# Design and Construction Note

## Book 100

Street Layout and Pavement Design Guidelines

Version 1.3

### Book 100 - Amendments

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Street Layout and Pavement Design Guidelines

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Pipe Colour for Underground Services

<table>
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<tr>
<th>SERVICE</th>
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<tr>
<td>Gas</td>
<td>Yellow Pipe or Yellow Striped Pipe</td>
</tr>
<tr>
<td>Traffic Signals</td>
<td>Orange Pipe</td>
</tr>
<tr>
<td>Electrical</td>
<td>Orange Pipe, Orange Striped Pipe or Orange Electrical Tape for directly buried cable</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>White Pipe</td>
</tr>
<tr>
<td>Water</td>
<td>Blue Pipe, Blue Striped Pipe or Black Pipe</td>
</tr>
<tr>
<td>Sewerage</td>
<td>Cream Pipe, Grey Pipe or Cream &amp; Grey Striped Pipe</td>
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Colors of pipe relate only to PVC and polyethylene pipe and other materials could be used, particularly in older established areas unless otherwise stated. Some services may be buried directly in the ground and not in conduits.

General Notes:

1. This Design and Construction Note has been prepared in reference to Utility Providers Code of Practice for WA (UPSC 2015).
2. Always dial: 1100 before you dig to check what services are located in the area you are working in.
3. Further notes regarding the road reserve allocation for utility providers are provided on sheet 2 of this document.
Road Reserve Allocation for Utility Providers - General Notes

1. Horizontal measurements relative to the Property Line on each side of the road reserve.

2. Although diagrams show a single utility conduit within each corridor, these may carry multiple cables of the same utility where applicable.

3. Junction pits and access chambers may extend into the 2.4-3.0 metre corridor by arrangement with the electricity network provider.

4. Use of the 4.2-5.0 metre corridor may be used by arrangement between utility providers.

5. Traffic light installation cables shall be located in the verge/footpath by arrangement with utility providers. Some variations may be necessary to standard utility alignments following negotiation and approval from other affected utility providers.

6. In new developments Power and Communications distribution cables are to be laid in locations shown. Under established footpaths some variations may be necessary following negotiation and approval from other affected utility providers.

7. In general, no underground utility service shall exceed a nominal 300mm diameter within the 0-3.0 metre corridor. Larger utility services may be located within this corridor following negotiation and approval of other utility providers.

8. Reticulation / Non-Potable, rising irrigation or non-drinking water mains location options indicated as non drinking water pipes in the diagram. Agreement must be obtained from relevant water utility prior to works commencing.

9. The planting of street trees should be of a type and variety to cause minimal interference to utility services.

10. Utility services may, in special circumstances, be located beneath the carriageway where verge space is insufficient. Consultation must be made and agreements obtained with all relevant utility providers and the City of Perth.

11. Refer Utility Providers Code of Practice for standard minimum clearances when undertaking works within the road reserve.

12. Cover, bedding and backfill are to be in accordance with utility provider’s requirements and the requirements specified in Design and Construction Note: 102.07 to 102.09 - Reinstatement of Block and Asphalt Pavements After Trenching.

13. All reticulation to be laid within +/-100mm wherever practicable of the indicated centre line and secured against movement with initial backfill. Some utility practices may vary from this requirement particularly for multiple utility services.

14. Low voltage cables used for street lighting shall be installed in the 2.4-3.0 metre allocation. Cabling outside of the alignment shall be run at right angles to the corridor. Streetlight cabling in median strips shall be installed directly between poles but installation under road ways shall be avoided.

15. Where there are problems with the 0-0.5 metre alignment, power may be installed on the 2.4-3.0 metre alignment subject to approval by the power provider.

16. Services allocation in the 3.0-4.2 metre alignment shall be by agreement with nominated utility providers.
Pipe Colour for Underground Services

<table>
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Colours of pipe relate only to PVC and polyethylene pipe and other materials could be used, particularly in older established areas unless otherwise stated. Some services may be buried directly in the ground and not in conduits.

General Notes:

1. This Design and Construction Note has been prepared in reference to Utility Providers Code of Practice for WA (UPSC 2015).
2. Always dial: 1100 before you dig to check what services are located in the area you are working in.
3. Further notes regarding the road reserve allocation for utility providers are provided on sheet 2 of this document.
Road Reserve Allocation for Utility Providers in Narrow Roads - General Notes

1. The designers of narrow road reserves are obliged to consider the relationship of all utility services, surfaces and furniture with each other. The corridors shown in this diagram can only be varied with approval from all affected utility service providers.
2. All measurements generally relate to the distance from the property line on each side of the road reserve unless otherwise specified.
3. Access chambers may extend into the trees and lights corridor.
4. In general, no underground utility service shall exceed a nominal 300mm diameter within the 0-3.0 metre corridor. Larger utility services may be located within this corridor following negotiation and approval of other utility providers.
5. Reticulation & irrigation mains are to be located beyond the 3.0 metre alignment.
6. For narrow reserves with a wide road surface, the verge space available may be insufficient for trees while maintaining minimum clearances from other utility services.
7. Provision of an alignment for water distribution mains and other trunk services can be placed adjacent to the sewer, if the required space is available.
8. Cover, bedding and backfill are to be in accordance with utility provider's requirements and the requirements specified in Design and Construction Note: 102.07 to 102.09 - Reinstatement of Block and Asphalt Pavements After Trenching.
9. For stormwater and sewers:
   9.1. Access chambers and maintenance shafts should be positioned in the sewer corridor. Alternatively they may need to be positioned in the road surface.
   9.2. The minimum distance from the pipe to the property boundary shall be 1.0 metres.
   9.3. Access chambers and maintenance shafts should be clear of the kerb.
   9.4. The minimum cover to sewer shall be 0.9 metre.
10. All pits shall be totally contained within the utility service corridor except where approved by the utility service provider whose alignment is encroached upon. This may require staggering of pits.
11. Underground power cables may be installed on the 2.4-3.0 metre alignment, where there are installation and maintenance issues adjacent to retaining walls in the 0-0.5 metre corridor provided it is acceptable to other Utility Service Providers and doesn’t interfere with street trees.
12. Service allocation in the 3.0-4.2 alignment shall be by agreement with nominated utility providers.
General Notes

1. Barrier kerb height: 130-150mm.
2. Carriageway/traffic lane cross-fall to be 2% minimum to comply with AGRD part 3 & MRWA supplements.
3. Footpath cross-fall must comply with Australian standard AS1428.4 & AGRD part 6a.
4. Traffic lane widths must comply to the standards set out in Austroads - guide to road design.
5. *Traffic lane widths may require to be larger along bus routes. Consult with PTA for best practice.
6. For more detail regarding the footpath refer Design and Construction Note: Book 300.
7. Where a bus lane is incorporated into a street layout min. lane width 3.4m.
8. Where an alfresco area is proposed access of 1.5m minimum must remain for pedestrians.
Design and Construction Note
101.05
Street Layout and Pavement Design Guidelines
On-Street Parking Bay Dimensions

Reviewed: 30/10/2018

This document has been prepared by The City of Perth and is subject to change. It is the responsibility of the user to ensure that this Design and Construction Note has no further revisions by checking at https://www.perth.wa.gov.au

**ON-STREET PARKING BAY WIDTH (X)**

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<tr>
<th>SPACE USAGE</th>
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<tr>
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<tr>
<td>CARS &amp; LIGHT COMMERCIAL VEHICLES (all other streets)</td>
<td>2.3m</td>
</tr>
<tr>
<td>TRUCKS &amp; BUSES</td>
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**ON-STREET PARKING BAY LENGTH (Y,Z,W)**

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<tr>
<td>Y</td>
<td>ENTRANCE TO BAY IS NOT OBSTRUCTED</td>
<td>5.4m</td>
<td>6.5m</td>
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<tr>
<td>Z</td>
<td>INTERMEDIATE BAYS</td>
<td>6.0m</td>
<td>6.7m</td>
</tr>
<tr>
<td>W</td>
<td>END OF BAY IS OBSTRUCTED, SUCH AS A ‘NIB’</td>
<td>6.3m</td>
<td>6.7m</td>
</tr>
<tr>
<td>Y,W</td>
<td>LOADING ZONE</td>
<td>9m</td>
<td>10m</td>
</tr>
<tr>
<td>Y,W</td>
<td>BUS / COACH STAND</td>
<td>14m</td>
<td>15m</td>
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**General Notes**

1. This design and construction note has been prepared in reference to: AS/NZS 2890.5-1993 parking facilities part 5: On-Street Parking.
2. It is preferable for loading zones and bus bay entrances and exits to be splayed.
3. For more detail regarding the interface between the on-street parking and the footpath refer design and construction note: BOOK 300.
4. Disabled bays are to be provided at the footpath level. the size and pavement required are detailed in design and construction note: BOOK 300.
5. Where parking is angled at 90° adjacent to footpaths, cycle or shared paths parking stops must be installed in the bays to prevent vehicles from overrunning onto paths.
6. For wheel stop details refer to AUS/NZ 2890.1
**Street Layout and Pavement Design Guidelines**

**On-Street Motorcycle Bay Dimensions**

**General Notes**

1. Motorcycle parking zones are provided in most streetscapes.
2. Use of irregular spaces and undersize kerbside remnants are usually used for motorcycles. However, when there is a greater demand, motorcycle bays may be grouped together in place of a car embayment.
3. In situations where street trees are situated on extended footpaths between embayments, it is preferable for the motorcycle bay to be placed between the car bay and the 'nib'.
4. In accordance with AS2890.5-1993, the minimum size for a motorcycle parking space is 2.5m x 1.2m.
5. In narrow streets where parking embayments are less than 2.5m wide, angled motorcycle bays would be the preferred option.
Guidelines for the Gradient Design of Footpaths in Urban Areas

In Urban Areas, A Footpath is Defined as a Paved Pedestrian & Cyclist Area Between the Edge of Road and the Property Boundary.

- LONGITUDINAL GRADIENT
  The longitudinal grade is the percentage of slope running parallel with the direction of the road. The longitudinal grade of a footpath is restrained along one edge to match the longitudinal grade of the road and kerb. To avoid large swings in the cross-fall of the footpath, the level of building entrances must be considered. Best practice ensures that the level of pavement and entrances along the building and property line match the longitudinal grade of the road. When building a long distance pedestrian facility it should be considered as a walkway in accordance with AS 1428.1.

- CROSS-FALL GRADIENT
  The cross-fall grade is the percentage of slope in the direction perpendicular to the road. It is best practice to have the cross-fall so that water flows away from building and property lines and towards the road. If this is unachievable the footpath requires to be designed so that drainage flows away from the building line. To allow sufficient drainage footpaths should have minimum grade of 1:100 (1% fall). To allow accessibility the footpaths should have a maximum grade of 1:25 (4% fall). The cross-fall grade of a footpath may vary along the length of the road. This variance should be minimised.

General Notes

1. For Information on the Standard Paving Details Used Within the City of Perth Refer to Design and Construction Note: BOOK 300.
General Notes
1. Avoid placement of street furniture, signs etc. In clearway next to the building line to provide a safe path of travel.
2. Place ramps so that they face each other in the direction of travel.
3. This Design & Construction Note is for the placement of pedestrian ramps. For information on the standard installation. Detail of pedestrian ramps refer the Design and Construction Note: BOOK 300.
**General Notes**

At signalised intersections, tactile indicators should not be placed at pedestrian refuges or median islands unless a pedestrian push button has been provided or there is a significant change in the direction of pedestrian travel.
Cycle Plan 2029
This Design and Construction Note shall be read in conjunction with the City of Perth Cycle Plan 2029, which is available at the URL: www.perth.wa.gov.au/cycleplan

This Design and Construction Note outlines the desired infrastructure provided to cyclists along different strategic cycling routes. The different types of strategic cycle routes fall in to the following four classifications:

- Regional Routes
- City Cycle Routes
- Integrated Cycling Routes
- Pedestrian Priority Zones

The classification of a cycling route can be identified on the Strategic Cycle Network - Refer to the City of Perth Cycle Plan 2029 document.

1) General
For all dedicated cycle paths, shared paths, cycle lanes and integrated shared lanes, the regulatory signage required shall be provided as per MRWA Standards. Where practical, signage shall be placed on poles to avoid cluttering the surface of the path and combined to reduce the number of poles required.

The width of any dedicated cycle paths, shared paths, cycle lanes and integrated shared lanes, must comply with the latest Austroads Guidelines, MRWA standards and Australian Standards.

2) Regional Routes
Regional routes provide connections between major destinations in the wider metropolitan region and should be built to cater for high levels of cyclists.

The typical surface treatment for Regional Route cycle paths in the City of Perth is a black asphalt path with white line-marking that is separated from the vehicular traffic. Where an asphalt path is provided in a verge or planted area, the edges must be capped using a flush concrete beam.

a) Separating Pedestrians and Cyclists:
Pedestrians and cyclists travelling together along regional routes should only be separated by providing a dedicated cycle path parallel to a pedestrian footpath, if there are high numbers of pedestrians and the width provided to pedestrians is considered generous.

b) Intersections & Crossings:
Pedestrians and cyclists shall cross intersections using a shared crossing. The width of ramps provided shall be the same width as the path provided, with tactile indicators installed for the full width.

Where pedestrians and cyclists are crossing at a signalised intersection together, bike lanterns and pedestrian lanterns are to be provided. At unsignalised intersections advisory ‘Give Way’ and ‘Take Care’ signs are to be provided.
c) Custom Advisory Symbols:
City of Perth custom advisory symbols applied to the surface of the shared path shall be provided at the start and end of shared paths and also be provided at points of significance along the shared path such as vehicle crossings and areas of increased pedestrian activity. Example of commonly used advisory symbols:

![Advisory Symbols]


d) Slow Points (Chicane):
A slow point for cyclists can be provided on regional routes, where they are approaching a hazard, by creating a chicane using two barriers. The barriers shall be installed to create a sharp double bend to slow cyclists. Where practical a signage panel shall be attached to the barriers warning cyclists of the upcoming hazard.
For more detail regarding the chicane and installation refer Design and Construction Note: Book 500.

e) Service Pits and Drainage:
To minimise the impact on the surface of the shared path, service pits that are placed within an asphalt shared path shall have infill lids. Infill material is to be black asphalt to match the surface.
The shared path should be designed so that runoff from rain falls towards a road or verge. If this is not practical drainage structures can be installed. The preferable drainage solution for shared paths is a trench drain that runs along the lower side of the shared path. Where an open drainage gully pit is required, it must be installed with a cycle friendly grate.

3) City Cycle Routes
City Cycle routes will be typified by dedicated cycle lanes in a number of forms and will connect regional routes and major destinations.
The typical treatment for City Cycle Routes in the City of Perth is on-street cycle lanes with black asphalt and white line-marking. Cycle lanes shall be placed along the kerb and where on-street parking is provided a 500mm buffer between parking and cycle lanes shall be provided.

a) Intersections & Crossings:
At signalised intersections cycle lanes shall have cycle detection loops, cycle symbols, cycle head-start boxes and cycle lanterns. Cycle head-start boxes provide cyclists with a queuing area and cycle lanterns provide priority to cyclists to allow cyclists to
proceed through the intersection prior to vehicular traffic. The size and layout of loops, symbols and head-start boxes must comply with the MRWA standards.

Where cyclists cannot cross a signalised intersection with vehicular traffic safely, there may be instances where cyclists transition to footpath level and merge with pedestrians. These areas are considered Pedestrian Priority Zones. In these situations, pedestrians and cyclists shall cross intersections using a shared crossing with bike and pedestrian lanterns provided.

At conflict areas such as intersections and driveways with high traffic, green surface treatment shall be applied to the cycle lanes. Typical use of the green surface treatment is listed below:

- Green surface treatment shall be provided for all cycle head-start boxes.
- 20m of green surface treatment shall be provided where a cycle lane approaches a signalised intersection.
- Green surface treatment shall be provided for the length of cycle lanes crossing unsignalised intersections.

At high conflict areas which required additional protection, raised cycle lane separators such as 'armadillos' can be installed between the cycle lane and vehicular traffic lane. These raised cycle lane separators provide extra protection from vehicles encroaching the cycle lane and cannot be used where vehicles are permitted to cross the cycle lane.

b) Drainage Pits:
Where an open drainage gully pit is required within the cycle lane, it must be installed with a cycle friendly grate. All new gully pits shall be supplied with a cycle friendly grate and all existing gully pits shall be retrofitted.

4) Integrated Cycling Routes
Integrated Cycling routes are characterised by slow-speed bicycle friendly routes that provide fine grain or direct connectivity to destinations in the urban environment.

The typical treatment for Integrated Cycling Routes in the City of Perth is wide on-street lanes to be used by both cyclists and vehicles, in areas with speeds no greater than 40km/h. Lanes to be provided shall be wider than standard traffic lanes and be black asphalt with white line-marking.

a) Intersections & Crossings:
At unsignalised intersections cyclists are to proceed through the intersection as a member of the general traffic.

At signalised intersections, if sufficient space is available cycle lanes shall be provided for 20m approaching the intersection, with cycle detection loops, cycle symbols, cycle head-start boxes, cycle lanterns and green surface treatment as per the intersection detail for City Cycle Routes.

b) Signage:
A blue 'Share the Road' sign (manufactured and installed by MRWA) and a white paint cycle symbol (placed centrally in the lane) shall be placed at the beginning of
Integrated Cycle Routes and after signalised intersections. All regulatory signage required shall be provided as per MRWA Standards.

5) Pedestrian Priority Zones
Pedestrian Priority Zones are areas with concentrated cultural, social and recreational uses where vehicle access is significantly restricted. The zones are predominantly pedestrian spaces that can accommodate slow-speed cycling. Pedestrian Priority Zones may also refer to the footpaths at signalised intersections which cyclists are permitted to utilise but where pedestrians still remain the priority consideration for design.

The surface treatment for these areas will typically be block paved, the detail of which may vary depending on the location.

a) Signage:
Advisory signage for cyclists in these areas may use typical 'sign on pole' arrangements and Custom Advisory Symbols applied to the pavement surface. The Custom Advisory Symbols, similar to those used for regional routes, may be applied at the start and end of Pedestrian Priority Zones and at points of significance which may identify hazards and potentially aid way-finding. Examples of commonly used advisory symbols are shown in this document, refer 2c - Regional Routes, Custom Advisory Symbols.

b) Slow Points (Chicane):
A slow point for cyclists can be provided on Pedestrian Priority Zones, where they are approaching a hazard, by creating a chicane using two barriers. The barriers shall be installed to create a sharp double bend to slow cyclists. Where practical a signage panel shall be attached to the barriers warning cyclists of the upcoming hazard.

For more detail regarding the chicane and installation refer Design and Construction Note: Book 500.
60mm AC14 IN ACCORDANCE WITH MRWA SPECIFICATION 504.

7mm EMULSION PRIMERSEAL IN ACCORDANCE WITH MRWA SPECIFICATION 503

CRUSHED ROCK BASE BASECOURSE - MINIMUM COMPACTION 99% IN ACCORDANCE WITH MRWA SPECIFICATION 501

COMPACTED CRUSHED LIMESTONE SUBBASE - MIN COMPACTION 96% IN ACCORDANCE WITH MRWA SPECIFICATION 501

COMPACTED SUBGRADE - MINIMUM COMPACTION 96% IN ACCORDANCE WITH MRWA SPECIFICATION 302. MIN CBR 12%

General Notes

The preferred treatment for roads within the municipal boundaries of the City of Perth is a flexible asphalt road pavement.
1) General

a) Road asphalt shall be designed in accordance with MRWA Engineering Note.9 and meet the minimum design life as specified.

b) Road pavements shall be designed in accordance with MRWA Engineering Note.9 and meet the minimum design life as specified.

c) Design of the pavement shall involve consideration of the following five inputs:
   i) Design Traffic Loading
   ii) Sub-Grade Evaluation
   iii) Environmental Impact
   iv) Pavement and Surfacing Material
   v) Construction and Maintenance

d) Road pavement design shall be carried out by a qualified engineer with appropriate knowledge of pavement design in the local environment.

e) The pavement design, including all considerations, assumptions, sub-grade test results, calculations, detailed drawings and any other relevant documentation shall be submitted to the City of Perth for endorsement prior to the commencement of construction and/or procurement of materials. Drawings provided shall clearly indicate the structure, material types and thickness of each layer of the proposed pavement and surfacing. Any variation to these requirements may be accepted by the City of Perth in special circumstances.

f) Rigid pavement design may be considered in special circumstances, through consultation with the City of Perth.

2) Surface, Base Material, Subgrade & Earthworks

For specification of the road surface and base material refer:

- MRWA Specification 501 - Earthworks
- MRWA Specification 302 - Earthworks
Referenced Documents

(ASCE 2013) ASCE Policy Statement 418
(DGLWA 2011) Asset Management - Framework and Guidelines
(IPWEA NSW 2010) Recycled Materials in Road Pavements Specification
(IPWEA WA 2002) Restoration and Reinstatement Specification
(MRWA 2013) Engineering Road Note 9 - Procedure for the Design of Flexible Pavements
(MRWA 2018) MRWA Specification 201 - Quality Systems
(MRWA 2013) MRWA Specification 302 - Earthworks
(MRWA 2018) MRWA Specification 501 - Pavements
(MRWA 2017) MRWA Specification 503 - Bituminous Surfacing
(MRWA 2017) MRWA Specification 504 - Asphalt Wearing Course
(MRWA 2017) MRWA Specification 508 - Cold Planing
(MRWA 2015) MRWA Specification 510 - Asphalt Intermediate Course

Referenced Australian Standards

AS 1289:2014 Methods of testing soils for engineering purposes
Note: Multiple parts available, refer all appropriate parts.
AS 2008-2013 Bitumen for Pavements
AS 2150-2005 Hot mix asphalt - A guide to good practice
AS 3798-2007 Guidelines on earthworks for commercial and residential developments
Road Surface Material Specification

1) General
   a) Road surface shall be designed for a minimum of 25 years design life in accordance with MRWA Engineering Note 9.
   b) Class C320 bitumen binder with 75 blow Marshall properties shall be used and shall comply with AS2008-1997 & MRWA 504.
   c) Asphalt shall be laid in accordance with AS2150-2005 & MRWA 504. Asphalt shall not be laid if rain is imminent or if the temperature of the surface taking asphalt is less than 15°C for wind speed < 20km/hr; 20°C for wind speed > 20km/hr.

2) Tolerances
   a) Values for testing of road surface tolerances shall be MRWA 504.

3) Testing
   a) All testing shall be conducted in accordance with the relevant Australian Standard and/or Main Roads WA Standards MRWA 503, MRWA 504 & MRWA 210, by a NATA qualified independent testing authority.

4) Non-Conforming Road Surface
   a) If the road surface does not conform to any of the specified requirements, the road surface shall be profiled and resurfaced with fresh asphalt. Resurfacing shall have a minimum transverse width of the trafficable lane and a minimum longitudinal length of 20m. The corrected pavement will be subjected to re-testing to ensure it conforms with all of the specified requirements. The City will bear no cost for any correction done for non-conforming surfaces.
Road Base Design Guidelines

Road base and sub-base design shall be in accordance with MRWA Specification 501 - Pavements.

Road Earthworks and sub-grade design shall be in accordance with MRWA Specification 302 - Earthworks.
Recycled Material for Pavements, Earthworks and Drainage

“The City of Perth achieves environmental improvement while supporting its social and economic need through equity and integration. Environmental impacts will be prevented, minimised and managed in city activities while creating and maintaining a resilient, diverse and attractive environment. The Perth environment will evoke pride, connection and a sense of place with its community.”

City of Perth - CP 8.0 Environment Policy

The City of Perth supports the increased recovery and use of recycled materials to minimise our environmental impact by reducing the consumption of natural resources. This will minimise our contribution of extracting unsustainable quantities of natural resources and provide sustainable solutions to protect the availability of these resources for future generations.

1) Selecting Recycled Materials
   a) The selection of recycled materials shall be in accordance with "Recycled Materials in Road Pavements Specification" (IPWEA NSW 2010).
   b) Each material class (Base, Sub-Base etc.) must conform to the properties outlined in IPWEA specification for recycled materials.
   c) The supplier must provide certification of material testing by a NATA qualified independent testing authority in accordance with AS1289:2014.
   d) Stabilised road base material can be used for road construction, but the specification for these materials shall be lodged to the City prior to proceeding with the pavement design.

2) Compaction and Placement of Recycled Materials
   e) When using recycled materials, appropriate method of compaction and placing technique shall be employed to avoid the possible breakdown of weakened constituents during construction.
Reinstatement of Flexible Pavement After Trenching
The reinstatement of sub-grade and flexible pavement after trenching works must be carried out in accordance with the City of Perth specifications (SPM.INBOX@cityofperth.wa.gov.au).

Reinstatement of Pavement After Trenching
The reinstatement of sub-grade and pavement after trenching works must be carried out in accordance with the City of Perth specifications in Book 300 & co-ordinated with SPM.
Reinstatement of Rigid (Granite) Pavement After Trenching

This document outlines the reinstatement requirements specific to rigid (granite) paving within the City of Perth. Along with the information specified in this document, reinstatement of trenches must comply to the appropriate specifications outlined in the Design and Construction Note: 102.06 - Reinstatement of Block and Asphalt Pavements After Trenching, such as general information and information regarding the installation and backfilling of pipes and conduits.

Where the reinstatement of rigid (granite) paving in footpath areas is required, the concrete slab and granite pavers must be installed to comply with the specifications in this document, to the satisfaction of the City of Perth supervisor and the details given in Design and Construction Note: Book 300.

All structures that are removed during the works must be reinstated, this includes expansion joints, isolation joints, steel reinforcement and gas vents.

1) Concrete

Prior to laying Concrete, ensure that the underlying sub-grade is compacted to 95% MMDD.

All reinstated concrete to be Fibre Reinforced Concrete, fibres as stated below. Concrete strength to be C40 with a maximum 20mm aggregate with 80mm slump.

Fibre Name: Dramix  
Fibre Type: RC 65 / 60 BN  
Fibre Dosage: 20kg/m3.

Mix concrete until all materials are uniformly dispersed and every particle of aggregate is coated with mortar. Place concrete into final position by conveyor, skip, chute or shovelling within 90 minutes of the cement placed into the mixer, so segregation and loss of fluids does not occur.

Once placed, the concrete must be fully compacted by mechanical vibrator. Vibrators shall be withdrawn from the concrete slowly at a speed not exceeding 25mm per second so that the void created by the vibrator closes behind it. Care shall be taken that vibrators be kept out of contact with reinforcement and formwork. Concrete shall be cured for seven days by covering with an approved sealed waterproof membrane kept in contact with the concrete, which is kept moist at all times.

2) Concrete Curing

Concrete shall be cured continuously for a minimum duration of 7 days, until the minimum compressive strength is achieved as per table 4.4 of AS3600-2018. Allow for sufficient ponding/sprinkling of the concrete with water prior to installing an impermeable membrane over the concrete. Maintain concrete at a constant temperature and prevent moisture loss during curing period. Other curing methods can be submitted to the City of Perth for consideration and approval.

3) Granite Paving

The granite paving to be used is called Austral Verde. Finish to be exfoliated. Stone type to be confirmed by Geological Survey of Western Australia as being the correct stone type. The applicant shall be liable for any additional costs associated with allowing for the correct stone type. For details of laying pavers and correct paving unit size refer Design and Construction Note: Book 300.
4) Adhesive
Prior to application: Remove sand, oils and deleterious products from surface of concrete with the use of brooms and pressure washer. Check line level and set out as per existing pattern. Paving pellets set within area prior to laying.
Adhesive to be: *Parex Davco SE7 with 50/50 Davelastic mix with water*, or approved equivalent. Apply as per manufacturer’s specification.

5) Laying Pavement
Cleaning stonework: Clean stonework progressively as the work proceeds. Clean stonework to remove mortar smears, stains and discolouration, using an approved method using clean water only. Do not use acid as this will discolour the stone material. Provide details for approval prior to commencing stonework.

Laying tolerances: Laying of stone shall be carried out to the following tolerances:
- Deviation from the levels or vertical plane indicated: ± 2mm
- Deviation of paving and stone walls over a 3 metre straight edge: ± 3mm, non-accumulative
- Maximum deviation across joints: 2mm

Bedding: If the concrete substrate has inadequate key for mortar bedding, such as steel trowel finish, do not lay bed until the surface has been adequately roughened by mechanical means; such as scabbling.
Stone Placement:
- Wipe clean surface of stone
- Set line and level
- Mix adhesive as per the manufacturer’s recommendations
- Trowel out adhesive to 10mm across a 2 metre square area
- Lay and set level of paver to tolerance
- Allow adhesive to cure
- Treat top surface with pre-sealant

6) Pre-sealant (Prior to Grouting)
Prior to application: Allow adhesive appropriate time to cure. Clean stonework to remove mortar smears, stains and discolouration, using an approved method using clean water only. Do not use acid as this will discolour the stone material.
Apply one coat of *Spirit Marble and Tile Care “Pre Seal”* as per the manufacturer’s specification.

7) Grout
Sand for grout: Colour (Natural Grey), grading and source shall be determined so as to closely match the granite background material colour; and subject to approval of samples.
Colour: Grout colour to match existing grout. Provide evidence that sufficient quantity of sand is available so as to provide consistency of colour for grouting mixes. Keep any stockpiled sand dry.
Characteristic compressive strength: Compressive strength of the granite pavers.
Grout Jointing:
- Mix *Lanko 701 or approved equivalent* grout to manufacturer's specifications & screed into paving gaps
- Wipe excess off paving surface and clean surface with damp sponge
- Joint size to be 5mm nominal; ± 2mm

Carry out jointing and pointing simultaneously to form a homogenous bed, rake to a depth to match existing surrounding pavers.

7) Surface Treatments
Surface sealing after cleaning: Seal exposed faces of stone to protect the material. Apply two coats of *Spirit Marble and Tile Care "Water Based Premium Seal"* as per manufacturer's specification to paving surface. The use of acid for cleaning the stonework is forbidden, as the acid will stain the stone material.

Cleaning: Leave the stonework clean on completion

8) Slab Expansion Joints
General: All Expansion & Isolation Joints must be reinstated in their original locations and/or receive prior approval for new locations by City of Perth, City Design Engineers.

Isolation Joints: 7mm nominal joint; to depth of slab, filled with joint filler.

Expansion Joints: Dowels: R20mm smooth round bars at 300mm centres, 65mm depth from top of slab. 3mm Saw cut: to 45mm depth from top of slab. 7mm Widening Saw cut: that may expand up to 17mm and contract due to thermal movement up to 2mm, to 40mm depth from top of slab.

Filler material: Use compatible sealant and bond breaking backing materials that are non-staining to masonry. Do not use bituminous materials with absorbent masonry units.
- Back-up rods: Closed cell polyethylene
- Primer: As recommended by the manufacturer; and
- Elastomeric sealant: Single component polyurethane

9) Pavement Expansion Joints
General: Provide expansion joints in the granite paving that correspond to all structural joints in the concrete substrate.

Expansion joints in stone paving located over structural joints to be 15mm wide preformed joint of Maxiseal mastic with 3mm thick stainless steel (305) side walls. For detail of expansion joint refer: *Design and Construction Note: Book 300*

Installation of joint: Install preformed joint in accordance with the manufacturer's recommendations, including masking the joints. Top of the joint filler colour shall match the adjacent grouted joints.

10) Curing of Adhesive and Sealants
Opening the works area to traffic can only be done once appropriate time has been permitted for all adhesives and sealants to cure. The times listed below are to be measured from the completion of works:
- Pedestrian traffic: 7 days
- Vehicle traffic: 28 days
General Notes

1. After cutting trench, exposed reinforcement should be treated to prevent corrosion.
2. If any new pits to be installed require a collar for strength, it should be formed below the paving level and pavement laid on top of the collar as per paving installation.
Standard City Grey Paving

1) Performance Specification:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
<th>Tested By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>Minimum 35-40 Mpa</td>
<td>Std ASTM C99</td>
</tr>
<tr>
<td>Breaking Load</td>
<td>Minimum 3kN</td>
<td>in accordance AS4456.5</td>
</tr>
<tr>
<td>Salt Resistance</td>
<td>21/26 cycles</td>
<td>in accordance AS4456.10</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>Minimum of Ha 3</td>
<td>Std ASTM C1353</td>
</tr>
<tr>
<td>Moisture Absorption by Weight</td>
<td>Max 9% by weight</td>
<td>Std ASTM C97</td>
</tr>
</tbody>
</table>

2) Testing of Paving:
All proposed paving must have test results to confirm the above properties are fulfilled. Testing to be irrespective of orientation and be performed on exfoliated finished samples. The required methods and standards of testing are:

ASTM Standards:
- C97/C97M Test methods for absorption and bulk specific gravity of dimension stone.
- C119 Terminology relating to dimension stone.
- C170/C170M Test method for compressive strength of dimension stone.
- C241/C241M Test method for abrasion resistance of stone subjected to foot traffic.
- C880/C880M Test method for flexural strength of dimension stone.
- D7102 Test method –intact rock core specimens.

Australian Standards:
- AS4456.5-2003 Masonry units and segmental pavers and flags - Methods of test - Determining the breaking load of segmental pavers and flags
- AS4456.10-2003 Masonry units and segmental pavers and flags - Methods of test - Determining resistance to salt attack

3) Approval of Test Results
The appropriate specimens should be prepared from the supplied samples and the above test work completed prior to supply of paving.
Granite Paving

1) Performance Specification:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>Minimum 135 Mpa</td>
<td>Tested by Std ASTM C99</td>
</tr>
<tr>
<td>Modulus of Rupture</td>
<td>Minimum of 12 Mpa</td>
<td>Tested by Std ASTM C99</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>Minimum of Ha 25</td>
<td>Tested by Std ASTM C1353</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>Minimum of 10Mpa</td>
<td>Tested by Std ASTM C880</td>
</tr>
<tr>
<td>Slip Resistance</td>
<td>Minimum of Class W</td>
<td>Tested in accordance AS4586</td>
</tr>
<tr>
<td>Coefficient of Thermal Expansion</td>
<td>Max of 8.4x10 -6/°C</td>
<td>Tested by Std ASTM E831</td>
</tr>
<tr>
<td>Moisture Absorption by Weight</td>
<td>Max 0.30% by weight</td>
<td>Tested by Std ASTM C97</td>
</tr>
<tr>
<td>Density</td>
<td>Minimum 2560 kg/cum</td>
<td>Tested by Std ASTM C97</td>
</tr>
<tr>
<td>Breaking Load</td>
<td>Minimum 34kN</td>
<td>Tested in accordance AS4456.5</td>
</tr>
</tbody>
</table>

2) Testing of Paving:
All proposed paving must have test results to confirm the above properties are fulfilled. Testing to be irrespective of orientation and be performed on exfoliated finished samples. The required methods and standards of testing are:

ASTM Standards:
C97/C97M Test methods for absorption and bulk specific gravity of dimension stone.
C99/C99M Test method for modulus of rupture of dimension stone.
C119 Terminology relating to dimension stone.
C170/C170M Test method for compressive strength of dimension stone.
C241/C241M Test method for abrasion resistance of stone subjected to foot traffic.
C880/C880M Test method for flexural strength of dimension stone.
D7102 Test method –intact rock core specimens.

Australian Standards:
AS4456.5-2003 Masonry units and segmental pavers and flags - Methods of test - Determining the breaking load of segmental pavers and flags
AS4586-2013 Slip resistance classification of new pedestrian surface materials

3) Approval of Test Results
The appropriate specimens should be prepared from the supplied samples and the above test work completed prior to supply of paving.
Sandstone Paving

1) Performance Specification:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>Minimum 27.6 Mpa (Dry &amp; Wet)</td>
<td>Tested by Std ASTM C99</td>
</tr>
<tr>
<td>Modulus of Rupture</td>
<td>Minimum 2.4 Mpa (Dry &amp; Wet)</td>
<td>Tested by Std ASTM C99</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>Minimum of Ha 2</td>
<td>Tested by Std ASTM C1353</td>
</tr>
<tr>
<td>Moisture Absorption by Weight</td>
<td>Max 8% by weight</td>
<td>Tested by Std ASTM C97</td>
</tr>
<tr>
<td>Density</td>
<td>Minimum 2003 kg/cum</td>
<td>Tested by Std ASTM C97</td>
</tr>
</tbody>
</table>

2) Testing of Paving:
All proposed paving must have test results to confirm the above properties are fulfilled. Testing to be irrespective of orientation and be performed on exfoliated finished samples. The required methods and standards of testing are:

- ASTM Standards:
  - C97/C97M: Test methods for absorption and bulk specific gravity of dimension stone.
  - C119: Terminology relating to dimension stone.
  - C170/C170M: Test method for compressive strength of dimension stone.
  - C241/C241M: Test method for abrasion resistance of stone subjected to foot traffic.
  - C880/C880M: Test method for flexural strength of dimension stone.
  - D7102: Test method – intact rock core specimens.

- Australian Standards:
  - AS4456.5-2003: Masonry units and segmental pavers and flags - Methods of test - Determining the breaking load of segmental pavers and flags
  - AS4586-2004: Slip resistance classification of new pedestrian surface materials

3) Approval of Test Results:
The appropriate specimens should be prepared from the supplied samples and the above test work completed prior to supply of paving.

4) Use of Sandstone, Natural Stone and other non-standard paving materials:
Sandstone, Natural Stone and paving materials that are not included in the City of Perth Design and Construction Notes must be approved by the City of Perth. Prior to submission for approval, a sample shall be prepared and all required tests carried-out. The tests required shall be determined through consultation with the City of Perth.