public during the works. Relevant plans showing details of correct types and uses of barricades and signs may be obtained from the Council's – Construction Management Group.

Spoil is to be disposed of by the Contractor. Bluestone kerbs, flags and pitchers shall be cleaned and removed to Citywide's Henderson Street Depot, North Melbourne, to the satisfaction of Council's Supervisor and or disposed of by the Contractor as directed by Council's Supervisor.

7.0 Pipes

The pipes shall be of the best quality reinforced concrete, free from visible cracks, splits, chips and other defects, perfectly cylindrical in section, true to line and of the internal diameter shown on the plan. Ends shall be of similar quality. The pipes shall be clearly marked with the date of manufacture. If elliptical reinforcing is used, the pipes shall have the word "Top" clearly stencilled on the inside of the pipe at the correct place.

* Pipes shall be of the size specified on the drawings and either:

* Socketed reinforced concrete to comply with AS 4058 - 2007, with rubber ring joints complying with AS.1646 - 2007 or

* Fibre reinforced concrete including fittings, to comply with AS 4139-2003.

The Class of pipe shall be chosen in accordance with the requirements of AS 3725-2007.

8.0 Drainage

The ground shall be excavated for the drains, pits and junction chamber to the lines and depths indicated on the drawing. Any trench which may have been excavated to a greater depth than necessary shall be filled into the required level with concrete 1:3:6 mix. All trenches shall be of sufficient width to allow for the proper laying and jointing of the pipes, and shall be suitably timbered. Any accident, subsidence or damage caused by defective or insufficient timbering will be attributed as negligence on the part of person or persons undertaking these works, and the responsibility will lie with these parties.

9.0 Pipe Laying

Upon completion of the excavation, the pipes of the diameter specified on the drawings shall be bedded on a minimum of 75mm consolidated sand. All pipes shall be laid true to lines, level and grades, and shall be butted tightly together with lips, and be bedded firmly for their entire length. The joints of such pipes shall be tightly packed with cement mortar, and neatly stuck off clean and flush. Such mortar shall be mixed in the ratio of 1:2.

10.0 Tolerances

Any deviation from alignments, levels, grades, dimensions, etc., as shown on the drawing must be within the following limits:-

Drain: level + 10mm alignments + 20mm

Pipes: all dimensions + 10mm

11.0 Ground Support

Trench excavation deeper than 1.5m shall comply fully with the provisions of Mines Act 1958 and Mine (Trenches) Regulations 1982.

The ground support should be installed as quickly as possible after the trench has advanced sufficiently to allow it. The support shall bear tightly against the sides of the trench and shall be inspected regularly by the Foreman in control of the work.

12.0 Drainage Pits and Junction Chamber

12.1 Pits

Drainage pits shall be of the type indicated on the drawings and shall be constructed at the appropriate locations and to the levels indicated. All pipes connections to pits shall be neatly made, and the ends of all pipes properly trimmed off and stopped with cement mortar. When constructed in concrete, the walls of the pit shall be of 150mm thickness with AS 4671-2001 SL82 reinforcement placed centrally. If constructed in brickwork, pit works shall be of 230mm thickness, and such bricks shall be thoroughly bedded and well flushed up with 3 to 1 cement mortar, with alternative header and stretcher courses. All joints (which shall not exceed 10mm) shall be flushed and bagged down. No bats shall be used except for closures.

12.2 Junction Chamber

The junction chamber shall be constructed at the appropriate location and to the level specified on the drawing. The chamber, if constructed in brickwork, shall be of 230mm thickness and be in accordance with the specification for Pits. When constructed in concrete, the walls shall be of 150mm thickness with AS 4671-2001 SL82 reinforcement placed centrally.

12.3 Pit and Junction Chamber Foundations

All foundations shall be to the overall dimensions shown, and shall be of 150mm thick reinforced concrete, such reinforcing consisting of SL82 mesh fabric of AS 4671-2001 or as otherwise specified on the drawings.

12.4 Covers and Grates

All pits shall be fitted with standard City of Melbourne frames, grates and covers or as specified in the approval letter.

13.0 Bricks

All bricks shall be well burnt, hard, sound with sharp arises and of true shape, uniform in colour, and free from imperfections. The bricks shall be of a uniform standard size.

14.0 Cement

Cement shall conform to AS 3972-2010.

15.0 Sand

Sand shall conform with the requirements of AS 2758-1998 and AS 1141-1997 and shall have a grading within the limits as defined in the code.

16.0 Coarse Aggregate

Coarse aggregate shall conform with the requirements of AS 2758-1998 and AS 1141-1997, and shall have a grading within the limits for 20mm nominal size aggregate.

17.0 Reinforcement

Steel fabric shall conform with the requirements of AS 4671-2001.

18.0 Backfilling

All crushed rock used in the works shall be Class 2, 20 mm nominal size, as specified in Section 812 of the VicRoads Standard Specifications for Roadworks and Bridgeworks - 1995.

The trench shall be backfilled with Class 2 crushed rock to the springing line of the pipes immediately after completion of laying.

No further backfilling shall be done until Council's Supervisor has inspected the work.

Further backfilling shall be with layers of crushed rock, Class 2, no thicker than 150mm compacted to 95% Modified Relative Compaction.

19.0 Reinstatement of Kerb, Channel, Footpath and Roadway

The Contractor shall organise reinstatement of kerb, channel, footpath and roadway surfaces with Council's Civil Infrastructure Maintenance Contractor, Citywide Service Solutions. The contractor shall notify Warren Bates - telephone 9267 5170 prior to commencement of works.

20.0 Cleaning Up of Site

Upon completion of all drainage works and back-filling, the site shall be left in a neat and tidy condition, to the satisfaction of the Council's Manager - Engineering Services or his representative.

21.0 Drawings

The Contractor/Developer shall supply Council with a set of as constructed drawings in digital format.

22.0 Cost

All labour and material costs associated with the drainage works shall be borne by the contractor.

Approved Drain Connection Pipe Types

For underground stormwater drain connections

- Fibre Reinforced Concrete Pipe (Class 2 minimum)
- Reinforced Concrete Pipe (Class 2 minimum)
- Glazed Earthenware
- Cast Iron
- Galvanised Wrought Iron
- Melbourne Water approved UPVC Sewer Class Min Cover: 450mm in non-trafficable area
- 750mm in trafficable areas

For pipe connections across a footpath to a street channel

- Fibre Reinforced Concrete Pipe
- Galvanised Wrought Iron Box Culvert or Pipe Section
- Cast Iron Pipe

Box Culvert sections to a street channel

Four-sided welded mild steel plate, hot-dipped galvanised,

1. 6mm thickness for up to 230mm wide
2. 10mm thickness for 230mm to 380mm wide,
3. 10mm thickness with a centre wall if wider than 380mm

Pre-cast reinforced concrete box culvert section, either,

1. Invert and set into a in-situ concrete base slab 100mm thick, reinforced with minimum AS 4671-2001 Ref No. SL62 mesh. This base slab shall extend 75mm beyond each side of the culvert; or
2. If the kerb face is not sufficient for the above arrangement the box culvert shall be laid with a minimum 10mm chequer plate hot-dipped galvanised lid securely fastened to the walls of the culvert.

No drain connection pipe less than 75mm diameter will be approved.

Manager - Engineering Services