CITY OF SYDNEY

Sydney Streets

Technical Specifications

Version: 2019

Contents

Preamble

The Sydney Streets Technical Specifications detail the design and construction standards for physical assets in our city, including roads, footpaths, kerbs, gutters, street lighting, and survey and stormwater infrastructure.

The Technical Specifications ensure these assets continue to provide services in a reliable and cost-effective manner for the benefit of the people who live, work in and visit our city.

They are for use by staff, developers, consultants and service providers of the City of Sydney (the City).

Since the previous issue of Technical Specifications, significant new design details, materials and construction methods have become available. This edition replaces previous editions and is based on research and analysis of industry standards, specifications and best practice.

These Technical Specifications supersede the previous issues that focused primarily on infrastructure design and construction.

This updated version recognises asset management and asset handover as a very significant contributor to the long-term asset management of City infrastructure. It also aligns with the City's new editions of:

- The Streets Design Code
- Street Tree Master Plan
- Sydney Lights Code
- Principles of Sustainability established by Sustainable Sydney 2030 and subsequent strategic planning and project initiatives such as the Liveable Green Network.

A/ CITO Technical Services Manager

Introduction

General

The primary purpose of the Technical Specifications is to outline the City's approach to consistent infrastructure asset management, which is underpinned by design, construction and asset handover for the purpose of City's ongoing inspections and maintenance.

The City of Sydney Local Government Area (LGA) covers approximately 26 square kilometres and includes the following areas:

City Centre (CBD), The Rocks, Walsh Bay, Barangaroo, Millers Point, Ultimo, Pyrmont, Surry Hills, Woolloomooloo, Kings Cross, Elizabeth Bay, Rushcutters Bay, Darlinghurst, Chippendale, Darlington, Camperdown, Forest Lodge, Glebe, Alexandria, Beaconsfield, Centennial Park, Erskineville, Newtown, Redfern, Rosebery, Waterloo and Zetland.

NSW Government agencies have environmental responsibilities in the LGA and the Australian Government Department of Defence has administrative control over Garden Island. The NSW Government Roads and Maritime Services has jurisdiction over State Roads and Port facilities.

The city is densely urbanised and is intensively used for a variety of purposes including residential, commercial, tourism and cultural activities.

The City's Sustainable Sydney 2030 vision for a sustainable world-leading metropolis requires the City to respond to both the changes that are occurring through its growth and the challenges associated with regional and global impacts such as climate change. The overarching themes for Sydney 2030 are:

- A revitalised city centre at the heart of a global Sydney
- An integrated inner Sydney transport network
- A liveable green network
- Activity hubs as the focus for the city's village communities and transport
- Transformative development and sustainable renewal.

One of the 10 targets the City has set as part of its Sustainable Sydney 2030 Strategy Plan states that "By 2030, the City will reduce greenhouse gas emissions by 50 per cent compared to 1990 levels, and by 70 per cent compared to 1990 levels by 2050."

One way in which greenhouse gases can be reduced is through the choice of lower carbon footprint materials. Wherever possible, the City proposes sustainable options for materials and construction techniques in these Technical Specifications.

Scope

These Technical Specifications set the guidelines for asset design, construction and handover for asset operation and maintenance. For reference, standard technical drawings are included.

The Technical Specifications apply to the design, construction and asset handover of infrastructure within the City of Sydney LGA that is under the City's control.

The Technical Specifications also provide direction for design, construction and asset handover for private development that has implications on the public domain.

The City also encourages the use of the Technical Specifications in areas within its boundaries to achieve a coordinated and consistent approach to support long-term maintenance benefits and consistent design and construction standards for the public domain.

The Technical Specifications do not replace Australian Standards or any project-specific Natspec documentation (Other Standards), but rather complement them, as they may not cover the same content. All these guidelines are to be followed. For this reason, there may be instances where both the Technical Specifications and the Other Standards are used on a given project. Where there is an inconsistency between the Other Standards and the Technical Specifications, the Technical Specification will take precedence unless the City directs otherwise.

The City expects that any project design consultant engaged by the City will consider the content of the Sydney Streets Technical Specifications and ensure that they are adequately included within relevant project documentation. Any departures from the Technical Specifications and the Other Standards must be agreed to by the City in relevant project documentation before a project design consultant proceeds with any of them.

Reading the Specifications

The Specifications comprise the following sections:

Introduction
This section provides an overview of how the Technical Specifications are set out, their use and relation to the City's public domain framework.

A: Design
This section outlines the key design considerations for City infrastructure.

B: Construction
This section provides information and standard requirements for construction.

C: Standard Drawings
This section provides standard design drawings, which are also referred to in these Technical Specifications.

User

The Technical Specifications provide technical information including standard drawings for the public infrastructure within the City's Local Government Area, enabling the City, its community, designers, consultants and contractors to understand and deliver assets to the City's requirements. The Technical Specifications should be used by all stakeholders involved with planning, design and approval of infrastructure works for the City.

Application of the Technical Specifications

The Technical Specifications outline the overall asset design, construction and handover strategy, which encompasses the functional asset management approach to the City's infrastructure.

Refer to the City maps prior to applying the Technical Specifications and also confirm which Australian Standards are applicable.

Refer to the Streets Design Code for infrastructure installation details.

Engagement of an independent, professional and qualified infrastructure designer is essential.

Glossary of Terms	
Authorities	Authorities such as AGL, Ausgrid, Department of Planning, Optus, Roads and Maritime Services, Sydney Water and Telstra.
The City	The Council of the City of Sydney.
City's Representative	The person nominated by the Council of the City of Sydney to act on the City's behalf in the discharge of its contractual responsibilities.
Community Liaison Officer	A person employed by the City or Service Provider to directly communicate with the community.
Consultants	Specialist consultants appointed or novated to the Service Provider.
DBYD	Dial Before You Dig.
Excavation	Excavation in all classes of material, matter or substance.
Handover documents	All documents provided by the Service Provider to the City on Practical Completion as specified, including as-built drawings.
MGA Coordinate System	Map Grid of Australia (MGA). This is a standard Universal Transverse Mercator (UTM) projection and is used by all states and territories across Australia.
PMP	Project Management Plan.
PSM	Permanent Survey Mark.

Glossary of Terms	
Practical completion	Practical completion is the stage of the project when the Works are generally considered to be practically complete and when there are no outstanding defects (except for minor items) and the project can be put to its intended use.
Proprietary items	Manufactured proprietary items selected or approved by the City for inclusion/installation in the project by the Service Provider.
Road classification	Medium to heavy traffic • 15,000 to 25,000 vpd (vehicles per day) • 500 to 1,500 hvpd (heavy vehicles per day) • 60 km/h to 80 km/h speed limit • Roads with design traffic equal to or exceeding 107 Equivalent Standard Axles (ESA). Light to medium traffic • < 15,000 vpd (vehicles per day) • < 500 hvpd (heavy vehicles per day) • ≤60 km/h speed limit • Roads with design traffic less than 107 Equivalent Standard Axles (ESA).
Service Provider	Any parties such as contractors, suppliers, consultants, developers, authorities or staff who are planning, designing and conducting the Works.
Site	Land and structures within the extent of the Work's area/site boundary, including storage areas. The site area includes privately owned property that is to be dedicated to the City as a public asset.
Specifications	This detailed statement of materials, dimensions and quality for all work that is to be built, installed or manufactured for the City or for work that is to be dedicated to the City as a public asset.
SSM	State Survey Mark.
Stakeholders	Persons, groups or organisations with interests in the project, who require special consideration or consultation prior to or during Works being undertaken.
Sub-service provider	Party conducting Works for the Service Provider.
Supervisor	Supervisor appointed by the Service Provider to supervise site works.
Suppliers	Suppliers of goods for use.
SWMS	Safe Work Method Statement.
Tenant	Tenants or Lessees of Private Property on non-government and non-Crown land. Generally, tenants neighbouring the site boundary.
TMP	Traffic Management Plan.
Works	All Works required to complete the project as specified and approved.

Standards, Policies and Codes of Practice Applicable

All Works shall be carried out in a sound, efficient and well-executed manner and in accordance with sound engineering practice and principles.

Unless otherwise specified, materials and works must be in accordance with the engineering purpose and intent of the drawings and these specifications, and the relevant standards of Standards Australia, the City of Sydney, utility authorities and Roads and Maritime Services (RMS, formerly the RTA).

Compliance

The Service Provider shall complete all Works in accordance with the relevant statutory requirements, standards, codes and guidelines including but not limited to:

Publisher	Title
City of Sydney	City's Contractors Safety Handbook supplied at the induction process.
City of Sydney	Sydney Streets Design Code.
City of Sydney	The Central Sydney Heritage LEP.
City of Sydney	The Central Sydney LEP.
City of Sydney	Street Tree Master Plan.
City of Sydney	Code of practice for construction hours/noise within the central business district.
Office of Environment and Heritage (OEH) – NSW	Managing Urban Stormwater: Soils and Construction Volume 1 & 2; the Clean Air Act; and the Protection of the Environment Act.
RMS	Various specifications
NSW Government legislation	Work Health and Safety Act 2011.
SafeWork NSW	Various work health and safety regulations and requirements.
NSW Streets Opening Conference, 7th Edition 2009	Guide to Codes and Practices for Streets Openings.
Land and Property Information	Survey Mark Preservation
SAI Global	Australian Standards
SafeWork Australia	Codes of practice, guidance materials, information sheets and fact sheets; SafeWork Australia: Asbestos – Code of Practice and Guidance Notes.

A1 & A2 General Design Requirements

The purpose and intent of the Technical Specifications is to provide guidelines for design and construction of civil infrastructure on Sydney streets on behalf of the City of Sydney (the City), including written specifications and standard drawings to obtain high-quality design and construction.

The Technical Specifications are primarily to be used by developers, construction companies and designers on civil infrastructure projects with specific focus on:

- Footways
- Kerb and Gutter
- Roadways
- Street Furniture
- Street Lighting
- Road Signage and Pavement Markings
- Stormwater Drainage
- Survey Marks
- Pavement Restorations

Notably excluded from this document are guidelines for the design and construction of public buildings, landscaping and parks, which are also owned and managed by the City.

The Sydney street design is directly related to traffic needs and specifically:

- Streets, intersections, driveways and pedestrian facilities shall be designed to provide for the greatest safety for motorists, pedestrians and cyclists.
- Accessibility shall be provided in accordance with the requirements of the Disabilities Act.

The design details and criteria are intended to aid in preparation of plans and specifications and are considered minimum standards; a complete design will usually require more than what is presented in this document.

As with any design criteria, occasions may arise where the minimum standards are inappropriate. In these cases, a variance shall be considered. Written request for each variance should be directed to the City.

Prior to the Service Provider beginning work, an approved set of plans and specifications must be on file with the City. All contracts, bonds, insurance, permits and licences must be fully executed by the Service Provider before beginning work.

The City's review and approval:

- will only be to determine if the plans, specifications and construction conform to the City's requirements
- will not relieve the Design Professional and Service Provider/Owner from responsibility for any variation from the City requirements or adequate design standards
- shall not constitute any assumption of responsibility or liability for the design or construction.

No permits for construction will be issued until the design documents have been certified by a registered professional.

All design and construction within public domain works shall be by or under the direct supervision of a registered professional. All drawings and support data submitted to the City for approval must bear their seal and signature.

A3 Roads and Structures Design

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A3 ROADS AND STRUCTURES DESIGN

3.1 INTRODUCTION

The City of Sydney Streets Technical Specifications have been developed to ensure the provision of high-quality civil infrastructure compatible with the City's maintenance, asset management and serviceability requirements.

These technical specifications are output-based and specify the criteria that must be satisfied for roads and street civil assets owned by the City. Roads and streets infrastructure shall be designed by suitably qualified and experienced professionals and in compliance with these specifications and all relevant legislation, standards and current practice.

This document shall be read in conjunction with Technical Specifications B: Construction and C: Standard Drawings.

3.2 EXCEPTIONS

Departures to the requirements stipulated in the City's Sydney Streets Technical Specifications A: Roads and Street Design, B: Construction and C: Standard Drawings are only permitted with the written approval of the City.

Departures shall be requested in writing. Failure to gain approval prior to construction may result in an order to remove, redesign or reconstruct non-compliant elements.

Written approval shall be required for each instance of non-compliance and shall include a comprehensive explanation of the following:

- description of the proposed departure
- clauses for which departure is sought
- justification when compliance is not possible.

Where the departure is sought during construction, justification as to why the departure was not reasonably foreseeable during the Construction Certificate or detailed design stages is also required.

3.3 CERTIFICATION

Roads and Streets shall be designed by suitably qualified and experienced professionals and certification shall be required stating that the proposed design complies with:

- City's Sydney Streets Technical Specification A3: Roads and Streets Design
- City's Sydney Streets Technical Specification B: Construction
- City's Sydney Streets Technical Specification C: Standard Drawings
- All relevant Standards/Specification/Guide/Standard Drawings that include Austroads Guide to Pavement Technology, RMS Specifications and Standards Drawings.

Certification is required for the design of all elements even where the City's standard drawings are used. The City's standard drawings are to be used for guidance only and the consultant has to verify each of the drawings and details for the project specific requirements (e.g. geometry, loading, subgrade capacity, exposure classification) and amend them as required. At the end, the consultant needs to certify all the details and drawings that will be used in the project.

For flexible pavement design, CIRCLY software is to be used to justify the accuracy of the flexible pavement design. All pavement design considerations and CIRCLY design output are to be certified and submitted to the City.

Similarly for rigid pavement design all design considerations and design calculations are to be certified and submitted to the City. It will need to be justified how all these comply with the requirements of Austroads Guide to Pavement Technology, RMS Specifications and Standards Drawings.

3.4 RELEVANT STANDARDS

Roads and streets shall be designed and constructed in accordance with all relevant standards. This includes the standards listed below; however, it should be noted that the list is not exhaustive. The requirements of these Technical Specifications will prevail where the following standards are in conflict with it:

- Roads and Maritime Services guidebooks
- Austroads Guide to Pavement Technology
- RMS Specifications and Standards Drawings.

3.5 SOFTWARE

CIRCLY software is to be used to justify the accuracy of the flexible pavement design.

For rigid pavement design, relevant software used by the RMS and other NSW organisations (where available) is to be used to justify the accuracy of the design.

3.6 DATA REQUIREMENTS

The following information shall be required with every detailed design or Construction Certificate that includes roads and streets:

- General Plan
- Utilities Investigation Plan
- Relevant City standard drawings
- Certification of Design
- Construction Certification.

3.6.1 GENERAL PLAN

A general plan of the proposed works shall be provided at a suitable scale such as 1:200 at A3 and include the following:

- Title block, legend, north point, scale and scale bar
- Property boundaries
- Roads and road names
- Proposed development
- Existing and proposed levels, e.g. road, footpath, other topographical features, etc.
- Relevant topographical features
- Dimensions and/or coordinates accurately identifying the position of all assets without the need to scale positions off plans.

3.7 GENERAL DESIGN PRINCIPLES FOR ROAD DESIGN

Roads should be designed to:

- provide safe, short and fast thoroughfare and access to all road users (motor vehicles, cyclists and pedestrians)
- clearly convey the primary function to road users and encourage appropriate driver behaviour
- deliver traffic volumes at speeds compatible with function
- provide convenient location for services
- provide an opportunity for landscaping
- allow for parking, where appropriate
- have due regard to topography, geology, climate, environment and heritage of the site
- provide low cost of ownership
- comply with these Technical Specifications and relevant Austroads and RMS Guidelines and/or Standards.

The appropriate design criteria for a specific road largely depend on a set of economic indicators: the costs of construction and operation on one side and financial benefits to the community on the other. These are strategic parameters that influence a decision to build a road. Economic analysis, in conjunction with traffic analysis, determine the functional class of the road and the design speed. This section must be read in conjunction with the relevant Austroads and RMS Guidelines and/or Standards.

3.8 GENERAL DESIGN PRINCIPLES FOR STREET DESIGN

A well-designed street requires street design coordination through planning, design detailing and implementation. Composing and considering all elements within the street is a significant contributor to the character and appearance of a place as well as providing a safe and comfortable pedestrian domain.

Good design and layout of elements:

- create a safe street
- reinforce the street hierarchy
- provide required paths of travel and pedestrian priority
- provide a clear and direct composition that reinforces the major design elements
- integrate seamlessly into the paved ground plane
- are located consistently throughout the public domain to reflect the overall special character.

This section must be read in conjunction with the Sydney Street Code.

3.9 BRIDGES AND STRUCTURES DESIGN REQUIREMENTS

Any major structure (e.g. bridge, retaining wall, public stairs/steps/ramps) and inaccessible structures (e.g. box culvert) shall have a 100 year design life and Australian Standard AS5100 is to be used in the design. Further to that appropriate concrete mix (e.g. concrete mix complying with RMS Specification B80) is to be used to ensure a 100 year design life. Australian Standard AS5100.5 is to be used for concrete exposure classification, concrete cover, etc.

- AS5100 – Bridge Design
- RMS QA Spec B80 – Concrete Work for Bridges

Any new bridge and culvert under the road shall be designed for unrestricted vehicular load capacity and shall be capable of supporting all vehicular load of Australian Standard AS5100.2 that include SM1600 and HLP400.

Minor structures are to be designed as per relevant Australian Standards (e.g. AS3600, AS4100). A minimum design life of 50 years shall be achieved in the design unless specified higher by the Council. The Standards to be used include the following:

- AS3600 – Concrete Structures
- AS3735 – Concrete Structures for Retaining Liquids
- AS2870 – Residential Slabs and Footings
- AS2159 – Piling – Design and Installation
- AS4100 – Steel Structures.

Steel structures and their surface coatings are to be designed to ensure a minimum of 50 year design life unless specified higher by the Council. Design standards include the following:

- AS4100 – Steel Structures

Shotcrete is to comply with relevant RMS QA Specification (e.g. B82, R68):

- RMS QA Spec B82 – Shotcrete Work
  (For shotcrete work with 100 year design life, e.g. tunnels and retaining walls)
- RMS QA Spec R68 – Shotcrete Work without Steel Fibres
  (For works such as stabilising slopes in conjunction with soil nailing or rock dowelling)

Where stainless steel element is used in council works, the Grade 316 with a minimum of 100 year design life is to be used. Stainless steel items are to be appropriately isolated from carbon steel items where both types of steel are used in the same structure.

Rock bolts to be used in any cliff remediation work shall have a minimum 100 year design life.

For timber works, relevant Australian Standard and RMS Specifications are to be used in the design, construction and surface and preservative treatments. Design report and drawings shall clearly list all these documents to demonstrate how the most appropriate timber grade and timber treatments are used in the design and construction.

A4 Stormwater Drainage Design

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A4 STORMWATER DRAINAGE DESIGN

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A4 STORMWATER DRAINAGE DESIGN

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A4 STORMWATER DRAINAGE DESIGN

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4.1 INTRODUCTION

The City of Sydney Stormwater Drainage Design Technical Specifications have been developed to ensure the provision of high-quality stormwater infrastructure compatible with the City's maintenance, asset management and serviceability requirements.

These Technical Specifications are output-based and define the criteria that must be satisfied by stormwater networks that are to be owned by the City or located on public land within the City's local government area. Stormwater infrastructure shall be designed by suitably qualified and experienced professionals and in compliance with these Technical Specifications and all relevant legislation, standards and current practice.

This document shall be read in conjunction with B10: Stormwater Drainage Construction, all other parts of the City's Sydney Streets Technical Specifications, and Part C: Standard Drawings.

4.2 EXCEPTIONS

Departures to the requirements stipulated in the City's Sydney Streets Technical Specifications, A4: Stormwater Drainage Design, B10: Stormwater Drainage Construction and Part C: Standard Drawings are only permitted with the written approval of the City's Principal Engineer – Water Assets.

Variations shall be requested in writing using the Drainage Standards Variation Form and a Drainage Standards Variation Approval Summary Sheet signed by the Principal Engineer – Water Assets and shall be obtained prior to construction. They are both available in Annexure B and can be downloaded from the City's website. Failure to gain approval prior to construction may result in an order to remove, redesign or reconstruct non-compliant elements.

Written approval shall be required for each instance of non-compliance and shall include a comprehensive explanation of the following:

- Description of the proposed variation
- Clauses for which variation is sought
- Justification as to why compliance is not possible.

Where the variation is sought during construction, justification as to why the variation was not reasonably foreseeable during the Construction Certificate or detailed design stages is also required.

4.3 CERTIFICATION

Stormwater infrastructure shall be designed by suitably qualified and experienced professionals and certification shall be required stating that the proposed design complies with:

- City's Sydney Streets Technical Specification A4: Stormwater Drainage Design
- City's Sydney Streets Technical Specification B10: Stormwater Drainage Construction
- City's Sydney Streets Part C: Standard Drawings
- All other relevant standards.

Certification is also required for the hydraulic and structural design of all elements. Structural certification is not required for items constructed as per City of Sydney standard drawings.

4.4 RELEVANT STANDARDS

Stormwater drainage shall be designed and constructed in accordance with all relevant standards. This includes the following standards; however, it should be noted that the following list is not exhaustive. The requirements of these technical specifications will prevail where the following standards are in conflict with it:

- Sydney Streets Technical Specifications
- Sydney Streets Technical Specification B10: Stormwater Drainage Construction
- Sydney Streets Standard Drawings
- The relevant Australian Rainfall and Runoff Projects, numbers 1 to 21 inclusive
- Australian Runoff Quality, A Guide to Water-Sensitive Urban Design, Engineers Australia, 2006
- The Constructed Wetlands Manual, Volume 1 and 2, NSW Department of Land and Water Conservation, 1998
- Condition Assessment & Asset Performance Guidelines, Practice Note 5: Stormwater Drainage, Institute of Public Works Engineering Australia
- 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 2566.1 Buried flexible pipelines – structural design
- 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 3725 Loads on buried concrete pipes
- AS 3735 Concrete structured for retaining liquid
- AS 3972 Portland and blended cements
- AS 3996 Metal access covers, road grates and frames
- AS 4058 Precast concrete pipes (pressure and non-pressure)
- AS 4139 Fibre reinforced concrete pipes and fittings
- AS 3571-1989 Glass filament reinforced thermosetting plastics (GRP) pipes – Polyester based – Water supply, sewerage and drainage applications
- AS/NZS 5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
- Polyethylene pipe code 2004 3rd Edition Version 3.1– Water Services Association of Australia

- ISO 10467:2004 Plastic piping systems for pressure and non-pressure drainage and sewage – Glass reinforced thermosetting plastics (GRP) systems based on unsaturated polyester resin.
- ISTT Trenchless Technology Guideline – Cured in place lining systems, new version August 2005
- ISTT Trenchless Technology Guideline – Close fit thermoplastic lining, new version August 2005
- ISTT Trenchless Technology Guideline – Pipe bursting and splitting, new version June 2005.

4.5 DATA REQUIREMENTS

The following information shall be required with every detailed design or Construction Certificate that includes stormwater infrastructure:

- General Plan (services and drainage plan)
- Utilities investigation plan
- Long sections
- Drainage Details
- Relevant City of Sydney standard drawings
- Certification of Design
- Drainage Design Variation Form
- Catchment Plan
- Hydrologic and Hydraulic Design Data
- Water Quality Design Data
- Environmental Impact Assessment
- Structural Certification.

The following information shall be required for any project that requires stormwater relining works:

- A plan showing the extent of the proposed relining works including the size of the host conduit
- Details of any proposed additional structures or modification of existing structures in order to gain access to undertake the Works, including all relevant City of Sydney standard drawings
- Structural requirements for the liner, the method of relining to be undertaken and design calculations with certification of the structural capacity of the liner
- CCTV of the host conduit depicting current conditions
- Information regarding kerb outlet connections is only required on the General Plan.

The following sections provide additional detail on the requirements for each item listed above. Annexure A provides design checklists to ensure all relevant information is included with drainage designs.

4.5.1 GENERAL PLAN

A general plan of the proposed Works shall be provided at a suitable scale such as 1:200 at A3 and include the following:

- Title block, legend, north point, scale and scale bar
- Property boundaries
- Roads and road names
- Proposed development
- Existing and proposed levels, e.g. stormwater, road, footpath, other topographical features, etc.
- Relevant topographical features
- Existing stormwater network
- Proposed stormwater network

- Dimensions and/or coordinates accurately identifying the position of all stormwater assets without the need to scale positions off plans
- Stormwater pits and structures labelled from upstream to downstream using “line number/pit number” format
- Labels or schedule identifying the requisite pit or structure types, properties and relevant standard drawing or detail
- Existing and proposed pipe or conduit size
- Appropriate labels describing the proposed Works.

4.5.2 UTILITIES INVESTIGATION PLAN

A Utilities Investigation Plan shall be prepared documenting the position of all services in the vicinity of the proposed stormwater works. The plan shall be provided at a suitable scale such as 1:500 at A3 and include the following:

- Title block, north point, scale and scale bar
- Property boundaries
- Road and road names
- Existing and proposed stormwater
- Location of all utilities services
- Location of potholing and surveyed service levels
- Photographs of potholed services.

Where the services investigation is large and complex, the above plan can be supplemented with a detailed service investigation report.

4.5.3 LONG SECTIONS

Long sections of all stormwater conduits are required for all projects where the total length of new conduit exceeds 4.8 metres.

Notwithstanding the above, long sections are not required in the following circumstances:

- Relining of existing stormwater conduits
- Replacing existing conduits like for like and there are no service intrusions in the existing conduits.

4.5.3.1 SCALE AND DATUM

Scale: 1:200 horizontal at A3
1:20 vertical at A3

Datum: AHD

4.5.3.2 TITLE BLOCK

Title block, legend, scale and scale bar shall be provided.

4.5.3.3 DIAGRAMS

The following shall be drawn on the upper portion of the long sections:

- Invert
- Obvert
- Surface
- Pits and structures
- Pit/structure labels in the form of 'Line Number/Pit Number'
- 20yr ARI HGL
- 100yr ARI HGL
- Position of other services crossing pipeline
- Label service utilities with type of service and type and number of conduits.

4.5.3.4 LABELS

The middle portion of the long sections shall indicate the length of each reach and include the following information:

- Dimension/type/strength class
- Length @ grade %
- 20yr ARI peak flow rate.

4.5.3.5 DATA TABLE

The lower portion of the long section shall include a data table with the following information:

- Datum
- WAE invert (blank space to be completed post construction)
- 20yr ARI HGL level
- Existing surface level
- Proposed surface level
- Design invert level
- Chainage.

4.5.4 DRAINAGE DETAILS

Details shall be provided for all stormwater structures not covered by the City of Sydney standard drawings. Details shall be provided at an appropriate scale such as 1:20 at A3 and include all relevant detail to document the physical and structural features. Detail includes but is not limited to the following:

- Title block, legend, scale and scale bar
- Plan of each structure
- Sections as appropriate
- All dimensions
- Prefabricated items such as covers
- Structural steel design
- Notes and specifications.

4.5.5 CITY OF SYDNEY STANDARD DRAWINGS

Where possible City of Sydney standard drawings shall be used. A copy of all referenced City of Sydney standard drawings shall be provided with the Construction Certificate and construction drawings.

4.5.6 DRAINAGE DESIGN VARIATION FORM

The Drainage Design Variation Form and Variation Approval Summary Sheet are only required where a variation to the Technical Specifications is requested. They are both available in Annexure B of this chapter and can be downloaded from the City's website.

The purpose of the Drainage Design Variation Form is to:

- Document the proposed scope and extent of non-compliance
- Identify the elements of the Stormwater Design and Construction Technical Specifications where variance is sought
- Provide a justification for the proposed variation.

The purpose of the Variation Approval Summary Sheet is to:

- Summarise the proposed variance
- Provide written approval or refusal of the variation request.

Where a variation to the design or construction specifications is sought during the construction phase of a project, justification is required as to why the variation could not have been reasonably foreseen during the detailed design or construction certificate stages.

The following are not considered to be valid justifications for a variation:

- Failure to undertake proper services locating and potholing during the Construction Certificate or detailed design phases
- In order to avoid modifications to development consent or proposed design
- In order to avoid redesigning, removing or reconstructing elements that have already been constructed.

4.5.7 CATCHMENT PLAN

A catchment plan shall be provided at a suitable scale such as 1:500 at A3 and include the following:

- Title block, north point, scale and scale bar
- Property boundaries
- Pit and pipe layout
- Pit labels
- Sub-catchment delineation
- Label indicating catchment area
- Flow direction arrow pointing to outlet.

4.5.8 HYDROLOGIC AND HYDRAULIC DESIGN DATA

The hydrologic and hydraulic capacity of the stormwater network shall be designed in accordance with Section 4.7 of this chapter. The hydrologic and hydraulic design shall be provided to the City as either a DRAINS File and supporting information in accordance with Section 4.5.8.1 or as a comprehensive design report and design summary sheets as outlined in section 4.5.8.2.

4.5.8.1 DRAINS FILE REQUIREMENT

Where the DRAINS hydrologic and hydraulic modelling software is used for the design of the stormwater network, a copy of the DRAINS modelling file shall be provided. The modelling file shall conform to the following:

- The Catchment Plan outlined in Section 4.5.2 shall be used as a background with the modelled drainage network elements schematised in their true positions on the plan
- The stormwater network shall be schematised in the model at full scale and in its actual position on the background plan

- All required storm events and durations
- The extended hydrological parameters shall be used
- Standard Drains pit inlet capacity curves shall be used wherever appropriate
- Where non-standard pit inlet capacities are used, a supplemental report shall be provided outlining the calculation and justification for the adopted inlet capacities.

4.5.8.2 HYDROLOGIC AND HYDRAULIC DESIGN REPORT

Where the DRAINS hydrologic and hydraulic modelling software is not used for the design of the stormwater network, a comprehensive stormwater design report as well as hydrologic and hydraulic design summary tables shall be provided.

The Stormwater Design Report shall include the following:

- A description of the hydrologic and hydraulic modelling software package used including the suitability of the software for this purpose
- The methodologies employed in the calculation of rainfall, runoff and hydraulic capacity
- The adopted pit inlet capacities
- Where non-standard pit inlet capacities are used, the calculation and justification for the adopted inlet capacities
- The hydrologic and hydraulic parameters utilised and the appropriateness of the selected values
- Description and justification of boundary conditions.
- Completed hydrologic and hydraulic design summary tables as specified in Annexure C shall be provided.

4.5.9 WATER QUALITY DESIGN DATA

Water quality improvement devices shall be designed in accordance with Section 4.12 of this chapter. The water quality improvement design shall be provided to the City as either a MUSIC File and supporting information in accordance with Section 4.5.9.1 or as a comprehensive design report and design summary sheets as outlined in Section 4.5.9.2.

4.5.9.1 MUSIC FILE REQUIREMENT

Where the MUSIC water quality improvement modelling software is used for the design of the water quality improvement devices network, a copy of the MUSIC modelling file shall be provided.

4.5.9.2 WATER QUALITY IMPROVEMENT DESIGN REPORT

Where the MUSIC modelling software is not used for the design of the stormwater quality improvement devices, a comprehensive design report shall be provided.

The design report shall include all relevant information including the following:

- A description of the water quality improvement device modelling software package used, including the suitability of the software for this purpose
- The methodologies employed in the calculation of pollutant reductions
- The device bypass design arrangements
- The parameters utilised and the appropriateness of the selected values.

4.5.10 ENVIRONMENTAL IMPACT ASSESSMENT

- Where the stormwater works are to be undertaken as part of a Development Consent, the environmental impacts were assessed as part of the Development Application and further assessment is not required.
- Where the Works are to be undertaken without a Development Application, the environmental impacts of the stormwater works shall be assessed as part of a Review of Environmental Factors.

4.5.11 STRUCTURAL CERTIFICATION

Certification of the structural design is required for all stormwater structures except for City of Sydney standard drawings. The structural certificate shall be accompanied with the detailed design calculation of the structure.

All structures shall be designed to achieve 100 years' life expectancy and shall be designed in accordance with relevant Australian Standards. All concrete structures shall be designed and constructed as if they are liquid-retaining structures to minimise cracks and maximise the life expectancy of structures.

4.6 DATA HANDOVER

The following is required to be provided to the Water Assets Team upon completion of the project:

- Marked "Works as Executed" plans
- Asset location file
- Asset data sheet
- CCTV of newly constructed conduits.

Where water quality improvement devices are created, the above information shall be accompanied by the following:

- Product specifications for all prefabricated GPT devices installed
- Operation and maintenance manual for each GPT device.

Where stormwater-relining work has been undertaken, the following information shall be provided upon completion of the project:

- Lining product specification and material data sheets
- Structural design documentation
- CCTV of host pipe prior to commencement of Works
- CCTV of host pipe with all preparations completed and ready to accept the new liner
- CCTV upon completion of lining demonstrating proper installation of liner.

4.6.1 WORKS AS EXECUTED DRAWINGS

Plans of Works - As - Executed shall be provided electronically in PDF format consisting of the design plan with red line markings indicated as-built data. The as-built data shall include the following:

- The position of all stormwater assets
- Pipe sizes and invert levels at the upstream and downstream ends of each pipe reach
- A description of all pits and structures including the type, grate, cover and kerb inlet length
- Pit and structure invert and surface levels.

4.6.2 ASSET LOCATION FILE

A DXF file shall be supplied indicating the position of pipes, pits, structures and other stormwater assets.

Each asset type shall be represented as outlined in Table 1.

The positions shall be provided in the GDA 1994, MGA Zone 56 coordinate system.

Each asset shall be provided with a unique label.

TABLE 1
DXF FILE PROPERTIES

Asset type	Feature type	Notes
Conduit	Line	Centre line of conduit
Pit	Point	Centre of grate along the kerb line. Where there is no kerb line, the centre of the pit structure shall be used
Headwall	Point	Centreline of the outlet pipe on the wall
GPT	Point	Centre of the GPT structure. Where the unit consists of multiple structures then the centre point of each structure shall be provided
Raingarden	Polygon	Polygon representing the extent of planting for each raingarden.

4.6.3 ASSET DATASHEET

The asset data sheets in Attachment D shall be completed.

Each asset (e.g. pit, pipe, GPT and raingarden) shall be:

- represented by a single row in the data sheets
- provided with a unique label corresponding to the label provided in the DXF file.

4.6.4 CCTV FOOTAGE

CCTV footage shall be provided for all new pipes and for all existing pipes modified. The footage shall comply with the following:

- The files shall be in MPG4 format
- File resolution shall be 640 by 480 pixels, 3Mbps and 25 frames per second
- Each pipe reach (i.e. between two pits) shall be provided as a separate file
- The CCTV inspection shall be undertaken in accordance with the IPWEA Condition Assessment & Asset Performance Guidelines, Practice Note 5, Stormwater Drainage
- The speed and panning of the footage shall be sufficient to demonstrate that there are no significant cracks in the pipe and that the joints have been properly constructed
- The files shall have a name corresponding with the unique label provided in the DXF file and asset data sheet
- A summary report (*.pdf) shall accompany the data.

4.6.5 PRODUCT SPECIFICATIONS

Product specifications and all available guarantees shall be provided for all prefabricated products used such as gross pollutant traps and relining products.

4.6.6 OPERATION AND MAINTENANCE MANUAL

Where gross pollutant traps or other water-quality devices or non-standard assets (excluding raingardens) are constructed, an operation and maintenance manual shall be provided, which shall cover the following:

- Description of the asset and its components
- The design life of the asset and the individual components
- The maintenance procedures, frequency and equipment needs
- Demonstrated appropriate vehicle and equipment access
- Cost for all required maintenance activities
- A copy of the design plans, Works as Executed plans, specifications, instruction manuals and warranties for the asset.

4.7 HYDROLOGIC AND HYDRAULIC DESIGN CRITERIA

4.7.1 GENERAL STANDARDS

General standards for hydraulic design are as follows:

- Relevant Australian Rainfall and Runoff Projects, numbers 1 to 21 inclusive
- Be consistent with current industry best practice.

The requirements of these technical specifications will prevail where the above standards are in conflict.

4.7.2 HYDROLOGIC DESIGN

The hydrologic and hydraulic design shall comply with the following:

- Appropriate hydrologic and hydraulic modelling software shall be used
- Hydrology shall be determined using the ILSAX type time-area method or an appropriate storage routing model
- The use of methods such as the Rational, Advanced Rational or Probabilistic Rational methods is not permitted
- The use of hand calculations or design charts is not permitted.

4.7.2.1 DESIGN STORMS

The stormwater network shall be designed in accordance with the Major/Minor design concepts outlined in Australian Rainfall and Runoff, A Guide to Flood Estimation. Design storms shall be as follows:

Major: 100 year Average Recurrence Interval (ARI), also referred to as 1% AEP.

Minor: 20 year ARI, also referred to as 5% AEP.

Simulation of additional design storms may also be required in order to comply with Section 4.7.4 and Section 4.7.5.

4.7.2.2 STORM DURATIONS

All design storms shall be simulated for the following durations:

- 5 minutes
- 10 minutes
- 15 minutes
- 20 minutes
- 25 minutes
- 30 minutes
- 45 minutes
- 60 minutes
- 90 minutes
- 120 minutes.

The worst-case duration shall be used for determining the required capacity of each structure and conduit.

4.7.3 HYDRAULIC DESIGN

Hydraulic calculations shall comply with the following:

- Appropriate hydrologic and hydraulic modelling software shall be used
- The capacity of conduits shall be calculated using hydraulic grade line analysis
- All conduits shall meet the required Minor Storm capacity without pressurisation
- Surcharging of the network is not permitted, except for the downstream reach where connecting to an existing network with capacity less than the 20yr ARI
- Open-channel capacity shall be determined using appropriate open-channel hydraulic methods such as solving the energy equation using the standard step method
- Open-channel capacity shall not be determined using simplistic methods such as a single application of the Manning equation
- The use of hand calculations, design charts or monograms is not permitted.

4.7.3.1 INLET CAPACITY

Inlet capacity shall be determined in accordance with published industry data where available.

Additional information regarding the inlet capacity of certain existing inlet types commonly found in the City has been provided in Annexure E. Where available, the City's inlet capacity data shall be used.

Where non-typical inlet types are utilised and no published data is available, an appropriate relationship shall be determined. Documentation of the method used in deriving the relationship as well as a justification for the selected method shall be provided.

4.7.3.2 INLET BLOCKAGE FACTORS

Blockage factors shall be applied to all stormwater inlets as outlined in Table 2 below.

TABLE 2
PIT DESIGN BLOCKAGE FACTORS

Pit type	On grade blockage factor	Sag blockage factor
kerb inlet <= 1.0m	50%	70%
kerb inlet > 1.0m	20%	50%
V grate or grate only	90%	90%
Strip drain or other	95%	95%

Should the pit design specifications lie outside the table above, Australian Rainfall and Runoff (ARR) Project 11 – "Blockage of Hydraulic Structures" should also be consulted and a valued derived by the ARR method adopted, subject to the approval of the Principal Engineer - Water Assets, City of Sydney.

4.7.3.3 OVERLAND FLOW LIMITS

Gutter flows and overland flow paths shall comply with the requirements in the following tables. The carriageway width indicated in the tables below shall be calculated from kerb face to kerb face ignoring parking bays. ARI is the average recurrent interval.

TABLE 3
100 YEAR ARI GUTTER FLOW LIMITS FOR CARRIAGEWAYS <= 7 METRES WIDE

Criteria	Limit
Maximum depth	100mm
Maximum flow width	3.0m
Maximum depth x velocity	0.6m^2/s

TABLE 4
100 YEAR ARI GUTTER FLOW LIMITS FOR CARRIAGEWAYS > 7 METRES WIDE

Criteria	Limit
Maximum depth	150mm
Maximum flow width	3.5m
Maximum depth x velocity	0.6m^2/s

TABLE 5
100 YEAR ARI OVERLAND FLOW LIMITS FOR PEDESTRIAN AND SHARED ZONES

Criteria	Limit
Maximum depth	50mm
Maximum flow width	1.5m
Maximum depth x velocity	$0.4m^2/s$

4.7.3.4 PIT LOSSES

Pit losses shall be determined in accordance with published 'Missouri Chart' references.

4.7.3.5 DOWNSTREAM BOUNDARY CONDITIONS

Where a network is being sized in accordance with the Minor Storm requirements, the downstream starting level for the hydraulic grade line shall be the higher of the following for the Minor Storm:

- The obvert of the pipe
- Ocean Boundary Conditions
- Hydraulic Grade Line of the downstream connection conduit
- 150mm below the surface, where the downstream conduit capacity is less than the 20yr ARI.

Where the impacts of a proposed network are being analysed, the downstream starting level for the hydraulic grade line shall be the higher of the following:

- The obvert of the pipe
- The hydraulic grade line of the downstream network for the same storm event
- For flood prone land, flood levels reported in the relevant City of Sydney flood study
- Ocean boundary conditions consistent with the relevant City of Sydney flood study.

4.7.4 ADVERSE IMPACTS

Stormwater networks shall also be analysed for the 5yr ARI and 10yr ARI when:

- Connecting to an existing stormwater network with capacity less than the 20yr ARI
- Overland flow paths are obstructed by other road features such as raised thresholds or kerb extensions
- Entry points to adjacent existing buildings are below the 20yr ARI.

Stormwater shall not result in adverse impacts on private property for the 5yr ARI, 10yr ARI, 20yr ARI and 100yr ARI.

4.7.5 CONSISTENCY WITH FLOODPLAIN MANAGEMENT REQUIREMENTS

Stormwater design shall be consistent with the City's floodplain management requirements including the following:

- Interim Floodplain Management Policy
- Recommendations in the relevant Floodplain Management Plan adopted by the City.

Variations to these technical specifications can be approved under Section 4.5.6 where requirements of a site-specific flood study approved by the Water Assets Team conflict with the specifications.

4.8 NETWORK LAYOUT

4.8.1 GENERAL LAYOUT

The general layout of the network shall comply with the following:

- The network shall be laid out in a logical fashion consistent with the topography
- Conduit capacity shall progressively increase in the downstream direction except for the existing network at the downstream connection point
- The network shall be laid out in the most hydraulically efficient manner
- Stormwater conduits shall not cross above or below other stormwater conduits
- Conduits shall be constructed in straight lines and uniform grade.

4.8.2 CONDUIT LOCATION

Stormwater conduits shall generally be located as follows:

- Below the kerb with the outside diameter of the pipe flush with the back of the kerb; or
- Centrally located within the kerbside traffic lane.

Notwithstanding the above, conduits can be aligned in other locations in the following instances:

- Utilities or other constraints prevent installation in the preferred location
- Drainage is required to cross the road or service areas that cannot drain to the road
- Connection to existing drainage requires deviation from the preferred location.

4.8.3 PARALLEL CONDUITS

Parallel conduits shall comply with the following:

- The conduits shall be laid side by side with the minimum spacing required to achieve proper compaction of the adjoining material to achieve the required support
- The stacking of conduits is not permitted
- Conduits shall be the same size and shape except where augmentation of an existing conduit necessitates variance
- Conduits shall have the same upstream and downstream invert level except where augmentation of an existing conduit necessitates variance.

4.8.4 PROXIMITY OF OTHER STRUCTURES

Structures in the vicinity of the stormwater network shall not impose a structural load on any stormwater asset.

Structures within the ‘zone of influence’ shall be piered or have foundations extending below the invert level of the pipeline. The ‘zone of influence’ is the area that extends horizontally from the edge of the conduit by the depth to invert and extends vertically from the surface to the invert depth.

4.8.5 DRAINAGE EASEMENTS

All conduits through private land that drain public land or drain adjoining private land shall be located within drainage easements.

All drainage easements shall comply with the following:

- Easement terms shall be in accordance with the standard terms for a Drainage Easement under the Conveyancing Act 1919 (NSW)
- Where the conduit drains public land, the easement shall be in favour of the City of Sydney
- Where the conduit does not drain any public land, the easement shall be in favour of the private land that drains through the conduit
- In all cases, authority to modify or extinguish the easement shall be vested in the City of Sydney
- Easement widths shall be in accordance with Table 6.

TABLE 6 – EASEMENT WIDTHS

Criteria (Conduit diameter/width and depth to invert)	Width
375mm <= Diameter/width < 750mm	1.8m
750mm <= Diameter/width < 1200mm	2.2m
1200mm <= Diameter/width < 1500mm	3.0m
Diameter/width => 1500mm and depth <= 3	Diameter/width plus 2m
Diameter/width => 1500mm and depth > 3	Diameter/width plus 4m

4.8.6 PROXIMITY OF OTHER UTILITY SERVICES

The minimum separation between the stormwater network and other utility services shall be the greater of the following:

- The requirements of the other service utility authority
- 100mm.

4.8.7 PIT LOCATIONS

General requirements for pit locations are as follows:

- Stormwater pits within the wheel tracts on vehicle traffic lanes shall be avoided where practical
- The maximum conduit length between two pits shall not exceed the length specified in Table 7
- All pipe connections shall be via accessible pit structures and the direct connection of one drainage line to another shall not be permitted.

Stormwater pits with surface inlets shall be required at the following locations:

- All low points within the kerb and gutter
- All other low points in the public domain
- At sufficient intervals along kerb and gutter and other overland flow paths to collect runoff meeting the requirements of Section 4.7.3.3.

Stormwater pits shall be required where there is a change in any of the following conduit properties:

- Cross-sectional shape
- Size or dimension
- Grade
- Direction
- Material type
- Joint type.

TABLE 7 – MAXIMUM PIPE LENGTH BETWEEN STORMWATER PITS

Criteria (conduit diameter/width)	Maximum distance between pits
375mm = diameter/width	40m
750mm <= diameter/width < 1500mm	60m
Diameter/width => 1500mm	100m

4.9 STRENGTH CLASS

4.9.1 PROXIMITY OF PITS TO VEHICLE AND PEDESTRIAN CROSSINGS AND INTERSECTIONS

Stormwater inlet pits are not permitted on the kerb and gutter at the following locations:

- On the radius within intersections
- Within the bounds of a signalised pedestrian crossing
- Within kerb ramps at non-signalised pedestrian crossings
- Within vehicle crossings.

Where there are existing kerb inlet pits at proposed vehicle or pedestrian crossing sites, the following modifications shall be made:

On grade pits:

- An additional kerb inlet pit or pits shall be provided to ensure equivalent inlet capacity is retained
- New kerb inlet pits shall be provided on the upstream side
- Where site constraints prevent installation on the upstream side, it is permitted to install new kerb inlet pits on the downstream side
- Where possible, the existing pit shall be removed; however, if site constraints prevent removal, the pit shall be modified as follows:
    i. If the existing pit is in a driveway crossing and is to be retained, a grated cover shall be provided
    ii. If the existing pit is in a pedestrian crossing and is to be retained, a solid infill cover shall be provided.

Sag pits:

- An additional kerb inlet pit or pits shall be provided to ensure equivalent inlet capacity is retained
- Kerb inlet pits shall be provided on both sides of the crossing
- The pedestrian crossing shall be regraded towards the adjacent inlet pit and the existing pit shall be removed. Where site constraints prevent removal of the existing pit, a solid infill cover shall be provided on the pit.
- A sag without a kerb inlet pit or grate-only pit is not acceptable.

4.9.2 CONDUIT ANGLES AT PITS

The acute angle between each inflow pipe and the outlet shall be no less than 95 degrees. Conduits shall not connect at the corner of a pit (i.e. birdsmouthing).

4.9.3 PROXIMITY TO TREES

Where practical, stormwater infrastructure within the drip line of trees shall be avoided. Where trees are unavoidable, an arborist's report shall be required. Additional investigations of tree roots may be required.

4.9.4 INTEGRATION WITH PUBLIC DOMAIN

The overall integration of the stormwater network with the public domain shall be considered including the proximity to footing for poles, street furniture, and the like.

4.9.5 OUTLET STRUCTURES

The number of outlet structures discharging into the harbour, watercourses or water bodies shall be minimised. Land adjoining these areas shall be drained through existing outlet structures where permitted by topography.

Outlet structures shall comply with the following:

- Designed in accordance with relevant standards and best practice for the type of structure and the relevant water body
- Comply with all planning and legislation requirements
- Minimise the potential for scouring or erosion
- Ensure the long-term stability of the receiving area and adjoining structures.

4.9.6 OTHER STORMWATER AUTHORITIES

Portions of the stormwater network within the City are owned by other government authorities such as Sydney Water, Sydney Harbour Foreshore Authority and Roads and Maritime Service.

Connections to the stormwater assets of other government authorities shall be undertaken with the approval of and in accordance with the requirements of the relevant authority.

Variations to these technical specifications, in order to avoid connection to other public authorities' stormwater assets, shall not be permitted.

4.10 CONDUIT DESIGN

4.10.1 CONDUIT TYPE

Stormwater conduits shall comply with the following:

- Steel reinforced precast concrete stormwater pipes with standard rubber ringed belled socket joints shall be used for all pipes located in the public domain or owned by the City
- Steel reinforced precast concrete stormwater pipes with rubber ring flush joints can be used where cover or utility constraints prevent the use of belled socket joints
- Fibre reinforced precast concrete pipes with rubber ring flush joints can be used where a pipe is to be fully encased in concrete
- All concrete pipes shall be rated for a Class 4 load (minimum)

- Steel reinforced precast concrete box culverts may also be used for all box culverts located in the public domain or owned by the City
- Steel reinforced precast concrete box culverts shall be rated for direct traffic loadings with no cover
- Cast in situ conduits or other material types shall not be used in the public domain or for City-owned conduits
- Irrespective of the above requirements, the base of box culverts shall be cast in situ steel reinforced concrete.
- A minimum 20mm deep V drain shall be cast into the base slab of culverts.

4.10.2 MINIMUM CONDUIT SIZE

The minimum size of City-owned conduits shall be as follows:

- Pipelines – 375mm nominal diameter
- Box culverts – 450mm width by 300mm height nominal.

Where box culverts are used, the width shall not exceed four times the height.

4.10.3 PERMITTED GRADES

The grade of conduits shall comply with the following:

- The conduit grade shall be within the range specified in Table 8 below
- The grade of a conduit can be reduced to an absolute minimum of 0.5 per cent where topography, existing stormwater or utility services prevent installation of a conduit within the preferred range
- Drop pits shall be used to ensure the maximum grade specified in Table 8 is not exceeded
- Vertical pipelines shall not be permitted.

TABLE 8
PERMITTED GRADE

Criteria (Conduit diameter/width)	Minimum grade	Maximum grade
375mm <= diameter/width < 1200mm	1%	10%
Diameter/width => 1200mm	1%	5%

4.10.4 INVERT LEVELS

Invert levels of conduits shall comply with the following:

- Invert levels shall be no lower than mean high tide
- The fall within pipes shall be in the downstream direction
- Reverse grades are not permitted
- Charged conduits are not permitted
- Submerged outlets are not permitted.

4.10.5 STRUCTURAL DESIGN

Conduit structural design shall be in accordance with all relevant Australian Standards and shall consider the anticipated loadings over the entire life of the asset.

Conduits shall be designed for the SM1600 series vehicle loads (minimum).

Notwithstanding the above, all conduits in the public domain or owned by the City shall be a minimum Class 4.

4.10.6 CONDUIT COVER

Where possible, conduits shall have a minimum cover of 600mm. Where this cannot be achieved due to site constraints such as utility services or connections to existing drainage, the minimum cover permissible is as follows:

- Pipes – 150mm
- Box culverts – 100mm

Pipes shall be concrete encased where the cover is less than or equal to 300mm.

Pipes with cover less than 600mm and more than 300mm shall be assessed to ensure the structural integrity of the pipe is not compromised under expected loads specified in Section 4.10.5 and the pipe shall be concrete encased if necessary.

Concrete encasement shall comply with the following:

- Minimum encasement thickness shall be 150mm mass concrete surrounding the entire conduit
- Where the cover is less than 200mm, a 50mm asphalt surface shall be maintained and the balance of the cover shall be concrete encasement with steel reinforcement
- Subject to the calculated service loads, steel reinforcement within the encasement may be required to ensure structural strength
- Where the concrete encasement above the pipe is less than 150mm, steel reinforcement shall be required over the top of the pipe
- Where it is proposed that stone kerb be placed on top of the pipe, a minimum of 100mm concrete encasement with steel reinforcement is required between the pipe and the stone kerb
- Where it is proposed that concrete kerb and gutter are to be placed on top of the pipe, a construction joint shall be required to separate the concrete encasement from the kerb and gutter, and steel reinforcement shall be required in the gutter.
- Conduit cover shall not exceed 2 metres.

4.10.7 DECOMMISSIONING OF REDUNDANT CONDUITS

Conduits not in use shall be decommissioned. Decommissioned conduits shall be removed where possible. Where site constraints prevent the removal of a decommissioned conduit, the conduit may remain in the ground, provided the following:

- The conduit is disconnected from the live stormwater network at the point where the conduit connects to the live network
- Where the decommissioned conduit was connected to a live stormwater structure or box culvert at the downstream end, the live structure or culvert shall be properly repaired and sealed with a concrete wall
- Where the decommissioned conduit was directly connected to a live pipe at the downstream end, the live pipe shall be repaired by replacing the unsealed conduit length
- The downstream end and all upstream inlets to the decommissioned conduit are sealed with mass concrete plugs
- The conduit shall be backfilled with a sand slurry.

4.11 STORMWATER STRUCTURE DESIGN

4.11.1 STANDARD STRUCTURES

The City provides a suite of standard design cast in situ reinforced concrete structures. Stormwater structures shall comply with the following:

- All stormwater structures shall be cast in situ reinforced concrete
- All stormwater structures shall include suitable maintenance access from the surface
- Where possible, standard City of Sydney structures shall be utilised.

4.11.2 NON-STANDARD STRUCTURES

4.11.2.1 GENERAL REQUIREMENTS

Where City of Sydney standard structure designs cannot be used, a non-standard structure shall be specified subject to the following:

- The structure shall be cast in situ reinforced concrete
- The structure shall as far as possible comply with the features of the most similar City of Sydney standard drawing
- The structure shall comply with all requirements in these technical specifications and the City's construction specifications
- All stormwater structures shall be designed to an appropriate loading capacity to suit the loading capacity of the specified grate (Class 'D' for trafficable areas and Class 'C' for areas only subjected to pedestrian activity). The loading criteria shall comply with AS3996 and the ultimate-limit state design load shall be the same as the ultimate-limit state design load for the specified loading classification of the grate (210KN for Class 'D' and 150 KN for Class 'C' Grates).
- If grates are supported by suspended slab, the thickness of the concrete slab shall not be less than 125mm at the thinnest location under the grate.

4.11.2.2 MAINTENANCE ACCESS

Maintenance access requirements for non-standard structures shall comply with the following:

- The access grate or cover shall be a minimum of 900mm rectangular or 600mm circular.
- The access shafts shall be a minimum of 900mm by 900mm square where the depth is less than 2m.
- The access shafts shall be a minimum of 1200mm by 1200mm square where the depth is greater than 2m, and the access cover shall be precast within a concrete surround.

4.11.3 KERB INLETS

4.11.3.1 GENERAL REQUIREMENTS

All kerb inlets shall be precast concrete to the relevant Australian Standard with permitted nominal lengths as follows:

- 2.4m
- 1.8m
- 0.9m

The longest permitted kerb inlet length that can be accommodated by site constraints shall be used.

Kerb inlet heights shall comply with the following:

- The top of the kerb inlet shall be flush with the top of the kerb
- The minimum opening height is 125mm
- The maximum opening height is 200mm

Kerb-only and grate-only pits are not permitted on roads; however, due to the number of such existing pits in use, inlet capacity information has been provided in Annexure E for hydraulic analysis purposes.

The approved stone kerb inlets listed in Annexure E are also permitted.

4.11.3.2 EXISTING TRACHYTE KERB INLETS

Existing trachyte kerb inlets shall be retained or re-used where possible provided that a bicycle safe grate is also used.

Pit inlet capacity shall be analysed as per Annexure E for 100mm kerb heights, the grate-only inlet capacities in Annexure E shall be used.

Should the existing trachyte kerb inlets provide insufficient inlet capacity, additional kerb inlet pits shall be provided in the vicinity in order to provide the requisite inlet capacity.

4.11.4 GRATES AND COVERS

The preferred covers are rectangular and shall comply with the following:

- Infill covers with a surface material matching the surrounding surface
- Covers shall be bolted down with a minimum of four bolts
- Where grates and covers are within a landscaped/grassed area, the main chamber of the pit shall be recessed (200mm minimum depth) below ground and an access shaft provided to surface level with a concrete mowing strip (150mm minimum width) around the grate or cover
- Covers shall be a minimum strength Class D.

Alternatively, circular covers can be used subject to compliance with the following:

- The word “Stormwater” is embedded into the cover material and will remain visible for the life of the cover
- Sewer covers or covers with the word “Sewer” inscribed on the cover shall not be used
- Covers shall be bolted down with a minimum of three bolts
- Covers shall be a minimum strength Class D

4.11.5 TRAPPED GULLIES

Trapped gullies are legacy assets from combined stormwater/sewer systems.

Trapped gullies shall be demolished, completely removed and replaced with standard stormwater pits in accordance with these technical specifications, except for networks where combined stormwater/sewer systems remain or on systems where there is no downstream gross pollutant trap.

Prior to the removal of trapped gullies, site investigations shall be undertaken to confirm that there are no sewer connections to the stormwater in the vicinity of the Works.

4.11.6 BRICK OR MASONRY STRUCTURES

Brick and masonry structures are legacy assets no longer supported and are not to be modified or refurbished. Where it is necessary to undertake work on brick or masonry structures, they are to be removed and replaced with modern reinforced cast in situ concrete structures complying with the requirements of these technical specifications.

Notwithstanding the above, a brick or masonry structure can be retained and modified or refurbished in these circumstances:

- The scope of modification is limited to replacing the lintel, grate or cover
- The structure is an integral part of an existing brick or masonry conduit
- The structure is within a heritage area and forms part of a heritage item.

4.11.7 DECOMMISSIONING OF REDUNDANT STRUCTURES

Where a stormwater structure is no longer required such as in Section 4.9.1 of these technical specifications, the structure shall be decommissioned.

All decommissioned stormwater structures shall be completely demolished and removed.

4.12 STORMWATER QUALITY IMPROVEMENT DEVICES

4.12.1 RAINGARDENS

4.12.1.1 GENERAL REQUIREMENTS

- Raingardens shall be designed in accordance with the following general requirements:
- Prior to design of the raingardens, a full catchment analysis shall be undertaken to ensure the raingarden does not have any negative impact on floodplain or the impact is negligible
- When the raingardens are built in a floodway, the designer shall ensure that impact of the raingarden on the flood storage capacity is negligible
- The raingardens shall be modelled using MUSIC and the results shall be submitted to the City for approval
- The planting area of an individual raingarden shall be no less than 8 square metres
- The raingarden shall be designed in such way to have negligible negative impact on the floodway capacity
- No permanent ponding is allowed in the raingarden pits.

4.12.1.2 STORAGE CAPACITY

- Raingarden ponding capacity shall be equivalent to the volume of the rainfall created by a 25 minute 3 months storm. When this volume cannot be achieved, a minimum volume of three cubic meters shall be provided in the raingarden.
- Depth of the storage in the raingarden shall not be less than 150mm and not more than 280mm. The depth of the raingarden's storage capacity shall be measured from the lowest point that water can enter or exit the raingarden.
- Any pit chambers or other structures in the raingarden are not allowed. If any pits are in the raingarden, the area and volume of these structures and pit chambers shall not be included in the storage volume calculation.

4.12.1.3 IN-FLOW

- In no circumstances shall the raingarden be utilised as the surface run-off collection device
- Raingardens shall be designed as off-line systems with an appropriate bypass at upstream. Where drainage network is in the proximity, the bypass shall consist of a surface run-off collection device which is connected to the stormwater network.
- Where connection to the stormwater network is not possible, an overland flow path can be designed as bypass. The overland flow path shall be designed to have minimum interference with traffic and pedestrian activities.

- The raingarden inlet shall be designed to allow all surface run-off caused by minor rainfall events to flow freely to the raingarden
- The raingarden inlet device shall be designed to allow the entrance of a maximum 2 ARI surface run-off into the raingarden, calculated for the critical time of concentration of the catchment. Regardless of the catchment size, the flow entering the raingarden shall not exceed 30 litres per second.
- The level at the raingarden's entry shall be 50mm lower than the level of the bypass
- The bypass shall be designed in such way that it is activated when:
    - the flow exceeds maximum entry flow specified in the clauses above
    - the raingarden is full.
- Appropriate erosion control and energy dissipation shall be provided at the entry to the raingardens that ensures planting is not damaged by erosive forces
- A gross pollutant trap/device, as per the City's standard drawings, shall be incorporated within the raingarden's inlet device, immediately upstream of the raingarden to intercept gross pollutants and sediment.
    - The size of the mesh shall be 50mm x 50mm stainless steel mesh where installed within the inlet pit
    - An inlet restriction plate shall be installed at the entry point to the raingarden. The plate shall be installed flush with the top and face of the kerb. The maximum opening size in the plate shall be 50mm and the plate shall be installed at 50mm distance from the invert of the kerb.

4.12.1.4 SURCHARGE

- A raingarden with an appropriate bypass system shall not include a surcharge inlet pit unless it is in these circumstances:
    - The raingarden is within a flood way
    - The bypass is only an overland flow path.
- The surcharge pit's level shall be at least 50mm lower than the lower levels of the surrounding kerb. A minimum 50mm freeboard shall be increased considering the actual water level in the raingarden during high peak flow of major events.
- The level of the surcharge pit shall not be lower than the bypass activation level.
- The surcharge pit shall be a maximum 600mm square.

4.12.1.5 DESIGN

- The raingardens' media layers shall be designed in accordance with the City's standard drawings
- Unlined raingardens shall be limited to the following suburbs:
    - Rosebery
    - Waterloo
    - St Peters
    - Beaconsfield
    - Zetland
    - Alexandria.
- Unlined raingardens shall only be used where ground conditions permit infiltration and there is sufficient distance from buildings and structures to ensure these structures will not be adversely impacted by the raingarden.
    - Ground infiltration rate shall be more than 100mm/hour
    - The highest predicted underground water table shall be 1500mm lower than the levels of the raingardens.
- Infiltration rates and the underground water table shall be determined prior to design by an accredited experience geotechnical engineer.

- Partly lined raingardens shall be used where ground conditions permit infiltration and protection is required for adjoining buildings or structures
- All other raingardens shall be lined.

4.12.1.6 MAINTENANCE

All raingardens and associated components shall be designed in accordance with Sections 4.6.6 and 4.11.2.2.

All submissions for raingarden design shall include a maintenance schedule addressing maintenance activities, access, frequency, type, amount of resources and annual cost.

4.12.1.7 PLANTING

The raingarden shall be located in a position that provides a minimum of six (6) hours of sunlight daily.

Planting of the raingarden shall be approved by the City's Assets and Services Team.

Some of the species which are allowed in the raingarden are listed below.

- *Callistemon sp*
- *Westringia sp*
- *Dianella sp*
- *Lomandra sp*
- *Carpobrotus glaucescens*
- *Hibbertia scandens*
- *Doryanthes excelsa*
- *Banksia robur.*

4.12.2 GROSS POLLUTANT TRAPS

4.12.2.1 DESIGN REQUIREMENTS

The design should also be in accordance with the other criteria outlined in the Technical Specifications and in particular those detailed below:

- Devices shall have a diversion chamber with a fixed weir and a high flow bypass
- The device shall have separate access shaft provision to the diversion chamber, treatment area and storage area for inspection, maintenance and cleaning
- The device shall treat the three-month ARI design flow rate with high flows bypassing the device
- The device storage shall be sized for a six-month cleaning interval
- The device shall have off-line storage
- Surcharging of devices onto roads as a bypass method shall not be permitted and devices shall not at any time cause surcharging
- The device shall be fitted with suitable lifting lugs to allow for installation (where appropriate).

4.12.2.2 DEVICE PERFORMANCE

The performance of the device shall comply with the following:

- The device shall be designed to achieve 100 years life expectancy
- The device shall remove no less than 70% of all particles between 0.125mm and 5mm in size and 90% of particles greater than 5mm in size
- The device shall remove 30% of Total Phosphorus
- The device shall treat the three-month ARI design flow rate with high flows bypassing the device
- The device shall be sized for a six-month cleaning interval
- Devices shall have non-blocking self-cleaning screens
- Total pollutant storage volume per device shall not exceed 3 cubic metres and shall not be less than 0.7 cubic metres
- Devices shall have a high flow bypass
- Surcharging of devices onto roads as a bypass method shall not be permitted and devices shall not at any time cause surcharging
- Devices shall be designed in a manner that minimises blockage of the device or remobilisation of pollutants.

4.12.2.3 CLEANING AND MAINTENANCE REQUIREMENTS

In order to facilitate cleaning operations, devices shall comply with the following:

- The device shall be designed to facilitate a suitable, easy and safe cleaning process. Access openings shall be provided directly over the inlet pipe, the outlet pipe and the pollutant collection area
- The device shall be designed to have screens that can be easily removed to enable cleaning behind the screens or sufficient room between the wall and screen to allow cleaning in a safe manner
- Devices shall be designed to avoid the need for cleaning personnel to enter confined spaces
- Devices shall be designed to minimise the contact of cleaning personnel with pollutants
- Devices shall be designed with consideration of the access necessary to replace internal components of the device
- Access and working platforms shall be provided to the device suitable to permit the required cleaning process as well as accommodate the required cleaning equipment
- Pollutant storage areas shall be enclosed with public access to pollutants limited by covers.

4.12.2.4 ACCESS AND WORKING PLATFORMS

Access and working platforms for cleaning activities shall comply with the following:

- Sealed working platforms shall be provided to accommodate eductor trucks for cleaning
- Driveways and working platforms shall be designed to permit cleaning vehicles to park adjacent to the device with the device located at the rear of the vehicle or on the left (passenger) side of the vehicle
- The road itself could be used as a working platform if it is a low traffic road and there is sufficient width to allow the safe passing of traffic around the cleaning truck, cleaning operations will not damage the road, and there are no other safety issues that necessitate off-road working platforms
- Suitable working platforms and areas shall be provided off road where access to a device is required via a high traffic road
- Access to devices shall be from either a public road or a sealed driveway accessible via a public road
- Driveway access from high traffic roads shall permit cleaning vehicles to enter and exit in the forward-facing direction
- Where driveway access is proposed on low traffic roads, it is preferred that the driveway be designed to permit vehicles to exit in the forward-facing direction
- Sufficient separation shall be provided from pedestrian walkways and cycleways to ensure maintenance operations do not conflict with pedestrian and cycle movements.

4.12.2.5 DEVICE AND MATERIAL TYPES

The design of custom devices or the selection of a proprietary product shall be undertaken in consultation and with the approval of the City's Water Assets team. The device once installed shall be designed to take traffic loadings of maintenance vehicles such as eductor trucks.

The devices shall consist of the following material types:

- Reinforced concrete structure
- Stainless steel or heavy galvanised mild steel screening components
- Access covers can be mild steel, ductile iron or cast iron to a minimum strength Class D.

4.13 RELINING

General requirements for relining are as follows:

- Relining shall be undertaken for the entire length of a pipeline between its upstream and downstream pit
- Stormwater pits at the upstream and downstream end shall be modified to facilitate the relining if required
- Any buried pits, blind pits or significant bends along the length of Works shall be replaced with standard junction pits
- The liner shall be designed to withstand all loads anticipated over the life of the liner assuming the host pipe is fully deteriorated with no remaining strength
- The deteriorated host pipe and its surrounding embedment shall be considered to support the liner but no bonding or composite action shall be assumed between the liner and the host pipe
- Where a pipeline is located outside a road reserve, beneath a building or is subject to a point load, a structural analysis shall be provided calculating the likely loads that will be imposed on the liner.

4.14 FOOTPATH DRAINAGE

4.14.1 GENERAL REQUIREMENTS

Where possible footpaths shall be graded towards the kerb and gutter, raingardens or garden beds to as much as possible avoid the need for stormwater infrastructure.

Where stormwater drainage within the footpath cannot be avoided:

- Footpath drainage shall comply with the requirements of these technical specifications that are applicable to all other road drainage
- All surface inlets shall be grated sump drains
- Grates shall be heel proof in high pedestrian traffic areas and pedestrian proof in low or medium pedestrian areas
- Footpath drainage shall be connected to the underground stormwater network.

4.14.2 CENTRAL SYDNEY PRECINCT

Footpath drainage within the Central Sydney planning precinct shall comply with Section 4.14.1 and the following requirements:

- Notwithstanding Section 4.10.2, the minimum size of a pipe on the footpath can be reduced where utility services constraints do not permit the use of a 375mm diameter pipe
- The pipe size shall be as large as can be accommodated by the site constraints but no less than 150mm diameter

- Notwithstanding Section 4.10.1, a uPVC pressure pipe, minimum Class 12 to AS1477, can be used for 150mm diameter pipes
- The minimum pit length and width shall be 300mm by 300mm
- The minimum cover for a 150mm diameter pipe shall be 100mm with the pipe concrete encased.

4.14.3 TRENCH GRATES OR STRIP DRAINS

4.14.3.1 PERMITTED USE

The use of trench grates or strip drains is generally not permitted. However, it is accepted that in certain circumstances, it is not possible to drain a site using alternative methods.

Where no other alternative is possible, trench grates or strip drains can be used in the following locations:

- At the top of stairways or stairway landings
- Across accessible ramps
- Across an opening to a private property where it is not possible to drain away from the property boundary
- As a gutter bridge as per Section 4.14.4.

4.14.3.2 GENERAL REQUIREMENTS

Trench grates and strip drains shall comply with the following:

- The length shall be minimised
- Notwithstanding Section 4.10.2, the minimum dimensions shall be 300mm wide by 300mm deep
- Shall withstand a Class D loading
- Shall be embedded in a minimum of 150mm thick mass concrete
- Grates shall be bolted down
- Heel-proof grates shall be used in high pedestrian traffic areas and pedestrian-proof grates in low or medium pedestrian areas.

4.14.4 GUTTER BRIDGES

4.14.4.1 PERMITTED USE

Where a low point within a gutter needs to be drained, gutter bridges shall be used in the following circumstances:

- There is no existing piped drainage within a reasonable distance of the low point to permit the connection of a below ground stormwater network
- Utility constraints prevent the installation of a conduit to the minimum size specified in Section 4.10.1
- To connect adjoining raingardens across a pedestrian footpath.

4.14.4.2 GENERAL REQUIREMENTS

General requirements for gutter bridges are as follows:

- The design shall comply with the City's standard drawing for gutter bridges
- Notwithstanding Sections 4.10.2 and 4.14.3.2, the minimum internal dimensions of a gutter bridge are 100mm high by 450mm wide
- Access points shall be provided either along the entire length or at changes in direction
- The surface material of the gutter bridge shall be consistent with the surrounding surface material
- Suitably slip-resistant and heel-proof grates can be used

- Notwithstanding Sections 4.11.4 and 4.14.3.2, a Class B cover or grate can be used where surface constraints prevent vehicle traffic from mounting the kerb and traversing the gutter bridge
- A gutter bridge is permitted to discharge directly into a stormwater pit or back to a kerb
- Kerb inlets and outlets shall be designed to withstand vehicle loads and impacts.

4.15 PRIVATE CONNECTIONS

4.15.1 STORMWATER DRAINAGE CONNECTION APPROVAL APPLICATION

All private stormwater connections require approval prior to construction. Applications for private connections shall be undertaken using the Private Connection Application Form available from the City's website.

4.15.2 KERB OUTLETS

4.15.2.1 OUTLET CONFIGURATION

Kerb outlets shall comply with the following:

- Discharge to the kerb and gutter
- A single discharge point shall be provided for each property at the most appropriate location
- Where a property fronts multiple roads and/or it is not physically possible to utilise a single discharge point then an additional discharge point can be provided on alternative road frontages
- The number of discharge points shall be minimised
- The number of discharge points from a property to the kerb shall not exceed three (3)
- The minimum spacing between discharge points from the same property is six (6) metres
- Conduits shall be laid in a straight line from the property boundary preferably perpendicular to the property boundary or gutter
- A maximum of three (3) parallel conduits are permitted at any single discharge point
- Parallel conduits shall have a minimum 300mm separation between centrelines
- No bends, pits or other structures shall be installed on private conduits on public land
- Conduits shall not be directly connected to a stormwater pipe or conduit (see Section 14.3 for direct connection requirements).

Acceptable conduits are as follows:

- 90mm uPVC pressure pipe Class 12
- 150mm wide by 100mm high, mild steel, heavily galvanised channel provided the wall thickness is a minimum of 4mm
- 150mm wide by 50mm high, mild steel, heavily galvanised channel can be used for 100mm high kerbs provided the wall thickness is a minimum of 4mm.

Where there is no kerb and gutter, the following shall be undertaken:

- Kerb and gutter shall be provided
- Directly connect to the stormwater network as per Section 4.15.3

4.15.2.2 DISCHARGE LIMITS

- The maximum permitted discharge from any property is 25 litres per second for storms up to and including the 20yr ARI
- Groundwater, dry weather flows and base flows shall not discharge to the kerb and gutter

- Where property discharge exceeds the maximum permitted kerb outlet discharge or includes groundwater, base flows or dry weather flows, the property shall be directly connected to the stormwater network as outlined in Section 4.15.3.

4.15.2.3 BASEMENT DISCHARGES

- All basements shall connect directly to the stormwater network as outlined in Section 4.15.3.

4.15.3 DIRECT CONNECTIONS

4.15.3.1 GENERAL REQUIREMENTS

Private stormwater drainage shall connect to the public stormwater network at the following locations:

- An existing stormwater inlet pit on the kerb along the property frontage
- An existing stormwater junction pit on a public stormwater network that traverses the property.

Where there is no existing public stormwater network through the property or along the road frontage of the property, the following shall be undertaken:

- A stormwater kerb inlet pit and pipe network shall be provided on the road along the property frontage and connected to the existing public stormwater network
- The new network shall be designed and constructed in accordance with the City's requirements, service the public land and be dedicated to the City
- The private network shall connect to the public network at a kerb inlet pit.

4.15.3.2 CONDUITS

Private conduits on public land connecting to
the public stormwater system shall comply with the following:

- The conduits shall not drain public land and shall remain in private ownership
- Conduits shall traverse public land in a straight line from the property boundary to the connection point on a public stormwater pit
- No private stormwater structures are permitted on public land
- Conduits greater than 150mm nominal diameter shall be reinforced concrete
- Conduits less than or equal to 150mm nominal diameter can be uPVC pressure pipe Class 12.

4.15.3.3 BACKFLOW PREVENTION AND SURCHARGING

Where a connection is greater than a single 150mm diameter conduit, backflow prevention shall be provided.

A non-return valve shall be provided within the private property immediately prior to discharge to ensure that the public network does not surcharge into the property.

A surcharge point shall be provided within the property, immediately upstream of the non-return valve, to permit the property to discharge via the surface in situations where the public network capacity is exceeded.

4.15.3.4 OTHER STORMWATER AUTHORITIES

Where a direct connection is proposed to another public authority's network, such as Sydney Water or the Roads and Maritime Service, the direct connection shall comply with the requirements of the other authority in addition to compliance with the City's requirements.

4.15.3.5 POSITIVE COVENANT

All properties with a direct connection to the public stormwater network shall include a positive covenant on the property title.

4.16 ON-SITE DETENTION

4.16.1 REQUIREMENTS

- Compliance is required with the Sydney Water on-site detention requirements
- In addition to Sydney Water requirements, the City may impose on-site detention requirements only if required under section 4.15.2.2.
- Where on-site detention is provided, the City requires a positive covenant to be registered on the property title to ensure proper maintenance and functioning of the on-site detention.

ANNEXURE A
DESIGN CHECKLIST

Drainage Design Checklist	
General Plan	☐ Yes
Catchment Plan	☐ Yes
Long sections	☐ Yes
Relevant City standard drawings	☐ Yes
Drainage Details or All structures are as per City standard drawings	☐ Yes or ☐ Yes
Utilities Investigation Plan and additional investigation report if required	☐ Yes
Drainage Design Variation Form or No variations from the City's Stormwater Design and Construction Technical Specifications are proposed and any variations discovered post-construction will be rectified prior to asset handover	☐ Yes or ☐ Yes
Statement of Environmental Effects or Development consent already obtained	☐ Yes or ☐ Yes
DRAINS file depicting hydraulic design or Hydraulic Design Report and Hydraulic Design Summary Sheet	☐ Yes or ☐ Yes

ANNEXURE B
DRAINAGE DESIGN VARIATION FORM AND DRAINAGE VARIATION APPROVAL SUMMARY SHEET

DRAINAGE VARIATION APPROVAL SUMMARY SHEET

Item	Clause	Variation Description	Approval*
1			☐ Approve or ☐ Refuse
2			☐ Approve or ☐ Refuse
3			☐ Approve or ☐ Refuse
4			☐ Approve or ☐ Refuse
5			☐ Approve or ☐ Refuse
6			☐ Approve or ☐ Refuse

* To be completed by Water Assets team

Date

Principal Engineer Water Assets
City Infrastructure & Traffic Operations

DRAINAGE DESIGN VARIATION FORM

Item 1
Clause where variation is sought:
Description of variation:
Justification for variation:
*Decision:
☐ Approve or ☐ Refuse
*Notes or conditions:

* To be completed by Water Assets team

Water Assets

City Infrastructure & Traffic Operations

ANNEXURE C
HYDROLOGIC AND HYDRAULIC DESIGN SUMMARY TABLES

HYDROLOGIC DESIGN SHEET

Name:

Job No:

Date:

Description:

Page(s):

ARI:

Pit/Structure	Hydrology							Pit / Structure				Overland Flow							
	Area (ha)	Impervious / Pervious (%)	Flowpath length (m)	Slope (m/m)	Additional Time (min)	Total Time (min)	Total Flow (L/s)	Junction Pit (Y / N)	Grade / Sag (G / S)	Grate Size (L m / W m)	Kl Length (m)	Approach Flow (L/s)	Slope (m/m)	Flow Depth (m)	Flow Velocity (m/s)	Velocity X Depth (m^2/s)	Inflow (L/s)	Bypass Flow (L/s)	Remarks

HYDRAULIC DESIGN SHEET

Name: | Description: | Page(s):

Job No: | Date: | ARI:

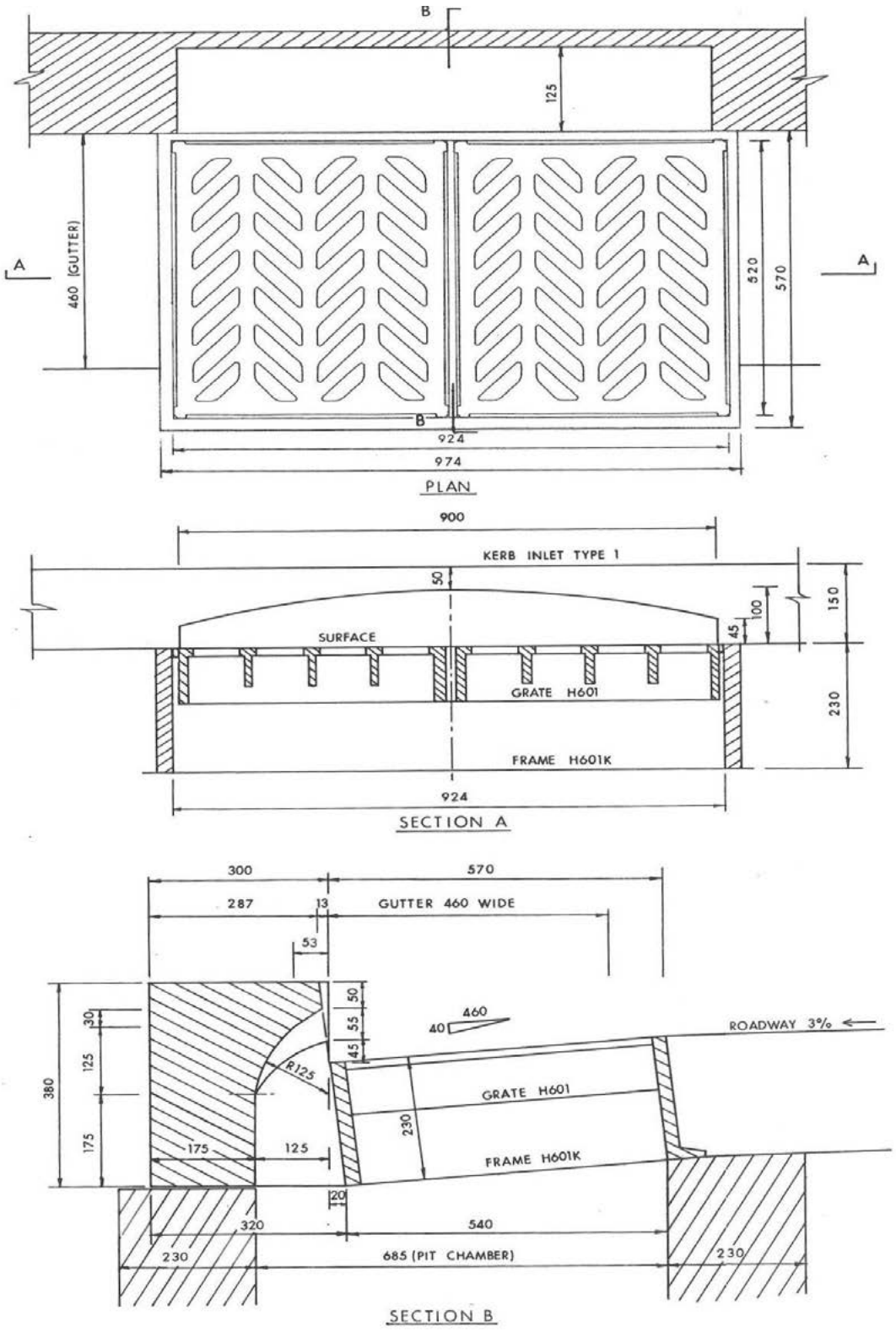
Pipe	Branch	Length (m)	Flow rate L/s	Pipe Diameter (mm)	Full Pipe Velocity (m/s)	$V^2/2g$	Upstream Surface Level (m AHD)	Downstream Water Limit (m AHD)	Upstream Water Limit (m AHD)	Upstream Pit Coefficient K_u	$K_uV^2/2g$	User HGL at Downstream Pit (m AHD)	HGL at Downstream Pit (m AHD)	HGL Slope Sf (m/m)	Pipe Friction Loss Sf.L (m)	User HGL at Upstream Pit (m AHD)	Remarks

ANNEXURE D
ASSET DATASHEETS

ASSET DATA SHEETS ARE AVAILABLE FROM THE CITY OF SYDNEY WEBSITE IN EXCEL FORMAT.

ANNEXURE E
APPROVED STONE KERB INLETS

TRACHYTE KERB INLETS



TYPICAL DETAIL FOR TRACHYTE KERB INLET PIT

Existing trachyte kerb inlets can be re-used provided that a bicycle safe grate is also provided. Pit inlet capacity shall be as per the following tables. For 100mm kerb heights, the grate-only inlet capacities shall be used.

Kerb-only and grate-only pits are not permitted on roads; however, due to the number of existing pits in use, inlet capacity information has been provided below for hydraulic analysis purposes.

CoS trachyte kerb inlet with bicycle-safe grate on 150mm high kerb

0% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
11	11
20	20
25	25
38	38
60	57
82	73
100	83
117	92
140	102
148	105
155	107
226	124

1% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
10	10
29	29
41	41
59	57
81	70
95	76
116	84
146	92
178	101
210	109

3% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
12	12
30	29
45	42
60	53
83	67
97	73
119	83
150	96
209	107

5% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
15	15
33	30
47	39
63	50
85	65
100	72
123	79
152	82
180	86
225	90

7% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
12	12
30	25
55	41
123	70
162	75
197	81

Sag	
Depth (mm)	Inlet Capacity (l/s)
0	0
140	60
155	80
187	125
233	175
253	257
275	295

CoS trachyte kerb inlet only on 150mm high kerb

0% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
100	49
145	57
160	59
227	70

1% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
81	34
95	37
120	43
149	46
181	51
214	56

3% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
85	28
100	32
123	37
153	41
212	45

5% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
15	7
33	12
47	16
63	20
85	26
103	31
125	34
155	36
180	36

7% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
12	6
30	11
55	15
123	27
162	32
195	33

Sag	
Depth (mm)	Inlet Capacity (l/s)
0	0
145	60
165	80

CoS bicycle-safe grate only

0% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
100	82
140	98
155	99
225	115

1% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
80	62
93	66
115	72
145	80
180	88
210	92

3% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
85	59
99	63
120	70
150	77
209	84

5% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
15	14
33	26
47	33
63	42
85	53
100	58
123	64
153	66
175	68
225	72

Sag	
Depth (mm)	Inlet Capacity (l/s)
0	0
140	60
155	80
195	125
205	175
275	257
337	295

7% Longitudinal Fall	
Approach Flow (l/s)	Inlet Capacity (l/s)
0	0
12	10
30	22
55	34
123	55
162	60
198	67

Data derived from physical modelling outlined in the document: Manly Hydraulics Laboratory; Hydraulic Model Studies of Grate, Lintel and Modified Gully Pit Designs for Pyrmont Redevelopment; Draft Report MHL690; Public Works Report No. 94018; July 1994; ISBN 0 7310 2740.

Stone kerb inlet pits

Approved stone kerb inlets shall be in accordance with standard drawings 1.1.12 and 1.1.13. Pit inlet capacity data is not available at this time.

A5 Street Lighting Design

Contents

A5 STREET LIGHTING DESIGN

Contents

A5 STREET LIGHTING DESIGN

5.1 SCOPE

This specification sets out the Lighting & Electrical design brief, technical requirements, Design Review and approval process and installation requirements for carrying out designs for the Public Domain Lighting including shared pathways, main roads, plazas and parks throughout the City Of Sydney's (the City's) LGA.

This specification shall be applied for all Public Domain Lighting and associated Electrical design required to be carried out for the City.

5.1.1 AUSTRALIAN STANDARDS

Lighting and Electrical design specifications are not to be limited to this document but also need to comply with all relevant Australian standards as well as the City's standard, B8 Street Lighting.

Standard	Description
AS/NZS 1158.0:2005	Lighting for roads and public spaces Part 0: Introduction
AS/NZS 1158.1.1:2005	Lighting for roads and public spaces - Vehicular traffic (Category V) lighting - Performance and design requirements (Under review)
AS/NZS 1158.1.2:2010	Lighting for roads and public spaces Part 1.2: Vehicular traffic (Category V) lighting – Guide to design, installation, operation and maintenance
AS/NZS 1158.2:2005	Lighting for roads and public spaces Part 2: Computer Procedures for the calculation of light technical parameters for Category V and Category P lighting
AS/NZS 1158.3.1:2005	Lighting for roads and public spaces Part 3.1: Pedestrian area (Category P) lighting – Performance and design requirements (Under review)
AS/NZS 1158.4:2015	Lighting for roads and public spaces Part 4: Lighting for roads and public spaces - Lighting of pedestrian crossings
AS/NZS 4282:1997	Control of the obtrusive effects of outdoor lighting
SA/SNZ TS 1158.6:2015/ Amdt 1:2018	Lighting for roads and public spaces - Luminaires – Performance
IES TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources
IES LM-79-08	IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80-15	IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
IES LM-84-14	Measuring luminous flux and colour maintenance of LED lamps, lighting engines and luminaires
IES TM-28-14	Projecting Long-Term luminous flux Maintenance of LED lamps and luminaires
IEC 61347-2-13	Particular requirements for d.c. or a.c. supplied electronic control gear for LED modules
IEC 61547:2009	Equipment for general lighting purposes - EMC immunity requirements
IEC 62386 version 2	Digital Addressable Lighting Interface (DALI) standard
AS 3100:2017	Approval and test specification - General requirements for electrical equipment
AS/NZS 60598.1:2017	Luminaires - General requirements and tests
AS/NZS 60598.2.3:2015	Luminaire Particular Requirements – Luminaires for road and street lighting

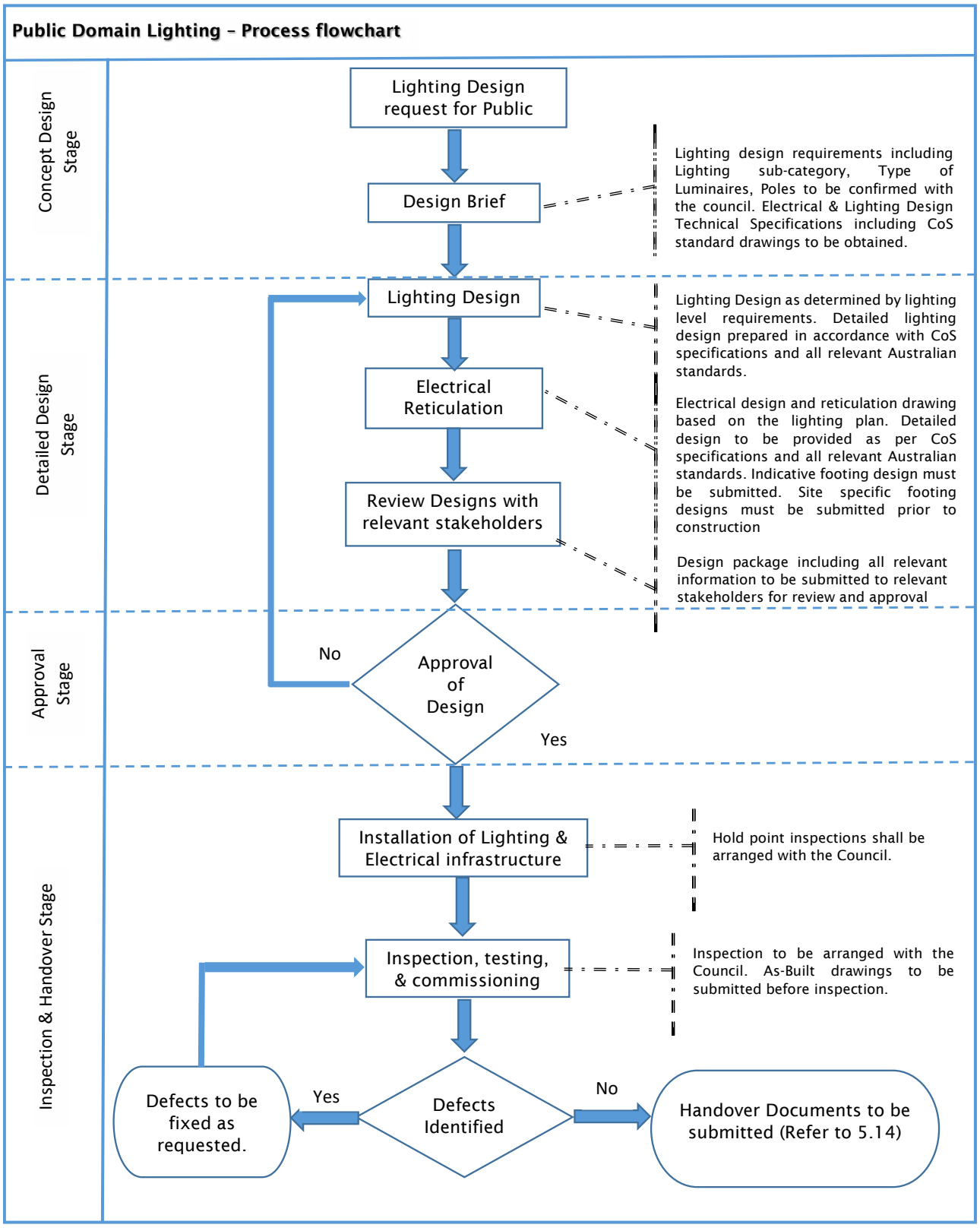
Standard	Description
AS CISPR 15:2017	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
IEC 61643-11:2011	Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods
ANSI C136.2-2018	American National Standard for Roadway and Area Lighting Equipment – Dielectric Withstand and Electrical Transient Immunity Requirements
ANSI C136.41	Dimming Receptacles
Zhaga Interface Specification: Book 18Edition 1.0, July 2018	Luminaire Extension Module & Receptacle
RoHS 2 (2011/65/EU)	Restriction of the use of certain hazardous substances
AS/NZS 3000: 2018	Wiring Rules
AS/NZS 3017:2007	Electrical installations – Verification guidelines
AS/NZS 3008.1.2017	Electrical installations – selection of Cables for alternating voltages up to and including 0.6/1kV – Typical Australian installation conditions.
AS/NZS 3100: 2017	Approval and test specification – General requirements for electrical equipments.
AS/NZS 3439.1.2002	Low-voltage switchgear and controlgear assemblies – Type-tested and partially type-tested assemblies
Service and Installation Rules of New South Wales, Nov 2018	The electricity industry standard of best practice for customer connection services and installations

5.1.2 ACCEPTABLE LIGHTING DESIGN PROGRAM

The City Of Sydney shall accept lighting design submissions, using these lighting programs:

- AGi32
- Perfect Lite – Road & Outdoor Lighting Design Software

5.2 PUBLIC DOMAIN LIGHTING – PROCESS FLOWCHART



5.3 LIGHTING DESIGN

5.3.1 GENERAL

Lighting schemes must be designed and installed such as to avoid any unwanted light spill and light pollution. The overall lighting scheme must provide maximum safety and shall not be overdesigned. AS/NZS 1158 clearly specifies the choice of whether to install a road lighting scheme in compliance with relevant Australian standards and, if so, the choice of appropriate subcategory of lighting rests with the road controlling authority. The lighting designer shall confirm the lighting level requirements with the City before commencing any lighting design.

5.3.2 LIGHTING DESIGNER

Lighting designs shall be undertaken by a suitably qualified and a competent practising lighting designer. The designer must be conversant with Australian local codes for outdoor lighting. The designer must provide a lighting design and statement confirming that design complies with the requirements of the specified standards and signed off. It will be the designer's responsibility to ensure that the lighting scheme meets all the relevant City of Sydney and Australian standards requirements.

5.3.3 LUMINAIRES

Luminaires that are owned and maintained by the City shall be as per the City's approved standard suite of LED luminaires. For more information, refer to the City's Sydney Lights Design Code:

http://www.cityofsydney.nsw.gov.au/development/planning-controls/development-policies/public-domain-design-codes

If non-standard luminaires are proposed, approval must be obtained from the City. The designer must submit the details as per Annexure 11 of this specification.

5.3.4 LIGHTING CATEGORY

Applicable Lighting sub-categories shall be confirmed with the City before commencing any lighting design.

5.3.5 CATEGORY V LIGHTING

This lighting category is applicable to roads on which the visual requirements of motorists are predominant, e.g. traffic routes. It includes subcategories V1 to V5. Includes provisions for motorways, arterial, sub-arterial and main roads.

The design is to comply with the Light Technical Parameters (LTP) of AS/NZS1158.1 Road Lighting – Vehicular traffic (Category V) lighting. The design should provide a lit environment conducive to the safe and comfortable movement of vehicular and pedestrian traffic at night and discourage illegal acts.

5.3.6 CATEGORY P LIGHTING – LOCAL ROADS, CYCLEWAYS, PATHWAYS AND PLAZAS

This lighting category is applicable to roads on which the visual requirements of pedestrians are dominant e.g. local roads and to local area traffic management devices. It provides a lit environment to help pedestrians orientate themselves, detect potential hazards, discourage fear of crime and crime against the person. Also, it includes lighting which is applicable to outdoor public areas, other than roads, where the visual requirements of pedestrians are dominant, e.g. plazas, parks and shopping precincts. Subcategories range from P1 to P12.

The design is to comply with the LTP of AS/NZS1158.3 Road Lighting – Pedestrian area (Category P) lighting. The principles of "Crime Prevention through Environmental Design" shall be considered.

5.3.7 PEDESTRIAN (ZEBRA) CROSSINGS

The principal objective is to provide advanced warning to motorists of the presence of the crossing, associated signs and markings. Enhanced pedestrian visibility shall be provided by direct illumination of the pedestrians. The lighting scheme involves both vertical and horizontal illuminance over the designated area.

Lighting requirements shall comply with the LTP as specified in AS/NZS 1158.4:2015. Light spill and glare must be minimized. Supplementary flood lighting on pedestrian crossings shall comply with PX1 or PX2 Sub-category unless otherwise specified.

5.4 LIGHTING DESIGN REVIEW

A Lighting design certified by a suitably qualified practising lighting engineer, shall be submitted to the City for review and approval, prior to commencing any installation work. The lighting design and layout shall be as per the requirements specified for the below lighting design documents and design drawings.

5.4.1 LIGHTING DESIGN DOCUMENTS

The following lighting design documents shall be submitted for review and approval:

- Lighting design drawing
- Records of any non-compliant design elements
- Alternative compliant lighting design
- Lighting design brief and certificate signed-off.by the consultant. Refer to Annexure 1 of this document.
- Name of the computer program used
- Luminaire intensity distribution tables in IES/CIE format and the origin of photometric data
- Details of the road surface reflection assumed in Category V design calculations, if any.

5.4.2 LIGHTING DESIGN DRAWING

- The luminaire schedule and description shall be provided with the details below:
- Manufacturer, name of luminaire, power consumption (watts), distribution (optics) type, colour temperature, outreach arm dimensions, pole type, mounting height to luminaire optical centre, pole offset, lamp/luminaire lumens, light loss factor (LLF) and luminaire/pole colour.
- The calculation summary shall indicate all relevant LTP and compliance as per AS/NZS 1158 for Category V & P lighting respectively.
- In case of Category V straight sections of road lighting, Perfectlite pole spacing table confirming compliance for the relevant category V shall be submitted along with the lighting layout. The lighting layout shall indicate pole spacing as a reference point.
- Lighting calculation points for horizontal and vertical illuminance shall comply with the requirements as specified in AS/NZS1158.2.
- Luminaire labels with mounting height should be shown.
- Obtrusive lighting calculations on adjacent residential properties as per relevant Australian standards must be provided.
- Luminaire orientation where it is not shown by symbol.
- Highlight all areas of non-compliance.

5.4.3 LIGHTING LAYOUT DRAWINGS

- All engineering drawings shall be legible, clear, readable and complete. They must clearly illustrate the proposal and enable both assessment of compliance with this document and accurate construction.
- Drawings showing pole locations, existing underground services and electrical reticulation must be included on the landscape layout.

- A locality diagram indicating the overall layout and location of works, with all street names must be shown.
- A North point symbol shall be provided on the drawing.
- A luminaire schedule must be included as specified in 5.4.2 above.
- The lighting design details shall include the lighting subcategory that the scheme has been designed to meet.
- Electronic drawings must be prepared in an industry standard format suitable for later addition of As-Built information.
- Drawings shall be supplied in electronic format as DWG (drawn to scale of 1:250@A1) and PDF formats.

5.4.4 LIGHT POLE, MOUNTING AND FOOTINGS

- Specifications for the poles e.g. pole type, colour; must be obtained from the City during the design stage.
- Certification of the structural design is required for all components of structures except manufactured components, which are part of the approved City lighting suite. The structural certificate shall be accompanied by the detailed design calculations for the structure.
- Footing designs and all associated mounting details must be certified by a competent practising structural engineer and shall be submitted to the City for review and approval. Supporting detailed design and calculations must also be submitted along with the certificate.
- Footing designs for frangible energy absorbing poles shall be undertaken in accordance with AS/NZS1158.1.2.
- All structures shall be designed to achieve 50 years of life expectancy and shall be designed in accordance with relevant Australian standards. Provisions for corrosion prevention shall be considered for all members, especially members which are in contact with the ground.
- All electrical conduits and embedded members shall be considered during the design to ensure constructability of the footing without any compromise to the structural integrity of the structure.
- Shop drawings of the poles must be submitted to the City for review and approval prior to manufacture.
- Mount type shall be Ragbolt Assembly with standard pole baseplate.
- Hold-Down (HD) bolts shall not be exposed above the ground including those on new poles to be owned by Ausgrid. Refer to Annexure 6, Section A-A for details.
- Certification of footing construction by a suitably qualified structural engineer as per site condition/ approved design, shall be submitted to the Council.

5.5 POLE SETBACK

Below specified pole setbacks shall be applicable to all new poles to be owned by the City and Ausgrid:

- Minimum pole setback shall be 600mm from the face of the kerb, unless otherwise specified.
- Minimum pole setback at intersections shall be 1000mm from the face of the kerb.

5.6 POLE ORIENTATION

Unless otherwise specified, pole outreach arms and luminaires shall:

- Be oriented at 90 degrees to the centreline of the road.
- Have an upcast angle of “0” degrees.

5.7 POLE LOCATIONS

- Pole locations shall be agreed upon before commencing landscape design.
- Pole locations shall be clear of all driveways, existing underground services, obstructions, existing utility pits, awnings etc.
- The location of existing street trees can be a significant constraint to lighting layouts and designs. Tree canopies may conflict with pole installations or light spill from luminaires, and excavation for pole footings and cable trenches can severely affect tree roots. Proper consideration of these constraints is necessary to ensure a viable design and mitigate the impact to trees. Advice should be sought from the City's tree management team.

5.8 TEMPORARY LIGHTING

- If the existing luminaires are to be removed for any construction activity, the designer must provide a temporary lighting design for review and approval by the City. Temporary lighting shall comply with the requirements of AS/NZS 1158.
- Unless temporary lights are operating, existing lights shall not be removed or decommissioned.
- Electrical installations for the construction and demolition sites (including hoardings), shall comply with AS/NZS 3012.

5.9 EXISTING AUSGRID LIGHTING

This section is only applicable, if the Council decides to retain existing Ausgrid lights.

- A suitably qualified practising lighting design engineer shall undertake lighting design to confirm if the existing Ausgrid lights comply with the City's nominated lighting subcategory requirements. Detailed lighting calculations and lighting layout must be submitted to the City for review and approval.
- If the existing street lighting does not comply with the City's nominated lighting subcategory, designers shall propose an alternative compliant lighting design. Detailed lighting calculations and lighting layout must be submitted to the City for review and approval.
- If the proposed alternative lighting layout requires removal, addition or relocation of any poles/luminaires, an ASP level 3 design consultant shall be engaged to undertake design works and to obtain approval from Ausgrid prior to construction.
- ASP level 3 design shall be submitted to the City for review and approval prior to obtaining certification from Ausgrid and before construction commences.
- A lighting consultant or ASP level 3 consultant shall be responsible for lodging applications with Ausgrid for all lighting upgrade-related works with the City's approval on the application form.
- Residual value charges associated with removal of existing Ausgrid assets shall be borne by the developer through the City.

5.10 CBD AREA LIGHTING REQUIREMENTS

- Smartpoles shall be installed within the CBD area in accordance with the Sydney Lights Design Code.
- Intersection traffic lights shall be replaced with Smartpoles.
- Pole layout needs to be confirmed with the City.
- Removal of redundant Ausgrid lights must be arranged via ASP 3 level design process.
- ASP level 3 design shall be submitted to the City for review and approval prior to obtaining certification from Ausgrid and before removal of poles.

- A lighting consultant or ASP level 3 consultant shall be responsible for lodging applications with Ausgrid for all lighting.
- ASP 3 level design and associated Ausgrid charges shall be borne by the developer.

5.11 ELECTRICAL RETICULATION DESIGN

5.11.1 GENERAL

- Electrical designs shall be undertaken by a suitably qualified and a competent practising Electrical designer. The designer must be conversant with relevant Australian and the City of Sydney standards. The designer must provide a design statement confirming it complies with the requirements of the standard and signed off.
- It will be the designer's responsibility to ensure that the electrical design complies with AS/NZS 3000, Service and Installation Rules – NSW, Ausgrid and the City's requirements.
- Electrical design shall be submitted to the Council for review and approval before commencing any installation works on site.

5.11.2 POWER SUPPLY, ELECTRICAL CIRCUITS AND RETICULATION

- The point of power supply can be determined in consultation with the City to determine whether the lights can be powered from existing Main SwitchBoard (MSB) or whether a new electrical supply connection is required.
- If a new meter supply connection is required, the point of supply location shall be determined by application to Ausgrid.
- If an existing MSB exists, then the consultant must inspect the existing electrical infrastructure to identify the source of supply, and determine its suitability for installation of additional electrical load.
- If a three-phase power supply is adopted then circuits shall be designed to balance the load across all phases, so that adjacent luminaires are not on the same phase. GPOs shall be on a separate single-phase supply as indicated in Figure A below.
- In case of single phase power supply, adjacent lights shall not be connected on the same sub-circuit, separate circuit arrangement shall be used.
- The electrical consultant shall provide electrical schematics, for example:

Figure A

- The electrical consultant shall provide the following information:
- Existing current maximum demand
- Maximum demand calculation
- Single line diagram of the MSB
- Electrical cable size and percentage voltage drop/fault loop impedance, calculations shall be provided using PowerPack or PowerCad software programs.
- Detailed electrical reticulation plan indicating conduit depth, pits, and cable size and cable type.
- Electrical supply reticulation design and footing designs shall be provided for approval prior to carrying out any construction activity. Footing designs shall be certified by a competent practising structural engineer.

- All cabling installed underground for public lighting reticulation shall be enclosed in a 63mm diameter Heavy Duty (HD) PVC rigid conduits, unless otherwise specified. No cables shall be directly buried. Electrical warning PVC marker tape shall be installed above all conduits used for reticulation. Use of flexible or corrugated conduits is not permissible.
- The layout and depth of electrical conduits shall comply with the requirements of Annexure 5 of this document.
- Electrical conduits must be installed clear of Tree Protection Zones (TPZ) and any existing underground services.

5.11.3 CABLE ROUTES

The designer shall undertake site investigation to assess the local conditions to decide the cable route.

- Accessibility – All cabling must be wholly within road reserves or public spaces or in the easement to be provided.
- The cable route selection shall aim to reduce sharp bends and lengths.
- There shall be no joints in LV cables.
- All LV cables shall be terminated in cabinets and terminal box at the base of pole.
- The surface layer shall be assessed for excavation and reinstatement – e.g. soil, road crossing and concrete.
- The underground layer shall be assessed for ease of excavation – potholing along the route as required confirming the full trench depth is achievable.
- Conduits shall be installed along the most direct route between columns and between the turret/cabinet and the column.
- Conduits shall cross under footpaths and roads at right angles where possible so that the reinstatement and length of cable is minimal.
- "Dial Before You Dig" information should be obtained to check clearances from other utility services (gas, electrical, water and communication reticulation).

5.11.4 CABLE TYPE, TERMINATIONS AND PROTECTION

- Main underground cables shall be single phase or three phase, 2C + Earth or 4C + Earth Cu/PVC/XLPE, 0.6/1kV.
- Standard minimum cable size shall be 6 Sq.mm for wall mounted lights and 16 Sq.mm for Street lights and pedestrian lights, to comply with circuit requirements. Unless otherwise specified.
- All cables shall have type V75 or V90 insulation and shall have stranded copper conductors.
- All surface mounted cables shall be fire rated type.
- Main cables shall be terminated at the base of each pole. A dedicated 10 A MCB + 30mA RCD shall be installed at the base of each column for the luminaire supply. Refer to Figure B for details.

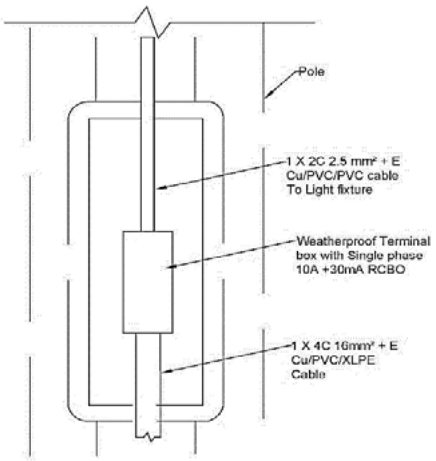


Figure B

- All the cables from the base of the poles to the luminaires shall be a minimum of 2C+Earth 2.5 Sq.mm Cu/PVC/PVC.
- Consultants shall provide detailed drawings indicating the above arrangement clearly.
- The number of circuits shall suit circuit loading and voltage drop calculations.
- All circuits shall be a loop in, loop out arrangement.
- The insulation of the cables shall be coloured as shown in the table below:

Circuit	Type	Colour
Three phase circuits	A Phase	Red
	B Phase	White
	C Phase	Blue
	Earth Conductors	Green and Yellow
	Neutral Conductors	Black

5.11.5 ELECTRICAL PITS

- Pits shall be located adjacent to each pole.
- Pits are required at every road crossing and horizontal/vertical changes of direction of conduits.
- A pit shall be installed adjacent to the MSB.
- Pits shall be located to minimise water ingress and must be finished flush to the Finished Floor Level (FFL).
- Refer to Annexure 9 for details.

5.12 MAIN SWITCHBOARD (MSB)

- Refer to Annexure 3.1 and 3.2 for the City's standard drawing for single/three-phase MSB size and details.
- Shop drawings for the MSB must be submitted for review and approval by the City before manufacture.
- If a non-standard MSB is required, shop drawings shall be provided for review; written approval must be obtained before manufacturing and installing the MSB.

5.13 MAIN EARTHING

- Refer to Annexure 12 for main earthing schematics.
- Earthing shall be Multiple Earthed Neutral (MEN) type.
- Main earth electrode size and depth – Shall comply with AS/NZS 3000 requirements.
- All exposed earth electrodes and clamps shall be galvanised to prevent rusting.
- Suitable earth clamps shall be used for connection of earthing cable to the earth rod, with warning tags engraved with "Main Earthing conductor – Do Not Disconnect"
- Earth pits shall be used to access main earth electrode. To be installed adjacent to the MSB and shall be flushed with the FFL.
- Main earthing cable size shall be designed by an Electrical consultant based on fault levels.
- Main earthing cable shall be run in a PVC HD conduit between the earth pit and the base of the MSB.
- Above earthing arrangement shall be submitted along with the electrical reticulation design, for the City's review and approval.
- The depth of the earth rod and size shall comply with AS/NZS 3000 requirements.

5.14 LIGHTING CONTROL SYSTEM

- All functional lighting shall be supplied from its dedicated lighting circuit and controlled by a PE cell. The PE cell must be installed on a luminaire or pole closer to the MSB.
- No other type of control system apart from that specified above must be used for functional lighting.
- Dynamic/ Decorative lighting – the lighting control system must be approved by the City prior to progressing lighting design.
- Drawings shall be submitted showing mounting details for decorative luminaires and the location of all electronic drivers and control equipment.

5.15 INSTALLATION, TESTING AND INSPECTION

- Installation of all Works shall be as per the drawings approved by the City.
- Any deviation from the approved drawings shall be reported back to the City and written approval must be obtained for any deviation before commencing any Works.
- At the practical completion of installation works, the contractor must organise a handover inspection to be attended by City lighting team representative.
- The City's representative will be available on site to carry out visual site inspections (post installation) of electrical and lighting assets.
- The electrical contractor must carry out all the electrical tests required as per AS/NZS 3017. The electrical contractor must organise and make available all relevant calibrated tools and equipment before commencing any electrical test on site. All electrical test must be witnessed by the design consultant.
- The City's standard ABLOY padlocks (2) are to be installed to the MSB cabinet. Contact the City's security team at security@cityofsydney.nsw.gov.au.
- The contractor must supply and install asset ID labels. Refer to Annexure 10 for details.
- A laminated copy of the As-Built drawing and Single Line Diagram (SLD) must be attached to the inner side of the MSB cabinet door.
- The Council will advise of the defects list, if any. Upon receiving it, the contractor must address the issues and arrange for final inspection.
- The contractor shall provide As-Built drawings before arranging a final inspection. Refer to section 5.17 of this document for As-Built drawing requirements.
- The contractor shall provide a signed copy of the City's "Details of new lighting installation inspection, test and completion certificate" as per Annexure 2.
- All lighting and electrical installation works, shall be certified by the design consultants on the project. The electrical consultant on the project must witness the electrical tests and sign off the certificate as per Annexure 2.

5.16 HOLD AND WITNESS POINTS

- Refer to Section 8.6 of these specifications in B8: Street Lighting Construction.

5.17 AS-BUILT DRAWINGS REQUIREMENTS

The following information shall be provided on the As-Built drawings in AutoCAD and PDF format:

- Drawings in AutoCAD and PDF format stamped “AS-BUILT” showing pole locations with GPS coordinates and offset dimensions as per site reference points. Plans must be provided in hard copy and electronic format, based on Australian Height Datum (AHD) and Map Grid of Australia (MGA) orientation, Zone 56.
- The pole schedule, including footing type, Asset ID label numbers, pole height, pole offset, pole type, luminaire details, outreach arm length, luminaire mounting height, pole colour and luminaire colour.
- The drawing, indicating electrical conduits layout, pits and cable runs per conduit including depths, offset and circuit labels as installed on site for the complete installation. Cables and conduit size shall be specified on the drawing.
- Location of the MSB and Pillar number from where the MSB is fed from or the Ausgrid Pole number/ location in case of Special Small Services (SSS) supply.
- Footing drawings and designs as installed on site, certified by a suitably qualified practising structural consultant.

5.18 HANDOVER DOCUMENTS

Below documents need to be submitted as part of handover:

- As-built drawings as per the requirements specified in section 5.17 above.
- Certification by a suitably qualified practising structural consultant for footings, stating that the installation is fit for purpose and complies with the approved design and site-specific underground obstructions and soil conditions.
- Electrical contractors must issue a Certificate of Compliance for Electrical Work (CCEW) form for all electrical installation works. CCEW forms are available from NECA. It is essential that the installation work complies with AS/NZS3000 Wiring Rules and any other relevant standard and is tested as required and certified as being safe.
- A copy of Notification Of Service Work (NOSW) must be provided.
- An electrical design and installation certification from the electrical consultant engaged on the project as per Annexure 2.
- A lighting engineers’ certification confirming that the installed lighting complies with the design intent.
- Operation and maintenance manual including product manuals.
- Product warranties.

ANNEXURE 1:
LIGHTING DESIGN BRIEF AND CERTIFICATE

City of Sydney Technical Services Use Only	
CoS Design Requirements:	Scheme:
DA Number:	Signed by City Infrastructure Lighting Representative:

Location	Lighting Category	Column Type	Lantern Type	Lamp Source

The following sections to be completed by the ACCREDITED LIGHTING DESIGNER and approved by the City of Sydney Council, City Infrastructure PRIOR to any work commencing:

Location			
Lighting Category			
Computer package used			
Mounting Height (m)			
Column arrangement			
Overhang (m)			
Effective Width (m)			
Lantern Type			
Lamp Type & Wattage (W)			
Lamp Design lumens			
Maintenance Factor			

ANNEXURE 1:
LIGHTING DESIGN BRIEF AND CERTIFICATE

Location			
Required Maintained Ave			
Calculated Maintained Ave			
Required (Up maint) or (Uo)			
Calculated (Up maint) or (Uo)			
Required Min (Eh maint)			
Calculated (Eh maint)			
Required (Ev maint)			
Calculated (Ev maint)			
Required Min (UL)			
Calculated (UL)			
Required Max Ti			
Calculated (Ti)			
Required Min (Es)			
Calculated (Es)			

Underground Cable size:	mm^2	Cable Type:	
Calculated Volt drop:	V	Calculated Loop Impedance of each leg:	Ω
Overcurrent Protective Device of Outgoing Circuit:	AS	Rating:	A
Calculated Short Circuit current of each leg:	KA		
Maximum disconnection time 0.4 seconds:			

Mains Switch: AS		Type:	Rating: A
Number of Poles:			
Contactor/Relay type:		Rating: A	No. of Poles:

Electronic Time Clock:		Type:	
Power	Supply: V	Phases:	
Method of Earthing:			

ANNEXURE 1:
LIGHTING DESIGN BRIEF AND CERTIFICATE, CON'T

NOTE: All calculations to be shown on a separate sheet.

I/we being the person(s) responsible (as indicated by my/our signatures below) for the design of the lighting/ electrical installation, particulars of which are described on Page 1 and 2 of this form certify that the said work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with the current Code of Practice for Lighting AS1158, City of Sydney current specification for the installation of public domain lighting and the Rules for Electrical Installations published in AS3000, except for the departures, if any, stated in this certificate. The extent of the liability of the signatory is limited to the work described above as the subject of this

For the design installation at:	
Name of Designer: (BLOCK Letters)	Position:
Company Name:	
Signature:	Date:
For and ON BEHALF of CLIENT:	
Address:	
City of Sydney Technical Services Use Only.	
Checked By: (Name in BLOCK letters)	Position:
Signature:	Date:

Note: LIGHTING DESIGN BRIEF CERTIFICATE TO BE COMPLETED, CERTIFIED AND RETURNED ALONG WITH THE LIGHTING/ELECTRICAL DESIGN

ANNEXURE 2:
DETAILS OF NEW LIGHTING INSTALLATION INSPECTION TEST AND COMPLETION CERTIFICATE.

All commissioning and pre-handover inspections are to be carried out by the *contractor and witnessed by an accredited representative from City of Sydney, City Infrastructure. All completed forms are to be submitted to the City of Sydney. All electrical tests shall be witnessed by the electrical design consultant.*

VISUAL INSPECTION

Location:
Contractor:
Type of Installation: (e.g. street lighting, Park lighting, Plaza lighting, wall lighting, illuminated sign, etc)
Date of Inspection:

STRUCTURAL INSPECTION

Mark ☑ Satisfactory or ☒ Unsatisfactory On Completion:

☐	1.	Location of Lighting Equipment as per Drawing
☐	2.	Planting Depth/Footing size of Lighting Equipment as per Specification
☐	3.	Location of Cable as per Drawing
☐	4.	Depth of Cable as per Specification
☐	5.	Location of Road Crossing as per Drawing
☐	6.	Depth of Road Crossing as per Specification
☐	7.	Column footing as per Specification
☐	8.	Verticality Correct
☐	9.	Optical Orientation Correct

ANNEXURE 2:
DETAILS OF NEW LIGHTING INSTALLATION INSPECTION TEST AND COMPLETION CERTIFICATE, CON'T

Mark ☑ Satisfactory or ☒ Unsatisfactory On Completion:

1.	☐	Correct termination of cables in the column, lantern and control gear
2.	☐	Circuit conductors identified correctly
3.	☐	Conductor size correct for normal operation (or as specified)
4.	☐	Single pole or fuse in the phase conductor only
5.		Method of Protection against Direct Contact
	☐	a) Insulation of live parts
	☐	b) Barrier or enclosure
	☐	c) Out of reach (overhead lines only)
6.		Method of Protection against Indirect Contact
	☐	a) Presence of Protective Conductors
	☐	b) Presence of main equipotential bonding conductor
	☐	c) Presence of supplementary equipotential bonding conductor including doors of steel columns but excluding that of concrete columns
7.	☐	Presence of method of local isolation
8.	☐	Fuse ratings correctly rated for their purpose
9.	☐	Labelling in control pillar/switchboard enclosure of isolators and fuses
10.	☐	Prevention of mutual detrimental influence. Proximity of non-electrical services (e.g. fences or safety barriers)
11.	☐	Selection of equipment and protective measures appropriate to external influences
12.	☐	Adequate access to installed equipment
12.	☐	Presence of danger notices or other warning notices
14.	☐	Presence of circuit diagrams enclosed within control pillars/switchboard enclosure
15.	☐	Installation method of cables
16.	☐	Deviation from the materials listed in the specification
17.	☐	Other

ANNEXURE 2:
DETAILS OF NEW LIGHTING INSTALLATION INSPECTION TEST AND COMPLETION CERTIFICATE, CON'T

Details of new lighting installation inspection test and completion certificate.

(All entries recorded on this sheet to be determined by measurement. All instruments must bear a current calibration label).

Date of Test: _____ / _____ / _____

Instruments to be Used	Date when calibrated
Voltmeter 240/415V	
Ammeter 0–50 amp	
Megger 500V	
Loop Impedance Meter	
Prospective Short Circuit Tester	

Control Pillar

Installation de-energised (with all fuser carriers removed)

Continuity of Protective Conductors **Polarity** (Rph + Re):-

Mark ☑ Satisfactory or ☒ Unsatisfactory

Circuit 1	Ω	Circuit 1	☐
Circuit 2	Ω	Circuit 2	☐
Circuit 3	Ω	Circuit 3	☐
Circuit 4	Ω	Circuit 4	☐

Insulation Resistance
(Note: Remove neutral conductor from PME system)

Circuit 1	P-N	Ω
	P-E	Ω
	N-E	Ω
Circuit 2	P-N	Ω
	P-E	Ω
	N-E	Ω
Circuit 3	P-N	Ω
	P-E	Ω
	N-E	Ω
Circuit 4	P-N	Ω
	P-E	Ω
	N-E	Ω

Insulation Resistance (column wiring)
(All columns)

Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ
Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ
Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ
Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ

METHOD OF EARTHING: TN-C-S

ANNEXURE 2:
DETAILS OF NEW LIGHTING INSTALLATION INSPECTION TEST AND COMPLETION CERTIFICATE, CON'T

Installation Energised
(Measurements taken under load at cut-out incoming terminals)

Voltage at Origin _____ V

Prospective Short Circuit Current at Origin _____ KA

Loop Impedance at Origin _____ Ω

No. of Phases _____

Load at Origin _____ A

Measured Load		**Voltage at end of circuit**	
Circuit 1	A	Circuit 1	V
Circuit 2	A	Circuit 2	V
Circuit 3	A	Circuit 3	V
Circuit 4	A	Circuit 4	V

Loop Impedance at end of each circuit		**Prosp. Short Circuit Current at end of Circuit**	
Circuit 1	Ω	Circuit 1	KA
Circuit 2	Ω	Circuit 2	KA
Circuit 3	Ω	Circuit 3	KA
Circuit 4	Ω	Circuit 4	KA

ANNEXURE 2:
DETAILS OF NEW LIGHTING INSTALLATION INSPECTION TEST AND COMPLETION CERTIFICATE, CON'T

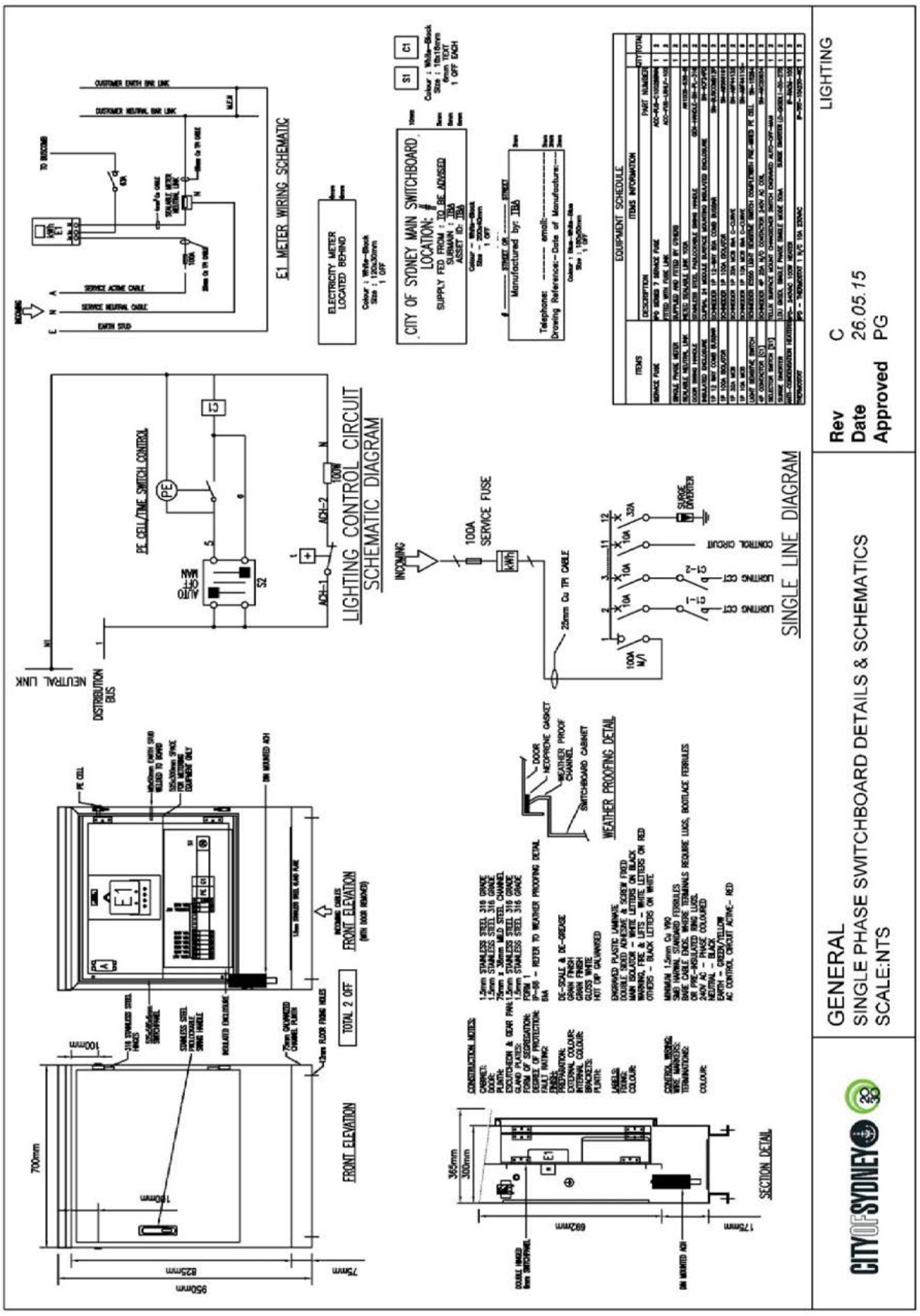
I/We being the person(s) responsible (as indicated by my/our signature(s) below) for the inspection and test of the street lighting and associated electrical installation particulars of which are described on the attached annexures of this form certify that the said work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with City of Sydney current Specification for the Installation of Public Domain Lighting and the Rules for Electrical Installations (AS3000) except for departure, if any, stated in this certificate.

The extent of liability of the signatory is limited to the work described above as the subject of this certificate.

For the inspection and test of the installation at:	
Name: (BLOCK Letters)	Position:
Licence No.:	
Company Name:	
Signature: (of Contractor in BLOCK Letters)	Date:
For and ON Behalf of:	
Address:	
Witnessed by (Name) (Design consultant): (Name in BLOCK letters)	Position:
Signature:	Date:

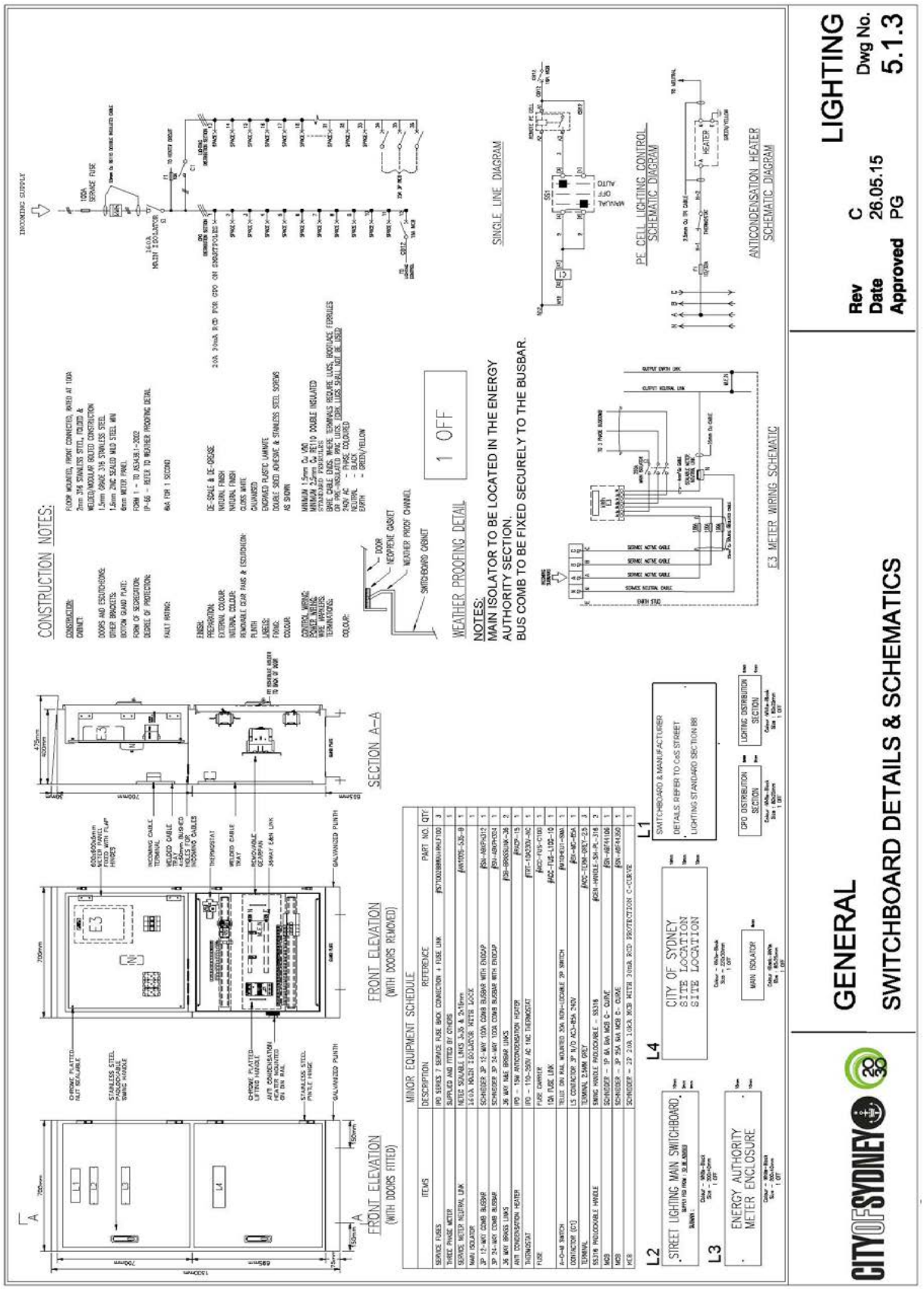
Comments:

ANNEXURE 3.1:
STANDARD DRAWING FOR SINGLE PHASE MSB



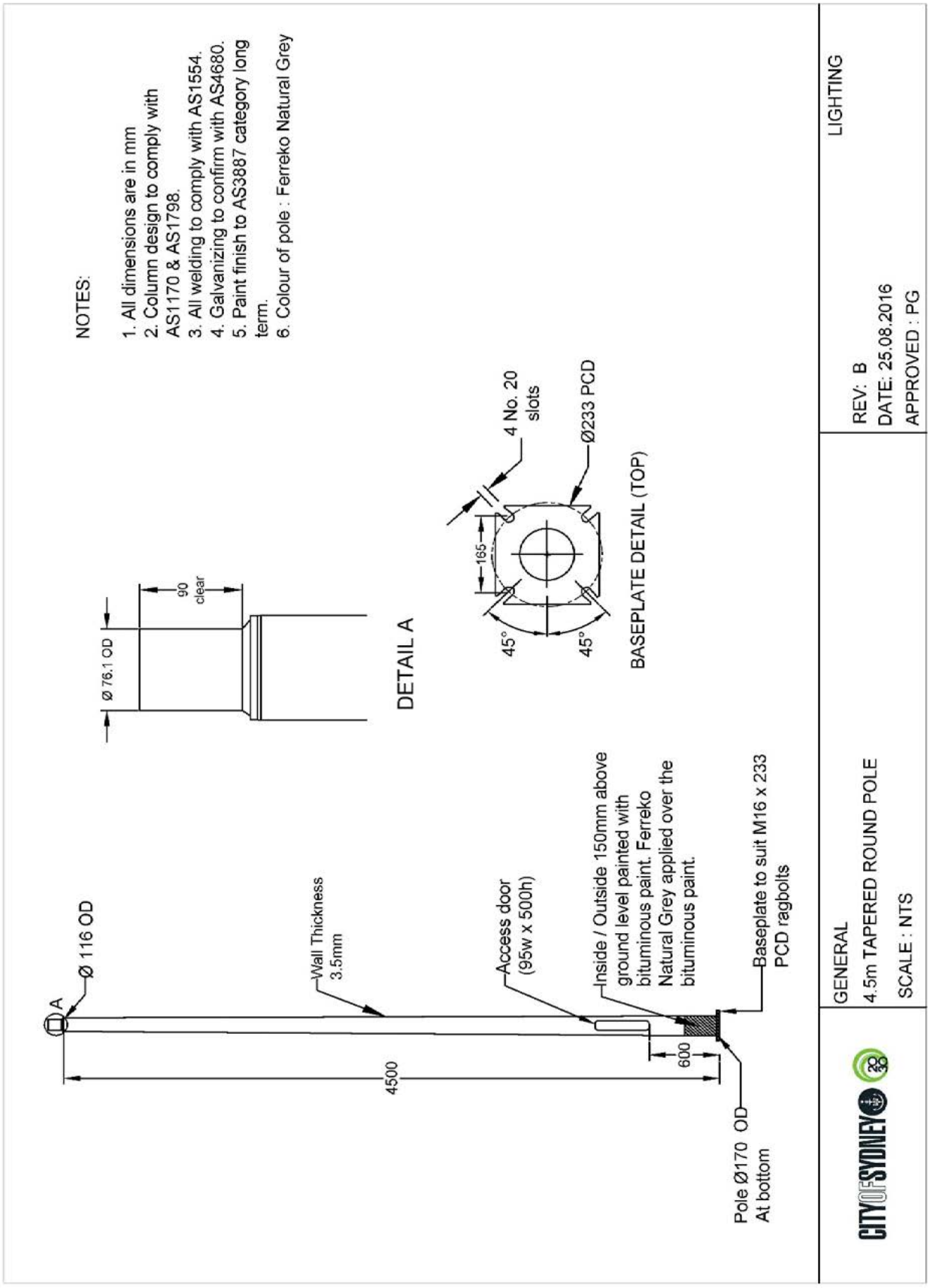
Note: Site-specific shop-floor drawings shall be submitted for approval prior to manufacturing.

ANNEXURE 3.2:
STANDARD DRAWING FOR THREE PHASE MSB



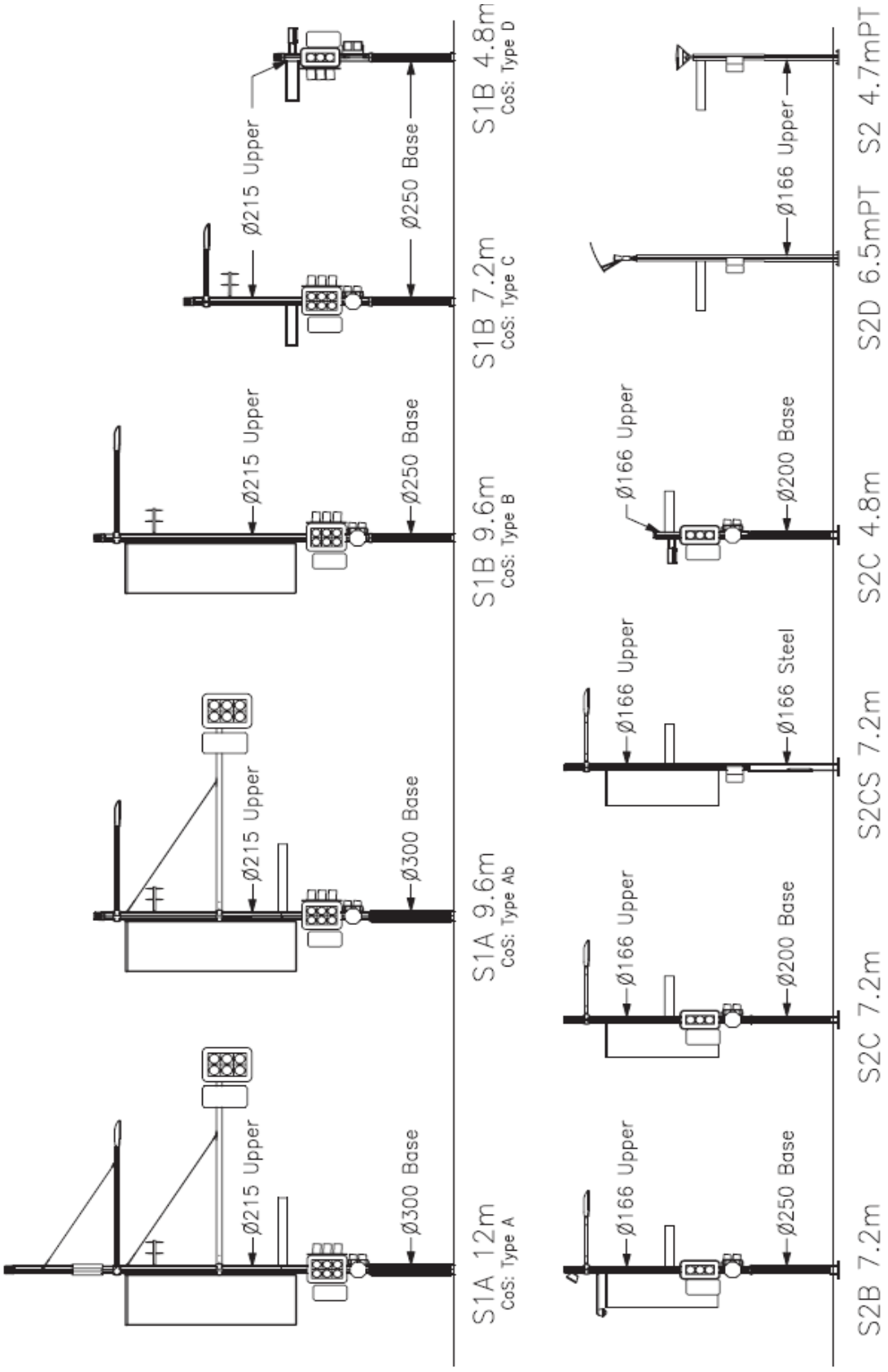
Note: Site-specific shop-floor drawings shall be submitted for approval prior to manufacturing.

ANNEXURE 4.1:
STANDARD DRAWING FOR TAPERED PEDESTRIAN POLES (4.5M O



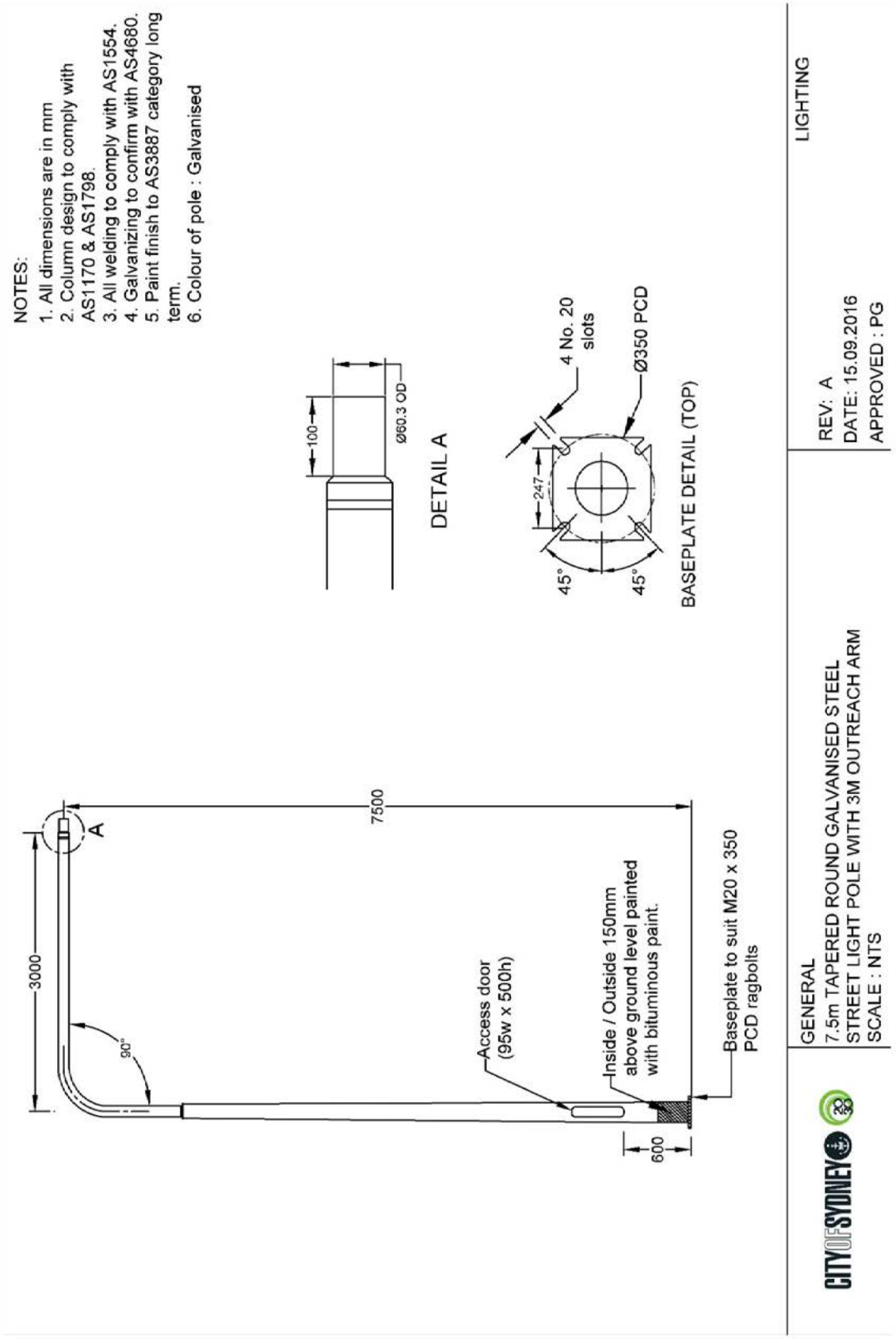
Note: Site-specific shop-floor drawings shall be submitted for approval prior to manufacturing.

ANNEXURE 4.2:
STANDARD DRAWING FOR SMART POLES



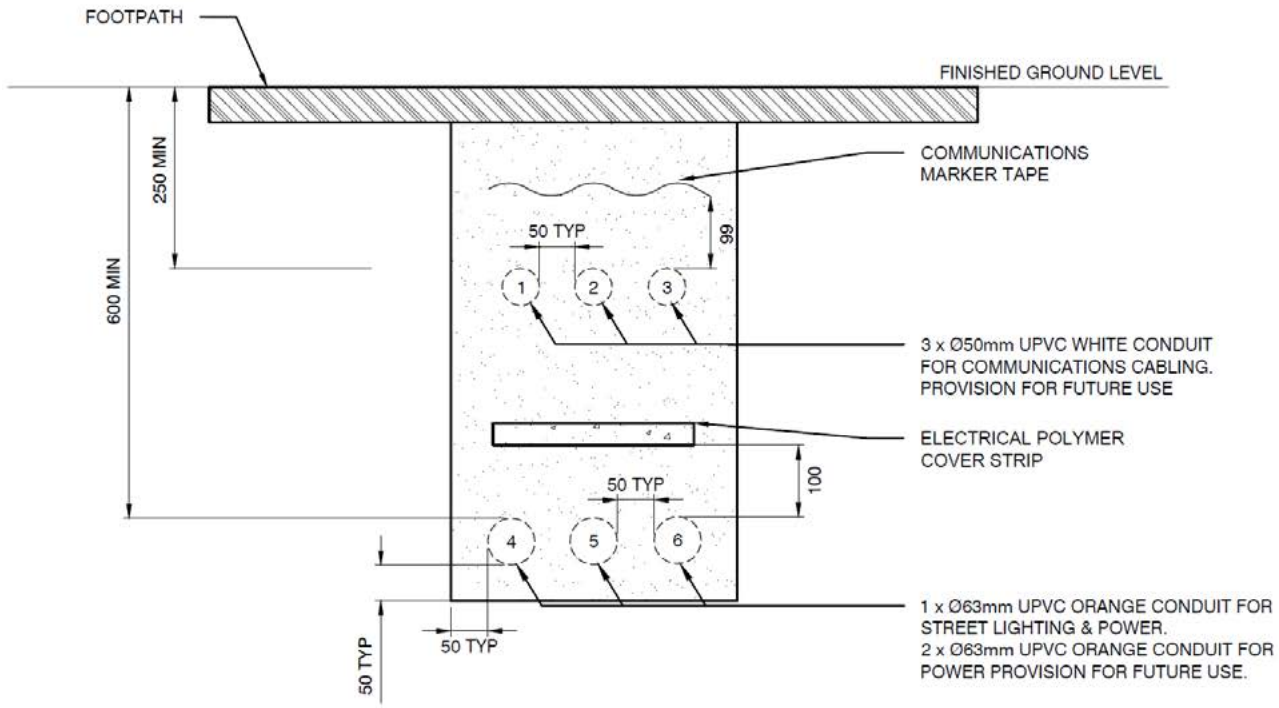
Note: Site-specific shop-floor drawings shall be submitted for approval prior to manufacturing.

ANNEXURE 4.3:
STANDARD DRAWING FOR GALVANISED STEEL STREET LIGHT POLES

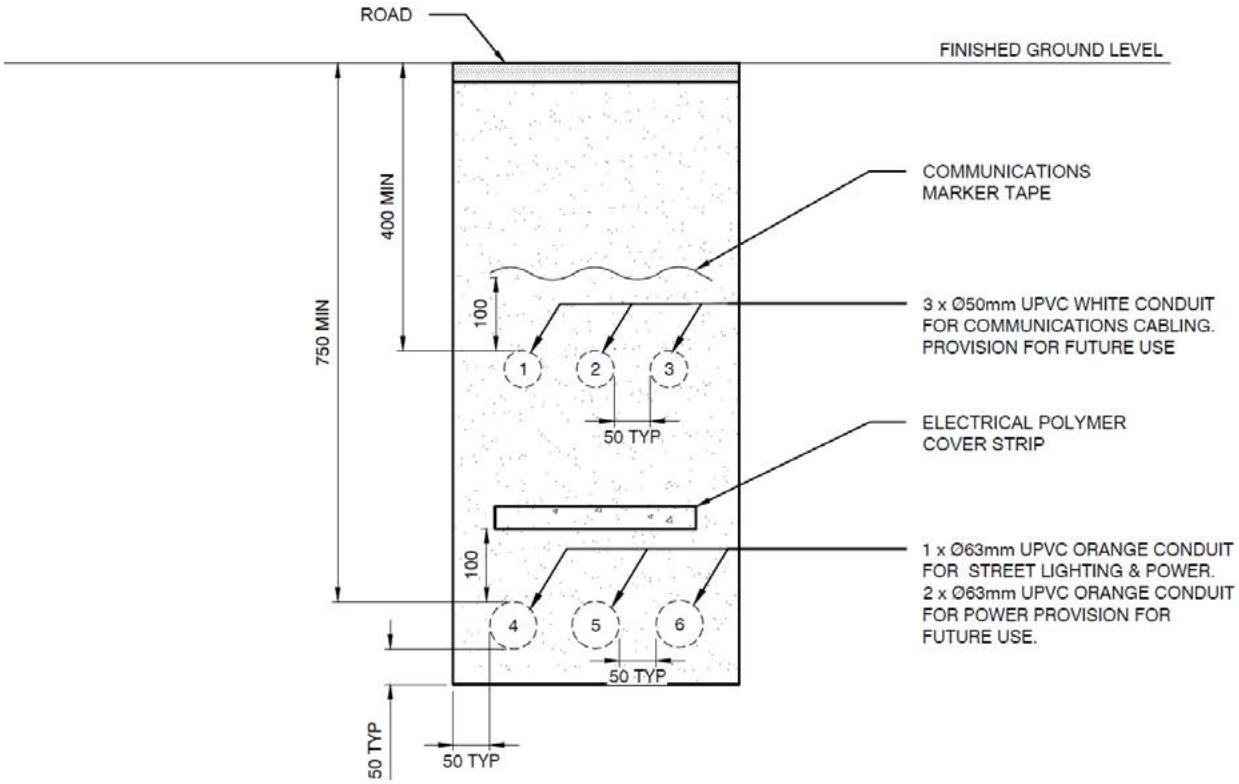


Note: Site-specific shop-floor drawings shall be submitted for approval prior to manufacturing.

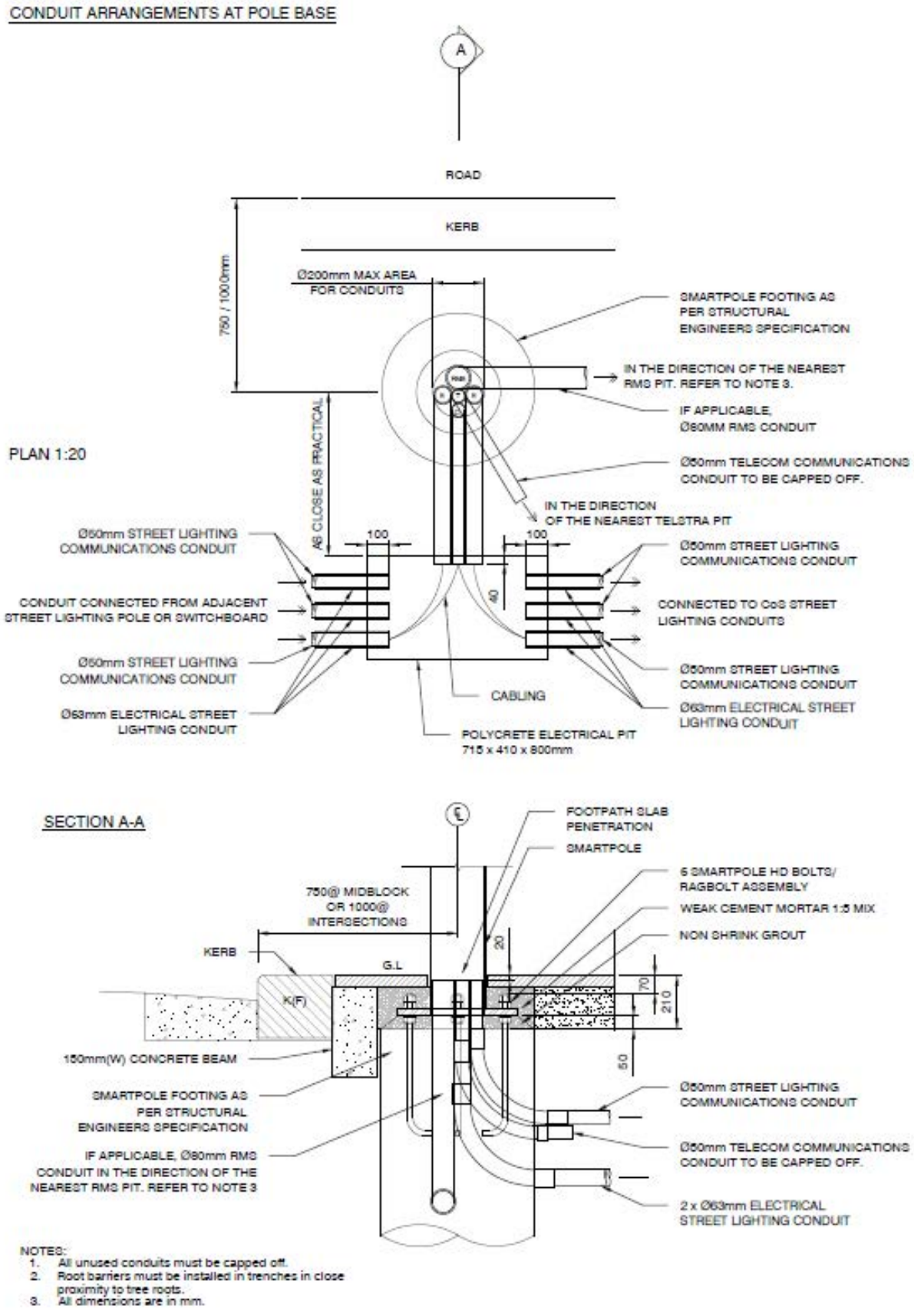
ANNEXURE 5:
TYPICAL ELECTRICAL AND COMMS CONDUIT ARRANGEMENTS



TYPICAL ELECTRICAL & COMMS
CONDUIT ARRANGEMENT (ROAD)

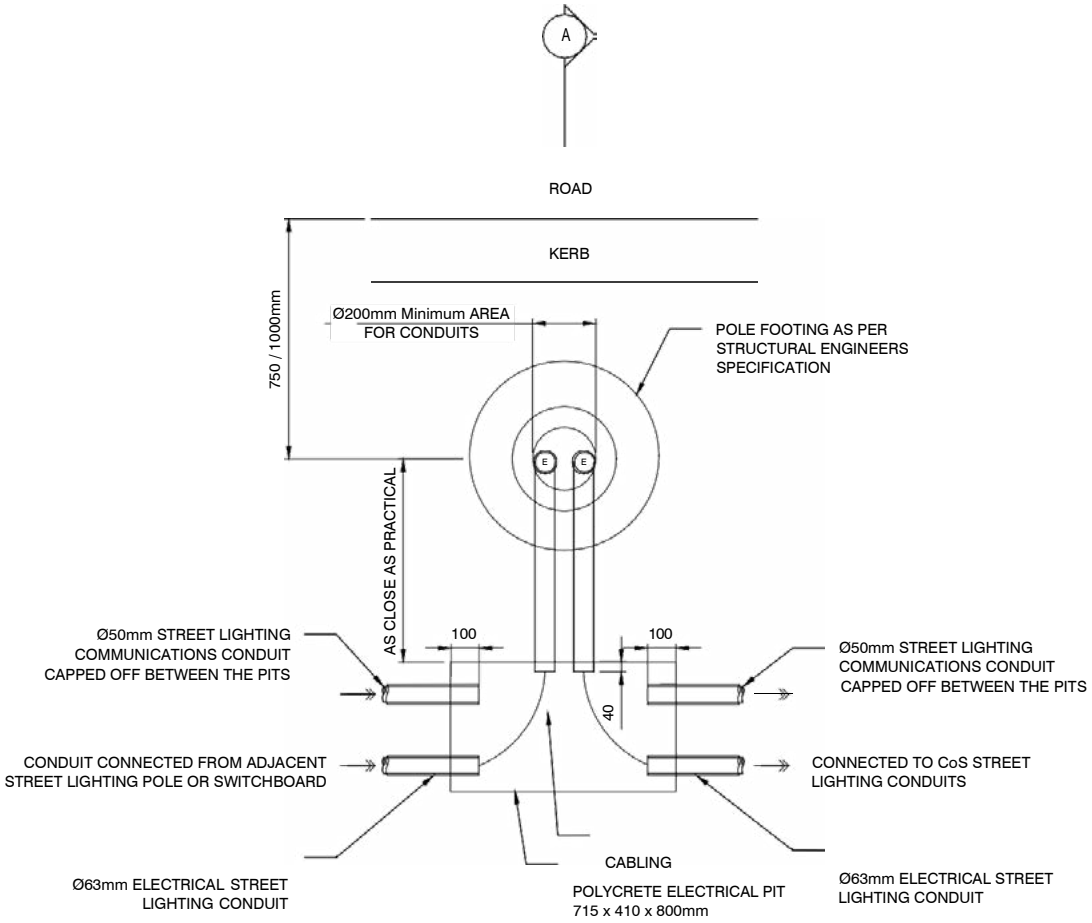


ANNEXURE 6:
CONDUITS ARRANGEMENT AT THE BASE OF SMARTPOLES

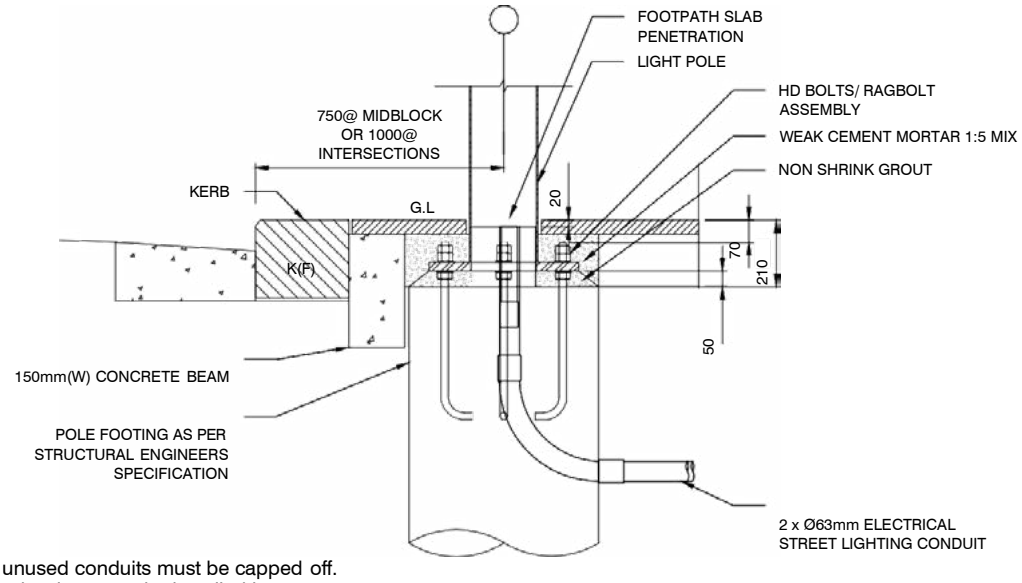


ANNEXURE 7:
CONDUITS ARRANGEMENT AT THE BASE OF STEEL OR PEDESTRIAN POLES

CONDUIT ARRANGEMENTS AT POLE BASE



PLAN (NTS)



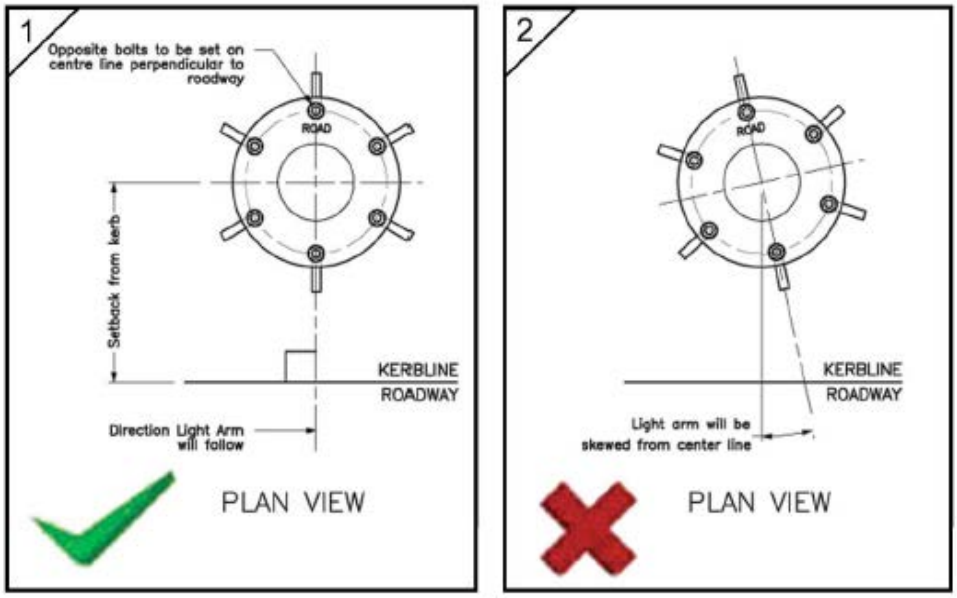
SECTION A-A

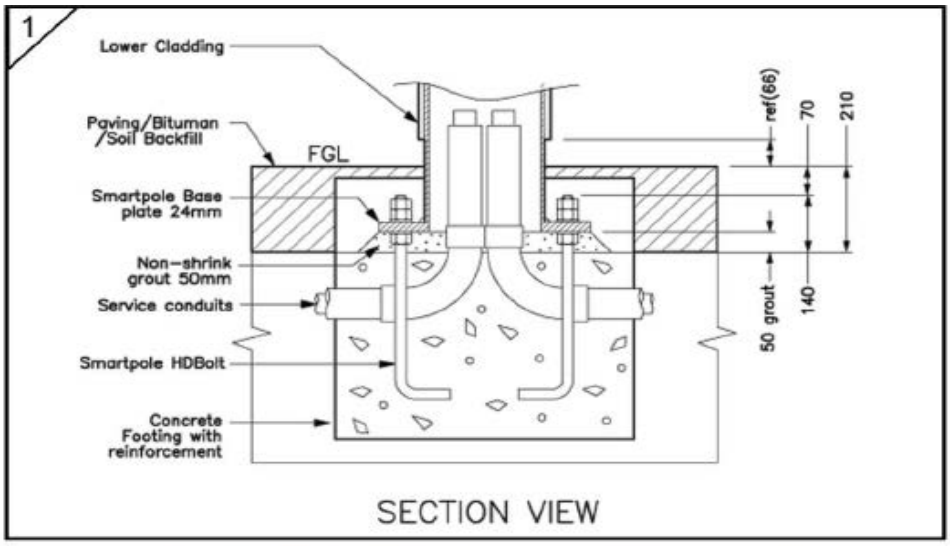
NTS

NOTES:

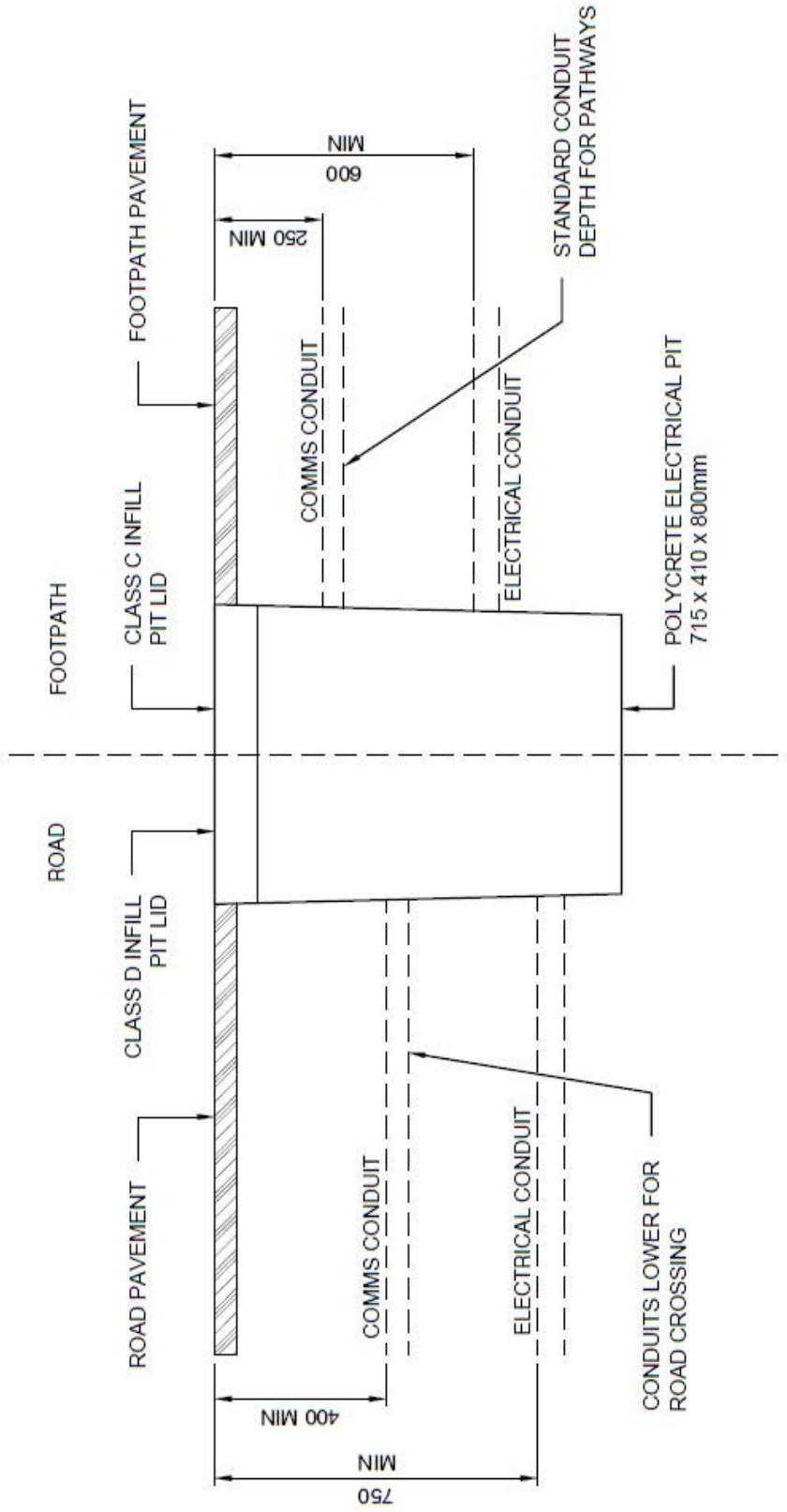
1. All unused conduits must be capped off.
2. Root barriers must be installed in trenches in close proximity to tree roots.
3. All dimensions are in mm.

ANNEXURE 8:
SMART POLE HD BOLT SETUP





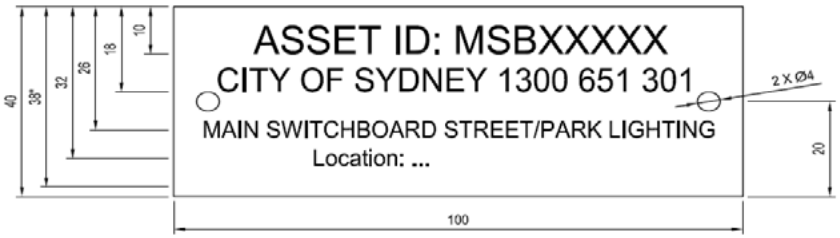
ANNEXURE 9:
GENERAL ELECTRICAL PIT ARRANGEMENT



Standard COS Pit class C to be used for garden areas and class D for crush rock pavement. Pit lid is to have a 75mm diameter Stainless Steel disc engraved “CoS- Electrical” set flush with lid surface using epoxy adhesive. The disc should be slip resistant.

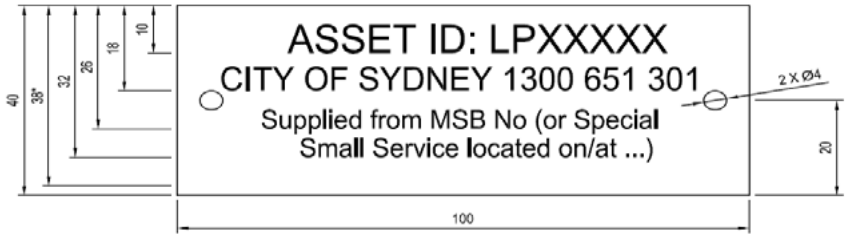
ANNEXURE 10:
ASSET ID PLATE DETAILS

MSB ID PLATE



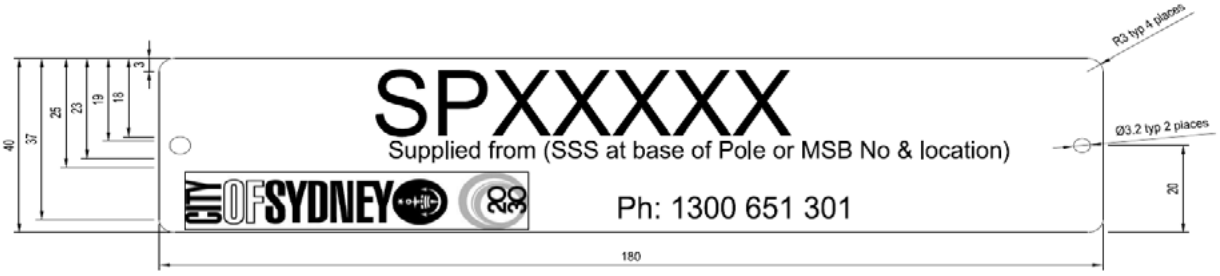
MSB ID PLATE DETAILS

POLE ID PLATE



POLE ID PLATE DETAILS

SMART POLE ID PLATE



SMART POLE ID PLATE DETAILS

NOTES:

- ARIAL NARROW 6mm HIGH FOR THE FIRST LINE OF TEXT
- ARIAL NARROW 5mm HIGH FOR THE SECOND LINE OF TEXT
- ARIAL NARROW 4mm HIGH FOR THE THIRD LINE OF TEXT
- DENOTES SPACE FOR THE 5TH LINE OF TEXT
- MATERIAL IS ALUMINUM 0.8mm THICK
- PLATE IS FITTED WITH 2 STAINLESS STEEL RIVETS OR SELF-DRILLING SCREWS
- TEXT TO BE ENGRAVED

ANNEXURE 11:
LUMINAIRE INFORMATION MINIMUM REQUIREMENTS

Item	Description	Minimum Requirement	Units/Format
1	Maximum spacing achievable in meeting lighting design specification	Lighting design calculations to AS/NZS1158 Part 3.1 & Part 1.1 (AGi32 or Perfect Lite) to provide evidence of luminaire performance declared (including for shielding options)	m
2	Luminaire – Brand, Type & Model No.	Luminaire brand, type and explicit model numbering to be provided	Description in text
3	Luminaire System Wattage	Total luminaire system Wattage to be provided	W
4	Luminaire Initial Lumen Output	Total luminaire initial lumen output to be provided	lm
5	Luminaire System Efficacy (As per LM-79)	Total luminaire system efficacy to be provided	lm/W
6	LED Module – Brand, Type & Model	LED model brand, type and explicit model numbering to be provided	Description in text
7	Rated Life of LED Module Hours at L70	LED model lifetime operating hours to 70% of initial lumen output	hrs@L70
8	Correlated Colour Temperature	4000K	K
9	Colour Rendering Index	75+ Ra	Ra
10	Chromaticity Tolerance - Average Chromaticity Shift (Δu'v') at 6,000 hours	As per SA/SNZ TS 1158.6 Table 5.3	Δu'v' and tolerance
11	Provide options for glare control devices including unit price	It is preferable to have extra glare control options available (eg to address front, rear, front & rear and all around shielding needs)	Y/N
12	Power Supply (Driver) Brand, Type, Model	Power supply brand, type and explicit model numbering to be provided	Description in text
13	Power Supply Dimming & Constant Light Output Capability	DALI 2.0 dimmable power supply required with constant light output capability. 0-10V Zhaga Book 18 power supplies compatible with DALI 2.0	Y/N
14	Power Supply Programming	Is manufacturer willing to pre-program DALI 2.0-enabled power supplies with asset management data to a pre-agreed format?	Y/N
15	Smart Controls and Smart City Readiness	NEMA/ANSI 7-contact socket and, where Zhaga Book 18 compliant interfaces are provided, these should be wired such that both NEMA/ ANSI 7 and Zhaga devices can control LED module switching and dimming.	Y/N
16	Surge Protection Device	20kV / 10kA	kV / kA
17	Ambient Operating Temp Range	To be stated	-X°C & +Y°C

ANNEXURE 11:
LUMINAIRE INFORMATION MINIMUM REQUIREMENTS, CON'T

Item	Description	Minimum Requirement	Units/Format
18	Rated Life of Power Supply	100,000 hours or more preferred	X hrs with y% total failure rate
19	Predicated Power Supply Failure Rate	0.2% per 1000 operating hours	% failure expected per 1000 hours (Based on Telcordia SR-332)
20	LED Drive Current	To be stated	mA
22	Electrical Class	Class I (single insulated) Class II (double insulated)	Y / N Y / N
23	IP Rating – Optical Module	IP66 preferred, IP65 minimum	IPXX
24	IP Rating – Gear Chamber	IP65 minimum	IPXX
25	IP Rating – Power Supply	IP66 preferred, IP65 minimum unless power supply is located within a gear chamber that is IP65 or greater	IPXX
26	Luminaire Body - Aluminium Alloy – Max Copper Content	As per as per SA/SNZ TS 1158.6 2.3.1 If cast or extruded aluminium alloy, LM6 grade alloy or better shall be used unless the manufacturer can provide acceptable evidence of performance outcomes for a differing alloy composition.	%
27	Luminaire Body Finish	Luminaire to be unpainted, Have all stainless steel fittings pre-greased Have regard to the galvanic series and provide a full list of metal components used in the luminaire along with commentary on the corrosion susceptibility of these material combinations Composite materials that are exposed to sunlight UVb tested to a minimum of 2000 hours	Y/N Y/N Description in text Y/N
28	Luminaire Dimensions	Luminaire dimensions to be provided	L x W x H in mm
29	Luminaire IK Rating	Minimum impact resistance (IK) rating of IK08.	IK0X
30	Wiring connection chamber	Have control gear/wiring connection chamber accessible without the use of tools. Have removable covers secured to fitting in open position and self-supporting during connection/maintenance	Y/N Y/N

ANNEXURE 11:
LUMINAIRE INFORMATION MINIMUM REQUIREMENTS, CON'T

Item	Description	Minimum Requirement	Units/Format
31	Smart Controls Readiness	Top or bottom mounting acceptable. Preference is for luminaires with both NEMA/ ANSI C136.41 compliant 7-contact and Zhaga Book 18 compliant interface	Description in text
32	ROHS 2 Environmental Compliance	ROHS 2 environmental compliance preferred Suppliers are required to comment on environmental soundness of design and materials used in the manufacture of items offered. In particular, reference to: a) Management of waste reduction. b) The use of re-usable and/or recyclable packing. c) Extended producer responsibility for safe recycling or disposal of materials at the end of their life.	Y/N
33	Does the luminaire have an existing approval under the NSW Energy Savings Scheme?	Approval or willingness to seek approval (if required under ESS Rules)	Y/N (If N, state willingness to apply for approval)
34	Luminaire optic/lens UV stabilisation method	Substantiation that degradation is insignificant over useful lifetime	Description in text
35	No Moving Parts	All luminaires shall have no moving parts (for example fans for thermal management)	Indicate Y/N
36	Component Fixing Devices	Toggle latches, catches, clips and hinges shall be stainless steel of not less than grade 304. In order to avoid electrolysis corrosion, brass and other copper alloys shall not be used in contact with aluminium or aluminium alloy. Control gear/ terminal block chamber shall be accessible without the use of tools. Where toggle latches are used to secure an external supplementary visor, they shall be capable of maintaining the IP rating of the optical chamber throughout the design life of the luminaire as well as being capable of resisting inadvertent opening by animals.	Indicate Y/N for each item

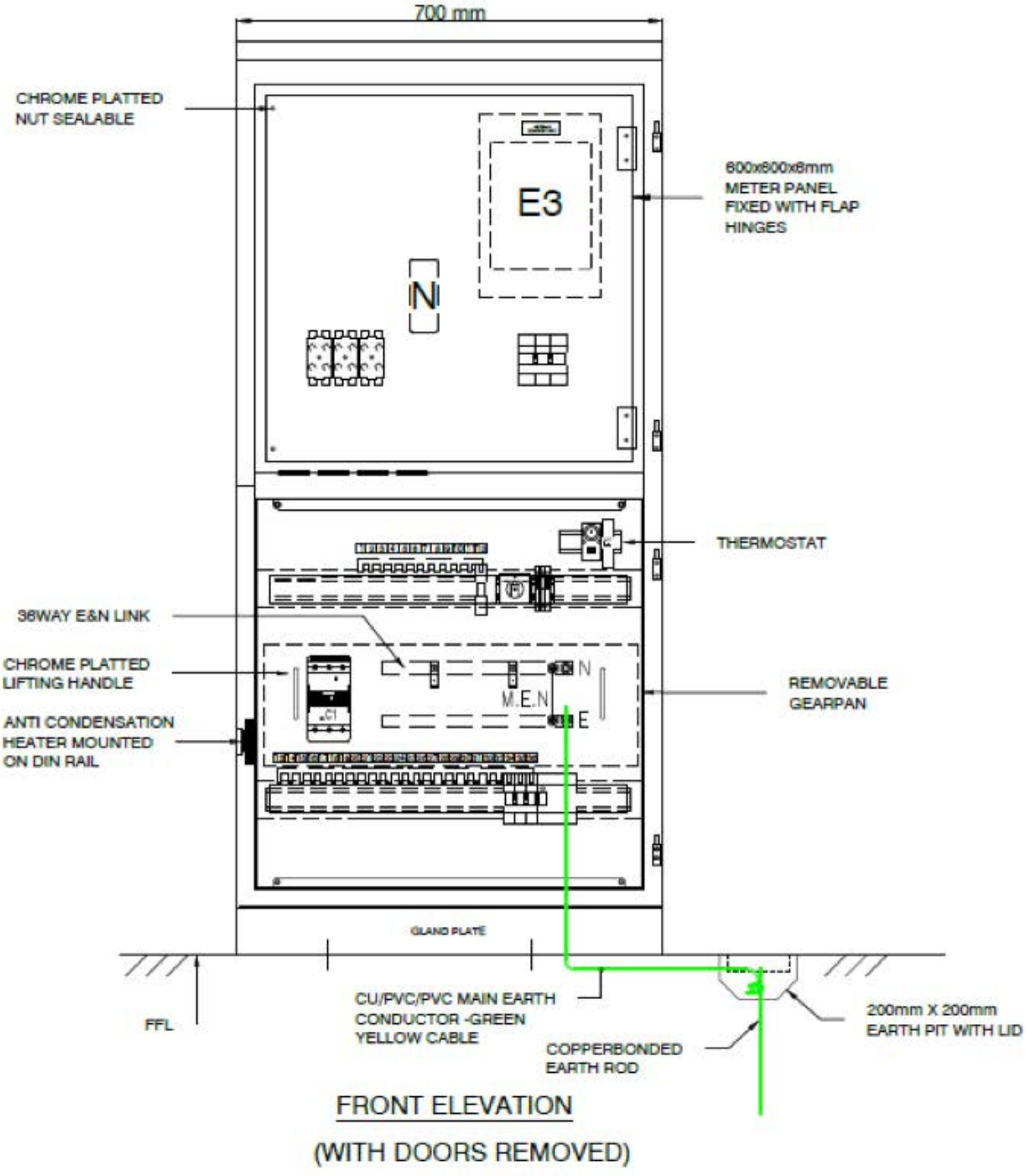
ANNEXURE 11:
LUMINAIRE INFORMATION MINIMUM REQUIREMENTS, CON'T

Item	Description	Minimum Requirement	Units/Format
37	Supporting Documentation (Provide ID number for relevant file)	Confirm that the following documentation and supporting material (with test reports from a NATA-accredited laboratory or a laboratory whose accreditation is recognised by NATA under the mutual recognition scheme) is available if your product is short listed: 1. Product brochures, technical data sheets (excerpts only, as applicable to the specific product) and dimensioned drawings. Do not provide full range catalogue. 2. IESNA LM-79 test report 3. IESNA LM-80 and IES TM21 calculations and extrapolations 4. Test report or material batch evidence of aluminium alloy copper content 5. Ingress protection test report as per the requirements of AS/NZS60598.1 6. Resistance to external mechanical impact as per AS/NZS 60598.2.3 7. Impulse voltage test as per Clause 5.5 of SA/SNZ TS 1158.6 8. Thermal endurance and thermal testing requirements as per Clause 5.6 of SA/SNZ TS 1158.6 9. Lens material datasheets demonstrating UV stability 10. A luminous intensity distribution Table (I - Table) for the luminaire in CIE and IES file formats corresponding to the LM-79 report provided 11. Photometric file (IES or CIE) 12. Perfect Lite or AGi32 sample installation analysis including a summary table for inputs to demonstrate conformance 13. A polar diagram clearly identifying peak intensity at 70, 75 and 80 in cd 15. ISTMT (In-SITU Temperature Measurement Test) report	Indicate Y/N for each item (and explanation for each negative response)

ANNEXURE 11:
LUMINAIRE INFORMATION MINIMUM REQUIREMENTS, CON'T

Item	Description	Minimum Requirement	Units/Format
37 Con't	Supporting Documentation (Provide ID number for relevant file)	16. One operational demonstration sample luminaire of the exact specification tendered, wired in an electrically safe manner with 3m of electrical flex and 3-Pin mains plug 17. Supplier's current Quality Assurance accreditation certificate in conformity with AS/NZS ISO 9001 or equivalent international standard. 18. The supplier shall provide with the offer information on: a. The period of service achieved by items offered within Australian service conditions. b. Customers who have a service history of the items offered. c. Contact names and phone numbers of relevant employees of those customers who can verify the service performance claimed. 19. Requirements beyond the scope of SA/SNZ TS 1158.6: a . Insulation Resistance Test – Clause 8.3.1 of AS 3100 b. Insulation resistance shall be measured at a voltage of 500 V d.c. c. The resistance between live parts and the external metallic body shall be not less than 1 MΩ d. High Voltage (Electric Strength Test) – Clause 8.4.2 of AS 3100 e. Test shall be applied as per clause 8.4.5 of AS 3100 and there shall be no disruptive discharges, that is, flashovers of insulation punctures during any high voltage test f. Spectral distribution graph	Indicate Y/N for each item (and explanation for each negative response)

ANNEXURE 12:
MAIN EARTHING SCHEMATICS



FRONT ELEVATION

(WITH DOORS REMOVED)

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH 5.13 MAIN EARTHING REQUIREMENTS.
2. EARTH CABLE SHALL BE RUN IN DIA PVC RIGID HD CONDUIT.
3. EXPOSED EARTH ELECTRODE AND CLAMP TO BE GALVANISED.
4. MAIN EARTH CONDUCTOR SIZE TO BE CALCULATED BASED ON THE FAULT LEVEL
5. EXPOSED EARTH ELECTRODE TO BE INSTALLED IN A PVC CONDUIT

EARTH PIT PHOTO

B1 Preliminaries and General Construction

Contents

B1 PRELIMINARIES AND GENERAL CONSTRUCTION

Contents

B1 PRELIMINARIES AND GENERAL CONSTRUCTION

Contents

B1 PRELIMINARIES AND GENERAL CONSTRUCTION

1.1 COORDINATION

The Service Provider will be responsible for coordination with other development works that could impact on the Works. This includes commercial and residential developments as well as the City's other Works, maintenance and upgrading work by services authorities, and any other work that may interface with the Works.

The typical issues and specific interfaces that must be considered include:

- Timing of the development
- Special requirements of the development
- The extent, location and timing of the services to be coordinated as part of the development
- Scope of work to be carried out by the development (e.g. underground access)
- Site and construction access requirements and parking and access location(s)
- Liaison with owners and Service Providers for ongoing and new development works to avoid any potential conflicts.

These issues must be taken into consideration in the preparation of the construction program for the Works.

1.1.1 COMPLIANCE CERTIFICATES, APPROVALS AND LICENCES

The Service Provider must apply and obtain all necessary approvals and permits required from all relevant authorities that may be affected by the Works.

Relevant authorities may include:

- AGL (gas installations)
- Ausgrid (electrical services)
- NBN
- Railcorp
- RMS (roads)
- Sydney buses
- Sydney Water (stormwater drainage)
- Telstra

Service Providers at early stages of design shall liaise with the above relevant authorities and obtain current forms from them to be submitted as required by the relevant authorities.

The Service Provider must pay all required fees and charges, exhibit all required notices, and comply with the regulations and requirements of each authority including the City's planning approval process. The Service Provider shall consider the timeframe required to obtain the approvals and permits to avoid delays of the Works.

ELECTRICAL SERVICES

Consultant's electrical certification

Electrical consultants engaged on the project must issue an electrical design and installation certification form. AS3000 certification for electrical installations works is necessary.

Contractor's electrical certification

For all electrical installation works, electrical contractors must issue a Certificate of Compliance for Electrical Work (CCEW) form. CCEW forms are available from the National Electrical and Communications Association (NECA). It is essential that the installation work complies with AS/NZS3000 Wiring Rules and any other relevant standard and is tested as required and certified as being safe.

LIGHTING

Consultant's lighting certification

Lighting engineers' certification must be supplied, confirming that the installed lighting complies with the design intent.

Structural certification for lighting footings by a practising structural consultant is required, stating that the installation is fit for purpose, and complies with the approved design and the site-specific underground obstructions and soil conditions.

Contractor's electrical certification

Electrical contractors must issue a Certificate of Compliance for Electrical Work (CCEW) form for all electrical installation works. CCEW forms are available from NECA. It is essential that the installation work complies with AS/NZS3000 Wiring Rules and any other relevant standard and is tested as required and certified as being safe.

Ausgrid certification

Provided shall be evidence of Ausgrid acceptance of street lighting upgrades on its network.

City of Sydney certification

Provided shall be the City's Test and Completion Certificate as per Annexure 2 in A5 Lighting Design of the Sydney Streets Technical Specifications.

Slip resistance testing and certifications

For trafficable surfaces, it is essential to get a slip resistance certificate from a NATA-approved laboratory. Two such certificates are required: before laying, after laying (if sealed) and after 12 months of use at the end of the Defects Liability Period.

Note that the supplier's brochures will not be accepted and certificates need to be from a NATA-approved laboratory.

Material test results and certifications

For trafficable surfaces, glass walls and fire proofing, it is essential to get safety certificate(s) from a NATA-approved laboratory.

Geotechnical certification

If applicable and if the project calls for major excavations and/or exploration then soil environmental investigation and reporting will be necessary. Geotechnical certification is needed to report on the site's environment before and during the Works. Certification will include soil classification, laboratory/field tests and reports.

Stormwater

The stormwater system in the city is owned in parts by Sydney Water and the City. Sydney Water owns a high percentage of small branch pipelines and pits. Sydney Water has specific requirements that must be met when upgrading or constructing new connections into their system.

The Service Provider shall consider the timeframe required to obtain the approvals and permits to avoid delays of the Works.

1.1.2 ROAD OPENING PERMITS

A Road Opening Permit is to be obtained by the Service Provider from the City prior to the commencement of any work within the public way. A Road Occupancy Licence will have to be obtained from RMS when working on a State Road, when affecting an intersection with traffic signals (typically within 50 metres of the intersection) or when advised by the City when applying for the Road Opening Permit.

Lead times to make such applications are to be managed by the Service Provider so that any delays from this process are minimised.

Any activities and restoration shall comply with *Part B12: Road Opening and Restoration* of the Sydney Street Technical Specifications.

1.1.3 CONSTRUCTION PROGRAMMING AND IMPLEMENTATION

The Service Provider is to plan and stage the Works so that they are carried out in normal working hours and as efficiently as possible.

Works near schools shall be conducted during school holidays unless otherwise approved by the City's Representative.

The program must be developed taking all of the above-mentioned limitations into consideration and all the limitations must be clearly depicted in the program.

Notwithstanding the above-mentioned requirements and limitations, the Service Provider may perform work of an ancillary or minor nature (including defect rectification and clean up) within the project area provided that:

- The site and work being performed is safe and clean at all times
- The site on which the work is being performed is capable of being used as a safe pedestrian thoroughfare for the public
- Such work does not continue for a period beyond two (2) days
- Access to all premises is maintained at all times.

1.1.4 WORKING HOURS

The standard working hours applicable to the City are:

City centre

- 7am to 7pm, Mondays to Fridays
- 7am to 5pm, Saturdays (no work on Sundays or public holidays).

Pyrmont

- 7.30am to 5pm, Mondays to Fridays
- 7am to 3.30pm, Saturdays (no work on Sundays or public holidays).

All other areas

- 7.30am to 5.30pm. Mondays to Fridays
- 7.30am to 3.30pm, Saturdays (no work on Sundays or public holidays).

With the exception of emergency repairs, work outside these hours and weekends will only be permitted with the prior written approval of the City's Representative.

Special time constraints may be applicable to certain special areas such as Martin Place and Pitt Street

Mall in order to not disturb trading activities and to cater for special events. Work must generally be carried out without disturbing trading activities and through-flow of traffic. In this respect, use of noisy equipment such as jackhammers and air compressors during lunch hour (12pm to 2pm) will not be allowed. In certain busy areas of the city such as Pitt Street Mall and Barrack Street, mufflers will have to be used on jackhammers and other equipment to minimise noise, in addition to any WorkCover requirements. Refer to the City's Code of Practice for Construction Hours/Noise within the Central Business District.

Certain annual events such as Anzac Day, City2Surf and Chinese New Year may restrict or deny access and available working hours in certain areas of the city during these events. The Service Provider may be required to be aware of the timing and extent of such events and program all Works to prevent any disruptions to them.

1.1.5 CONTINUITY OF CITY OPERATION

The Service Provider is responsible for maintaining all areas of work in a fully operational condition from the viewpoint of all road users including but not limited to:

- Pedestrians
- Cyclists
- Residents, shopkeepers and occupants of buildings
- Motorists
- Utility services
- RMS
- Sydney Buses
- Emergency services
- Maintenance workers
- Refuse collection.

The Service Provider may be required to provide all necessary temporary equipment to allow continuous operation and safety of the road users and general public during construction of the Works. This temporary equipment will include but is not limited to:

- Traffic lights
- Street lighting
- Road signs
- Lane marking, including sticks and stomps, and adjustment thereof
- Garbage bins
- Access to all properties
- Fences
- Safety barriers for vehicles
- Kerb ramps

All others as required for continuity of use of streets and footpaths safely and as directed by the City's Representative.

The Service Provider is responsible for minimising disruptions, delays, pollution and general nuisance to road users and the general public and particularly owners, tenants and occupants of adjacent buildings and properties during construction.

1.1.6 CITY-SUPPLIED ITEMS

The Service Provider may be required to develop a plan for coordination of City-supplied items. This plan may be required to include timing of the goods required relevant to each construction site, the nomination of external testing agencies who will be confirming product quality, and the applicable procedure of control of customer-supplied product.

The City-supplied items remain the property of the City at all times.

1.1.7 PROJECT MANAGEMENT PLAN

The Service Provider may be required by the City's Representative to lodge all or part of a Project Management Plan (PMP).

The Service Provider's PMP may be a controlled document, and will be updated (and developed as required) as site conditions evolve throughout the course of the construction. The PMP should incorporate the following as a minimum:

Corporate/Project Management System

- Explanation of and relationship to the Service Provider's corporate management system
- Organisational structure
- Statement of responsibilities for personnel appointed to the project
- Relevant corporate policies and procedures
- Project Program involving design, supply, construction planning and construction staging.

Construction Management Plan

Including a Pedestrian and Traffic Management Plan for the whole project as well as separate construction zones

- Services Management and Approval Plan
- Dilapidation Report.

Quality Plan

- Design Plan
- Documents and Records Management Procedure
- Procurement Plan
- Inspection and Test Plans
- Witness and Hold Point Schedule
- Plant and Equipment Register
- Control of Nonconforming Products Procedure
- Corrective and Preventive Action Procedure.

Work Health and Safety Plan

- Site office location, contact phone/email including 24-hour contact details of the Project Manager and Community Liaison Officer
- Compound plan
- Emergency response plan
- Induction procedure
- Plant and equipment inspection, testing and maintenance procedures
- Audit Plan
- Accessibility Plan
- Project Risk Assessment & Mitigation Plan
- Safe Work Method Statements
- Safety Data Sheets for hazardous chemicals and dangerous goods
- Incident Management
- WHS System Compliance
- Training Plan -– Relevant training of personnel and associated qualifications/certificates.

Environment Management Plan

- Waste Management Plan (including waste recovery and recycling)
- Asbestos Decontamination Procedure
- Hazardous Substances (including Fuel) Management
- Stormwater Management & Sediment Control Procedure
- Water Conservation Procedure
- Waste Removal Procedure
- Tree and other Vegetation Management
- Heritage and Archaeological Plan
- Vibration Management Procedure
- Noise Management Procedure
- Dust Minimisation Procedure.

Communications Plan

- Public liaison and issue-solving strategies including a complaints and suggestion register
- Authorities – Contact details for various approvals
- Signs and advertising details and locations

1.1.8 COMMUNICATION

1.1.8.1 COMMUNITY RELATIONS

The Service Provider is required to coordinate and conduct all communication with the property owners, tenants and public throughout the Works on a daily basis and shall be the first point of contact. The Service Provider recognises the importance to the City of maintaining good relations with the community and carrying out the Works with minimal disruption or disturbance to the community and undertakes to do all necessary to maintain such good relations.

1.1.8.2 COMMUNITY LIAISON OFFICER

The Service Provider may be required to appoint a full-time Community Liaison Officer who will maintain positive community relations in a proactive manner and will be the first point of contact for any property owner, tenant and general public enquiries and/or complaints and their satisfactory resolution. The Service Provider and Community Liaison Officer will deal with and resolve complaints as a matter of urgency and all enquiries as a matter of priority. The Service Provider must do all that is necessary to resolve all issues quickly to the benefit of the property owner, tenant or the general public.

1.1.8.3 NOTICE TO OWNERS AND TENANTS

The Service Provider must be proactive in keeping the community informed about the future Works and changes to the ongoing Works. This information must be provided to the community through letter drops, a site information board or door-knocking (personal visits) or a combination of these. The Service Provider must provide notice as below (at a minimum) to owners and tenants of properties located within or around a work site prior to commencing any work:

- Existing Infrastructure Upgrade Notices – four weeks before those works/changes
- Renewal or Replacement Works Notices – two weeks before those works/changes including changes to the buses, relocation of bus stops, changes to parking and other access

Construction Detail – Reminder Notices – door-to-door information (through personal visits) to occupants, two (2) to four (4) business days prior to commencement of those Works.

The community must be updated when the planned work method and program changes.

All information and letter drops to the community must be approved by the City's Representative and must be provided to the City's Representative a minimum of two (2) business days in advance of the required distribution date.

1.2 SITE REQUIREMENTS

1.2.1 SITE INFORMATION

The Service Provider must remain fully aware of the site conditions before and during construction of the Works.

Any additional work requires approval by the City's Representative. The Service Provider is to advise the City's Representative of all consequences, including programming of rectification.

1.2.2 SITE CONSTRAINTS

Further to the constraints and considerations specified elsewhere, the Service Provider's program for the Works and methods of construction must also take into account the following constraints:

- Temporary items, such as interim street lighting and traffic lights, may need to be installed and maintained in an operational condition during the period between the demolition of existing infrastructure and the installation of new infrastructure
- Temporary traffic lights and street lighting may be required to be in accordance with the requirements of the relevant authorities
- Continuity of cycleway operation
- Safe and adequate access is to be maintained at all times for disabled persons along the footpath and to the occupied premises at all times, including wheelchair access
- Clearance must be provided for public transport buses, which may travel in the kerbside lane
- Provision for emergency egress is to be provided through the work area in the event of fire or any other emergency event
- Bus stops and taxi stands will continue to operate adjacent to the Works during the construction period. The Service Provider is to provide clear marking and signage designating the alternate location of bus stops and taxi stands
- The Service Provider is to ensure that access to all properties (residential, office, commercial and all others) affected by the Works is retained
- The operating hours of all businesses, including night-time entertainment facilities, adjacent to the Works must not be disrupted except with the written approval of the business owner
- Provision of any necessary Loading Zones for businesses affected by the Works
- Protection of street trees, buildings and landscaping.

1.2.3 SITE ACCESS AND LIMITATIONS

The Service Provider is required to contain the Works within fenced/barricaded areas that prevent access to the public. Materials and equipment must not be stored outside fenced/barricaded areas, without written approval by the City's Representative.

1.2.4 SITE COMPOUND

It is the Service Provider's responsibility to obtain approval for site compound locations from the City's Traffic Operations, Environmental and Construction & Regulation units, in addition to all other approvals required from other stakeholders, such as the RMS, NSW Police, adjacent land owners and businesses.

The Service Provider may be permitted to put mobile ablution cubicles, if required, along the project length (preferably on side streets), provided separate approval is obtained from the City's Environmental Unit.

The Service Provider may be permitted to store materials within the work site area if space can be made available and providing they can be adequately secured from pedestrians and clear of access paths. Approval must be obtained from the City's Representative and any other relevant Authority. The Service Provider is responsible for the security of all materials and assets in use or left at the work site during the course of the Works and must retain adequate insurances.

1.2.5 PRE-CONSTRUCTION AND OPERATIONAL REQUIREMENTS

1.2.5.1 DILAPIDATION REPORT

The Service Provider may be required to submit a completed Dilapidation Report for the work areas, its surroundings and each private property adjacent to which the work has to be carried out. No Works are to be started prior to the Dilapidation Report

being approved by the City. The Service Provider may be required to arrange for an inspection of the private property at a time that suits both the owner and Service Provider, which may be outside normal working hours. In the course of a single visit, the Service Provider is to obtain all the information required to prepare the Dilapidation Report.

The condition of the adjacent items prior to construction of the Works is to be recorded. The Service Provider shall liaise with owners and tenants of adjacent facilities during the preparation of the dilapidation survey and supply a copy of the survey of each facility to its owner and tenant.

Each Dilapidation Report supplied to the City may be required to contain an acknowledgment by the owner and/or tenant that they have received a copy.

The Dilapidation Report will take the form of a report with digital photographs and a video recording (on a DVD or USB) of all the items within and adjacent to the work and also including both the exterior and interior of neighbouring facilities, including tunnels, basements, and all pits (including interiors). All photos in the report must be suitably labelled with the date and time taken, a statement of the extent and severity of the defect, its exact location, street name, direction faced, and any other relevant comments annotated.

The Dilapidation Report must clearly state the exact location of the defects so that the records can be used efficiently on a later date by anyone. Video and still photography may be required to be of a high quality to show all defects clearly, and must be provided to the City's Representative in a format compatible with a DVD or generic media player or on a USB.

Any cracks that are identified in the Dilapidation Report will be measured and marked with glass 'tell tales' under the supervision of a structural engineer, engaged by the Service Provider.

Particular attention must be paid to the condition of basements, tunnels and waterproofing membranes. Any evidence of leakage or water damage must be recorded.

The Dilapidation Report on service pits will be used to determine entitlement or otherwise for costs associated with repairs to such pits (if required by the City). Repairs to service pits and any other items within and around the Works, resulting from damage caused by the Service Provider while undertaking the Works will not entitle the Service Provider to additional costs.

Scope of Dilapidation Report

The Dilapidation Report must cover the following items as a minimum:

- The complete external facades at the ground and first storeys of all buildings immediately adjacent to and opposite the work site, including buildings in the side streets
- Complete basements and basement skylights
- Trees, shrubs and grasses
- All shopfronts and awnings, air-conditioning units, lighting and other equipment and plant installed on the exterior of buildings
- The interior room surfaces (at minimum, but not limited to, the rear of the external facades)
- All existing street furniture and signage including seats, public telephones, post boxes, parking meters, and the like
- All existing lighting poles, traffic poles and signs
- All existing footpaths and kerbstones
- All existing services and utilities where recording is possible
- All existing pit covers that are to be re-used
- Interiors of all existing service pits
- Raingardens
- Traffic facilities such as thresholds and speed humps
- Particular reference to any infrastructure, which during the execution of the Works the Service Provider will be required to temporarily remove and reinstall or replace at a later date
- A record of the outcome of the inspection of the interior of all existing services and utility pits with the relevant utility authority representative.

The Dilapidation Report must cover any of the above items that are within 6 metres of the Works. Typically, the Dilapidation Report shall also include details of the following:

Materials of construction

- General condition of materials
- Location and description of any defects including structural defects
- Location, size and description of any cracking.

1.2.5.2 RECORD OF DAMAGE

The Service Provider is required to create a Record of Damage for the site which includes both photographs and a statement as to what was damaged, the extent

of damage and how it was caused. This is required to determine who is responsible for damage to City assets should matters be raised in the future. The Record of Damage must document any damage to private property or City assets within the extent of the area occupied by the Service Provider during the Works, or affected by the Works, including areas proposed for storage and floating of plant.

1.2.6 EXISTING SERVICES

Prior to the commencement of any Works, the Service Provider shall use the Dial Before You Dig service to obtain current underground location plans to provide an indication of the presence of underground plant and services in the area of the Works.

It is the Service Provider's responsibility to visually expose the underground pipes and cables manually by hand digging or non-destructive digging techniques. The Service Provider shall take every precaution necessary to secure from damage all existing assets in, or adjacent to, the area of the work.

All damage caused in the execution of Works to any service or other existing Works shall be repaired as soon as possible. The Service Provider shall notify the City's Representative and the owner of the damaged service as soon as possible and at their own expense arrange and execute repairs to the satisfaction of the relevant authority. Where the relevant authority requires its own contractor to carry out repairs, the service provider will be responsible for payment of all costs incurred by the relevant authority in relation to the repairs.

1.2.7 RELOCATION AND ABANDONMENT OF SERVICES

The Service Provider shall notify the City's Representative immediately upon the discovery of services obstructing the Works. The appropriate service authority shall also be contacted if the service is not shown on the underground location plans obtained from the authority, or if they are shown at an incorrect location or depth. The obstructing service may need to be diverted, relocated, removed or abandoned, depending on whether it is live or disconnected. The Service Provider shall liaise with the City's Representative and the appropriate service authority to resolve the issue to their satisfaction.

When required, the Service Provider shall visually expose and clear around the services or other existing Works when and as directed. The removal, diversion or relaying shall be performed by the authorities, unless the Service Provider is directed by the City's Representative that the work be performed by them under the supervision and satisfaction of the appropriate authority.

Any relocated or abandoned services are to be noted in the as-built drawings.

1.2.8 SUPERVISION AND CONTROL

It is the Service Provider's responsibility to ensure that all supervisory and control staff are aware of the accepted practice and methods to be used in undertaking the approved Works.

The Service Provider shall be required to provide a competent Supervisor to be present for the duration of all Works. The Supervisor must be able to effectively communicate in English both verbally and in writing. The Supervisor is required to ensure that the operation is efficiently organised and executed and that the site is safe and accessible in all weather conditions.

1.2.9 ACCESS TO AWNINGS

The Service Provider will conduct all consultation with property owners and tenants regarding any access that may be required to private awnings. The City provides no undertaking to the Service Provider as to the structural adequacy of awnings. Where access to an awning is intended, all the Service Provider's personnel involved in this activity are to be trained and certified in working at heights and have an appropriate safe work method statement for the WHS measures implemented.

1.2.10 PARKING OF VEHICLES

Apart from vehicles that are essential for the Works, no other vehicles may be parked on the site. The Service Provider is responsible for organising the removal of any unauthorised vehicles parked on the site. The Service Provider will be required to obtain all approvals from the City's Construction & Regulation and Traffic Operations units for any required changes to Loading Zones or the parking of residents' and traders' vehicles.

1.2.11 CITY RANGERS

The Service Provider shall keep a copy on site of all approvals and permits relevant to the work for reference by the City's Rangers as required. Any restrictions placed on the Service Provider by a City Ranger will not be a cause for an extension of time or variation.

1.2.12 PLANT AND EQUIPMENT MANAGEMENT

The Service Provider is responsible for the safety and security of all plant and equipment left on site, and the Service Provider may be required to document how it intends to store, secure and/or insure such items.

Materials and equipment may not be stored outside fenced and barricaded areas, without written approval by the City's Representative.

1.2.13 CITY-SUPPLIED ITEMS

All City-supplied items must be marked by the Service Provider as "Property of City of Sydney", and a schedule of supplied and stored items is to be provided to the City's Representative in accordance with the contract provisions, where applicable.

1.3 TRAFFIC CONTROL

1.3.1 GENERAL

The Service Provider shall be required to comply with the requirements of the RMS publication *Traffic Control at Worksites Manual* and *AS 1742.3* for the provision of all necessary signs, barricades, lights and personnel to safely direct vehicles and pedestrians around the site while work is in progress.

The Service Provider shall also be required to comply with traffic and pedestrian control requirements as specifically directed by the City's Representative.

All site personnel employed by the Service Provider must understand and comply with the Traffic Control System being used at that site. All employees engaged in the preparation of Traffic Control Plans or onsite traffic control duties must hold the RMS Traffic Controller Certificate and any associated RMS Certificate as required for implementation of traffic control plans, including set-up, select/modify, and design/audit traffic control plans.

The Service Provider is responsible for monitoring and auditing traffic and pedestrian control at the site and ensuring that any deficiencies are promptly corrected.

The Service Provider is to actively liaise with the City's Representative on traffic and pedestrian control procedures and all other safety matters and may include situations where it is appropriate to barricade, provide temporary safety barriers or provide containment fencing to isolate the work site.

The Service Provider shall notify all authorities listed below if affected by the proposed work:

- RMS
- NSW Police
- Emergency Services Authority (Fire and Ambulance Services)
- Sydney Buses, taxis and shared cars – where a bus route or a bus stop is affected.

1.3.2 TRAFFIC MANAGEMENT PLAN

The Service Provider may be required by the City's Representative to prepare and obtain approval for a Traffic Management Plan for the Works.

The Traffic Management Plan, as a minimum, must include:

- Details of traffic staging arrangements associated with each Works' phase and the associated time periods
- Copies of Road Opening Permits and any other approvals from relevant authorities
- Traffic Control Plans, indicating specific traffic control arrangements
- Vehicle Movement Plans indicating the proposed travel paths for vehicles to access the work site and to enter, leave or cross the traffic stream
- Provision of access to adjoining properties impacted by the Works
- Provision of safe access for pedestrians and cyclists
- Proposed parking restrictions, including details of existing parking provisions affected and allowances for buses and taxis if applicable
- Provision of proposed temporary bus zones and confirmation of agreement by Sydney Buses
- Details of any proposed detours
- Names and contact details of all nominated personnel responsible for the traffic control devices, including details of out-of-hours contacts.

The Service Provider is responsible for ensuring that the required approvals are obtained for any temporary diversion of traffic or temporary removal of kerbside parking.

The costs relating to the preparation and approval of Traffic Management Plans are to be covered by the Service Provider.

1.3.3 TRAFFIC CONTROL PLANS

The Service Provider shall prepare Traffic Control Plans (TCPs) in accordance with the *RMS Publication Traffic Control at Worksites Manual* and *AS 1742.3* to warn and guide traffic around, past or through the work site and/or temporary hazard. The TCPs shall be approved by the City's Representative prior to the commencement of the work activity on site.

The selection and modification of standard TCPs or the design of project-specific TCPs shall be undertaken by personnel holding relevant RMS qualifications for Implement Traffic Control Plans or Prepare a Work Zone Traffic Control Plan respectively.

1.3.4 TEMPORARY FENCING AND BARRICADES

The type of temporary fencing to be used must be safe and suitable for the Works, workers and the public. The Service Provider must maintain the fencing to a high standard during construction by keeping it clean, tidy and free from posters and graffiti. Fencing shall be of the same colours and approved by the City's Representative. The feet on all temporary fencing must be oriented to not interfere with the safe passage of pedestrians. When temporary fencing is being used on an uneven surface or during windy conditions, the feet of the temporary fencing should be weighted down with sandbags or something similar to increase stability.

In areas of high pedestrian activity and upon approval of the City's Representative, plastic water filled devices may be used as a containment fence for workers or pedestrians.

1.3.5 SAFETY BARRIERS

Where required by the TCP, safety barriers shall be provided to protect work areas and pedestrian areas from the traffic. Only safety barriers listed on the RMS-accepted safety barrier systems register shall be used.

In accordance with the RMS Traffic Control at Worksites Manual, plastic water filler devices do not satisfy the requirements for use as a safety barrier and shall only be used as a containment fence for workers and pedestrians or as a delineation device. However, in accordance with the RMS Technical Direction RTD 2011/001 Safety Barriers, such devices, subject to compliance with usage and placement restrictions, may be appropriate for single shift usage. Any use of plastic water-filled devices must be approved by the City's Representative.

All barriers shall be correctly installed and maintained with holes to receive posts and chain mesh fencing.

Any temporary hoarding and scaffolding shall be designed and executed in accordance with the *City's Guidelines for Hoarding and Scaffolding*.

1.3.6 WORK ZONE CLEARANCE

Safe clearances between workers and through traffic shall be provided in accordance with the *RMS Traffic Control at Worksites Manual.*

The Service Provider shall allow for delineation devices, safety barriers, temporary speed limit reductions and the provision of a traffic controller as required to meet the requirements of the RMS manual.

1.3.7 SIGNAGE AND LIGHTING

The Service Provider shall provide signage on site in accordance with the approved Traffic Control Plan. Signs shall be erected and removed in sequence and as outlined in the *RMS Traffic Control at Worksites Manual.*

All signs are to be designed and manufactured in accordance with *AS 1743.*

Where there is no existing street lighting or it is deemed insufficient for night works, the Service Provider may be required to provide floodlighting of the worksite and/or the traffic controllers.
The requirement for floodlighting shall be determined by the City's Representative or the Service Provider.

1.3.8 FOOTPATH ACCESS AND ACCESS TO PRIVATE PROPERTIES DURING CONSTRUCTION

A minimum 1.2-metre clear width must be maintained for pedestrian access at all times along footpaths or roadways, pedestrian and kerb crossings and connections to adjoining properties. A greater clear width will be required by the City's Representative where high levels of pedestrian traffic exist, such as in the Sydney CBD.

Access to shops must be available for the public during business hours. Where excavation works limit accessibility to a shop during business hours, the Service Provider will provide safe and secure temporary access ramps of 1.2-metre clear width, incorporating handrails where considered necessary by the City's Representative.

To maintain safety and keep debris from the inside of properties, mats such as synthetic turf may be required to be securely placed in all footpath areas where the following circumstances prevail:

- A transition from a temporary ramp to a footpath or shop
- A temporary ramp from road level to footpath level
- Any unbound surface excavated as part of the Works.

All temporary ramps must be in accordance with current Disability Standards for Access, with no trip hazards.

Site management is to be in accordance with the requirements of the current edition of the RMS publication *Traffic Control at Work Sites*. With regard to separation of the pedestrians from the work site, there are two common standards:

- Areas outside of shops – the separation fence may be required to be water-filled plastic barriers
- For areas outside private residences – either as specified above or T-top portable orange bollards with 1-metre-high orange Parra webbing mesh.

In most cases, the Service Provider will be required to provide cold mix asphalt to join surfaces of different levels along the pedestrian/traffic pathways and remove any trip hazards as a temporary precaution.

Adequate vehicular access to properties shall be maintained at all times and may include the temporary installation of road plates where appropriate.

1.3.9 LOADING AND UNLOADING DURING CONSTRUCTION

Construction materials must be delivered during non-peak periods. It is the Service Provider's responsibility to obtain approval and permits for any such loading/unloading and barricading. Construction materials are to be stored only within the area under construction, and to the satisfaction of the City's Representative.

The following requirements apply:

- All loading and unloading associated with construction may be required to be accommodated on the site
- If, during excavation, it is not feasible for loading and unloading to take place on the site, the City may consider the provision of a Work Zone. The Service Provider is responsible for applying to, and obtaining approval from the City, for a Work Zone
- The Service Provider must obtain approval from the City's Traffic Operations unit.

1.4 ENVIRONMENTAL PROTECTION

1.4.1 ENVIRONMENTAL PERFORMANCE

The City is committed to being a leading environmental performer in its operations and activities. The Service Provider may be required to maintain processes and procedures that demonstrably implement an environmental management systems approach to maintaining and enhancing environmental performance in accordance with the City's policies.

1.4.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The City is committed to the protection of the local environment and the provision of safe conditions for the public. Breaches of environmental law will not be tolerated and may result in the City cancelling related agreements and/or contracts.

The Service Provider may be required by the City's Representative to demonstrate that it has a robust Environmental Management System that addresses the following environmental management considerations:

- Ensuring that Supervisors and personnel on the site are aware of the necessary environmental and safety protection requirements
- Ensuring that supervisors and personnel have adequate training in environmental management
- Having clear, documented and adopted environmental protection procedures in place
- Preventing pollutants from entering drains or waterways via drainage systems, e.g. via gutters, stormwater grates and stormwater pits
- Minimising the release of noxious gases to the atmosphere from plant and vehicles
- Minimising the release of dust into the environment
- Minimising the generation of excessive noise from plant and operations
- Avoiding the use of imported timber products that have no environmental certification

- Controlling and reducing waste by effective containment, separation, recycling and collection services
- Recording amounts of waste (sent to landfill) and recycled materials exported from the work site using waste data recording templates provided by the City when directed to do so
- Submitting waste and resource recovery data to the City in a satisfactory template format, including waste and recycling contractors used
- Provision of adequate protection to prevent sand, sediment and topsoil from being washed, carried or blown from construction and other work sites
- Demonstrating a clear preference for using recycled raw materials and products with recycled content rather than virgin materials
- Anticipate and plan for unexpected incidents
- Having a definite plan of action in the event of a pollution incident and the resources on hand to minimise environmental damage
- Provision of adequate protection to existing trees, raingardens and nature strips from being damaged or contaminated by construction activities
- Ensuring that worksites are maintained in such a condition as to provide a safe environment for pedestrians, personnel and passing vehicles
- Maintain infringement, penalty and provisional improvement notices issued by regulators (e.g. NSW EPA) and Corrective Action Notices issued
- A Principal Contractor may generally use their own systems, tools and forms (e.g. induction tools and training records) to meet the above responsibilities with the exception of documenting the amount of waste and recycled materials, for which the City's waste template must be used for reporting information.

1.4.3 ENVIRONMENTAL INITIATIVES AND TECHNOLOGY

The Service Provider is encouraged to submit best practice or novel environmental initiatives or advances in technology for inclusion in the Works for consideration and approval by the City's Representative.

1.4.3.1 SUSTAINABLE MATERIALS IN CONSTRUCTION

The City's Sustainable Sydney 2030 vision entails reducing its carbon footprint by 70 per cent by 2030. Therefore, minimising the greenhouse gas impact associated with its operations and infrastructure is important. One of the key pathways to lowering the emissions associated with infrastructure is through the replacement of standard construction materials with more sustainable and lower embodied emission options.

There are standards and guidelines that cover the replacement of construction materials with more sustainable options. The City endorses the use of such materials and highly regards the use of innovative materials, products or processes that reduce environmental impact through, for example, less carbon-intensive manufacturing processes. Obviously, such materials are still required to meet, or exceed, the standards required for construction.

The reduction of standard construction volumes of material is an important method of reducing embodied emissions and other environmental impacts, and can be achieved through sophisticated design. In addition to method, material replacement with more sustainable options can also reduce impacts.

Further information about the combination of options available for material replacement can be found in relevant sections, though importantly, two main areas have been prioritised based on their contribution to overall infrastructure emissions. These are concrete (used in infrastructure such as paths, pipes, drains, kerb and guttering) and asphalt (used in items such as roads and some pathways).

Asphalt has a substantial level of embodied emissions and therefore the City would like to source projects that substitute it with more sustainable options for both the process temperature and the virgin aggregate components.

Additionally, the City would prefer and encourage recycled/reclaimed water (e.g. captured rainwater) to be used wherever possible in place of mains potable water in the proposed projects.

1.4.4 ENVIRONMENTAL PROTECTION

The Service Provider shall ensure at all times that the requirements of all relevant Acts concerning noise and air, water and any other pollutants are fully observed. Key legislation includes:

- *Protection of The Environment Operations Act, 1997*
- *Environmental Planning and Assessment Act, 1979*
- *Pesticides Act, 1999*
- *Contaminated Land Management Act, 1997*

- *Poisons Act, 1966*
- *Work Health and Safety Act, 2011*
- *Roads Act, 1993.*

The Service Provider is required to take all steps necessary to protect the environment and in particular to provide erosion and sediment control measures described on drawings and any other additional measures required by the Environment Protection Authority or the City or other relevant authorities.

1.4.5 WATER, STORMWATER AND SEDIMENT CONTROL

The Service Provider shall comply with the requirements and recommendations of the NSW Office of Environment and Heritage, *Managing Urban Stormwater: Soils and Construction* (commonly known as the "Blue Book") published by the New South Wales Government, for the design and construction of erosion and sediment control measures. A sediment and erosion control plan shall be submitted to the City for approval prior to commencement of the Works or as part of the Construction Certificate approval package.

Stormwater and sedimentation control measures may be required to include, but are not be limited to, the following:

- The installation of sediment control measures at existing drainage inlet pits before the removal of topsoil or pavement materials and commencement of earthworks for formation within the catchment area of each inlet pit
- The prompt completion of all permanent and temporary drainage works, once started, to minimise the period of exposure of disturbed areas
- The limitation of areas of erodible material exposed at any time to those areas being actively worked
- The protection of all stockpile areas with diversion drains, spoil heap covers and/or sediment control fences that prevent the migration of sediment onto surrounding road or pedestrian pavements or stormwater drainage inlet pits.

Sediment control devices and their sediment contents shall be maintained in good order (emptied of sediment regularly) throughout the duration of Works and, where required, captured sediment may need to be disposed of offsite in an approved manner.

Works are to be planned and constructed so that drainage flow is maintained away from buildings and private properties at all times. This may involve the use of temporary means to directly drain clean run-off to the stormwater system or to store and then discharge water, using pumps if required.

1.4.6 NOISE AND DUST

All work including demolition, excavation and building work must comply with the *City's Code of Practice for Construction Hours/Noise 1992, Safe Work Australia Code of Practice for Managing Noise and Preventing Heating Loss at Work 2015 and the Australian Standard AS 2436-2010 Guide* to noise control on construction, demolition and maintenance sites, and any conditions of Development Consent.

The following appliances may not be used without written approval by the City's construction regulation unit:

- Appliances that emit noise of a highly intrusive nature (such as pile drivers and hydraulic hammers)
- Appliances that are not listed in Groups B, C, D, E or F of Schedule 1 of the City's *Code of Practice for Construction Hours/Noise 1992,* and *Australian Standard AS 2436-2010.*

It is the responsibility of the Service Providers and the contractors to obtain approval for any proposed variance to these noise levels from the City's construction regulation unit.

Cutting of pavers must be carried out in such a manner that the impact of noise and dust pollution on the public is avoided. This may require cutting offsite or away from the Works area.

The Service Provider is to use all means necessary to reduce and avoid dust and noise pollution. The Service Provider may be required by the City's Representative to monitor noise levels associated with work being undertaken and to provide reports at their own expense.

1.4.7 PROTECTION OF TREES

The Service Provider must comply with the City's Tree Management Controls contained within the Development Control Plan and Local Environment Plan, Street Tree Master Plan and/or any Interim Development Order. The Service Provider shall plan all operations to ensure that there is no damage to any trees outside the limits of approved clearing or trimming specified or directed by the City's Representative. No trees shall be removed, damaged or pruned by the Service Provider or subcontracted Service Providers other than those specified in the approved construction documentation and those indicated by the City's Representative.

Where branches intrude on the working area, any necessary trimming shall only be carried out by a qualified arborist approved by the City's Representative. Separate approval for pruning and trimming may be required from the City before the work is carried out.

Service Providers should consider and apply tree protection as described in the Street Tree Master Plan, which includes specific measures such as trunk wrapping with hessian where this can enhance the level of protection provided to the trees

If any tree is damaged during construction activities, see 1.4.7.8 Damage to trees during construction, for guidance.

1.4.7.1 STAFF TRAINING AND INDUCTION ON TREE PROTECTION

All staff working on the contract shall be adequately inducted to ensure they are aware of the relevant tree protection requirements.

1.4.7.2 TRUNK PROTECTION

Trunk and major limb protection shall be installed to any tree within 5 metres of the work site prior to any delivery of machinery or Works commencing, and shall remain in place for the duration of the Works. It shall consist of wrapping of each tree trunk and any major branches within the work area with hessian or similar material to limit damage, then spacing planks (50mm x 100mm or similar), at 100mm intervals, fixed against the trunk with tie wire or strapping. The trunk protection shall not be fixed to the tree in any instance, or in any fashion, e.g., no nails or screws are to be used.

1.4.7.3 TRENCHING AND EXCAVATION NEAR TREES

During any trenching or excavation works, the use of mechanical equipment must stop if tree roots greater than 50mm diameter are encountered. Approval must be sought from the City of Sydney Street Tree Coordinator (phone number 02 9265 9333) to cut any root greater than a 50mm diameter.

Excavation shall be done by hand, or other approved non-destructive method, in any area known to, or suspected of having roots larger than 50mm in diameter.

1.4.7.4 PRUNING

The Contractor shall not undertake pruning of any branch of any street tree without permission. If pruning or small branches or limbs are required for machinery access, or any other reason, contact the City's Street Tree Coordinator.

1.4.7.5 KERB REMOVAL ADJACENT TO TREES

Existing sections of kerbs adjacent to any street tree shall not be removed without approval from the Street Tree Coordinator. Removal of kerbs adjacent to mature trees can cause trees to become unstable and fail.

1.4.7.6 SIGNS – TREE PROTECTION

Temporary signs, or any other items, shall not be fixed or attached to any street tree.

1.4.7.7 STOCKPILING AND STORAGE OF MATERIALS

Fuel or any type of liquid waste shall not be stored or disposed of at the base of any street tree.

1.4.7.8 DAMAGE TO TREES DURING CONSTRUCTION

Any damage sustained to any street trees is to be immediately reported to the City's Street Tree Contract Coordinator, to determine the appropriate response for maintaining the health and structural integrity of the tree/s. Should any damage occur to the City's trees and not be rectified by the Contractor to a satisfactory standard, as directed by the City's Street Tree Coordinator, the City's will undertake the necessary works, which may include the full replacement of trees, and all associated costs will be recovered. Damage to street trees may also result in prosecution being sought under Sections 626 and 629 of the Local Government Act for an offence where such damage occurred willfully or negligently. Significant financial penalties can be imposed for such offences.

1.4.8 WATER DAMAGE

All necessary action shall be taken by the Service Provider to prevent excessive surface and/or sub-soil water from interfering with the progress of the Works. The work area shall be kept free from such water.

All reasonable measures shall be taken to prevent any damage to the Works by water due to flood, seepage or other causes.

Any work or material damaged by water from any source shall be removed, replaced with fresh material and reconstructed by the Service Provider.

Provision shall be made for the temporary drainage of any road boxing excavation or pavements in the event of rain. The Service Provider shall ensure that this temporary drainage does not cause erosion or siltation of any existing drainage works.

Appropriate arrangements must be made to provide anti-siltation measurements to prevent any harmful matters entering the stormwater system.

1.4.9 BURNING

No fires or burning of cleared material or rubbish will be permitted under any circumstances.

1.5 WORK HEALTH AND SAFETY (WHS)

1.5.1 WORK HEALTH AND SAFETY

Service Providers, working as contractors on behalf of the City, will be engaged in accordance with requirements defined in the City's *WHS Policy* and its Safety Management System Procedures.

The Service Provider holds full responsibility for site personnel, members of the public and all WHS issues arising in relation to the Works.

The Service Provider may be appointed by the City as the Principal Contractor for the purposes of the *Work Health and Safety Act and Regulations 2011*.

1.5.2 RISK MANAGEMENT

The Service Provider must manage risks to health and safety associated with the following:

- The storage, movement and disposal of construction materials and waste at the site
- The storage of plant on site that is not in use
- Traffic in the vicinity of the site that may be affected by construction work carried out in connection with the Works
- Essential services at the site.

When the Service Provider's or a subcontractor's tools and forms are used, documented evidence shall be maintained on site and made available for inspection by the City's Representative during routine WHS compliance checks.

1.5.3 PRINCIPAL CONTRACTOR

A Principal Contractor is required for any site where Works:

- Exceed a value of $250,000; or
- Do not exceed a value of $250,000 but involve high-risk construction work; or
- Involve demolition or asbestos removal for which a licence is required under Chapter 8 of *NSW Work Health and Safety Regulation 2011*.

1.5.3.1 PRINCIPAL CONTRACTOR REQUIREMENTS (CONSTRUCTION)

The Service Provider will be appointed by the City as the Principal Contractor where required at clause 1.6.3. The Service Provider as Principal Contractor must comply with all WHS laws and legislative responsibilities and duties.

For sites where the City has control or where the contract does not stipulate who is the Principal Contractor, the City will assume the role of Principal Contractor for the purposes of meeting WHS legislative requirements in relation to construction work. The City will provide the Service Provider with written confirmation in cases where it assumes the role of Principal Contractor.

Where a designated major project is undertaken, the Principal Contractor will have the capacity to engage the services of subcontractors and/or suppliers to meet project requirements.

A pre-commencement meeting between the City's Representative and Principal Contractor will take place to determine and agree on the monitoring and verification activities to be conducted for the duration of the contract. The type and frequency of monitoring and verification activities is subject to the risk level of the contract. The agreed arrangements will be documented and maintained in accordance to SMS System Procedure Document Management.

1.5.3.1.1 MINIMUM REQUIREMENTS

A Principal Contractor will be required to perform the following minimum tasks:

- Conduct a risk assessment for the Works and forward it to the City's Representative
- Develop, implement, maintain and keep up to date a Work Health and Safety Management

Plan (WHSMP) that complies with the City's Safety Management System requirements
- Provide the City's Representative with a copy of the WHSMP for review
- Develop and maintain an up-to-date hazard or WHS risk register for the Works. This may include copies of hazards identified through risk assessments undertaken or Safe Work Method Statements (SWMS)
- Provide the City's Representative with copies of the high-risk SWMS for review by the City, which must comply with the SWMS Review form
- Maintain a register of hazardous chemicals and copies of current safety data sheets
- Maintain a register of plant and equipment including records of inspection, testing and maintenance activities
- Maintain a register of Personal Protection Equipment issued to staff
- Keep records of any atmospheric testing or health surveillance undertaken for a period of 30 years (where required, typically for asbestos decontamination)
- Ensure all workers on site have completed the General Induction for Construction Work in NSW (White Card) training, or the equivalent
- Conduct and keep induction records for all persons carrying out construction work on the site, including:
    - Copies of records for General Induction for Construction Work in NSW (White Card), or the equivalent
    - Evidence of health and safety induction training related to the work activity.
- Conduct and record site-specific WHS induction training for all persons who enter the site
- Conduct and record daily pre-work briefings and toolbox talks
- Record and maintain workplace incident and investigation reports
- Maintain infringement, penalty and provisional improvement notices issued by regulators (e.g. SafeWork NSW) and Corrective Action Notices issued by the City
- Provide a copy of the City's Contractor Safety Handbook outlining the City's onsite requirements
- Keep copies of induction training records and site-specific induction topics covered for a period of three (3) years after the completion of the contract.

The Principal Contractor may use their own systems, tools and forms (e.g. induction tools or forms) to meet the above responsibilities.

1.5.3.1.2 DISPLAY SIGNAGE

The Principal Contractor must ensure signs are installed that:

- Show the Principal Contractor's name and telephone contact numbers (including an after-hours telephone number)
- Show the location of the site office for the project, if any
- Are clearly visible from outside the site, or the general area where the work is being undertaken.

1.5.3.1.3 RISK MANAGEMENT

The Principal Contractor must manage risks to health and safety and the environment. In particular, the risks associated with the following must be managed:

- The storage, movement and disposal of construction materials, hazardous materials and waste
- The storage of plant on site that is not in use
- Traffic in the vicinity of the site that may be affected by construction work carried out in connection with the Works
- Essential services at the site.

Where a Service Provider or subcontractor's tools and forms are used, documented evidence shall be maintained on site and made available for inspection by the City's Representative during routine WHS compliance checks.

The City's Representative must ensure that the supervisory personnel from the Principal Contractor are inducted using the "Principal Contractor Induction Form" and be provided with the City's Work Health and Safety Standards – Construction document.

1.5.3.2 WORK HEALTH AND SAFETY MANAGEMENT PLAN

The Principal Contractor shall provide a compliant Work Health and Safety Management Plan (WHSMP) to the City's Representative for review at the time the contract is signed and revisions shall be submitted as required.

- The WHSMP shall comply with the City's Work Health and Safety Management Plan form

- The WHSMP shall be maintained and kept up to date at all times
- Any updates shall be forwarded to the City's Representative within 48 hours
- The WHSMP will provide guidance for workers to comply with City's Work Health and Safety Standards – Construction requirements.

The minimum information that must be defined in the WHSMP includes:

- Project description
- Responsibilities
- High-risk construction work
- A risk management methodology and risk assessment
- Arrangements for ensuring compliance (e.g. inspection and testing)
- Arrangements for induction and safety training
- Arrangements for traffic management
- Arrangements for consultation and communication
- Emergency management
- Health and safety performance monitoring
- Managing of incident recording and investigation
- Site safety rules
- Safe Work Method Statements and procedures for the type of work being performed.

1.5.3.3 SUPPLY OF DOCUMENTATION

At a minimum, the following documents shall be made available on site for inspection by the City's Representative during the project:

- Work Health and Safety Management Plan
- Safe Work Method Statements (SWMS)
- Plant registers
- Hazardous substance registers (including Safety Data Sheets)
- Induction records
- Site inspection results
- Emergency plans and evacuation procedures
- Traffic management plan
- Daily pre-work briefings and toolbox talks
- Records of training and/or competency
- Incident and investigation reports
- Infringement/penalty notices issued by regulators.

1.5.4 CONTRACTOR REQUIREMENTS (CONSTRUCTION) – NOT REQUIRING A PRINCIPAL CONTRACTOR

Workplaces where the City has control over the workplace and where the contract does not stipulate the requirement for a Principal Contractor, the City will assume the role of controller of the work premises (refer to the definition section) for the purposes of meeting WHS legislative requirements in relation to construction work.

These contractors shall:

- Conduct a risk assessment for the task/project
- Prepare site-specific Safe Work Method Statements or operational procedures for the Works to be undertaken which meet the requirements required by the City
- Provide the City's Representative with copies of the high-risk SWMS for review by the City, which must comply with the Safe Work Method Statement Review form
- Provide site-specific induction training and supervision for the duration of the task.

1.5.5 RISK MANAGEMENT WORKSHEET

A Risk Management Worksheet (RMW) will be completed by the City to identify general WHS and environmental impact issues relating to the Works.

The RMW does not reduce the duties of the selected Service Provider under the WHS Regulations in identifying the hazards and eliminating or controlling the risks during construction works.

The RMW has been provided as a pre-tender inclusion to detail the specific requirements of the City and those control measures to be considered and/or applied during the Tender and Construction Phase of the Works.

1.5.6 SAFE WORK METHOD STATEMENTS

The Principal Contractor must prepare Safe Work Method Statements (SWMS) for all high-risk construction work activities as defined in Part 6 of the WHS Regulation 2011.

The SWMS must:

- Be site- and task-specific
- Be developed in consultation with workers and their representatives
- Clearly describe the high-risk construction work being done

- Break the work activity into a step-by-step sequence
- Assess the risk associated with each hazard by ranking it using a matrix that contains both likelihood and consequence
- Propose control measures to mitigate the identified hazards appropriate to the risk level and who is responsible to implement it
- State the training courses, qualifications, permits and licences required to do the task
- Make reference to applicable legislation, codes of practice and Australian Standards
- List the plant and equipment that will be used for the work
- Specify the inspection, testing and maintenance requirements for plant and equipment used in the task
- Factor in other surrounding work that may affect the way the work is carried out
- Identify the personal protective equipment required to be worn while performing the task.

The contractor/service provider must ensure that workers carry out their work in accordance with the SWMS.

For projects with a Work Health and Safety Management Plan, the SWMS must take into account all relevant matters within the plan.

The City's Representative will review all high-risk SWMS to verify compliance with the above-listed items prior to the work commencing. The review will be undertaken using the Safe Work Method Statement Review form. The City's Representative will provide recommendations for improvement where a SWMS does not meet the above criteria.

If subcontractors are engaged, the Service Provider must ensure that before commencing work, a written Safe Works Method Statement is provided by each subcontractor before the Works are carried out.

1.5.7 CONTRACTOR SITE INDUCTION

The Service Provider is responsible for providing a site-specific induction for all workers prior to the commencement of work activity.

The induction will include as a minimum: hazards specific to the area, tasks to be undertaken and where applicable in line with the SWMS, site rules, incident and hazard-reporting processes, emergency response information (exits, extinguishers, wardens and first aid personnel) and the location of amenities.

Construction site inductions shall be conducted in accordance with the requirements set out in the Safe Work Australia *Model Code of Practice – Construction Work.*

Confirmation of this induction will be provided to the City's Representative for inclusion on the project file.

1.5.8 ACCIDENTS AND INCIDENTS

The Service Provider is required to notify the City's Representative as soon as possible if the following occurs:

- A notifiable incident as listed under Part 3 of the *WHS Act 2011*
- Accidents involving loss of time or workers on alternative duties
- Near-miss incidents with accident potential such as equipment failure, slides and cave-ins
- City of Sydney property damage
- Pollution incidents.

The Principal Contractor shall notify Workcover and the City of all reportable incidents. The City's Representative will initiate an investigation to identify the root cause of the incident and where necessary, recommend appropriate corrective and preventative actions for the Service Provider to implement.

1.5.9 SUBCONTRACTORS AND LABOUR HIRE

The Principal Contractor is responsible for ensuring the health and safety of all site personnel including subcontractors and labour hire. As required, Subcontractor Agreements shall include clauses to cover:

- Details relating to the provision of risk assessments in relation to the task or activities to be conducted
- Provision of induction, training and supervision for personnel working on City workplaces/sites
- Provision of security checks for personnel working in sensitive areas such as childcare and/or cultural centres
- The carrying of a document detailing the qualifications and security checks and inductions undertaken by the carrier.

The Contractor is responsible for the coordination, management, site supervision, protection of all subcontractors and labour hire under the contract.

1.5.10 CIVIL WORKS SAFETY

1.5.10.1 PEDESTRIAN AND PUBLIC SEGREGATION

The construction site must be separated from the public at all times. The Service Provider must use fencing that complies with the Australian Standard *AS 4687-2007 Temporary fencing and hoardings*.

Signs are to be clearly visible from each accessible boundary. Signs must include emergency after-hour telephone numbers of the Service Provider, as required under Clause 308 of WHS Regulation 2011.

Controls shall be considered, such as localised barriers and mesh, for Works that may produce projectiles (including sawcutting and the breaking of concrete).

The Service Provider must provide suitable surfaces on all public access ways affected by the Works, to prevent trip and slip hazards and ensure all temporary paths shall meet disabled access requirements.

Access and egress into commercial and non-commercial properties will be provided at all times, and the routes and public access ways shall remain clear.

1.5.10.2 PERSONAL PROTECTIVE EQUIPMENT

The Service Provider must ensure that each worker is provided with, and wears at all times, all necessary and appropriate Personal Protective Equipment (PPE). Staff must be informed of any limitations of the equipment provided with the instruction and training necessary to ensure that the equipment controls the risk for which it is provided.

1.5.10.3 NOISE AND DUST CONTROL

The construction noise levels shall not reach or exceed the exposure levels, as detailed in Part 4.1 of the WHS Regulation 2011. The Service Provider must ensure the construction noise levels meet the requirements and levels detailed within the City Centre – Construction Hours/Noise Code of Practice 1992.

Contractors and Service Providers must plan work so noisy activities are minimised in public areas and ensure the control measures developed shall meet the requirements of *AS 2436-2010 Guide to noise control on construction, demolition and maintenance sites* (i.e. localised noise boxes or barriers) and the Safe Work Australia Model Code of Practice for Managing Noise and Preventing Hearing Loss at Work 2015.

Mesh fabrics, vacuum systems and water controls (spraying, damping down) can be used to prevent dust escape to public areas. However, the use of water must not create stormwater pollution via carriage of sediment into drainage systems (gutters, grates and stormwater pits).

Noise levels must be reduced and controlled to required levels. Acoustic reducers can be used to minimise the noise. Noise levels must not go over peak exposure (140dB[C]) and the daily average (85dB[A]).

1.5.10.4 LIVE SERVICES

Where possible, services will remain live during the Works, e.g. smartpoles and phone lines. The Service Provider must implement suitable controls to reduce the risk, including keeping copies of up-to-date drawings, applying permit to dig procedures and hand digging near live services.

The controls shall meet the requirements of Clause 304 of the *WHS Regulations 2011.*

1.5.10.5 BUSINESS EMERGENCY CONTROL ITEMS

The Service Provider will ensure no fire doors or emergency equipment are blocked or obstructed during the Works.

The Service Provider must, in consultation with the City's Representative, the building occupant or Strata Management and emergency services, provide suitable alternatives where required.

1.5.10.6 HAZARDOUS CHEMICALS

Hazardous chemicals must be managed on site. The Service Provider will undertake a risk assessment for all hazardous chemicals used or stored on site and ensure hazardous chemicals are stored in suitably labelled containers, with safety data sheets available and locked in a storage facility when not in immediate use and at the end of each day's work.

Controls must be developed to reduce uncontrolled exposure and release of hazardous substances into the environment, including gaseous release into the atmosphere.

The Service Provider must separate Works involving the use of or exposure to hazardous substances from the public and non-work-related employees at all

times and comply with the requirements of Chapter 7 of the *WHS Regulations 2011* for the use and identification of hazardous substances on site.

(Note: The definition of hazardous chemicals includes those detailed in the *National Occupational Hazardous Substances Information System, List of Designated Hazardous Substances (NOHSC:10005).*

1.5.10.7 ASBESTOS CONTAMINATION

If hazardous materials (including but not limited to asbestos) are not specified in the Contract Documents but are identified on site, the Service Provider must notify the City's Representative immediately and advise the type of substance and location as part of the notification.

This notification will include hazardous materials relating to in-ground service utility pipes, ducts and service pits (including but not limited to electricity, telecommunication, water and gas). It will also include any hazardous materials relating to awnings.

The Service Provider must control access to the area and organise for the decontamination of the area in consultation with the City's Representative.

The Service Provider must prepare a plan to manage the asbestos on site until it is removed. They shall engage a licensed removalist and provide a copy of the license to the City's Representative.

NSW WorkCover must be notified prior to removal of the asbestos and provide a copy of the notification to the City's Representative. The Contractor or Service Provider is responsible for sending the notifications to the City and the residence where required.

The Service Provider will be responsible for engaging a reputable contractor licensed by the Environmental Protection Authority of NSW to remove and dispose of asbestos ("the removalist"). A copy of the removalist's licence must be provided to the City Representative and a copy must be kept on site while decontamination and removal works are in progress.

All asbestos must be handled, isolated, removed and disposed of in accordance with all statutory requirements. A register is to be kept of all movements of the asbestos from the site to the disposal destination.

The Service Provider must obtain a clearance certificate from WorkCover prior to the reoccupation of the area and a copy of the certificate is to be provided to the City's Representative prior to Works recommencing.

The Service Provider must request the removalist ensure that original tip dockets issued by designated tips and machine-imprinted with the vehicle registration number, weight of load, load code and tipping date are retained and provided to the City's Representative.

The Service Provider must ensure that if asbestos removal or other activities are required to decontaminate asbestos from the site, all activity is carried out in a manner which minimises impacts on the community, including minimising disruption to everyday activities

All Works involving the removal of asbestos must comply with Chapter 8 of the *WHS Regulations 2011.*

1.6 QUALITY MANAGEMENT

The Service Provider shall plan, establish, implement and maintain a Quality System for the Works in accordance with the requirements of this section of the Technical Specifications. The Service Provider may require a Quality System that meets the requirements of *AS/NZS ISO 9002:1994 Quality systems – Model for quality assurance in production, installation and servicing*.

The Service Provider shall undertake and bear all costs of all independent and internal inspections and testing, surveillance of all manufacturing, construction and commissioning processes, and quality system audits.

A Quality Management Plan shall be prepared and presented for approval to the City's Representative prior to the commencement of work.

The Principal may, at their discretion, carry out audits and surveillance as appropriate.

1.6.1 CONFORMITY RECORDS

The Service Provider may be required to maintain (and issue on request) copies of conformity records as specified, including:

- Completed Inspection and Test Plans and associated checklists (including inspection and certification of formwork and scaffolding)
- Test results obtained from testing laboratories and the like
- Quality or test records obtained from manufacturers and suppliers

- Service Provider's certification of quality conformity and performance
- As-built documents (including operation and maintenance manuals/work as executed drawings)
- Service Provider Subcontractors' quality management systems that meet the requirements of the Service Provider's Quality Management System.

1.6.2 MATERIALS AND WORKMANSHIP

The City expects a high level of workmanship in all aspects of the Works.

The finished product must be of a quality satisfactory to the City's Representative and may be required to have an expected life of 20 years.

Upon request by the City's Representative, the Service Provider may be required to demonstrate that the Works, materials and workmanship have been undertaken in accordance with this specification and/or approved drawings.

The process for quality management is to be submitted with the Quality Management Plan.

1.6.3 INSPECTION

Unless otherwise stated in the schedule, the Service Provider may be required to provide two (2) working days' notice of the Witness Points and two (2) working days for Hold Points.

1.6.3.1 HOLD POINTS

AS/NZS ISO 8402:1994 – Quality management and quality assurance – Vocabulary defines a hold point as a point, defined in an appropriate document, beyond which an activity shall not proceed without the approval of a designated organisation or authority.

The approval to proceed beyond a hold point is usually given in written form, but it may be given by any other agreed system of authorisation.

For the purposes of this specification, hold points will apply at the points defined in the approved Project Management Plan, and also at any point at which non-conformance is detected and as outlined in Section 1.11 Hold and Witness Points.

1.6.3.2 WITNESS POINTS

A witness point is a point, defined in an appropriate document, which provides an opportunity for the designated organisation or authority to witness an inspection, or test an aspect of the Works, at their discretion.

The witness points also apply to the installation of traffic and pedestrian management devices for each stage of the Works, including protection devices for people and property, and as defined in Section 1.11 Hold and Witness Points.

1.7 ALIGNMENT AND SETTING OUT OF WORKS

1.7.1 SETTING OUT

The City will only provide the level and coordinates of Permanent Marks.

The Service Provider shall provide all labour, materials and other assistance that the City may require at any time to check the setting out or to make progress measurements of the work.

The Service Provider is to engage a registered surveyor to set out the Works including but not limited to the following:

- Kerb locations
- Lane widths
- Road levels
- Footpath levels
- Tangent points at intersections, as required for the setting out of paving, tree pits, traffic lights, smartpoles and any other items including street furniture.

The Service Provider is also to engage a registered surveyor to certify that the Works are within the site boundaries and not encroaching onto adjacent properties.

The Service Provider will be responsible for all other levels and coordinates from the design documentation and their coordination with existing levels and coordinates. The Service Provider is to notify the City's Representative of any discrepancy in the City-supplied survey levels or the design levels, in particular where design levels match existing levels, prior to construction of that element of work (such as kerbs and gutters, and footpath base slabs).

The Works are set out to the Australian Mapping Grid (AMG) and Australian Height Datum (AHD).

1.7.2 PRESERVATION OF PERMANENT MARKS

Permanent survey marks defining the position of street alignments are not to be removed or damaged without the specific permission of the City's Surveyors. If a mark cannot be retained or is in danger of being disturbed, a minimum of two weeks' notice must be given in writing to the Senior Surveyor prior to the commencement of Works.

Permanent marks within the City will generally comprise of either a brass disc marked State Survey Mark set in concrete or a brass bolt, stainless-steel bolt or brass pin-in lead plug fixed in the concrete road base and covered by a cast iron box marked MCS Survey, CCS Survey or similar.

Any activities in the vicinity of the survey permanent marks shall be undertaken in accordance with B11 Permanent Survey Marks.

1.7.3 RECOVERY OF SURVEY MARKS

On the recommendation of the City's Surveyors, the Service Provider may be required to engage a registered surveyor to recover all survey marks (including any alignment pins, permanent marks and cadastral survey marks) and to prepare a plan for information purposes only to be forwarded

to the Senior Surveyor. Survey Azimuth must be on MGA and all measurements must be of sufficient accuracy to redefine adjacent cadastral boundaries.

Depending upon the scale of Works, the Service Provider may also be required to lodge such a plan with Land and Property Information (LPI) for registration. Prior to any such lodgement with the LPI, the plan is to be submitted to the City's Surveyors for approval.

Where possible after the completion of Works, all infrastructure relating to any destroyed survey mark is to be reinstated to the satisfaction of the City's Surveyors. This may include (but is not limited to) construction and installation of a replacement cover box and concrete road base in the same position as the destroyed mark or in another location as determined by the City's Surveyors.

All permanent survey mark recovery activities shall be undertaken in accordance with *Part B11: Permanent survey marks* in the Sydney Streets Technical Specifications.

The Service Provider is to coordinate all Works and stages of Works with the City's Representative.

1.7.4 AS-BUILT DRAWINGS

As-built drawings are prepared to show changes made to the project during construction, and are the official records of the project at the time of construction completion. All additions, deletions and other changes made during construction are indicated by modifying the original contract drawings.

All changes and/or required additions shall be clearly identified in colour that contrasts with blue or black, preferably red. The as-built drawings shall be annotated in as much detail as necessary to clarify exactly what construction changes were performed.

Particularly for drainage and electrical assets, which are covered over, accurate as-built drawings are very important for asset management, operation and maintenance.

The Service Provider shall transfer the changes from the marked-up prints to the original electronic CAD files.

Certification, either by contractor or consultant, shall be placed on the as-built drawings and shall include a statement that the drawings were checked in the field and are a true representation of the improvements.

1.7.4.1 PHOTOGRAPHIC RECORD OF ALL WORKS PRIOR TO COVERING UP

The Service Provider is required to keep a detailed digital photographic record of all Works prior to covering up. The Service Provider must provide an electronic copy in JPEG format within 28 days of covering up of that work. The electronic record must clearly show and describe the date the photo was taken, the location and the nature of the work.

1.7.4.2 ASSET DATA SHEETS

In the Asset Data Sheets, among other items as shown below, the Service Provider is required to provide the levels and coordinates (complete position) of all completed Works including items on the roads and footpaths in MGA coordinate system in three dimensions on AutoCAD model.

As-built documents shall comply with a data entry system such as IPWEA ADAC system (Asset Design as Constructed) to ensure seamless integration of new assets into the City's GIS environment.

Service Providers at early stages of construction shall liaise with Asset Managers to obtain site codes and the like. The Asset Data Sheets shall be supplied at Practical Completion. For more information, refer to *Asset Data Sheets for Various Types of Assets* in the Annexures.

As an example, a typical Asset Data Sheet for cycle rack will include:

517292	**SITE_CODE**
Cycle Rack	**FEATURE_ ID**
Any identifier attached to the asset	**IDENTIFIER**
Information about the location	**LOCATION_ NOTES**
When constructed	**START_ DATE**
CPMS	**FEATURE_ TYPE_CODE**
FN-Bike Maintenance Stand	**FEATURE_ TYPE**
Coordinate in GDA94	**EASTING**
Coordinate in GDA94	**NORTHING**
URL	**PHOTO**
How long will this asset last (years)	**DESIGN_ LIFE**
Years/months from construction	**DEFECT_ LIABILITY**
URL but will need to be a TRIM link	**MAINT_ MANUAL_ LINK**
URL but will need to be a TRIM link	**AS_BUILT_ LINK**
OWCS – City of Sydney	**Owner**
Aluminium	**Material**

1.8 HERITAGE AND ARTEFACTS

1.8.1 HERITAGE CONSIDERATIONS

The Service Provider may be requested to prepare and implement a heritage and archaeological plan for the work. This plan will address the processes to adopt where Works are required in the vicinity of a heritage element, or otherwise in the event of the discovery of an archaeological item. Heritage works may be performed by suitably qualified and City-approved heritage conservators to ensure that heritage protocols are observed and that heritage elements are appropriately protected, removed, stored, conserved and reinstated as specified.

For locations of work that involve heritage items identified during the course of Works outside heritage-listed buildings, the Service Provider may be required to notify the City's Representative immediately so the issue may be addressed accordingly.

1.8.2 TRACHYTE AND SANDSTONE KERB CONSERVATION

Trachyte and sandstone kerb and gutter must be left in its original position unless otherwise specified by the City's Representative. Trachyte kerbs will remain the property of the City. If removed, the Service Provider will deliver them in good, clean condition to the City's store located within 20 kilometres of the CBD. The Service Provider shall submit records of all trachyte kerbs removed for verification by the City's authorised person. The Service Provider will be responsible for ensuring a suitable method is implemented when removing and transporting trachyte kerbs to minimise the risk of damage.

1.8.3 TRAM TRACKS

Tram tracks must be left in their current location and sealed over, where possible. However, some disturbance may be proposed and necessary in which case a basic digital photographic archival recording must be prepared for any uncovered sections of tram tracks prior to removal. A copy of this archival recording must be provided to the City's Representative.

1.8.4 OTHER ARCHAEOLOGICAL RELICS

In the event of any early brick drains or other relics being uncovered, Works must cease immediately and the City's Representative shall be contacted for advice of the requirements of the City's urban design and heritage section or the NSW Office of Environment and Heritage.

1.8.5 OTHER CULTURAL MATTERS

If, during Works, any suspected Aboriginal objects are found, Works shall cease immediately and the Service Provider must contact the City's Representative and the NSW Office of Environment and Heritage.

1.9 REINSTATEMENT OF DAMAGED INFRASTRUCTURE

Prior to final inspection by the City, all surplus material and rubbish shall be removed and the whole site left in a neat, tidy and fit-for-purpose condition.

Any City assets disturbed or damaged during construction shall be made good as directed by the City's Representative. Alternatively, any remediation works may be organised by the City's Representative at the Service Provider's expense.

The whole site shall be left in a neat, tidy and fit-for-purpose condition at the end of the Defects Liability Period.

1.10 HOLD AND WITNESS POINTS

Preliminaries	
1. Process Held	Sediment Control
Submission Details:	At least two (2) working days prior to setting up sediment control on site.
Release of Hold Point:	The City's Representative will inspect the sediment control, prior to authorising the release of the Hold Point.
2. Process Held:	Service Investigation
Submission Details:	At least two (2) working days prior to excavation works.
Release of Witness Point:	The City's Representative will confirm that all relevant service investigation has been undertaken, prior to authorising the release of the Witness Point unless advised otherwise.
3. Process Held:	Tree Protection
Submission Details:	At least two (2) working days before starting work near a tree.
Release of Witness Point:	The City's Representative will inspect the tree protection, prior to authorising the release of the Witness Point unless advised otherwise.
4. Process Held:	Safe Work Method Statements (SWMS)
Submission Details:	At least two (2) weeks before site establishment all SWMS shall be submitted to the City's Representative.
Release of Witness Point:	The City's Representative will review the SWMS, prior to authorising the release of the Witness Point unless advised otherwise.
5. Process Held:	Identification of Unsuitable Material or Soft Spots in Subgrade
Submission Details:	At least two (2) working days before removal or treatment of the unsuitable material.
Release of Witness Point:	The City's Representative will inspect the subgrade prior to releasing the Witness Point.
6. Process Held:	Smartpole Foundation Type
Submission Details:	At least two (2) working days before excavating the foundation.
Release of Witness Point:	The City's Representative will review the proposed foundation type for each Smartpole installation prior to releasing the Witness Point.
7. Process Held:	Smartpole Foundation Construction
Submission Details:	At least two (2) working days before installation of formwork and reinforcement.
Release of Hold Point:	The City's Representative shall inspect the formwork and reinforcing prior to releasing the Hold Point.
8. Process Held:	Subgrade/Fill Conformance
Submission Details:	At least two (2) working days prior to placing kerb and gutter footing, Smartpole footing, service pit and pavement base.
Release of Witness Point:	The City's Representative shall review the subgrade/fill testing report prior to releasing the Witness Point.

1.10 HOLD AND WITNESS POINTS, CON'T

Preliminaries	
9. Process Held:	Concrete Formwork and Reinforcement
Submission Details:	At least two (2) working days prior to installation of the formwork and reinforcement.
Release of Hold Point:	The City's Representative will inspect the installed formwork and reinforcement prior to releasing the Hold Point.
10. Process Held:	Tree Removal
Submission Details:	At least two (2) working days prior to the removal of any trees.
Release of Hold Point:	The City's Representative will inspect the trees marked for removal prior to releasing the Hold Point.
11. Process Held:	Site Protection
Submission Details:	At least two (2) working days prior to any demolition works.
Release of Hold Point:	The City's Representative will inspect the site prior to demolition to ensure all items to remain in place are adequately identified and protected prior to the release of the Hold Point.
12. Process Held:	Excavation to Required Levels
Submission Details:	At least two (2) working days prior to final excavation.
Release of Witness Point:	The City's Representative will inspect the excavation at finished level prior to release of the Witness Point.
13. Process Held:	Density Testing and Proof Rolling
Submission Details:	At least two (2) working days prior to testing and rolling.
Release of Witness Point:	The City's Representative will inspect the site during density testing and final proof rolling prior to releasing the Witness Point.
14. Process Held:	Service Trench – prior to laying of service
Submission Details:	At least two (2) working days prior to the laying of the service.
Release of Witness Point:	The City's Representative will inspect the excavated service trench prior to the laying of the service before releasing the Witness Point.
15. Process Held:	Service Trench – prior to backfill
Submission Details:	At least two (2) working days prior to backfilling of the service trench.
Release of Witness Point:	The City's Representative will inspect the laid service prior to backfilling of the trench before releasing the Witness Point.
16. Process Held:	Underground Structures
Submission Details:	A minimum of one (1) working day after demolition activities are undertaken above an underground structure.
Release of Witness Point:	The City's Representative will inspect the underground structure following demolition works above, prior to the release of the Witness Point.

1.11 ASSET HANDOVER

The City must be provided with accurate documentation describing how the assets have been constructed upon completion of works.

This information will be used to up-date the City's asset register which will help us to better manage our assets and provide quality information to others.

The following is a list of documents that must be supplied as a minimum:

- As-built drawings
- Asset data sheets
- Licences and approvals
- Operational and maintenance manuals
- Safety audits – if applicable
- Certifications and warranties
- CCTV for stormwater infrastructure – if applicable
- Dilapidation reports
- Construction and after photographs

The Asset Handover process is currently being reviewed and will be included in the next revision of this document.

B2 Earthworks Construction

Contents

B2 EARTHWORKS CONSTRUCTION

2.1 SCOPE

This Technical Specification sets out the requirements for earthworks for various construction works including roads, pathways and concrete structures.

Earthworks include:

- Clearing the site
- Excavation as required for proposed elements such as pole and furniture footings, tree pits, retaining walls, stormwater works, kerb alignments and conduit paths and any excavations required to complete the Works
- Excavation of footpath and road pavement as required
- Disposal, and preferably recycling offsite, of surplus excavated material
- Placing and compaction of fill material
- Ground preparation necessary to bring the site to the correct shape and level
- Preparation of the subgrades.

2.2 STANDARDS AND GUIDELINES

Unless stated otherwise in this Technical Specification, the approved drawings or elsewhere in the construction documents, work 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 work.

The following table indicates the Australian Standards, RMS Standards and other relevant standards applicable to this section. This table is not exhaustive and may not include all standards that apply to the work to be undertaken. It is the responsibility of the Service Provider to ensure that all relevant standards are met.

AS 1152–1993 Specification for test sieves

AS 1289 Methods of testing soils for engineering purposes (including supplements and amendments)

AS 1348 Road and traffic engineering – Glossary of terms. Part 1 – Road design and construction

AS 1726 Geotechnical site investigation code (including amendments)

AS 2436 Guide to noise control on construction, maintenance and demolition sites

AS 2601 Demolition of structures

AS 3798 Guidelines on earthworks for commercial and residential development

AS/NZS 2865 Safe working in a confined place

City of Sydney Guidelines for Temporary Protective Structures – Hoarding, Scaffolding, Shoring and Façade Retention, April 2001

Construction Safety Act

Environmentally Hazardous Chemical Act 1985

Landcom Publication (2004) Managing Urban Stormwater: Soils and Construction – Volume 1

NSW Construction Safety Act and Regulations 84A–J: Construction Work Involving Asbestos or Asbestos Cement

NSW Streets Opening Conference, 1997 – Information Bulletin on Codes and Practices

Requirements from all authorities and services/utility providers such as Telstra, Powertel, Optus, Sydney Water, AGL, Agility, City of Sydney, Ausgrid and others as required

RMS QA Specification 3071 Selected Material for Formations

Sydney Streets Technical Specifications – Chapter B12: Road Opening and Restoration

WorkCover Authority of NSW Code of Practice – Excavations

WorkCover Authority of NSW Code of Practice – Moving Plant on Construction Sites

WorkSafe Australia – Asbestos: Code of Practice and Guidance Notes.

2.3 PROTECTION OF THE EARTHWORKS

The Service Provider's responsibility for the Works shall include the protection of earthworks.

All excavations shall be appropriately managed to reduce water entering any excavation during construction. The following items shall be provided prior to, during and following earthworks operations:

- All materials and labour for the diversion of stormwater runoff from the Works
- Proper temporary drainage for conducting stormwater and any sub-soil ingress water across the site from adjacent properties or roads
- Controls for the uninterrupted flow at all times of stormwater runoff along existing gutters, water tables and conduits in the vicinity of the Works
- Controls for the temporary diversion of the stormwater runoff where the existing drainage is to be interrupted. No such interruption shall take place until this diversion is provided.
- An effective pumping plant as required for keeping all excavations free from water while construction is in hand
- Erosion and sediment controls to protect downstream and disturbed areas
- Works to be planned and constructed so that stormwater runoff is maintained away from the buildings and adjacent properties at all times. This may involve all temporary means to directly drain or to store and then discharge the water using pumps and the like.
- All diversions shall be of sufficient capacity to prevent flooding of the Works and adjacent properties, pavements and buildings to the satisfaction of the City's Representative
- Water shall not be pumped from excavations and discharged to either the public road or an existing drainage system unless specifically approved by the City's Representative
- Water from diversion works or pumped from excavations shall not be permitted to enter existing sewers unless specifically approved by the relevant authorities
- Dewatering of groundwater requires the relevant permits from the Department of Primary Industries and the Department of Water and Energy
- The Service Provider shall allow for the removal and appropriate disposal of all mud and debris, which may collect in the excavations
- If water enters excavations which are meant to receive concrete, the water shall be pumped out, any soft material unsuitable for receiving concrete taken out and replaced with either clean compacted sand or approved selected material as separately defined in this Specification.

Refer to the environmental protection requirements in Part B1: Preliminaries and General Construction

2.4 EXCAVATION

2.4.1 GENERAL

Any geotechnical information supplied by the City is for information purposes only. No guarantee is given for its accuracy. Description and classification of soils shall be in accordance with *AS 1726:2017 Geotechnical site investigations.*

No excavation shall be commenced until the Service Provider has undertaken a Dial Before You Dig (DBYD) search and obtained current underground location plans which provide an indication of the presence, location and depth of underground plant in the area of the Works. Refer to Part B1: Preliminaries and General Construction for existing services.

Excavation shall be carried out to the depths and dimensions shown on the approved plans and construction documents, or to such greater depths and dimensions as will ensure sound, permanent foundations. All excavation carried out shall be approved by the City's Representative before any materials or structures are placed on the excavated surfaces (hold point).

Excavations shall be conducted by machine and/or by hand as necessary to produce profiles to the accuracy required by this Specification, the approved drawings and the construction documents.

In carrying out excavation work, all reasonable precautions shall be taken against mishap or accident, whether arising from insufficient strength of supports, bad workmanship, breakage of machinery or plant, inefficient caulking or packing of open joints or spaces, flood, or any other cause whatsoever. The Service Provider shall be held solely responsible for all damage, injury or loss that may occur to buildings, structures, bridges, roadways, streets and other surfaces above and adjacent to the excavations; to all persons whether employed by the Service Provider, by the City or otherwise; and to their own and other works and plant, and the cost of all such damage, injury and loss and any compensation shall be met by the Service Provider

2.4.2 SAWCUTTING

Should excavation be required in an area of concrete or asphalt, sawcuts of a nominal 50mm depth shall be made in the surface prior to excavation to ensure a smooth joint is maintained in the existing surface.

In the case of excavations for drainage works, sawcuts shall be provided on both sides of the trench. For kerb and/or gutter works, sawcuts shall be provided around the perimeter of the area of pavement to be reinstated. Medians shall be sawcut on the face of new median kerb alignment.

Note the need to control runoff from sawcut blade cooling water. This is because this is a source of fine sediment pollution which must be controlled when contractors are conducting ad hoc sawcutting.

2.4.3 EXCAVATED MATERIALS

All materials cleared and excavated shall be removed from the site and recycled appropriately or disposed of legally by adhering to the provisions of the *Protection of the Environment Operations Act 1997.*

If, in the opinion of the City's Representative, an appropriate area exists on the site, suitable material may be stockpiled and used for backfilling, provided that excess stockpiled material is disposed of when all backfilling is completed. Special care is to be taken to ensure that the proposed stockpile does not impact on any existing trees or structures.

2.4.4 CONDITIONS BELOW GROUND

If rock or artificial obstructions are encountered, the City's Representative may permit modifications to approved details to mitigate some of the additional cost of excavating in rock or removing obstructions. A request in writing must be made by the Service Provider to amend the excavation detail. These requests will be typically approved if the plan does not adversely affect the structural strength, stability or the usefulness of the Works.

If groundwater is encountered, such sections of the site shall be dewatered as necessary and as specified to permit work to proceed as required or such other measures as may be authorised by the City's Representative shall be undertaken.

2.4.5 EXCAVATION IN ROCK

Where the Service Provider is required to excavate in naturally lying rock, the City's Representative is to be advised immediately. Consideration of hammering sound and vibrations to adjacent buildings must be considered. The City's Representative may request that a dilapidation report of surrounding properties is undertaken by the Service Provider.

2.4.6 EXPLOSIVES

Explosives are not permitted.

2.4.7 UNSUITABLE MATERIAL

Unsuitable material for the Works includes any areas of the earthworks foundation or any layer with the earthworks formation that rut excessively, yield or show signs of distress or instability, ground containing cavities, faults or fissures or ground contaminated by harmful substances including oil and chemicals.

Unsuitable material such as silt, mud, roots, organic matter, rubbish, areas of very soft clay or high moisture content and any other deleterious substances shall be disposed and replaced with select material as separately defined in this Specification.

The Service Provider shall rework or replace any material that has become unsuitable because of inappropriate construction activities. Inappropriate construction activities include poor surface drainage, restricted or inoperative subsurface drains, contamination, excessive-sized plant where the imposed local load exceeds the material strength, poorly maintained plant allowing leakage of oils and water onto the formation, and leaving the surface open to wet weather allowing moisture ingress.

2.4.8 EXCAVATION FOR PAVEMENTS

Excavation for pavements shall be carried out to form the boxing in which the pavement is to be constructed.

Any excavation in existing pavements shall have neat sawcut edges, in accordance with the sawcutting requirements as separately defined in this Specification, before excavating commences. Boxing shall extend over a sufficient width to allow construction of the pavement below and behind kerbing and edging.

If unsuitable material is found at subgrade level, the Service Provider must provide notice to, and receive an instruction from the City's Representative before commencing excavation and removal of such material.

2.4.9 EXCAVATION FOR TRENCHES

Unless otherwise specified and/or approved by the City's Representative, trenches for pipelines shall be excavated so as to provide adequate cover clearance between the outside of the pipe and the trench wall or sheeting in accordance with *AS/NZS 3725-2007 Design for installation of buried concrete pipes*. Trenches for utility service conduits shall conform to the Utility Authority's specifications.

Trench excavations shall be carried out below the pipe invert grade to accommodate bedding as specified and/or shown. All loose unexcavated material and projections of hard materials or rock protruding above plan grade shall be removed prior to the placement of bedding.

Additional excavation shall be provided under sockets or flanges of pipes and ducts to allow for jointing and to give the pipe or duct uniform bearing.

2.4.10 EXCAVATION FOR STRUCTURES

Excavation for structures shall extend a sufficient distance from the structure so as to permit placing and removing forms, installing drainage facilities where required, cleaning and inspection.

If foundation materials exposed at the approved/specified levels are considered by an independent geotechnical engineer (engaged by the Service Provider) not to be suitable, the Service Provider should seek the direction of the City's Representative and may be directed to excavate to the depth necessary to obtain a suitable foundation material and/or modify the foundation dimensions so as to achieve the allowable foundation bearing pressure.

Except where approved, specified or authorised by the City's Representative, excavations for footings shall not be overexcavated to allow for back forming and backfilling.

Excavations for footings, which have been carried beyond the lines and levels authorised, shall be backfilled with concrete or stabilised sand or as directed by the City's Representative at the Service Provider's expense.

The shape of under-cut sections of excavations for footings may be varied to suit the Service Provider's method of excavation or equipment provided that the effective slope of the under-cut section is not decreased and the proposed methodology is agreed beforehand by the City's Representative.

All rock above the levels specified and/or shown and all rock shattered, disturbed or loosened by the process of excavation shall be removed and the foundation surface shall be cleaned by air or water jets and by brooming and swabbing until it is as clean as the natural undisturbed condition of the rock permits.

All cracks, fissures, holes and soft spots in rock foundations shall be cleaned out and filled with concrete, grout or mortar, as directed by the City's Representative.

2.4.11 HAZARDOUS MATERIALS

The Service Provider shall give notice immediately to the City's Representative of any hazardous materials or conditions found, including but not limited to the following:

- Asbestos or material containing asbestos
- Flammable or explosive liquids/gases
- Toxic, infective or contaminated materials
- Radiation or radio-active materials
- Noxious or explosive chemicals
- Tanks or containers that have been used for storage of explosive, toxic, infective or contaminated substances.

Refer to Section 1.6 Work, Health and Safety of Part B1: Preliminaries and General Construction regarding the removal of hazardous materials and remediation of the site.

2.4.12 EXCAVATION AROUND TREES

The Service Provider must dig using hand tools whenever digging in the vicinity of tree roots. Care must be taken to ensure that no tree roots are damaged during all excavation activities.

Roots that are greater than 50mm in diameter measured at a distance of 3 metres from the tree trunk, must not be cut without prior approval from the City's Representative. Refer to Subsection 1.5.7: Care of Trees in Part B1: Preliminaries and General Construction

2.4.13 EXCAVATION AROUND SERVICES

The Service Provider must dig using hand tools whenever within 0.3 metres of a service pipe. Typically, there are more service pipes than listed on the DBYD drawings. These abandoned service lines may not be removed without approval of the managing Service Authority. Further investigation around the conduit may be required to determine the owner of the service line.

Dial Before You Dig plans note transmission cables such as high voltage gas or water mains that may need a Service Authority representative present when excavating near their service. The Service Provider is responsible for coordinating any Service Authority supervision.

2.4.14 SUPPORT OF EXCAVATIONS

The Service Provider shall provide all shoring, planking, propping, progressive backfilling and strutting necessary to retain the sides of the excavations, and to ensure safe working conditions, including safety covers over holes. The Service Provider has the sole responsibility for the sufficient support of the excavations on site (including any design and approvals required for such support).

Any collapse of the sides of excavations due to the Service Provider's failure to shore, brace and/or sheet such excavations shall be rectified and any materials, equipment, structures, services and the like damaged by such

collapses shall be repaired or replaced as directed by the City's Representative, and at the Service Provider's expense.

Such shoring, bracing and/or sheeting shall be satisfactorily maintained during the whole of the excavation and construction operations and shall be removed in a manner to prevent caving as the excavations are concreted and/or backfilled.

Where temporary supports are to be left in place, they shall be appropriately de-stressed and all cavities behind the supports shall be located and backfilled and compacted as specified elsewhere herein.

Where temporary supports are required as permanent structures, they are to be designed by the Service Provider's Engineer and approved by the City's Representative.

The Service Provider shall guard against the formation of voids outside sheeting, sheet piling, shoring and the like; however, should any voids form they are to be filled and compacted to the approval of the City's Representative.

The Service Provider shall remove shoring and timbering progressively as the work proceeds unless otherwise instructed.

2.4.15 VENTILATION OF EXCAVATIONS

Excavations shall be aired or ventilated as required by statutory authorities (e.g. WorkCover Authority of NSW) codes of practice for confined spaces and AS2865-2009 Confined spaces. Equipment shall be made available throughout the Works for continuous monitoring of the pits, including respirators, and for the rescue and resuscitation persons who may become affected by gases while working in the pits.

2.5 SELECT MATERIAL FOR BACKFILLING

Backfilling or filling in this section refers to all filling required to the subgrade level. Refer to Subsection 10.4.2: Fill and Pipe Support Material in B10: Stormwater Drainage for the requirements for fill material for stormwater trenches.

All materials used for temporary backfilling shall be in accordance with Stormwater Drainage Construction B12: Road Opening and Restoration.

Select material for backfilling shall be granular material which is naturally occurring, recycled or manufactured having a particle size distribution, determined in accordance with *AS 1289.3.6.1-2009: Methods of testing soils for engineering purposes – Soil classification tests – Determination of the particle size distribution of a soil – Standard method of analysis by sieving*.

Select material can be crushed rock, natural soil, gravel and sand, or other approved granular material consisting of clean, sound, durable fragments, free from organic matter from an approved source.

Grading limits for select fill shall be in accordance with *AS/NZS 3725:2007 Design for installation of buried concrete pipes* as tabulated below:

TABLE 2.5 - GRADING LIMITS FOR SELECT FILL

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

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.

The City encourages use of recycled materials where possible. Recycled material shall comply with RMS QA Specification 3071 – Selected Material in Formation Layers when used as select material and the grade limits above.

2.5.1 MOISTURE CONDITIONING OF FILLING MATERIALS

Fill is to be compacted at a moisture content of approximately +/- 2% of Standard Optimum Moisture Content. Strict adherence to this range is required.

Soils with moisture content greater than the specified compaction range shall be removed and replaced with complying material.

Soils with moisture content less than the specified compaction range must have water added from a water tanker prior to and during the compaction process.

2.6 PLACING AND COMPACTING FILL

2.6.1 PREPARATION OF SURFACES BEFORE PLACING FILL

After the site has been cleared, the natural ground surfaces on which fill or pavements are to be placed shall be scarified and compacted as specified in this Specification.

Heavy steel drum rollers (minimum applied load intensity of 4t/m width of drum) shall not be used within 1.5 metres of an existing buried service unless permitted by the relevant Service Authority. The use of vibrating rollers shall not be permitted. Any material which is soft, visibly deformed, unstable or deemed unsuitable by the Service Provider shall be excavated and replaced with fill in accordance with the requirements of this Specification.

2.6.2 PLACING AND COMPACTING FILL

Fill material shall be placed and compacted in successive horizontal layers for the full width of the cross-section. The loose depth of the material in each layer shall be such that when compacted the layer thickness shall be not more than 150mm.

At the time of compaction of each layer, the moisture content of the material shall be +/-2 per cent of Standard Optimum Moisture Content.

Equipment shall be properly weighted and sufficient passes shall be made to attain the compaction specified. In areas which are not suitable for rolling with power equipment, the Service Provider shall use mechanical hand tampers/plate compactors.

No compaction shall be accomplished by inundation or flooding.

If, at any time during the progress of the work, tests performed by the Service Provider show that the specified degree of compaction is not being obtained, the Service Provider's equipment and/or methods shall be replaced or modified, as required, to obtain the specified results.

The Service Provider may vary the scarifying and compacting methods adopted provided that it can be established to the satisfaction of the City's Representative that the material can still be compacted to the specified requirements.

At the completion of each day's work and at any time during a shift when a delay to work appears imminent on account of rain, all fill deposited shall be spread, graded and lightly rolled to form a surface sufficiently dense and shaped to shed the rain to drains. Upon resumption of work, those areas which have not been fully compacted shall be ripped for their full depth, cut to shape and processed as newly deposited fill.

Material which has been moisture softened following rainfall should be removed to the satisfaction of the City's Representative prior to placing additional fill over.

Acceptance of each layer is conditional upon the application of uniform and sufficient compaction effort by appropriate equipment over the whole of the layer.

2.6.3 PLACING AND COMPACTING STRUCTURE BACKFILL

Placing of backfill must be undertaken in layers so that any adjacent structures are not overloaded or damaged during compaction.

The placing of fill and backfill against brickwork or concrete work shall only be done where shown on approved construction documents or when otherwise approved by the City's Representative.

The placing of fill and backfill on both sides of foundation walls shall be equalised as far as possible and the difference in elevation between the two surfaces shall not exceed 600mm.

Fill and backfill shall be placed in layers not exceeding 200mm in compacted thickness allowing due care to avoid damage to any structures within the fill area and shall be compacted by rolling, tamping, vibration or other approved means.

2.6.4 PLACING AND COMPACTING TRENCH BACKFILL

Trench backfill shall be placed and compacted in accordance with *AS/NZS 3725:2007 Design for installation of buried concrete pipes* and/or the relevant Service Authority's specifications.

Backfilling shall proceed as rapidly as construction. Backfill shall be placed in layers not exceeding 150mm in compacted thickness allowing due care to avoid damage to any services within the trench area and shall be compacted as specified.

For drainage trench backfill, refer to B10: Stormwater Drainage Construction.

2.6.5 PREPARATION OF SUBGRADES

The Service Supplier shall notify the City's Representative when earthworks have progressed to a stage where the nature of subgrade material can be assessed. The City's Representative may order the removal of unsuitable material or other treatments including variations in pavement thickness to allow for the subgrade materials actually encountered.

The subgrade shall be excavated, trimmed and consolidated to levels ready to receive the first pavement course over the entire area to be surfaced. Low areas shall be filled with approved selected material and compacted to the following densities when tested in accordance with *AS 1289.0:2014 Methods of testing soils for engineering purposes – Definitions and general requirements*. Areas shall be retrimmed if necessary after compaction to the following requirements:

- 95 per cent of standard maximum dry density – All subgrades except under roads, and kerbs and gutters
- 100 per cent of standard maximum dry density – Under roads, kerbs and gutters, and building platforms.

2.7 TESTING

Testing may be carried out to determine whether the fill has the strength to hold loads placed on City footpaths and roads.

All testing must be performed by a NATA-registered laboratory.

The cost of all testing shall be paid by the Service Provider and the original of all laboratory reports shall be retained by the Service Provider and made available for inspection by the City's Representative. A certified copy of the tests reports must be provided to the City's Representative.

Work shall not proceed on any stage of the construction until the City's Representative has indicated that the test results on the previous stage are satisfactory.

2.7.1 TESTING FOR COMPACTION

Compaction shall be checked by a standard maximum dry density test and a field density test for materials other than sand or by the density index and field density tests for sands when directed by the City's Representative.

Tests shall be carried out in groups of at least three and compaction of the layer concerned will be considered to be satisfactory if no single result falls outside the specified density range. Should the results not reach this standard, the Service Provider shall again roll the area, if necessary after scarifying, adding water, blading to reduce the moisture content and/or removing and replacing excessively moist fill as may be required.

Should the City's Representative consider that the depth of insufficiently compacted material is greater than can be effectively compacted from the surface, material shall be removed to a depth at which compaction is satisfactory and replaced and compacted in layers.

The standard maximum dry density referred to in this Technical Specification for materials other than sand shall be the maximum standard dry density as determined in accordance with *AS 1289 – Test 5.1.1. Methods of testing soils for engineering purposes*

The modified maximum dry density referred to in this Technical Specification for materials other than sand shall be the maximum modified dry density as determined in accordance with *AS 1289 – Test 5.2.1. Methods of testing soils for engineering purposes*

The field density referred to in this Technical Specification for all materials shall be the dry density of the material in place as determined in accordance with *AS 1289 – Test 5.3.1. Methods of testing soils for engineering purposes*

The percentage of the standard maximum dry density (Dry Density Ratio) for materials other than sand shall be calculated from the formula given in *AS 1289 – Test 5.4.1. Methods of testing soils for engineering purposes*

The maximum and minimum densities of cohesionless materials shall be determined in accordance with *AS 1289 – Test 5.5.1. Methods of testing soils for engineering purposes*

The density index specified for sand (cohesionless materials) shall be calculated from the formula given in *AS 1289 – Test 5.6.1. Methods of testing soils for engineering purposes*

2.7.2 FREQUENCY OF TESTING

The following testing frequencies relate to acceptance on a 'not one to fail' basis.

The testing should be carried out in randomly chosen locations by the City's Representative and at the frequencies as given below; however, it may be appropriate to undertake testing in specific locations based on visual appearance or past experience (e.g. compaction may be more difficult to achieve adjacent to manholes, kerbs or over backfilled service trenches).

Where a test, or group of tests, is carried out on an area that has been subjected to essentially the same preparation and compaction procedures, and where the area is free from items that would affect compaction results (see examples in the above paragraph), the whole of this area is considered to be represented by this test or group of tests. The uniform area is generally known as a work lot.

On this basis, if one or more tests indicate that compliance with the specification has not been achieved, the whole of the area which has been submitted for testing is deemed not to comply, unless it can be demonstrated that the area in which the non-complying test result(s) can reasonably be separated from the whole. It should not be assumed a test result applies only to the area immediately surrounding it.

The required frequency of testing is not less than:

- 1 test per 50m^2 distributed reasonably evenly throughout the full depth and area; or
- 1 test per layer of 150mm thickness per material type per 200m^2 of surface area (but per 100m^2 for roads), whichever requires the most tests.

The testing frequency may be reassessed to the approval of the City's Representative, if a high degree of uniformity becomes evident during construction.

For trench filling, 1 test per maximum 50 linear metres per layer of 150mm thickness per material type is required.

2.9 FINISHED SURFACE OF EARTHWORKS

The area within the limit of the Works shall be graded, within the limits specified, to the required elevation and cross-section.

The finished surfaces shall be smooth, compacted as specified, and free from irregular surface changes.

Allowance for the effects of consolidation including the settlement of fill shall be made by placing extra material at the time of construction, or additional material shall be placed after consolidation has taken place.

The finished surface of the subgrade shall not vary more than -20mm, +0mm from the approved design grade or approved cross-section.

Grading shall include connections or entrances to drainage facilities or natural drainage, as shown, and shall not create pockets in which water will stand.

Deviations in the finished surfaces in excess of these limits, when tested with a three (3) metre straight-edge or profile template as applicable, applied parallel with and/or at right angles to the centre line of the area, shall be corrected by loosening to a minimum depth of 100mm, adding or removing material, reshaping, adjusting moisture content and re-compacting. This testing shall be repeated until the surface conforms to the limits specified.

2.9 QUALITY

2.9.1 INSPECTIONS

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

2.9.2 HOLD AND WITNESS POINTS

1. Process Held:	Excavation (Section 2.4)
Submission Details:	At least two (2) working days before starting the excavation on site.
Release of Hold Point:	The City's Representative will inspect the final excavated levels, prior to authorising the release of the Hold Point.
2. Process Held:	Compaction of Subgrade (Section 2.6.5)
Submission Details:	At least two (2) working days prior compaction of subgrade.
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise.
3. Process Held:	Backfilling (Section 2.6.3)
Submission Details:	At least two (2) working days before starting the backfilling on site.
Release of Hold Point:	The City's Representative will inspect the final finished backfill levels, prior to authorising the release of the Hold Point.
4. Process Held:	Compaction Testing (Section 2.7)
Submission Details:	Submit the compaction testing results at least two (2) working days before final levels are achieved.
Release of Hold Point:	The City's Representative will inspect the compaction results, prior to authorising the release of the Hold Point.
5. Process Held:	Location of Services (Section 2.4.1)
Submission Details:	At least two (2) working days prior to any earthworks being carried out.
Release of Hold Point:	The City's Representative will inspect the Dial Before You Dig details prior to authorising the release of the Hold Point.

2.9.3 TOLERANCES

On completion of cutting, filling and all incidental operations and before the placement of covering materials, finished surfaces shall conform to the tolerances in level and shape as outlined below.

Item	Activity	Tolerances	
1.	Cut subgrade in earth	• Level:	+0mm - 20mm
		• Straightness:	20mm departure from 3m straightedge both ways
2	Cut subgrade in rock	Level:	+0mm - 20mm
		Straightness:	Unspecified
3	Fill subgrade	Level:	+0mm - 20mm
		Straightness:	20mm departure from 3m straightedge both ways

B3
Concrete Works Construction

Contents

B3 CONCRETE WORKS CONSTRUCTION

3.1 SCOPE

This Technical Specification provides for the supply, forming, reinforcing, and placing of concrete used in the construction of pavements, drainage structures, kerb and gutter, miscellaneous or special structures.

3.2 STANDARDS 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 apply to the Works to be undertaken. It is the responsibility of the Service Provider to ensure that all relevant standards are met.

AS 1012.1–2001 Methods of testing concrete – Determining of the modulus of rupture

AS 1141 Methods for sampling and testing aggregates

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 1379 Specification and supply of concrete

AS 1478 Chemical admixtures for use in concrete

AS 1554 Structural steel welding

AS 2349 Methods of sampling Portland and blended cements

AS 2350 Methods of testing Portland and blended cements

AS 2758 Aggregates and rock for engineering purposes

AS 2870 Residential slabs and footings – construction

AS 2876 Concrete kerbs and channels (gutters) – manually or machine placed

AS 3582.1 Supplementary cementitious materials – fly ash

AS3582.2 Supplementary cementitious materials for use with Portland cement, Part 2: Slag – ground granulated iron blast-furnace

AS3582.3 Supplementary cementitious materials for use with Portland cement, Part 3: Amorphous silica

AS 3600 Concrete structures

AS 3610 Formwork for concrete

AS 3735 Concrete structures for retaining liquids

AS 3972 General purpose and blended cements

BS EN 14889 British Standard: Fibres for concrete. Steel fibres. Definitions, specifications and conformity

ACI 544-3 R08 American Standard: Guide for Specifying, Proportioning, and Production of FRC

ASTM C1116-03 Standard Specification for Fibre-Reinforced Concrete and Shotcrete

3.3 MATERIALS

3.3.1 CONCRETE

All concrete used shall generally be ready-mixed concrete unless approved otherwise.

Ready-mixed concrete shall be obtained from an approved ready-mix supplier and shall comply with *AS 1379.- Specification and supply of concrete*

Onsite-mixed concrete may be used where approved by the City's Representative and shall comply with the current edition of the relevant Australian Standard. The methods of batching, mixing and transportation shall be to the satisfaction of the City's Representative.

3.3.2 CONCRETE PROPERTIES

Concrete for the Works shall have a characteristic strength ranging between 25MPa and 40MPa unless noted otherwise on the drawings. The strength will be dependent on the type of Works and will be stated in the relevant section or on the drawings.

The maximum size of aggregate to be used shall be 20mm.

Concrete shall be of a consistency that it can be readily placed and compacted in the forms without segregation of the materials and without excess free water collecting on the surface. Concrete slump shall be 75mm maximum for manually placed concrete and shall be tested in accordance with *AS 1012, Part 3.- Methods of testing concrete – Determining of the modulus of rupture*

Concrete for use in kerb extrusion machines shall contain the maximum amount of water which will produce such consistency that, after extrusion, the shape of the kerb will be maintained.

3.3.3 SUSTAINABLE MATERIALS IN CONCRETE

The City has adopted the use of the Green Building Council of Australia (GBCA)'s Green Star MAT-4 as a standard with the following composition:

- 40 per cent cement replacement
- 50 per cent reclaimed water replacement
- 40 per cent coarse aggregate replacement
- 25 per cent fine aggregate replacement.

The City will consider the following alternatives to replace standard materials:

- Portland cement replacements
    - Ground Granulated Blast-Furnace Slag (GGBS)
    - Fly ash
    - Amorphous silica (silica fume)
    - Mineral additions (limestone)
    - Geopolymer techniques and products (which are generally more suited to pre-cast applications). Note the City of Sydney Wyndham Street trial in April 2019. Once outcomes are agreed upon, geopolymer may be used.
    - Virgin aggregate replacements
    - Recycled pavement (sourced in situ or from external projects) – recycled refers to both re-used sections as well as crushed and re-cast
    - Reclaimed/avoided waste aggregates
    - Blast furnace slag

  - Manufactured sands (waste processed as fine aggregate)
  - Recycled crushed glass (RCG)
  - Any other appropriate aggregate shown to reduce embodied emissions, which performs to all appropriate standards, and with the approval of the City.
- Steel reinforcement replacements
  - Fibre reinforced concrete (in accordance with Australian guidance and international standards).

Service Providers should design this replacement in accordance with *AS 3582 – Supplementary cementitious materials for use*, and should note that the City expects Service Providers to ensure adequate conditions for this replacement are met (i.e. that installation is varied where needed as a result of material replacement). For example, changes to installation may include extending curing time or varying compaction rates. The final material must comply to the performance specifications below, as well as *AS 3972-2010 – General purpose and blended cements*.

The City prefers and encourages replacement of these materials at GBCA's Green Star MAT-4 proportions provided. Should the Service Provider be able to exceed or not be able to achieve these proportions discussions and approval with the City must be sought.

3.3.3.1 FIBRE REINFORCED CONCRETE (FRC)

Fibre reinforced concrete (FRC) may be used in the construction of footpaths. The material shall be in accordance with appropriate standards and design loads and traffic shall comply with the City's Technical Specifications.

FRC shall have the minimum characteristics:

- Compression strength of the 28-days sample shall be minimum 32 MPa.
- Tensile cracking stress of the FRC shall be minimum 6 MPa.
- Modulus of the rupture shall be minimum 6 MPa.

The mixing process of the FRC in the batching shall be in accordance with the manufacturer's recommendation.

For Macro Poly Fibre concrete, the material's specification shall be in accordance with the following:

- Macro Poly Fibre Reinforcement shall be added to the concrete (with f'c of 32 MPa) at the rate of 4.6 Kg/m3
- Fibre shall meet all the requirements of *ASTM C1116, Type 3 Standard Specification for Fibre-Reinforced Concrete and Shotcrete*
- The dosage consists of 4kg/m3 of Macro Plastic Monofilament Poly Fibres from 40mm to 65mm long combined with 0.6kg/m3 of a Micro Poly Fibre 10mm to 20mm long
- The fibres shall be made from Virgin Polypropylene with a tensile strength of minimum 550Mpa and have sufficient ductility to permit 180 degree bends without rupture
- Macro Fibres shall be continuously deformed.

3.3.4 ADMIXTURES

The use of admixtures shall be subject to the approval of the City's Representative.

The Service Provider shall submit to the City's Representative details of the proposed source and nature of any admixtures and the proposed amount to be added.

Admixtures shall conform to the requirements of *AS 1478 Chemical admixtures for use in concrete* and shall not reduce the strength of the concrete. Admixtures shall not contain chlorides, chlorine, sulphur, sulphides or sulphites or any other substance detrimental to concrete or steel.

The use of chemical admixtures that result in Portland Cement reductions should be considered in relation to above sustainable materials in concrete aim, though the performance of the material must still meet or exceed all relevant design and construction requirements.

3.3.5 SAMPLING AND TESTING

The Service Provider may be required to carry out sampling and testing of concrete in accordance with the following requirements. Testing shall be carried out by an independent NATA Registered Laboratory using the relevant procedures set out in *AS 1012 Methods of testing concrete – Determining of the modulus of rupture, AS 1379 Specification and supply of concrete and AS 3600. Concrete structures*

Not less than three (3) specimens shall be made and tested for any sample representative of the day's concrete.

Where more than 15 cubic metres of concrete is placed in one (1) day, three (3) test cylinders shall be made for each 15 cubic metres or part thereof. Until despatched to the laboratory, the cylinders shall be stored undisturbed at the site in a moist condition, sheltered from the sun and wind, and protected from extremes of temperature. The Service Provider shall be responsible for providing the necessary curing facilities and for curing the test cylinders on the site.

One (1) test cylinder of each of the three (3) specimens shall be tested at 7 days, one (1) at 28 days and the third when required by the City's Representative. Should any two (2) test cylinders of a set fail to fulfil the compressive strength specified, the City's Representative may reject the whole or part of the concrete represented by these specimens in which case it shall be removed and replaced.

3.3.6 FORMWORK

Formwork shall be constructed of one of the following:

- Seasoned or kiln-dried timber
- Metal shutters with joints flush fitting and adequately sealed
- Pressed wood or plywood supported with timber of size and spacing approved by the City's Representative.

All exposed edges shall be chamfered not less than 20mm x 20mm to prevent mortar runs and to preserve smooth, straight lines. Internal angles shall be filleted where shown on the drawings.

Timber formwork shall be in long lengths free from loose knots and surface defects and uniform in thickness. Before re-use, form materials shall have all protruding nails withdrawn and surfaces to be in contact with concrete shall be thoroughly cleaned. Forms shall not be re-used if bulged or warped. All inside surfaces of formwork shall be coated with non-staining mineral oil, grease or other approved agent to ensure non-adhesion of the mortar.

3.3.7 REINFORCEMENT, TIE BARS AND DOWELS

Reinforcing steel for concrete pavements shall comply with the requirements of *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 appropriate.

All steel shall be clean and free from mill scale, loose rust or oil.

Tie bars shall be Grade 230S and dowels shall be Grade 230R steel, both complying with *AS 1302 Steel reinforcing bars for concrete*.

Dowels shall be straight, one piece and cut accurately to length. Ends of dowels shall be square and free from burrs.

Plastic bar chairs or plastic-tipped wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at 23 ± 5°C without malfunction. The Service Provider shall demonstrate that the proposed chairs conform to these requirements.

All reinforcing bars and mesh shall be supplied by an Australian Certification Authority for Reinforcing Steels (ACRS) accredited supplier and shall be appropriately marked with the supplier's unique identify mark. Any reinforcing steel or mesh not marked and/or supplied from an ACRS accredited supplier shall be immediately removed from the site.

3.3.8 SHOTCRETE (SPRAYED CONCRETE)

Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound, homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.

The minimum depth of sprayed concrete to be applied shall be 100mm for raingardens and 75mm elsewhere.

Sprayed concrete lining in open drains or natural rock-retaining walls shall be coloured to match the adjoining rock colour. Sprayed concrete shall have a minimum cement content of 380 kg/m3 as discharged from the nozzle and shall have a minimum compressive strength of 25 MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete.

Core testing of finished shotcrete or an onsite test panel (900mm x 900mm x 150mm) as determined by the City Representative shall comply with the Concrete Institute of Australia's *Recommended Practice for Shotcreting in Australia*. Cores shall be secured, accepted, cured, capped and tested in accordance with *AS 1012 Methods of testing concrete – Determining of the modulus of rupture*. The Service Provider shall provide equipment and facilities for the taking of cores from the work. The Service Provider shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores. Copies of test results shall be forwarded to the City's Representative.

At least 10 working days prior to applying any sprayed concrete, the Service Provider shall submit to the City's Representative details of the proposed procedures, plant, materials and mix proportions. Materials shall comply with *AS 3600- Concrete structures*

3.3.9 EPOXY GROUT

Epoxy grout shall be as specified on the construction drawings and be a commercial epoxy formulation of high compressive strength, greater than 100MPa. Where the Service Provider nominates to use an alternative product, full details of proposed materials and methods shall be submitted to the City's Representative prior to using the epoxy grout.

3.4 CONSTRUCTION

3.4.1 GENERAL

Concrete work shall be constructed accurately to the dimensions and details shown on the approved plans or as directed by the City's Representative.

The preparation of formation surfaces onto which concrete is to be poured shall be in accordance with the requirements of Section B2 Earthworks.

3.4.2 ERECTION OF FORMWORK

Erection and strutting of formwork and falsework shall be in accordance with the requirements of AS 3610.

Formwork shall conform to the shape, lines and dimensions required in the finished concrete. Formwork shall be rigid, watertight, braced and fixed so that it will remain in position and shape during the casting of the concrete. Formwork shall be constructed so that it can be removed without damage to the concrete.

All dirt, sawdust, shavings or other debris shall be removed from the inside of forms before placing concrete.

3.4.3 PLACING AND FIXING REINFORCEMENT

Reinforcement shall be carefully formed to the dimensions and shapes shown on the approved drawings. For mild steel reinforcing bars, cold bends shall be made around a pin having a diameter of four (4) or more times the nominal diameter of the bars.

Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of reinforcement bars will not be permitted.

Where practicable, all reinforcement shall be supplied in the full lengths shown in the approved drawings. Where not practicable, the Service Provider shall splice the reinforcement by lapping where directed. The lap shall not be less than 40 times the nominal diameter of the bars.

All reinforcement shall be accurately placed in the positions shown on the plans, and shall be securely held during the placing and compacting of the concrete by wiring together with annealed iron wire of not less than 1.2mm diameter, and by blocking and supporting the forms with plastic or metal chairs, or by other approved methods. Unless otherwise shown on the drawings, the minimum clear cover to reinforcement shall be 50mm or as specified in *AS 3600 – Concrete Structures*.

Reinforcement supports shall be made of durable materials strong enough to withstand the imposed loads without movement of the reinforcement. They shall be positively attached to the reinforcement and of such size as to maintain the specified cover. Bars shall be tied at all intersections except where spacing is less than 300mm in any direction when alternate intersections shall be tied.

Wooden supports shall not be used, nor shall metal supports or tie wires which extend to the surface of the concrete. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted.

All reinforcement when placed shall present a clean surface, free from grease, tar, paint, oil, mud, loose mill scale and loose or thick rust.

3.4.4 CORE HOLES AND EMBEDMENTS

Prior to pouring concrete all core and embedment requirements for all trades shall be installed.

In the case of core holes or embedments not shown on the drawings, or where temporary openings are required for construction purposes, appropriate details shall be submitted to the City's Representative at least seven (7) days prior to their construction.

Reinforcing bars may generally be slightly moved to clear core holes and embedments, but they shall not be cut, nor shall any cores be cut in hardened concrete without the approval of the City's Representative.

Where reinforcing mesh must be cut, additional reinforcing bars of at least equal strength to the cut reinforcement shall be placed at each side of the core hole or embedment.

3.4.5 PLACING OF CONCRETE

Concrete shall be transported and placed in accordance with the requirements of *AS 3600 Concrete structures.*

Movement of concrete to the pour face may be by means of suitable conveyors, clean chutes, pumping, or troughs or pipes which shall be made of metal or have metal linings. Water shall not be used to facilitate the movement.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2 metres or be deposited in large quantities at any point and moved or worked along the forms. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed.

Concrete shall be deposited in horizontal layers not exceeding 600mm in thickness and compacted such that each succeeding layer is blended into the preceding one by the compaction process. The concrete shall be

placed in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

The Service Provider may be requested to keep on site and make available for inspection a log book recording each placement of concrete including:

- Date
- The portion of work
- Specified grade and source of concrete
- Slump measurements
- Volume placed.

Unless adequate protection is provided, concrete shall not be placed during rain or when rain appears imminent. Prior to placing concrete, the area shall be clean and moist but free from any ponding of water.

No concrete shall be mixed or placed, without the approval of the City's Representative, when the air temperature in the shade is below 5°C or above 38°C unless special precautions are taken as approved by the City's Representative.

Concrete affected by environmental factors before it has set, including during mixing, transport or placing, shall be liable to rejection.

Concrete shall not be placed under water.

The Service Provider shall minimise shrinkage effects by pouring the sections of the wowrk between construction joints in a sequence such that there will be suitable time delays between adjacent pours.

3.4.5.1 PLACING OF FRC

Placement of Fibre Reinforced Concrete (FRC) is not significantly different from placing plain concrete. The same factors must be adhered to; good careful vibration, constant level checking and flat screeding will produce the first stage of a quality slab.

Like plain concrete, FRC can be placed either manually or mechanically.

All surfaces shall be finished to a smooth finish prior to applying the final finish. The constrictor shall ensure that the fibres and aggregates are not exposed in the smooth finish.

Once the smooth surface is achieved, the final finish (wood float, textures or burnished) may be applied.

3.4.6 COMPACTION OF CONCRETE

Concrete shall be compacted immediately after placing by immersion and/or screed vibrators accompanied by hand methods as appropriate to remove entrapped air and compact the mix. Form vibrators shall be used where use of immersed vibrators is impracticable. Concrete shall be fully compacted and entrapped air removed, but the concrete shall not be over-vibrated such that segregation is caused. Vibrators shall not come into contact with partially hardened concrete, or reinforcement embedded in it. Vibrators shall not be allowed to rest on reinforcement or be used to move concrete along the forms.

Exposed surfaces of the concrete shall be struck off and finished. Where shown on the drawings, corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted or neatly rounded.

3.4.6.1 KERB EXTRUSION MACHINES

Concrete used in kerb extrusion machines shall have a density not less than 96 per cent of the density achieved in a specimen cylinder prepared in accordance with *AS 1012.8, clause 1.7.5. Methods of testing concrete – Determining of the modulus of rupture.*

The Service Provider shall carry out concrete core tests in accordance with *AS 1012.14–1991. Methods of testing concrete – Determining of the modulus of rupture.*

Intervals of such tests shall be one test per lot if requested by the City's Representative. A lot shall be the kerb and channel cast in one day's production. The location for testing shall be the kerb and gutter tray or where there is not a gutter, the top of the kerb on the steepest downhill grade on which the kerb machine is travelling.

On incidental or isolated works or on works where the total length of kerb cast in one day's production is less than 150 linear metres, three core tests shall be conducted. The Service Provider shall request the City's Representative to nominate the position of each test.

The Service Provider shall fill holes due to core sampling with a suitable concrete mix coloured to match the kerb and channel within 48 hours of testing.

3.4.7 APPLICATION OF SHOTCRETE (SPRAYED CONCRETE)

Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as close to perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed from the surface after the initial set by air jet or other suitable means as work proceeds and disposed of.

Spraying shall be discontinued if wind causes the separation of the nozzle stream.

Concrete shall not be sprayed in air temperatures less than 5°C.

Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

Curing shall commence within one hour of the application of sprayed concrete, except for raingarden applications, and may be by water or by colourless wax emulsion curing compound complying with AS 3799 and applied in accordance with manufacturer's specifications.

In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven (7) days.

Curing is not required for sprayed concrete within raingardens unless directed by the City's Representative.

3.5 JOINTS

3.5.1 CONSTRUCTION JOINTS (COLD JOINT)

Construction joints shall be formed whenever it is necessary to cease concreting for 20 minutes or longer, except at expansion joints. The location of construction joints shall be as shown on the plans or as required and approved by the City's Representative.

These joints shall be perpendicular to the principal line of stress, and in general shall be located at points of minimum shear.

Before placing new concrete against concrete which has set, the forms shall be retightened and the face of the set concrete shall be roughened, cleaned of foreign matter, latent and loose or porous material, and saturated with water.

The face shall then be covered uniformly with a thin coat of neat cement and water to ensure bond and concreting shall then proceed immediately.

Pre-fabricated key joints are also acceptable to be used as construction joints. All key joints shall be approved by the City's Representative prior to use.

3.5.2 CONTRACTION JOINT (DUMMY JOINT)

Contraction joints shall be located as shown on the standard drawings. They can either be formed using an appropriate jointing tool or sawing once the concrete has partially cured.

Contraction joints shall be perpendicular to the principal line of stress and be one continuous line without deviation.

When concrete is reinforced, the steel should be placed in such a manner that only one half the reinforcing bars will span the joint. This establishes the plane of weakness at the joint area.

The Service Provider shall use a jointing tool for the installation of a contraction joint after the concrete has been edged, and prior to finishing of the surface.

Sawing for the installation of contraction joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without excessive ravelling, depending on weather conditions.

3.5.3 EXPANSION JOINTS

Expansion joints shall be provided as shown on the standard drawings or where directed by the City's Representative. Expansion joints shall be pre-moulded and made of either fibre, sponge rubber, plastic or bituminous impregnated cork. The expansion joint material shall be non-extruding in hot weather, or brittle in cold weather. All joints shall be neatly finished with an edging tool.

An expansion joint shall always be used where a concrete member will join or abut an existing structure of any type.

3.5.4 ISOLATION JOINTS

Isolation joints shall be provided where a pavement abuts a building, kerb, or any other rigid structures such as drainage pits or access holes.

3.5.5 SURFACE FINISHES

Kerb and gutter shall be finished with a steel trowel. Edges shall be finished with round chamfers as shown on the standard drawing.

In situ concrete footways, vehicular crossings and kerb ramps shall be finished with a medium wood float finish, generally perpendicular to the line of travel. Edges, joints and grooves shall be finished to approval with a rounded chamfer by using a steel edge or grooving tool. The smooth margin adjoining the rounded edge shall not be wider than 25mm and grooves shall not be less than 10mm deep.

All other exposed surfaces, unless otherwise shown on the drawings or directed, shall be struck off and finished with a wooden float, and joints and edges so shown shall be left neatly tooled. Concrete shall not be disturbed after it has been in the forms for 10 minutes.

Faulty and honey-combed portions shall be taken down and rebuilt if directed by the City's Representative.

The Service Provider shall immediately after removal of the forms, backfill the spaces adjacent to the concrete with sound material, thoroughly compacted, leaving the hole in a neat and good manner. Where kerb moulding machines are used, the Service Provider shall backfill 48 hours after placing concrete. Backfilling and/or the placement of pavement material shall only be undertaken with the prior approval of the City's Representative.

3.6 CONCRETE CURING AND PROTECTION

The requirements for curing and protection shall be in accordance with *AS 3600 Clause 19.1.5-Concrete structures* and this Technical Specification.

For all types of curing regimes, the concrete surface shall be maintained at a temperature not less than 5°C throughout the curing period.

All concrete pours shall be timed as such that the concrete has hardened sufficiently, by the time the last person leaves the site, to not allow any vandalism or graffiti to occur on the exposed faces of concrete. Where any exposed concrete is affected by graffiti, it shall be removed and replaced between the nearest joints.

Where appropriate or directed by the City's Representative, all exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand, hessian cloth or commercial curing compounds, in accordance with *AS 3799 Liquid membrane-forming curing compounds for concrete.*, for a minimum period of 72 hours. During this time, the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete.

3.7 STRIPPING OF FORMWORK

Formwork shall be stripped in accordance with *AS 3600 Clause 19.6.2 - Concrete structures*, where those requirements are more stringent than the relevant requirements of *AS 3610 Formwork for concrete* .

3.8 QUALITY

Any lot that does not meet all the requirements of this Technical Specification shall be rejected.

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Technical Specification.

3.8.1 INSPECTIONS

At least two (2) working days' notice shall be given for all inspections.

3.8.2 HOLD AND WITNESS POINTS

Construct Concrete	
1. Process Held:	Installation of Formwork (Section 3.4.2)
Submission Details:	At least two (2) working days before the installation of the formwork.
Release of Hold Point:	The City's Representative will inspect the installed formwork, prior to authorising the release of the Hold Point.
2. Process Held:	Installation of Reinforcement (Section 3.4.3)
Submission Details:	At least two (2) working days before the installation of the reinforcement.
Release of Hold Point:	The City's Representative will inspect the installed reinforming, prior to authorising the release of the Hold Point.
3. Process Held:	Finish of Concrete (Section 3.6)
Submission Details:	At least two (2) working days prior to finishing the concrete
Release of Witness Point:	The City's Representative will inspect the finished concrete, prior to authorising the release of the Witness Point unless advised otherwise.

3.8.3 TOLERANCES

Item	Activity	Tolerances
1.	**Subgrade** a) Relative Compaction	≥92% (modified compactive effort)
2	**Barriers, Footpaths etc.** a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 15mm under a 3m straight edge
	b) Relative Compaction of Subbase	≥95% (modified compactive effort) ≥98% (standard compactive effort)
3	**Formwork** a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work
4	**Fine Aggregate** a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate

3.8.3 TOLERANCES, CON'T

Item	Activity	Tolerances
5	**Coarse Aggregate**	
	a) Percentage of wear	Loss of weight shall not exceed 30%
	b) Crushing Value	Crushing value shall not exceed 25%
	c) Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%
	d) Particle Shape	The proportion of misshapen particles (2:1 ratio) shall not exceed 35%
	e) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of the sample aggregate
6	**Aggregate Moisture Content**	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed
7	**Consistency**	In accordance with *AS 1012.3, Method 1 Methods of testing concrete – Determining of the modulus of rupture*, the slump shall not exceed the nominated slump ±15mm In the case of concrete placed by extrusion machine, the slump will be between 10mm and 15mm
8	**Ready Mixed Concrete** a) Mixing and Delivery	The time taken from the introduction of water until the concrete is completely discharged shall not be more than 1.5 hours Where non-agitating equipment is used, the concrete shall be completely discharged not more than 30 minutes after the addition of water
9	**Placing and Compacting of Concrete**	Concrete shall not be placed without the approval of the City's Representative if the air temperature within 24 hours is likely to be below 5°C of the shade temperature and is likely to exceed 38°C.
10	**Finishing of Unformed/Formed Concrete Surfaces**	
	a) Wearing Surface	To be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3m length
	b) Finished Surfaces	
	i) Not Adjacent to Roads	≤25mm Plan Position ≤25mm Level
	ii) Adjacent to Roads	≤10mm Alignment ≤10mm Level
	iii) Culvert Inverts	≤25mm Alignment ≤10mm Level

B4
Kerb and Gutter Construction

Contents

B4 KERB AND GUTTER CONSTRUCTION

4.1 SCOPE

This is the Technical Specification for the construction of kerb and gutter including the supply, quality and placement of various kerb and gutter materials.

4.2 STANDARDS AND GUIDELINES

Unless stated otherwise in the Technical Specification, the approved drawings or elsewhere in the construction documents, the Work 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 Work.

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

- AS 2876 Concrete kerbs and channels (gutters) – Manually or machine placed
- AS3600 Concrete structures
- RMS QA Specification R15 Kerbs and Gutters
- ASTM C615/C615M-11 Standard Specification for Granite Dimension Stone.

4.3 MATERIALS AND COMPONENTS

4.3.1 STONE KERB

For direction on where to use each type of kerbing, refer to the Sydney Streets Design Code.

All stone supplied shall be natural, uniform quality in each grade, sound and free of defects – such as vents, cracks, fissures, seams, porous inclusions, foreign material, loose surface material striations, stains, discoloration and other defects – that are liable to affect its strength, appearance, durability or proper functioning under the intended conditions of use.

Stone kerb and gutter may be available from suppliers that are currently approved by the City (list supplied on request), or procured from the following quarries:

- Black Hill SA
- Fraser Range Norseman WA
- Deer Park VIC.

Other suppliers may be used, subject to approval by the City's Representative. All stone alternatives must be selected to match the colour, pattern and quality of the City's current supplied stone.

4.3.1.1 REPLACEMENT OF STONE KERB

All existing stone is to be retained or re-laid and shall remain in the dimensions and condition as found, unless approved otherwise by the City's Representative. Refer to B1: Preliminaries and General Construction of the Technical Specifications for on-site storage requirements.

Stone that has been confirmed as unserviceable by the City's Representative may be replaced with stone sourced from the City's stone storage yard, if available. Fees and charges will apply for replacement stone in accordance with the City's adopted schedule of fees and charges, available on the City's website. Where stone is to be replaced, the replacement stone is to match the dimensions of the stone that is being replaced. New stone shall be sourced as above.

4.3.1.2 GRANITE KERBS (AUSTRAL 'BLACK' AND 'VERDE')

Granite shall have a flame exfoliated finish with a 15mm x 15mm chamfer to the exposed top edge.

Radial kerb and gutter stones are required to be cut to the specified radius for all radii up to 7.5m at the kerb face. Radii greater than 7.5m at the kerb face can be formed from straight sections of kerb.

The supplier shall provide written certification that the supplied granite stone products meet the international *ASTM C615/C615M-11 Standard Specification for Granite Dimension Stone* for the following quality criteria:

AUSTRAL BLACK

Property	Test Standard	Performance Criteria
Compression strength (dry/soaked)	ASTM C170/C170M	> 185MPa (soaked)
Water absorption	ASTM C97/C97M	< 0.1% by weight
Bulk density	ASTM C97/C97M	> 2900kg/m3
Flexural strength (dry and soaked)	ASTM C880/C880M	> 14MPa (soaked)
Resistance to salt attack	AS/NZS 4456.10A	Durability Class A
Coefficient of thermal expansion	ASTM E831	< 0.000005 mm/mm/°C
Abrasion Resistance	ASTM C1353	> 113 Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Dimensional Stability	Draft SAA method	< 0.1 % (Wet-dry, hot-cold)
Secondary minerals content (petrographic)	AS 1141.26	< 2%

AUSTRAL VERDE

Property	Test Standard	Performance Criteria
Compression strength (dry/saturated)	ASTM C170/C170M	> 140MPa (soaked)
Water absorption	ASTM C97/C97M	< 0.1% by weight
Bulk density	ASTM C97/C97M	> 2560kg/m3
Flexural strength (dry and saturated)	ASTM C880/C880M	> 12MPa (soaked)
Resistance to salt attack	AS/NZS 4456.10A	Durability Class A
Coefficient of thermal expansion	ASTM E831	N/A
Abrasion Resistance	ASTM C1353	> 54 Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Dimensional Stability	Draft SAA method	< 0.1 % (Wet-dry, hot-cold)
Secondary minerals content (petrographic)	AS 1141.26	< 2%

4.3.1.3 TRACHYTE KERBS

Trachyte stone kerbing used in the City is generally old hand-cut stone with highly variable dimensions.

Trachyte may be sourced from the City's stone storage yard, if available. If not available from the City's store or other supply, then an alternative approved stone material should be used as directed by the City's Representative.

4.3.1.4 BLUESTONE KERBS

Bluestone kerbs shall be sawn with 1mm arris or rubbed on all edges. The top front edge of the kerb shall be cut to a 15mm x15mm chamfer.

Radial kerb and gutter stones are required to be cut to the specified radius for all radii up to 7.5m at the kerb face. Radii greater than 7.5m at the kerb face can be formed from straight sections of kerb.

All cut stones shall be free from any defect relating to strength, durability and appearance, and comply with the following:

- Cut and machined from sound basaltic stone with less than 20 per cent secondary minerals as determined by methods of microscopic examination and quarry sampling by the Road Construction Authority of Victoria
- Supplied from a quarry that is not used for aggregate, and shall be quarried only with black powder or other approved soft blasting technique
- Clear of all clay, overburden, soft, friable or weathered material and other foreign matter
- Free of sawcuts on all exposed faces
- Wearing qualities shall not exceed a percentage loss of 30 per cent as determined by the Los Angeles Abrasion Test

- Vesicles, veining or fracture lines considered detrimental to strength will be rejected
- Colour variation, vesicles and veining shall be of an equivalent standard to the City's existing bluestone kerbing
- Flint or other discolorations are to be avoided.

All cut stones shall meet the following criteria:

Property	Test Standard	Performance Criteria
Compression strength (dry/saturated)	ASTM C170/C170M	> 100MPa (soaked)
Water absorption	ASTM C97/C97M	< 1.8% by weight
Bulk density	ASTM C97/C97M	> 2500kg/m3
Flexural strength (dry and saturated)	ASTM C880/C880M	> 14MPa (soaked)
Resistance to salt attack	AS/NZS 4456.10A	Durability Class A
Coefficient of thermal expansion	ASTM E831	< 0.0000064 mm/mm/°C
Abrasion Resistance	ASTM C1353	> 19 Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Dimensional Stability	Draft SAA method	< 0.1 % (Wet-dry, hot-cold)
Secondary minerals content (petrographic)	AS 1141.26	< 2%

4.3.1.5 SANDSTONE KERBS

Existing sandstone shall be re-used and retained, where possible unless approved by the City's Representative.

New sandstone shall be roughly cut, fine-grained plain buff sandstone, aged and coloured to match the surrounding sandstone in the area, and sourced from the City's approved quarry. Other suppliers may be used subject to approval by the City's Representative. Stone must be selected to match the colour, pattern and quality of the City's current supplied stone.

The sandstone shall be of a hard and durable quality, free from sand balls, excessive discolouration and staining (tea leaf), quartz pebbles, fissures, sealed joints, hard ball, shale inclusions or any other defect and without clearly defined, easily split bedding planes.

Sandstone shall be natural cut on exposed faces with kerb face or gutter surface cut parallel to the bedding planes of the stone. The top front edge of the kerb shall be cut to a 25mm bull-nose arris.

Sandstone kerbing and gutter stones shall be free of sawcuts on all exposed faces.

All cut stones shall be free from any defect relating to strength, durability and appearance, and comply with the following:

Property	Test Standard	Performance Criteria
Compression strength (dry/saturated)	ASTM C170/C170M	> 50Mpa
Water absorption	ASTM C97/C97M	< 8% by weight
Bulk density	ASTM C97/C97M	>2000kg/m3
Resistance to salt attack	AS/NZS 4456.10:2003	Durability Class B
Abrasion Resistance (Taber)	ASTM 1353-98	>2Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14

4.3.2 CONCRETE KERBS AND GUTTERS

For locations where concrete kerb and gutter is to be used then this is to be constructed as cast in situ kerb and gutter unless specified and approved by the City's Representative.

At locations where precast concrete kerbs are in good condition and are to be retained, then a separate concrete gutter shall be formed and poured to match the existing kerb.

All concrete shall be a minimum 25 MPa with a maximum aggregate size of 20mm. A slump at the forms shall be no greater than 75mm.

Kerbs and gutters shall have a steel trowel surface finish.

Laying of concrete by machine shall only be undertaken with prior approval from the City's Representative.

All concrete shall comply with B3: Concrete Works Construction.

4.3.3 CONCRETE GUTTERS

Generally, a 450mm wide concrete gutter will be used on all kerb types unless specified and approved otherwise by the City's Representative. All concrete gutters shall be a minimum 25 MPa concrete with a maximum aggregate size of 20mm.

Where the adjacent gutter is not concrete, the Service Provider shall request direction from the City's Representative.

All concrete shall comply with B3: Concrete Works Construction.

Where the gutter is subjected to highly repetitive medium and heavy traffic, the gutter shall be 200mm thick and reinforced with trench mesh to suit the loading. These areas include but not limited to gutter in bus lanes, bus stops with more than 40 buses in a day, commercial and industrial driveways.

4.3.4 STONE GUTTERS

Existing stone gutters shall be retained or re-laid in the dimensions as found, unless directed otherwise by the City's Representative. If the City's Representative determines that the existing stone gutter is broken or substantially degraded, then a replacement stone must be used. The dimensions of new replacement stone shall match the existing stone, unless directed otherwise by the City's Representative.

Concrete gutter may be used instead of stone if directed by the City's Representative.

4.3.5 JOINTS

All joints shall be filled with expansive filler and sealed with flexible UV-resistant sealant. Silicone sealant is the preferred type of UV-resistant sealant to be used.

4.3.5.1 SANDSTONE KERBS

All sandstone kerbs shall have sandstone-coloured mortar joints. Refer to B3: Concrete Works Construction for mortar details.

4.3.5.2 CONCRETE KERBS

Expansion joints 10mm in width for the full depth of the kerb and/or gutter shall consist of suitable preformed joint filler. The joint filler shall be a preformed self-expanding cork strip or alternative approved by the City's Representative.

4.3.6 CONCRETE EXTENDED KERB INLETS (EKI)

Where extended kerb inlets are required in concrete kerb locations, they are to be constructed with precast concrete lintels as specified on the construction drawings.

Cast in situ lintels are not to be used unless shown on the construction plans or approved otherwise by the City's Representative.

4.3.7 STONE EXTENDED KERB INLETS (EKI)

Where extended kerb inlets are required in stone kerb locations, stone lintels must be used to match the stone material being used.

For trachyte, if lintels are not available, an approved alternative as per the *Sydney Streets Design Code* is to be used.

4.4 CONSTRUCTION

4.4.1 GENERAL

All works executed shall be constructed in straight lines or curves, true to the alignment and grade shown on the construction drawings and in accordance with the standard drawings.

Stone kerb and gutter stone shall be set by any of the following methods:

- Stones laid on a bed of zero slump concrete (this is the preferred method of laying hand-cut kerbs)
- Stones laid on an extruded footing with a maximum 30mm mortar bed
- Stones laid on a formed in situ footing with a maximum 30mm mortar bed.

Concrete gutters for stone kerb shall be poured in formwork and cast against previously set kerb face.

Concrete kerb and gutter shall be cast in situ.

4.4.2 EXCAVATION OF EXISTING KERB AND GUTTER

The Service Provider is responsible for excavating existing kerbs and gutters, including the removal and disposal of kerbs and gutters not made from natural stone.

Kerbs and gutters made from stone such as bluestone, trachyte, granite and sandstone are to be excavated and removed by the Service Provider with great care, by crane truck if necessary, to avoid damage to the stone. Stone, free of other excavated material, is to be transported by the Service Provider to the City's stone storage yard and unloaded and stacked, by crane truck if necessary, as directed by the City's Representative.

Kerb stone to be re-used on site can be stored on site if a suitable secure location is available, subject to approval by the City's Representative. Refer to B1 – Preliminaries and General Construction for on-site storage requirements.

All loose earth or stones are to be excavated and removed and the trench base graded to a smooth long section, reflecting the final kerb grade.

The subgrade or trench base shall be compacted to match the compaction specified for the adjoining road pavement subgrade, or to the satisfaction of the City's Representative, and shall be trimmed to a level to allow the full depth of the compacted bedding material to be achieved and ensuring that required levels are met.

Generally, the subgrade is to be compacted to achieve a California Bearing Ratio (CBR) of 4 per cent unless otherwise specified in the approved construction documents.

The width of the excavation shall allow for compaction of the adjacent pavement.

4.4.3 SUB-BASE COURSE OR BASE COURSE

New concrete kerb and gutter shall be constructed on a minimum 150mm thick base course of DGB 20 compacted to 98 per cent standard maximum dry density. This course shall be extended a minimum 150mm into the footway from the back of kerb alignment – refer to the Standard Drawings.

Where stone kerbing is to be laid on a concrete base, the base shall be a minimum 150mm thick. The base course can be cast in situ or be extruded base with or without extruded gutter.

Footings/concrete base shall be at least 50mm wider than the thickness of kerb being laid and the same width as the gutter stone being laid.

Where there is a high risk of failure of the joints, adequate subsoil drainage shall be provided below the gutter. The subsoil drainage shall connect to the storm water drainage network.

4.4.4 CONCRETE KERB AND GUTTER

Concrete kerb and gutters shall be cast in situ either by conventional methods of setting up forms and placing concrete or by a slip-form casting machine where approved by the City's Representative.

In flexible road pavements, a combined kerb and gutter shall be formed separate from the road. Where kerbs and/or gutters are to be constructed against an existing flexible pavement, a sawcut shall be made into the existing pavement 600mm off the gutter lip and the road reinstated as per the carriageway adjustment section below.

In concrete road pavements, concrete kerbs and gutters may be formed separately or formed together with the base or shoulder slab.

Where kerbs are constructed separately from the concrete base slab, they shall be dowelled to the base slab by steel tie bars, to dimensions shown on the Standard Drawings or inserted into holes drilled into the base slab and bonded with epoxy binder or other suitable methods.

4.4.5 RESETTING OF STONE KERBS AND GUTTERS

Kerbs and gutter stones to be raised and reset by the Service Provider are not to be removed from site without prior approval of the City's Representative. The stones are to be stored on site until required for use. The City's Representative may reject individual stones and require that other stones be used from other sections of the work area.

Stones that do not comply with the above will be rejected by the City's Representative and shall be replaced.

Where existing sandstone is damaged on any visible face, the face shall be repaired with a sandstone-coloured mortar mix.

4.4.5.1 CONCRETE FOOTING

New stone kerbs and gutters are to be bedded on the concrete footing with a 30mm layer of 4:1 sand/cement mortar, or another bedding agent approved by the City's Representative.

Mass concrete of a minimum strength of 25 MPa shall be laid behind the kerb to at least the height of the gutter to support the kerb.

Refer to Part C: Standard Drawings for further information.

4.4.5.2 NO SLUMP CONCRETE FOOTING

Stone laid shall be plumb and true to design line and level on a bedding of "no slump" concrete having a minimum strength of 20 MPa at 28 days with a maximum aggregate size of 20mm.

Zero slump concrete shall be placed in a layer at least 150mm thick and form a bed at least 100mm wider than the stone being laid – refer to the Standard Drawings.

Kerb and gutter units are to be set into the concrete by compacting with a heavy wooden tamping device or another method approved by the City's Representative which will not damage the kerb.

Refer to Part C: Standard Drawings for further information.

4.4.6 CARE OF STREET TREES

Where the base of the tree trunk is found to have grown over the existing kerb stone, the City's Tree Management unit must be contacted to assess the tree and the options available. The kerb stone must not be removed, and no works must be undertaken to the tree roots, without the prior consent of the City's Tree Management unit as the tree may be using the stone for structural support.

Refer to B1: Preliminaries and General Construction for tree care details.

4.4.7 ROAD GULLY GRATE ADJUSTMENT

Gully grates, inspection covers and frames are to be adjusted to new gutter levels by the Service Provider when required by the City's Representative.

Refer to B10: Stormwater Drainage for more details.

4.4.8 WORKING WITH HERITAGE SIGNIFICANT INFRASTRUCTURE

Kerb stones and/or gutter stones that are identified by the City as having heritage significance must be adequately identified and recorded before any approved works that would affect their position or state are carried out. Such stones shall be numbered, and their position recorded on a plan so that the stones can be re-laid in the same location. The documentation shall be submitted to and accepted by the City's Representative before work affecting the stones commences.

Refer to B1: Preliminaries and General Construction for requirements and details.

4.4.9 JOINTS

A 5mm wide and 20mm deep joint shall be formed on either side of the stone kerbs unless approved by the City's Asset Management team.

The joint between the stone kern and the footpath and the joint between the gutter and stone kerb shall be sealed with UV-resistant silicone sealant.

4.4.9.1 GRANITE STONE KERBS

Granite blocks shall be butt jointed with no gap.

4.4.9.2 BLUESTONE KERBS

Bluestone blocks shall be butt jointed with no gap.

4.4.9.3 SANDSTONE KERBS

All sandstone kerbs shall have concrete mortar joints between each block, finished in a smooth manner flush with the adjacent kerbs.

4.4.9.4 CONCRETE KERBS

Expansion joints shall be constructed at 6m intervals and where the gutter abuts gully pits, vehicle crossings and fences, building walls or retaining walls. In the case of concrete pavements, the joints shall coincide with transverse joints in the concrete base.

4.4.10 CARRIAGEWAY ADJUSTMENT

Carriageway works must be carried out after the completion of kerb and gutter construction.

At locations where carriageway resurfacing or reconstruction is not specified on the relevant designs, the existing carriageway shall be adjusted to match the new gutter by the following means:

- Sawcut to a depth of 50mm, a minimum of 600mm from and parallel to the gutter or dish gutter, sufficient to permit a fall into the gutter of between 1 per cent to 5 per cent
- Excavate the asphalt surface between the gutter and the sawcut, down to the existing base
- Resurface the excavated area with AC14 laid in accordance with the relevant sections of this Technical Specification.

4.4.11 CURING AND PROTECTION OF CONCRETE

The curing and protection of freshly placed concrete shall be as per B3: Concrete Works Construction.

4.4.12 DRAINAGE OUTLETS

Holes in stone for drainage shall be cut neatly through the kerb to the required size and shape of the connection. Connections shall be fitted neatly and sealed adequately up to 30mm into the back of the kerb.

For all kerbs, the maximum height of the outlets shall be 100mm from the invert level of the gutter and in accordance with the Standard Drawings. Where approved, multiple outlets shall be placed with a minimum 300mm gap between the centres of each outlet with a maximum of three (3) outlets in each set.

Pipes that end at the back of the kerb are to be sealed with mass concrete in accordance with the Standard Drawings.

4.4.13 DISH DRAINS

Dish drains are to be constructed on a base and subgrade complying with the requirements for concrete kerb and gutter.

Refer to Part C: Standard Drawings for further information.

4.4.14 DROP KERB ACROSS KERB RAMPS AND DRIVEWAYS

For concrete kerbs, the kerb is to be transitioned into a concrete lay back across driveways. At kerb ramps, the kerb is to be transitioned into the concrete kerb ramp.

For stone kerbing, the kerb is to continue across the driveway and kerb ramp, following the levels of the driveway and kerb ramp edge. The stone kerbing is to be laid on a continuous concrete base as per standard kerbing. Stone kerbs are to be cut as per the Standard Drawings to facilitate the change in the top of kerb levels across driveways and kerb ramps.

For trachyte stone kerbing, footing/base requirements for stone kerbs across driveways and kerb ramps are to be determined on a site-specific basis in consultation with the City's Representative, depending on available stones and their dimensions.

All stone kerbs are to have the top face angle to match the angle of the corresponding driveway and kerb ramp as per Part C: Standard Drawings.

4.4.15 STONE KERBS FOR RAINGARDENS

Stone shall be laid plumb and true to the approved design alignments and levels, on a continuous reinforced concrete footing that extends up to the edges of the stone kerb. If visible, the rear of the kerb shall have a neat finish to match the other visible kerb faces. Refer to Part C: Standard Drawings.

For trachyte kerbs, the stone selected shall be as deep as possible and the footing shall be adjusted to suit the variable depth.

Refer to B10: Stormwater Drainage for further requirements for raingardens.

4.5 QUALITY

4.5.1 INSPECTIONS

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

4.5.1.1 HOLD AND WITNESS POINTS

Construct New Concrete Kerb and Gutter	
1. Process Held:	Kerb setout (refer Section 4.4.8)
Submission Details:	At least two (2) day before the new kerb 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:	Compaction of Subgrade (refer Section 4.4.2)
Submission Details:	At least two (2) working days prior to compaction of subgrade.
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise.
3. Process Held:	Placement and compaction of DGB base (refer Section 4.4.3)
Submission Details:	At least two (2) working days prior to placing and compaction of DGB base.
Release of Witness Point:	The City's Representative will inspect the compacted DGB base, prior to authorising the release of the Witness Point unless advised otherwise.
4. Process Held:	Installing concrete formwork (refer Section 4.4.4)
Submission Details:	At least two (2) working days prior to installing concrete formwork.
Release of Hold Point:	The City's Representative will inspect the concrete forms and all corrections shall be made, prior to authorising the release of the Hold Point.
5. Process Held:	Carriageway adjustment compaction of subgrade (refer Section 4.4.10)
Submission Details:	At least two (2) working days prior to compaction subgrade for carriageway adjustment.
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise.
6. Process Held:	Carriageway adjustment placement and compaction of DGB base (refer Section 4.4.10)
Submission Details:	At least two (2) working days prior to placing and compaction of DGB base.
Release of Witness Point:	The City's Representative will inspect the compacted DGB base, prior to authorising the release of the Witness Point unless advised otherwise.
7. Process Held:	Cutting drainage outlets (refer Section 4.4.12)
Submission Details:	At least two (2) working days prior to cutting of drainage outlets.
Release of Hold Point:	The City's Representative will inspect the proposed layout, prior to authorising the release of the Hold Point.

4.5.1.1 HOLD AND WITNESS POINTS, CON'T

Construct Stone Kerb with Concrete Gutter	
1. Process Held	Inspection of existing stone (refer Section 4.4.2)
Submission Details:	At least two (2) working days before existing stone is to be removed.
Release of Hold Point:	The City's Representative will inspect the removed stone and determine if it is suitable for re-use or if it shall be disposed, prior to authorising the release of the Hold Point.
2. Process Held	Testing results for new stone (refer Section 4.3.1)
Submission Details:	At least ten (10) working days before stone is to be installed, all testing results for the new stone shall be submitted to the City's Representative.
Release of Witness Point:	The City's Representative will review the testing results, prior to authorising the release of the Witness Point unless advised otherwise.
3. Process Held:	Kerb setout (refer Section 4.4.8)
Submission Details:	At least two (2) days before the new kerb 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.
4. Process Held:	Compaction of Subgrade (refer Section 4.4.2)
Submission Details:	At least two (2) working days prior to compaction of subgrade.
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise.
5. Process Held:	Placement and compaction of DGB base (refer Section 4.4.3)
Submission Details:	At least two (2) working days prior to placing and compaction of DGB base.
Release of Witness Point:	The City's Representative will inspect the compacted DGB base, prior to authorising the release of the Witness Point unless advised otherwise.
6. Process Held	Prior to accepting delivery of new stone (refer Section 4.3.1)
Submission Details:	At least two (2) working days before stone is to be delivered.
Release of Hold Point:	The City's Representative will inspect all stone to see if damaged or the wrong type, prior to authorising the release of the Hold Point.
7. Process Held:	Prior to pouring concrete footing (refer Section 4.4.5.1)
Submission Details:	At least two (2) working days before concrete footing is to be poured.
Release of Hold Point:	The City's Representative will inspect the concrete footings, prior to authorising the release of the Hold Point.
8. Process Held:	Installation of stone kerb (refer Section 4.4.5)
Submission Details:	At least two (2) working days prior to installation of stone kerb.
Release of Hold Point:	The City's Representative will inspect that the stone kerb has been installed correctly, prior to authorising the release of the Hold Point.

4.5.1.1 HOLD AND WITNESS POINTS, CON'T

Construct Stone Kerb with Concrete Gutter	
9. Process Held:	Pouring of concrete gutter (refer Section 4.4.4)
Submission Details:	At least two (2) working days prior to pouring of new concrete gutter.
Release of Hold Point:	The City's Representative will inspect the gutter has been poured correctly, prior to authorising the release of the Hold Point.
10. Process Held:	Carriageway adjustment compaction of subgrade (refer Section 4.4.10)
Submission Details:	At least two (2) working days prior to compaction subgrade for carriageway adjustment.
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise.
11. Process Held:	Carriageway adjustment placement and compaction of DGB base (refer Section 4.4.10)
Submission Details:	At least two (2) working days prior to placing and compaction of DGB base.
Release of Witness Point:	The City's Representative will inspect the compacted DGB base, prior to authorising the release of the Witness Point unless advised otherwise.
12. Process Held:	Cutting drainage outlets (refer Section 4.4.12)
Submission Details:	At least two (2) working days prior to cutting of drainage outlets.
Release of Hold Point:	The City's Representative will inspect the proposed layout, prior to authorising the release of the Hold Point.

Construct Stone Gutter	
1. Process Held	Inspection of existing stone (refer Section 4.4.2)
Submission Details:	At least two (2) working days before existing stone is to be removed.
Release of Hold Point:	The City's Representative will inspect the removed stone and determine if it is suitable for re-use or if it shall be disposed, prior to authorising the release of the Hold Point.
2. Process Held:	Compaction of Subgrade (refer Section 4.4.2)
Submission Details:	At least two (2) working days prior to compaction of subgrade.
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise.
3. Process Held:	Placement and compaction of DGB base (refer Section 4.4.3)
Submission Details:	At least two (2) working days prior to placing and compaction of DGB base.
Release of Witness Point:	The City's Representative will inspect the compacted DGB base, prior to authorising the release of the Witness Point unless advised otherwise.

Construct Stone Gutter	
4. Process Held:	Prior to pouring concrete footing (refer Section 4.4.5.1)
Submission Details:	At least two (2) working days before concrete footing is to be poured.
Release of Hold Point:	The City's Representative will inspect the concrete footings, prior to authorising the release of the Hold Point.
5. Process Held:	Installation of stone gutter (refer Section 4.4.5)
Submission Details:	At least two (2) working days prior to installation of stone gutter.
Release of Hold Point:	The City's Representative will inspect that the stone gutter has been installed correctly, prior to authorising the release of the Hold Point.

4.5.2 TOLERANCES

Item	Activity	Tolerances
1.	**Level and Alignment**	• Finished construction level and alignment shall not vary more than 10mm from the specified design levels • Finished construction level and alignment shall not deviate from a straight edge 3m long by more than 5mm, subject to any necessary allowances on vertical and horizontal curves • Localised low spots where water is trapped along the gutter, particularly at kerb ramps, shall not be accepted
2.	**Adjacent Kerbstones**	
	a. Machine cut	• Top and front faces of adjacent machine cut kerbstones shall not differ by more than 2mm
	b. Hand cut	• Top and front faces of adjacent hand-cut kerbstones shall not differ by more than 5mm.
3.	**Kerbstone Fall**	• Top faces of 150mm wide kerbstones shall be set horizontally or up to a 3mm fall to the gutter • Top faces of 200mm to 300mm wide kerbstones shall be set horizontally or up to a 5mm fall to the gutter.
4	**Kerb Radii and Chamfers**	• Radii and chamfers for kerbstones and cast in situ concrete shall be no more than +/-2mm.

B5 Footways Construction

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B5 FOOTWAYS CONSTRUCTION

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B5 FOOTWAYS CONSTRUCTION

5.1 SCOPE

This Technical Specification provides guidance for the construction of footway pavements, from the supply, quality and placement of various pavement materials and finishes to the alignment, dimensions, cross-sections and levels shown on the construction documents or as directed by the City's Representative.

5.2 STANDARDS 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, the approved drawings or other construction documents and Australian Standards shall be referred to the City's Representative for decision before proceeding with the Works.

The following list indicates the Australian Standards and/or RMS Standards applicable to this section. This list is not exhaustive and may not include all standards which may apply to the Works to be undertaken:

- AS 1141.26 Methods for sampling and testing aggregates: Secondary minerals content in igneous rocks
- AS 2150 Hot mix asphalt – A guide to good practice
- AS/NZS 1428.4.1 Means to assist the orientation of people with vision impairment – Tactile ground surface indicators
- AS/NZS 4455 Masonry units and segmental pavers
- AS/NZS 4456 Masonry units and segmental pavers – Methods of test
- AS/NZS 4456.10 Determining resistance to salt attack
- AS/NZS 4456.5 Determining breaking load of segmental paving units
- AS/NZS 4456.9 Determining abrasion resistance
- AS/NZS 4663:2002 Slip resistance measurement of existing pedestrian surfaces
- AS/NZS 4586:1999 Slip resistance classification of new pedestrian surface materials
- Guide to the specification and testing of slip resistance of pedestrian surfaces - (Table 3B)
- ASTM C615/C615M – 11 Standard specification for granite dimension stone
- AUSPEC 1144 Asphalt (Roadways)
- CBPI Clay Paving Design and Construction
- CCMA Concrete Flag Pavements Design and Construction Guide.

5.3 MATERIALS

5.3.1 STONE PAVER REQUIREMENTS

All stone shall be natural, uniform quality and free of defects liable to affect its strength, appearance, durability or proper functioning under the intended conditions of use. Examples of defects are vents, cracks, fissures, seams, porous inclusions, foreign material, loose surface material striations, stains and discoloration.

Stone pavers may be available from suppliers that are currently approved by the City (list supplied on request) or procured from the following quarries only:

- Black Hill SA for Austral 'Black' granite
- Fraser Range Norseman WA for Austral 'Verde' granite
- Deer Park VIC for Bluestone.

Other suppliers may be used subject to approval by the City's Representative. Stone from alternative suppliers must be selected to match colour, pattern, dimensions and quality of the specified paver.

Stone paver types:

- Austral 'Black' and Austral 'Verde' granite pavers with flame exfoliated finish
- Deer Park Bluestone (Basalt) pavers with sawn finish (generally used for maintenance purposes only).

The nominated paver thickness for all footways and driveways is 50mm except for distinctive places such as George Street, Martin Place and Pitt Street Mall which shall be 60mm. The nominated thickness for infill service lids is 30mm unless specified otherwise. Refer to standard details for paver sizes and layout pattern.

The supplier shall provide written certification that the supplied granite stone products meet the international *ASTM C615/C615M – 11 Standard Specification for Granite Dimension Stone* for the following quality criteria:

AUSTRAL BLACK

Property	Test Standard	Performance Criteria
Compression strength (dry and soaked)	ASTM C170/C170M	> 185MPa (soaked)
Water absorption	ASTM C97/C97M	< 0.1% by weight
Bulk density	ASTM C97/C97M	> 2900kg/m^3
Flexural strength (dry and soaked)	ASTM C880/C880M	> 14MPa (soaked)
Resistance to salt attack	AS/NZS 4456.10A	Durability Class A
Coefficient of thermal expansion	ASTM E831	< 0.000005 mm/mm/°C
Abrasion resistance	ASTM C1353	> 113 Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Dimensional stability	Draft SAA method	< 0.1% (Wet-dry, hot-cold)
Secondary minerals content (petrographic)	AS 1141.26	< 2%

AUSTRAL VERDE

Property	Test Standard	Performance Criteria
Compression strength (dry and saturated)	ASTM C170/C170M	> 140MPa (soaked)
Water absorption	ASTM C97/C97M	< 0.1% by weight
Bulk density	ASTM C97/C97M	> 2560kg/m^3
Flexural strength (dry and saturated)	ASTM C880/C880M	> 12MPa (soaked)
Resistance to salt attack	AS/NZS 4456.10A	Durability Class A
Coefficient of thermal expansion	ASTM E831	N/A
Abrasion resistance	ASTM C1353	> 54 Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Dimensional stability	Draft SAA method	< 0.1% (Wet-dry, hot-cold)
Secondary minerals content (petrographic)	AS 1141.26	< 2%

BLUESTONE

Property	Test Standard	Performance Criteria
Compression strength (dry/saturated)	ASTM C170/C170M	> 100MPa (soaked)
Water absorption	ASTM C97/C97M	< 1.8% by weight
Bulk density	ASTM C97/C97M	> 2500kg/m^3
Flexural strength (dry and saturated)	ASTM C880/C880M	> 14MPa (soaked)
Resistance to salt attack	AS/NZS 4456.10A	Durability Class A
Coefficient of thermal expansion	ASTM E831	< 0.0000064 mm/mm/°C
Abrasion resistance	ASTM C1353	> 19 Ha
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Dimensional stability	Draft SAA method	< 0.1% (Wet-dry, hot-cold)
Secondary minerals content (petrographic)	AS 1141.26	< 2%

The testing authority shall be AMDEL or NATA-approved.

The following tolerances apply to stone paver size and shape:

Maximum deviation	Deviation from required dimensions for paver face dimensions for items of thickness up to 90mm shall be 1mm
Squareness	The squareness difference between diagonals shall be no greater than 1.5mm
Thickness	+/- 2mm
Flatness	Honed surfaces: 0.5mm per metre Sawn or sandblasted faces: 1.5mm per metre
Edge straightness	0.5mm per metre
Maximum deviation of paver face from plane	Finishes: 1.5mm in 1200mm Natural riven faces: 10mm in 1200mm

5.3.2 CONCRETE UNIT PAVER REQUIREMENTS

The materials and manufacture of concrete paving units shall comply with *AS 4455 Masonry units and segmental pavers* unless specified otherwise in the Technical Specification or the approved construction documents.

Concrete paving units shall be sound, firm, dense, dimensionally stable and consistent, with a smooth unblemished upper surface and with unrumbled units having unbroken square edges evenly all round. Units that exhibit cracking, 'boniness' or are considered by the City's Representative to be excessively porous, brittle or friable shall be liable to rejection.

Paving unit colours shall be uniform and shall match that of approved sample units over the full area of the pavement. The nominated paver unit thickness for all footways and driveways is 50mm, unless specified otherwise. Refer to the standard details for paver sizes and layout pattern.

Concrete Unit Pavers can be obtained from Pebblecrete Insitu Pty Ltd. Other suppliers may be used subject to approval by the City's Representative. Pavers from alternative suppliers must be selected to match the colour, pattern, dimensions and quality of the specified paver.

The supplier shall provide written certification that the supplied pavers comply with the following:

Colour and type: Pebble Crete PPX 1201: 120D or similar to be approved by the City's representative

Surface finish: Honed – 150

Chamfer: The paver shall have square edges with no chamfers, unless otherwise specified in the approved construction documents.

Property	Test standard	Performance criteria
Unconfined compressive strength Sample conditioning prior to test: Dry	AS/NZS 4456.4	> 25 MPa Dry > 20 MPa Saturated
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Breaking load of segmental paving units	AS/NZS 4456.5	Breaking load > 9.4 kN Modulus of rupture > 7.7 mpa
Ambient density	AS/NZS 4456.8 and 14	> 2260 daN kg/m^3
Water absorption	AS/NZS 4456.8 and 14	< 4.9 wi
Abrasion resistance	AS/NZS 4456.9	Mean abrasion index of 3.5

The following tolerances apply to the concrete unit paver size and shape:

Maximum deviation	Deviation from required dimensions for paver face dimensions for items of thickness up to 90mm shall be 1mm
Squareness	The squareness difference between diagonals shall be no greater than 1.5mm.
Thickness	+/- 3mm
Flatness	Honed surfaces: 0.5mm per metre Sawn or sandblasted faces: 1.5mm per metre.
Edge straightness	0.5mm per metre
Maximum deviation of paver face from plane	Finishes: 1.5mm in 1200mm Natural-riven faces: 10mm in 1200mm

5.3.3 BRICK PAVER REQUIREMENTS

Clay bricks and pavers shall be made from naturally occurring minerals that are kiln-fired to lock in their colour and strength for life.

Clay paving units shall be sound, firm, dense, free of distortion, dimensionally stable and consistent, with a smooth upper surface and with unrumbled units having unbroken edges as specified evenly all round. Units which exhibit cracking, bloating or are considered by the City's Representative to be excessively porous, brittle or friable shall be liable to rejection.

Clay brick pavers are to be supplied in the following colour mix, unless otherwise specified in the approved construction documents:

- Chestnut 40%; Brahman Granite 30%; and Maple 30% – Austral Bowral colours or equivalent.

Brick pavers shall have a thickness of 65mm and comply with the recommended specifications by the CBPI.

Property	Test Standard	Performance Criteria
Minimum characteristic breaking load	AS/NZS 4456.5	> 5 kN
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Mean abrasion resistance	AS/NZS 4456.9	3.5 cm^3
Dimensional deviation		DPA2[1]

Notes:

1. CCMM Concrete Segmental Pavements Guide to Specifying

5.3.4 QUALITY CONTROL SAMPLES FOR PAVERS

Upon request, control samples of each type and grade of stone and other paver type shall be supplied. The following requirements apply:

- Not less than three (3) quality control samples of each product shall be provided
- Full-size pieces of the smallest units
- The expected range shown of variations of colour pattern, texture and surface finish in the pavers to be supplied
- Each sample labelled for verification.

Prior to confirmation of any order, the paver supplier shall supply certified test results for the supplied pavers from an agency with NATA or AMDEL accreditation. The test report shall confirm that all paving, infill pit lids, setts and any other footpath products have achieved a minimum surface class of P4 or P5 when wet in accordance to *HB 198:2014 (Table 3B) – Guide to the specification and testing of slip resistance of pedestrian surfaces.*

A stain resistance test may be conducted by the City's Representative to check a sample against reaction to acidic products such as Coca-Cola and other food items.

5.3.5 MORTAR BED AND SLURRY MATERIALS

Trial mixes of mortar bedding material must be carried out and tested before the commencement of the Works to adequately select a mix that meets the strength requirement. Strength-testing reports shall be available on request to the City's Representative for approval.

All mortar for the pavers is to comply with *AS 3700 Masonry Structures*, in particular Sections 4, 5 and 10, and is to be a 3:1 (river sand) cement. A slurry mix is to be applied on top of this bedding, with a latex additive before laying of pavers to increase bond and compressive strength. The mortar minimum thickness shall be 25 mm and the maximum 30 mm. The amount of mix shall not exceed the quantity required to lay pavers within 45 to 60 minutes, depending on climate conditions.

All components shall be measured by means of calibrated containers. The minimum compressive strength of the mortar mix shall be no less than 10 MPa at seven (7) days. Also refer to Subsection 5.4.7

The bonding slurry shall consist of one (1) part fine-washed sand and six (6) parts Portland Type A cement by volume mixed by hand or mixer while adding water to ensure a smooth, homogenous consistency, free of lumps.

Bonding slurry with latex additive shall be applied to concrete base and on top of mortar mix or underside of paver.

5.3.6 BEDDING SAND

Bedding sand shall be well-graded sand that can pass through a 4.75mm sieve and be suitable for concrete manufacture. The sand shall be of uniform moisture content between 4 per cent and 8 per cent when spread, and shall be protected against rain when stockpiled on site prior to spreading. Saturated sand shall not be used.

The bedding sand shall comply with the following grading limits:

Sieve Size (mm)	% Passing
9.52	100
4.75	95–100
2.36	80–100
1.18	50–85
0.600	25–60
0.300	10–30
0.150	5–15
0.075	0–10

The bedding sand shall be free of soluble salts or other contaminants likely to cause efflorescence or lead to reduced skid resistance.

5.3.7 ASPHALT

Asphalt concrete pavement of AC10 and AC5 shall be supplied in accordance with *AS 2150 Hot Mix Asphalt – a Guide to Good Practice*.

Modified asphalt concrete with a polymer additive to significantly increase the softening point to resist point loads may be approved by the City's Representative for use in outdoor dining areas where specified.

The City encourages the use of warm-mix asphalt technologies where possible. It is the responsibility of the Service Provider to manufacture the warm mix with the aid of appropriate additives so that the workability and durability of the asphalt mix remains intact. The quality of the warm mix asphalt must meet *AS 2150 - Hot Mix Asphalt – a Guide to Good Practice*.

5.3.8 CONCRETE

Concrete, the material and methods of mixing, placing and curing shall comply with the requirements set out in B3: Concrete Works Construction.

5.3.9 BASECOURSE MATERIALS

DGB20 materials shall comply with AS *1289.3.6.1. Recycled materials* where possible. Refer to B6: Roadways Construction for details on recycled materials requirements.

5.3.10 STRUCTURAL SOILS

Structural soils such as Gap Graded or Bimodal Support soils shall be used where specified in hard surfaced areas for planting street trees.

All sampling shall be carried out in accordance with the methods described in AS *1141.3 (1986) Methods for sampling and testing aggregates*. Three samples per 1000m^3 are taken. Each sample must consist of a minimum of 10 increments. Samples are to be thoroughly blended and labelled. For projects requiring less than 1000m^3, one sample is required.

Samples are tested by an approved laboratory to the above minimum specification.

5.3.11 STRUCTURAL CELLS

Structural cells or structural support cells may be used under the footpaths. The cells may be only used around the tree to provide room for root growth. Size, depth, materials and installation scope shall be submitted to the City for approval in the design stage of the projects.

5.4 CONSTRUCTION

5.4.1 GENERAL

Footways shall be constructed according to the following, depending on the paving type as specified:

- Stone and concrete unit pavers shall be laid with a 30mm thick 3:1 mortar bed as specified on a 110mm 32MPa concrete base with SL72 reinforcing mesh. Pavers shall be laid with a 3mm gap between pavers. The concrete base thickness for driveways varies from 150mm to 250mm as indicated on the standard details.
- Clay brick pavers shall be laid with a 25mm to 30mm sand-bedding layer on a 150mm DGB20 flexible base course with sand joints between pavers
- Asphalt footway pavements shall consist of either:
    - Flexible pavement – 15mm AC5 DG wearing course, 35mm AC10 DG intermediate course and a 100mm DGB20 base course
    - Rigid pavement – 25mm AC5 DG on a 110mm 32MPa concrete base with SL72 reinforcing mesh, where specified.
- In situ concrete footway pavements shall consist of a 110mm 32MPa concrete base with SL72 reinforcing mesh on a 100mm DGB20 base.

5.4.2 EXCAVATION OF EXISTING PAVERS

The Service Provider is responsible for excavating existing pavers where necessary.

Pavers are to be excavated and removed by the Service Provider with great care, to avoid damage to the paver. Pavers, free of other excavated material, are to be transported by the Service Provider to the City's stone storage yard and unloaded and stacked, by crane truck if necessary, as directed by the City's Representative.

Pavers to be re-used on site can be stored on site if a suitable secure location is available, subject to approval by the City's Representative. Refer to B1: Preliminaries and General Construction for on-site storage requirements.

5.4.3 CUTTING AND PREPARATION OF PAVERS

Storage: Store pavers so that they are protected from the weather and atmospheric pollution, and in conditions that avoid staining, marking or damage to the pavers.

Cutting units: Maintain sharp arises and accurate joints and margins.

Laying pavers: Perform the necessary cutting and shaping to the required sizes. Cut pavers to fit neatly around all penetrations and fixtures including pit covers, lighting and traffic poles, signs and the like. Refer to the standard drawings for minimum unit lengths, band widths and faceted zones.

Protection: When laying the paving, protect all fixtures from damage, including pit covers, lighting and traffic poles, signs and the like.

Noise and dust: Refer to B1: Preliminaries and General Construction for requirements for noise control and environmental protection.

Requirement: When cutting pavers, provide dustproof screens and covers to protect existing finishes, adjacent buildings and the immediate environment from dust, noise and debris. All cutting activities are to be situated away from residences and retail traders.

Dry cutting: The use of dry methods of cutting pavers on site is not permitted.

Wet cutting: The use of wet methods of cutting pavers on site is permitted subject to compliance with the requirements of the City and *AS 2436-1981 Guide to noise control on construction*. Prevent slurry runoff from wet cutting operations from marking or tracking across adjacent paved areas. Collect residual water and slurry and divert them to an approved means of disposal. Do not allow slurry to enter grates, gutters or tree pits.

5.4.4 SUBGRADE

The Service Provider shall excavate or fill as may be required to bring the pavement bed to the full specified depth below the finished pavement level. All formation shall be thoroughly compacted as below and shall be neatly trimmed true to line, level and cross-slope, to provide for the full specified thickness of pavement in all places.

Any soft or damp patches shall be removed and replaced with suitable imported fill material and shall be thoroughly compacted to achieve a standard maximum dry density of 95 per cent when tested in accordance with *AS 1289 Methods of testing soils for engineering purposes* and a minimum CBR shear strength of 4 per cent. Refer to B2: Earthworks.

If the required strength and compaction is not able to be achieved then the Service Provider shall replace and compact the top 75mm layer with DGB20 to meet the required compaction.

The subgrade shall be formed to the required profile as detailed in the standard details.

A subsoil drainage system shall be installed where specified.

5.4.5 BASECOURSES

The basecourse shall be specified flexible or rigid as follows:

Flexible base shall consist of a 100mm to 150mm thick layer of DGB20 compacted to not less than 98% Standard Maximum Dry Density to *AS 1289 - Methods of testing soils for engineering purposes*.

Rigid base shall consist of a 110mm 32 MPa concrete base with SL72 reinforcing mesh for asphalt wearing course and pavers. A heavy broom finish shall be applied to the slab surface, parallel with the fall of the slab for drainage and bonding purposes. Allow concrete base to harden sufficiently, generally overnight, before laying pavers or applying asphalt course. The concrete base for driveways varies from 150mm to 250mm in thickness as indicated on the standard details.

Refer to the standard drawings for details.

5.4.6 STRUCTURAL CELLS

The excavation for structural cells shall be a minimum 400mm wider than the actual cells at the base of the excavation. This allows for adequate compaction of the fill material around the structural cells.

Construction methodology and procedures including but not limited to type of soil, drainage and compaction ratio shall be approved by the City prior to commencement of the construction.

5.4.7 METHOD OF LAYING STONE AND CONCRETE UNIT PAVERS

Laying of pavers shall be carried out by an experienced and qualified Service Provider. Paver laying procedures shall be conducted as follows:

- Clean concrete base of any dirt or dust.
- Moisten concrete base surface with a light spray of water. Pour a 1:1 cement and fine sand: water slurry mix (bond coat) over the concrete base prior to placing bedding mortar.
- Mix thoroughly 3:1 sand:cement by volume as a semi-dry mix mortar, ensuring a uniform mix and sufficient strength (min 10 MPa at seven (7) days). Prior to mixing, check sand is moist by squeezing a handful and ensuring the sand maintains its shape. Water may be added in the specified proportions to impart to the mix with sufficient consistency. Only sufficient bedding mix should be prepared and laid to enable the laying operation to be completed within a reasonable time. Refer to 5.3.5 for more details on mortar and slurry material.
- Place semi-dry mix mortar over the slurry coat. Installation of mortar mix to be 10 per cent to 15 per cent higher than required levels (or higher as necessary) prior to compaction of stone pavers.
- Apply pre-mixed 1:1 cement and fine sand:water slurry mix to cover area of mortar to be paved. No delay in laying of pavers after application of the cement slurry.
- Paving units shall be laid surface dry on the slurry coated mortar bedding course with a joint width of 1-3mm between adjacent pavers.
- Tamp down paving units into position ensuring full contact with the mortar bed with minimum deviation between edges of adjacent pavers
- Check individual paver units for correct installation as work proceeds. Where stone pavers do not align properly, are loose, drummy or rock, remove non-compliant pavers, remove mortar bed (full depth) and repeat mortar bed and paver installation procedure again.

5.4.8 METHOD OF LAYING BRICK PAVERS

Brick pavers shall be placed on the uncompacted screeded sand bed to the nominated laying pattern, with care being taken to maintain the specified bond throughout the Works. Paving units shall be placed such that all joints are correctly aligned.

Sand bedding

- The sand bedding shall be spread loose in a uniform layer screeded in a loose condition to a level such that, after compaction, the pavers shall be at the correct levels and profiles.
- The spread sand shall be carefully maintained in a loose condition and protected against pre-compaction both prior to and following screeding. Any pre-compacted sand or screeded sand left overnight shall be loosened before further paving units are placed. The sand bed shall not be screeded in advance of the laying face to an extent to which paving will not be completed on that day.
- Screeded sand must be fully protected against accidental pre-compaction, including compaction by rain or dew. Any screeded sand which is pre-compacted prior to laying of units shall be removed and brought back to profile in a loose condition.

Compaction

- The paving units shall be compacted to achieve consolidation of the sand bedding (approximately 10mm settlement), and brought to design levels and profiles by not less than two (2) passes of a high-frequency, low-amplitude mechanical flat-plate vibrator having a plate area sufficient to cover a minimum of 12 paving units.

- Compaction shall proceed as closely as possible following laying and prior to the application of any traffic.
- Compaction should not be attempted within one metre of the laying face. Compaction shall continue until lipping has been eliminated between adjoining units.
- All work to within one metre of the laying face must be left fully compacted at the completion of each day's laying.
- Any units that are structurally damaged during compaction shall be immediately removed and replaced.

Filling joints

- After compaction of the paving blocks and prior to the termination of work on that day and prior to the application of any construction traffic, sand for joint filling shall be spread over the pavement.
- The joint-filling sand shall be well-graded sand passing a 2.36mm sieve and be suitable for concrete manufacture. The joint-filling sand shall be as dry as practical when spread.
- The joint-filling sand shall comply with the following grading limits:

Sieve Size (mm)	% Passing
2.36	100
1.18	90–100
0.600	60–90
0.300	30–60
0.150	15–30
0.075	5–10

The joint-filling sand shall be free of soluble salts or other contaminants likely to cause efflorescence or lead to reduced skid resistance.

- The filling sand shall be broomed to fill the joints and the pavement recompacted to achieve compaction of the joint-filling sand. As the Works proceed, joints shall be checked for adequacy of filling and any shortfall shall be made good prior to further compaction taking place. Any excess surface sand shall be removed promptly from the surface of the paving blocks.

5.4.9 LAYING ARRANGEMENTS

Stone and concrete unit pavers shall be laid with a joint width of 3mm between adjacent pavers as shown in the standard details, unless specified otherwise. The expansion joint shall run parallel to the kerb and gutter. Refer to the standard drawings for make-p and faceted zones.

Brick pavers shall be laid with a joint width of 3mm between adjacent pavers in a 45 degree herringbone pattern unless specified otherwise.

5.4.10 EXPANSION AND CONTRACTION JOINTS

Refer to 5.4.13: IN SITU CONCRETE PAVING.

5.4.11 EDGE RESTRAINT FOR BRICK PAVING

Adjacent to free edges where paving units do not adjoin a hard paved surface, a mass concrete-edge restraint shall be provided. The concrete shall be finished at a level 35mm above the base of the paver and shall be a minimum thickness of 100mm and depth of 200mm.

The adjacent ground shall be graded to meet the top of the paving.

5.4.12 LAYING OF ASPHALT PAVING

Asphalt concrete footways shall be laid in accordance *AS 2150 Hot mix asphalt – A guide to good practice*.

Asphalt shall be compacted only with static (non-vibratory), self-propelled, steel-wheeled rollers with a mass of rollers of 2t to 3t. Compaction by hand methods with tampers or vibrating plates shall be limited to small areas inaccessible to rollers where approved by the City's Representative. Maximum layer thickness should be limited to those that will enable the specified density to be achieved.

5.4.13 IN SITU CONCRETE PAVING

The Service Provider shall construct in situ concrete paving as shown on the standard details and as detailed in this Technical Specification.

In situ concrete paving for footpaths, vehicular crossings and kerb ramps shall be finished with a medium broom.

In situ concrete footpaths shall be a 110mm 32MPa concrete base with SL72 reinforcing mesh, typically placed on a 100mm thick DGB20 base.

All in situ concrete paving slabs shall have isolation joints along the building line, kerb line, any rigid structure, drainage pits, and at any penetrations. Expansions joints 10mm thick with an approved self-expanding joint filler shall typically be provided at 12m maximum spacings. Contraction joints comprising a 25mm deep or 1/3 to 1/4 slab thickness sawcut or dummy (tooled) joint shall be provided at the lesser of 6m or 1.5 times the pavement width spacings

Concrete footpaths shall be typically 1.8m wide unless directed otherwise by the City's Representative.

5.4.14 CLEANING

Cleaning should be as follows:

General

- Leave clean on completion.
- Clean area progressively with hard sponges and clean water as the work proceeds without using acid and without damage to the work, as necessary to remove mortar smears, stains, discolouration and the like.
- Ensure that all adjacent surfaces are left clean on completion, including adjacent kerbs, pit covers, bitumen paving.
- Remove mortar smears from adjacent surfaces.

Precautions

- Prevent run-off from the cleaning operations from marking or tracking across adjacent paved areas.
- Collect residual water and cleaning wastes and divert them to an approved means of disposal.

Requirements

- Cleaning is to be undertaken, using one or more of the following methods:
  - Hydraulic
  - Hydro-air
  - Steam-water jet.
- Brushes may be necessary to remove certain surface impurities and fibre brushes are recommended for this purpose.
- Chemicals, which may damage the surface or do not comply with the relevant EPA regulations, are not to be used.

The Service Provider is required to handover the paving to the City's Representative at Practical Completion in a clean condition. If the general public has been allowed access onto the paving during the construction period, the Service Provider must clean the paving to be ready for Practical Completion.

5.4.15 PROTECTIVE SEALANT

A protective sealant shall be applied to seal the surface of all concrete, brick and stone unit paving. The sealant shall be a penetrating type and protect the pavers from staining, ease cleaning and lower the frequency of maintenance. The sealant shall not affect the paver's colour or reduce its slip resistance.

The penetrating sealant shall be applied to the surface including over any joint filler material as soon as possible after being laid, and prior to opening the area to pedestrian use.

The sealant shall be applied as per the directions in the manufacturer's technical data sheet.

When protective sealing is completed, the following are to be provided:

- The full specification and information for the protective sealant (e.g. it may be protective sealant similar to DuPont StoneTech Professional Heavy Duty Exterior Sealer or an approved equivalent)
- A guarantee for heavy, medium and light foot and road traffic.

5.5 VEHICULAR CROSSINGS (DRIVEWAYS), KERB RAMPS AND STAIRS

5.5.1 REMOVAL

Where required and approved, driveways and kerb ramps shall be removed by excavating and removing any existing kerb and gutter and/or layback and constructing new kerb and gutter across the kerb opening prior to reconstruction of the footway and roadway.

The kerb, gutter and footway shall be constructed from material matching the kerb, gutter and footway adjacent to the opening unless specified otherwise. The reconstructed areas must finish flush with all adjacent surfaces.

5.5.2 CONSTRUCTION

Areas are to be excavated to the required depth below finished levels and the subgrade compacted to form a uniform working platform. Refer to B2: Earthworks Construction for details.

Formwork is to be solidly set to enable the concrete base to be poured true to the required line and level.

The bases of vehicular crossings or kerb ramps are to be separated from the concrete base of the surrounding footway, or building line or kerb stones by a layer of 10mm thick expansion joint filler as shown in the standard details.

5.5.2.1 VEHICULAR CROSSINGS (DRIVEWAYS)

Vehicular crossings (driveways) shall be constructed as shown in the standard details.

During the construction of any vehicular crossing, the Service Provider may be required to undertake road restoration or reconstruct sections of footpath in the vicinity of the crossing and layback.

5.5.2.2 KERB RAMPS

Kerb ramps shall be constructed in conjunction with the construction of the kerb and gutter. The ramps shall be constructed according to the standard details and the Technical Specification and in the positions shown on the approved drawings or as otherwise directed by the City's Representative.

5.5.2.3 REINFORCED CONCRETE STAIRS

Concrete steps shall be constructed as specified in the approved plans. The concrete shall be placed in one course to the full depth of the riser as shown in the approved plans and according to Technical Specification B3: Concrete Works Construction. Expansion joints shall extend the full depth of the slab in locations as shown on the plans. The edges of such joints shall be finished with an edging tool having a 6mm radius.

5.5.3 SURFACE FINISH

Concrete shall be finished with a heavy broom finish applied to the slab surface, parallel with the fall of the slab for drainage and bonding with the asphalt finish.

Concrete laid as the final surface shall be finished with a medium broom finish generally perpendicular to the line of travel and edged.

5.6 TACTILE GROUND SURFACE INDICATORS (TGSI)

Where required, TGSIs shall comply and be installed as specified in the approved plans in accordance with *AS 1428. Means to assist the orientation of people with vision impairment.* Discrete Stainless Steel Hazard and Directional Tactile Ground Surface Indicators shall be used unless specified otherwise.

The service provider shall ensure that directional tactile indicators comply with slip-resistance requirements in both directions, and the design and arrangement of all TGSIs shall be comply with *AS 1428.4.1 - Means to assist the orientation of people with vision impairment.*

Indicators shall be installed to the manufacturer's recommendations.

5.7 HANDRAILS

Where required, handrails shall comply and be installed as specified in the approved plans in accordance with *AS 1428.- Means to assist the orientation of people with vision impairment.*

5.8 UTILITY COVERS

5.8.1 GENERAL

The Service Provider shall visit the site and confirm the locations, sizes and numbers of the existing utility pits.

All covers shall be recessed and in-filled with paving material specifically cut to lie flush with the cover edge and surrounding paving. The pattern shall continue through the lid, perpendicular to the frame where possible. Infill lids in granite shall be constructed as per the standard drawings.

It is the Service Provider's responsibility to notify the relevant Service Authority when working around their respective infrastructure.

5.8.2 ADJUSTMENT AND RELOCATION

Where the level of the footpath or roadway is altered from its existing level, the Service Provider shall adjust and relocate all the existing pit frames and covers that are to be retained so as to finish flush with the adjacent finished footpath or road surface.

The Service Provider shall ensure that the existing pit frames and pit covers that are to be re-used are free from rust and from twists and warps, which would result in uneven seating of the pit covers when relocated.

Where granite paving is to be installed, metal lids are to remain and all infill lids are to be granite infill as per the standard drawings.

All Utility Authorities should be contacted regarding realignment of utility covers and activity coordinated prior to the commencement of the Works.

5.8.3 AUTHORITY STANDARDS

All pit covers are to comply with the standards and requirements of the relevant Service Authority.

Refer to Technical Specification B1: Preliminaries and General Construction. All work on existing and new pits typically requires only the use of subcontractors who are approved by the asset owner.

5.8.4 LOADINGS

For pit covers in the footpath, loading Class C, 150kN shall be used unless noted otherwise. Driveway pit lids shall have higher load-carrying capacity and comply with Class D loading of the pit lids. They shall be installed as per relevant Service Authority requirements. Refer to the standard details.

5.9 QUALITY

5.9.1 LOAD TESTING

No pavers or stonework are to move or rock under pedestrians, wheelchairs, typical delivery trolleys or test loading. The Service Provider is to test load each completed lot (section) of paving to determine the extent of any unbonded, loose or defective pavers.

The test loading method shall be as follows:

General Footpath

- Loading vehicle: Johnston CN201 Sweeper (five (5) tonne, gross) or equivalent, fully loaded with cleaning liquid
- Number of passes: Four (4)
- Acceptance criteria: No visible movement in the pavers, cracks or other forms of failure.

Driveways

- Loading vehicle: Eight (8) tonne (gross) truck, fully loaded
- Number of passes: Four (4)
- Acceptance criteria: No visible movement in the pavers, cracks or other forms of failure.

Rectification shall be as follows:

- If less than 10 per cent of the lot (section) area fails the load test: Remove and relay individual pavers on new mortar bedding. Retest the lot (section) area.
- If 10 per cent or more of the lot (section) area fails the load test: Remove and relay the entire lot (section).

5.9.2 IN SITU SLIP RESISTANCE TESTING OF NEW SURFACES

The Service Provider shall test the in situ slip resistance of the new unit paving according to *Guide to specification and testing of slip resistance of pedestrian surfaces - (Table 3B)*, once the pavement has been sealed. The Service Provider shall test a minimum of five (5) locations for each site condition that is tested. The Service Provider shall seek agreement of specific test locations from the City's Representative before testing.

The following minimum slip resistance shall be achieved for new surface and jointing material:

Property	Test Standard	Performance Criteria
Slip Resistance Classification of new pedestrian surfaces Wet pendulum test method at manufacture and completion of construction	SA HB 198:2014 (Table 3B)	P5 for slopes steeper than 1:14 P4 for slopes under 1:14

Pavements that do not meet the above minimum slip resistance shall be reground and rectified at the Service Provider's own expense.

5.9.3 INSPECTIONS

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

5.9.3.1 HOLD AND WITNESS POINTS

Construct New Paved Footway	
1. Process Held:	Set-out and excavation complete (Section 5.4.2)
Submission Details:	At least two (2) working days before commencing excavation
Release of Hold Point:	The City's Representative will inspect the excavation, prior to authorising the release of the Hold Point
2. Process Held:	Compaction of Subgrade (Section 5.4.4)
Submission Details:	At least two (2) working days prior to compaction of subgrade
Release of Witness Point:	The City's Representative will inspect the compacted subgrade, prior to authorising the release of the Witness Point unless advised otherwise
3. Process Held:	Placement and compaction of DGB Basecourses where required for flexible pavements (Section 5.4.5)
Submission Details:	At least two (2) working days prior to placing and compaction of DGB base
Release of Witness Point:	The City's Representative will inspect the compacted DGB Base, prior to authorising the release of the Witness Point unless advised otherwise
4. Process Held:	Installing concrete formwork and reinforcements where required. (Section 5.4.12)
Submission Details:	At least two (2) working days prior to installing concrete formwork
Release of Hold Point:	The City's Representative will inspect the concrete forms and reinforcements shall be made, prior to authorising the release of the Hold Point

Construct New Paved Footway	
5. Process Held:	Placement of concrete (Section 5.4.12)
Submission Details:	At least two (2) working days prior to placing concrete
Release of Witness Point:	The City's Representative will inspect concrete finish levels and expansion joints, prior to authorising the release of the Witness Point unless advised otherwise
6. Process Held:	Preparation of sand or mortar bedding layer (Section 5.9.1)
Submission Details:	At least two (2) working days prior to placing pavers
Release of Witness Point:	The City's Representative will inspect mortar strength tests or sand bedding thickness, prior to authorising the release of the Witness Point unless advised otherwise
7. Process Held:	Laying of pavers (Section 5.4.10 and 5.4.11)
Submission Details:	At least two (2) working days prior to laying of pavers.
Release of Hold Point:	The City's Representative will inspect the finish including levels, joints and sealant, prior to authorising the release of the Hold Point

5.9.3.2 TOLERANCES

All surfaces shall be finished in conformity with the lines, grades, thicknesses and cross-sections shown on the drawings or specified or directed by the City's Representative within the following limits:

Item	Activity	Tolerances
1.	**Footpath** a. Surface Level	• The deviation of the finished work from line or level shall not exceed 20mm in 10m • No steps in the footpath or between any two adjacent pavers shall be more than 2mm • On curves or in shaped areas, the deviation of the finished work from a 3m straight edge shall not exceed 15mm at any point • The slope at any point on the surface shall not be less that 1 per cent and not exceed 3 per cent • Unless otherwise specified or directed, the finished surfaces shall be shaped to shed surface water from the entire area in the directions of the natural slope or towards the constructed surface drains.
2.	**Tie-in at features** a. Surface Level	The finished surface shall be shaped to match existing features, e.g. pit covers, edgings and driveways, within 2 mm
3.	**Paving Alignment** a. Surface level	The alignment of the paving shall not differ from the specified line by more than +/-50mm, provided that the minimum pavement width is achieved at all points throughout the construction.

Note: Material tolerances are included in Section 5.3: Materials of this Technical Specification.

B6 Roadways Construction

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B6 ROADWAYS CONSTRUCTION

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B6 ROADWAYS CONSTRUCTION

6.1 SCOPE

This Technical Specification addresses the construction of flexible and rigid road pavements and describes the requirements for the preparation for, and placement of, the various road pavement layers and general provisions for inspection, testing or other aspects of road work.

6.2 STANDARDS AND GUIDELINES

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

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

The following table indicates the Australian Standards and RMS Standards applicable to this section. This table is not exhaustive and may not include all standards which may apply to the work to be undertaken.

Sydney Streets Technical Specification B12: Road Opening and Restoration	
AS 1141	Methods of sampling and testing aggregates
AS 1160	Bituminous emulsions for pavement construction and maintenance of pavements
AS 1289	Methods of testing soils for engineering purposes
AS 1428.2	Design for access and mobility – Enhanced additional requirements – Buildings and facilities
AS 1428.4	Design for access and mobility – Tactile ground surface indicators for the orientation of people with vision impairment
AS 1478.1	Chemical admixtures for concrete, mortar and grout – Admixtures for concrete
AS 1672.1	Limes and limestones – Limes for building
AS 2758.1	Aggregates and rock for engineering purposes – Concrete aggregates
AS 2881	Methods of testing for asphalt mix aggregates
AS 2891	Methods of sampling and testing asphalt
AS 3582.1	Supplementary cementitious materials for use with Portland and blended cement – Fly ash
AS 3972	Portland and Blended Cement
AS 4455	Masonry units and segmental pavers
AS 4456.1	Masonry units and segmental pavers – Methods of test – Sampling for compliance testing
AS 4456.2	Masonry units and segmental pavers – Methods of test – Assessment of mean and standard deviation

AS/NZS 4456.10	Masonry units and segmental pavers – Methods of test – Determining resistance to salt attack
AS/NZS 4456.13	Masonry units and segmental pavers – Methods of test. Determining pitting due to lime particles
AS/NZS 4456.5	Masonry units and segmental pavers – Methods of test – Determining breaking load of segmental paving units
AS/NZS 4456.9	Masonry units and segmental pavers – Methods of test – Determining abrasion resistance
BSEN	British Standard: Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test.
RMS QA 3051	Granular Base and Subbase materials
RMS QA 3071	Selected Material in Formation
RMS QA 3152	Aggregates for Asphalt
RMS QA 3153	Reclaimed Asphalt Pavement Materials
RMS QA 3154	Recycled glass aggregates
RMS QA 3201	Concrete for Maintenance
RMS QA 3204	Joint Fillers for Concrete Pavement and Structures
RMS QA 3211	Cement, Binders and Fillers
RMS R106	Sprayed Bituminous Surfacing (with Cutback Bitumen)
RMS R116	Asphalt (Dense Graded and Open Graded)
RMS R83	Jointed Concrete Base
RMS T116	Recycled Stone Aggregates
RMS T160	Benkelman Beam Deflection Test

6.3 MATERIALS

6.3.1 BASE AND SUBBASE MATERIALS

Coarse and fine aggregate components of the base and subbase materials shall comply with *RMS QA Specification 3051 Granular Base and Subbase Materials for Surfaced Road Pavements.*

DGB20 and DGS40 materials shall comply with *AS 1289.3.6.1* and *AS 1289.3.6.3* respectively.

Concrete pavement base course materials shall comply with AS 2758.1, provided that percentage SO3 by mass shall not exceed 0.1 per cent.

6.3.2 ASPHALT CONCRETE

Asphalt concrete shall be supplied, laid, sprayed and compacted in accordance to *AUS-SPEC 1144 Asphalt (Roadways) and RMS QA Specification R116 Heavy Duty Dense Graded Asphalt* Concrete should only be used with the consent of the City Representative.

6.3.2.1 SUSTAINABLE MATERIALS IN ASPHALT

The City prefers and encourages the use of recommended AAPA Reclaim Asphalt Pavement (RAP), and the use of warm-mix application, composed of:

- 30% RAP for base courses with the use of "a bitumen binder one class softer than otherwise specified which will compensate for the influence of hardened binder in the RAP, and produce asphalt mixes of comparable stiffness, fatigue resistance and deformation resistance to mixes manufactured with virgin materials." (AAPA, National Asphalt Specification, 2nd edition, 2004)
- 15% RAP for wearing courses and applications that will experience high shear forces with the City's approval. Further increase in RAP may be considered and approved by City's Representative where appropriate.

Further reduction in application temperatures is preferred and encouraged, and the City will consider semi-warm mix use in suitable applications.

Process temperatures provided by the European Asphalt Pavement Association (EAPA) define:

- Hot mix ranging from ~120 to 190°C
- Warm mix ranging from ~100 to 140°C
- Semi warm mix ranging from ~70 to 100°C
- Cold mix as unheated/ambient (~20°C).

Service Providers should design the RAP replacement in accordance with *AS 2150:2005 Hot mix asphalt – A guide to good practice* (where relevant), and *AS 2758.5:2009 Aggregates and rock for engineering purposes – Coarse asphalt aggregates*. The Service Provider should also note that the City expects Service Providers to ensure adequate conditions for this replacement are met (i.e. that installation is varied where needed as a result of material replacement). For example, changes to installation may include extending the application time or varying compaction rates. The final material must comply with the performance specifications outlined elsewhere in this and associated documents.

Materials	Property	Acceptance Criteria	Reference document
Course aggregates	Flakiness Index	35% maximum	AS 2758.5, AS 1141-15
	Wet Strength (10% fines)	150 KN minimum	AS 2758.5, AS 1141-22
	Los Angeles Abrasion	30% maximum	AS 2758.5, AS 1141-23
	PAF Value	45 minimum	AS 1141-40, AS 1141- 42
Fine aggregates	All passing 4.75mm sieve	Clean, hard, durable and free from clay or organic matter	RMS 3152
Binder Class 170 or Class 320 or PMB	All relevant properties pertaining to Hot mix AC	Marshall mix design	AS 2008-2013 and RMS 3252 for PMB

6.3.2.2 ASPHALT CONCRETE WARM MIX ASPHALT

Warm-mix asphalt technologies allow the producers of asphalt pavement material to lower the temperatures at which the material can be mixed, placed and compacted on the road. Reductions of 10°C to 20°C have been documented. Such drastic reductions have the obvious benefits of cutting fuel consumption and decreasing the production of greenhouse gases which is one of the key visions of the City.

Warm mix asphalt shall be manufactured with the aid of appropriate additives so that the workability and durability of the asphalt mix remains intact. The quality of the warm mix asphalt must meet the current Australian Standard.

The use of other approved sustainable material such as proprietary product TonerPave is encouraged on base course and wearing course.

6.3.3 STONE SETTS

Where stone setts are to be used, roadway porphyry stones are to be used unless otherwise nominated by the City's Representative. Types of stone setts such as cobblestones/setts, sawn pavers and random stone crazy pavers will be specified in the approved plan. The porphyry stone setts must comply with the following properties as a minimum:

Density	2555kg/m^3
Water absorption	0.65% ~1.00%
Compressive Strength	200~221Mpa
Flexural Strength	22.5MPa
Skip/Slip Resistance	P5 for slopes steeper than 1:14 P4 for slopes under 1:14
Tolerances	
i) Split Paving Plan	
≤ 700mm =	± 8mm
≥ 700mm =	± 12mm
ii) Split/Riven Paving Thickness	
≤ 600mm =	± 15mm
> 600mm =	± 20mm

The samples of porphyry stone setts and the test results must be submitted to the City's Representative for approval.

6.3.3.1 MORTAR FOR STONE SETTS

Portland cement, siliceous coarse sand (free from clay and organic material), and pure uncontaminated drinkable water are to be used to prepare mortar paste for stone setts. The mortar bed for stone setts shall be no more than 30mm and shall have sufficient moisture for compaction and curing. Machine mix mortar shall be used with 1 part cement and 3 parts sand. Curing shall be allowed for 21 days.

6.3.3.2 USE OF LATEX ADMIX FOR STONE SETTS

The City recommends the use of a latex mortar admixture such as Laticrete or equivalent on top of concrete base and mortar bed. All products are to be approved by the City's Representative before use.

6.3.4 UNIT PAVERS

Where unit pavers are to be used for segmental pavement construction, the details shall be submitted to the City's Representative for approval. Testing results, from a nominated NATA-registered laboratory, shall comply with the requirements of *AS 4455 Masonry units and segmental pavers*.

Types of unit pavers such as precast concrete paving, tactile paving, porphyry stone paving, porphyry setts paving or other types will be specified in the approved plan.

6.3.4.1 FIRED CLAY PAVING UNITS

Clay segmental pavers shall comply with the requirements of *AS 4455*. Recycled pavers may be used provided they meet all the criteria.

Refer to *Section 6.2: Standards and Guidelines* for sampling, measurement of breaking load, resistance to salt attack, pitting due to lime and determination of slip/skid and abrasive resistance.

Refer to Table 6.3.4.2 for dimensional tolerances, characteristic breaking load, slip/skid and abrasive resistance and flexural strength.

Samples

Submit two (2) samples of each different type and/or source of paving for approval by the City's Representative prior to ordering. Samples have to be indicative of the paver to be supplied for each different type of paving.

The net area of any paving sample shall not be less than 75 per cent of the gross plan area. For the purpose of sampling, a lot is defined as a maximum 1,000m^2 of paving in the gross plan area for each paver type and/or manufacturer.

Surface coatings

Surface coatings shall not be applied to clay paving units without the prior written approval of the City's Representative.

Appearance

Clay paving units shall be sound, firm, dense, free of distortion, dimensionally stable and consistent, with a smooth upper surface and with unrumpled units having unbroken arises, chamfered or radiused as specified evenly all round. Units which exhibit cracking, bloating or are considered by the City's Representative to be excessively porous, brittle or friable shall be liable to rejection. Paving unit colours shall fall within the colour range of the approved sample units over the full area of the pavement.

Laying pattern

Unless otherwise specified by the City's Representative, concrete pavers for road pavements shall be placed in accordance with the drawing and specification and shall be in accordance with the requirements for the appropriate road application as shown in
Table 6.3.4.2.

6.3.4.2 CONCRETE PAVING UNITS

The materials and manufacture of concrete paving units shall comply with the requirements of AS 4455. Recycled pavers may be used provided they meet all the criteria.

Refer to Section 6.2 Standards and Guidelines for sampling, measurement of breaking load, flexural strength and determination of tactile indicator tiles, slip/skid and abrasive resistance.

Refer to Table 6.3.4.2 for dimensional tolerances, characteristic of breaking load, slip/skid and abrasive resistance and flexural strength.

Samples

Submit two (2) samples of each different type and/or source of paving for approval by the City's Representative prior to ordering. Samples have to be indicative of the paver to be supplied for each different type of paving.

The net area of any paving sample shall not be less than 75 per cent of the gross plan area. For the purpose of sampling, a lot is defined as a maximum 1,000m^2 of paving in the gross plan area for each paver type and/or manufacturer.

Surface coatings

Surface coatings shall not be applied to concrete paving units without the prior written approval of the City's Representative.

Appearance

Concrete paving units shall be sound, firm, dense, dimensionally stable and consistent, with a smooth unblemished upper surface and with unrumpled units having unbroken arises, chamfer or radius as specified evenly all round. Units which exhibit cracking, 'boniness' or are considered by the City's Representative to be excessively porous, brittle or friable shall be liable to rejection. Paving unit colours shall be uniform and shall match that of approved sample units over the full area of the pavement.

Production

Paving units shall be mechanically vibrated in separate moulds and retained within the mould for 24 hours before stripping. Concrete shall be constantly cured.

Laying pattern

Unless otherwise specified by the City's Representative, concrete pavers for road pavements shall be placed in accordance with the drawing and specification and shall be in accordance with the requirements for the appropriate road application as shown in Table 6.3.4.2.

Table 6.3.4.2

Application	Characteristic breaking load[1] (KN)	Characteristic flexural strength (MPa)	Min Thickness (mm)	Dimensional deviations (Category from AS4455)	Slip resistance (co-efficient of friction)	Abrasion resistance (mean abrasion index)
Roads – Traffic Categories						
Light to Medium	5	3	80	DPB2	0.4	5
Medium to Heavy	5	3	80	DPB2	0.4	5
Industrial Pavements[2]	10	4	80	DPB3	0.4	7

Notes on Table 6.3.4.2

1. The resultant joint width is a combination of paver dimensional deviation and laying procedures.
2. At 28 days for concrete paving units.

6.3.4.3 BEDDING SAND

Bedding material shall be clean washed sand of a grading complying with the limits prescribed in Table 6.3.4.3 below:

Table 6.3.4.3

AS Sieve Size (mm)	Percentage Passing by Mass
9.500	100
4.750	95–100
2.360	80–100
1.180	50–85
0.600	25–60
0.300	10–30
0.150	5–15
0.075	0–10

6.3.4.4 JOINTING SAND

Material for filling unbound joints shall be sand of a grading complying with the limits given in Table 6.3.4.4 below:

Table 6.3.4.4

AS Sieve Size (mm)	Percentage Passing by Mass
2.360	100
1.180	90–100
0.600	60–90
0.300	30–60
0.150	15–30
0.075	5–10

Jointing sand shall be free of deleterious quantities of soluble salts and other contaminants which would cause surface staining. Sand used for bedding is not suitable for joint filling.

6.3.4.5 EXPANSION JOINTING

Expansion joint material shall be 10mm thick self-expanding cork filler complying with the requirements of the standard specification unless specified otherwise by the City's Representative.

Engineer's drawings showing jointing details with spacing shall be provided to the City for each project.

6.3.4.6 BEDDING MORTAR AND SLURRY FOR PAVERS

All mortar for the pavers is to comply with *AS 3700 Masonry Structures* and is to be a 3:1 (river sand) cement semi-dry mix. The minimum compressive strength of the mortar mix shall be no less than 15 MPa at seven (7) days. All components shall be measured by means of calibrated containers

Trial mixes of mortar bedding material must be carried out and tested before the commencement of the Works to adequately select a mix that meets the strength requirement. Strength-testing reports shall be available on request to the City's Representative for approval.

All mortar for the pavers is to comply with *AS 3700 Masonry Structures,* in particular Sections 4, 5 and 10, and is to be a 3:1 (river sand) cement. A slurry mix is to be applied on top of this bedding, with a latex additive before laying of pavers to increase bond and compressive strength. The mortar minimum thickness shall be 25 mm and the maximum 30 mm. The amount of mix shall not exceed the quantity required to lay pavers within 45 to 60 minutes , depending on climate conditions.

The bonding slurry shall consist of one (1) part fine-washed sand and six (6) parts Portland Type A cement by volume mixed by hand or mixer while adding water to ensure a smooth, homogenous consistency and free of lumps.

Bonding slurry shall be applied to concrete base and on top of mortar mix.

6.3.5 CONCRETE

Refer to B3: Concrete Works Construction.

6.3.6 PAINT FOR ASPHALT

The paint for asphalt shall be a cement modified, acrylic polymer and aggregate blend developed specifically for use over asphalt.

The paint shall have superior adhesion, flexibility and abrasion resistance as well as chemical resistance. It shall conform to the following characteristics:

Characteristic	Test Specification	Result
Solids by Volume	ASTM D-2697	66.8%
Solids by Weight	ASTM D-2369	80.1%
Density	ASTM D-1475	1.75 kg/l
Flash Point	ASTM D-3278	> 93°C
Percentage Pigment (by weight including cement)	ASTM D-3723	62 +/- 2%
Sheen	ASTM D-523	< 3 @ 85°

6.3.7 INLAYED THERMOPLASTIC PAINT

The inlayed thermoplastic paint shall be performed in the specified colour and pattern. The thermoplastic material shall have a thickness of 2.3mm, and consist of colour-pigmented plastic film with imbedded reflective glass spheres, uniformly distributed throughout the entire cross-sectional area.

6.3.8 RECYCLED MATERIAL

For specifications for recycled materials, refer to *Section 6.3.2.1 Sustainable Materials in Asphalt.*

6.3.9 SAMPLING AND TESTING OF COURSE MATERIAL

Materials for soil, coarse aggregates and fine aggregates shall comply with *AS 1141*. All tests shall be conducted by a NATA-accredited testing authority. Testing shall be carried out in accordance with *AS 2891*.

6.3.10 SAMPLING AND TESTING OF BEDDING MIX

Trial mixes of mortar bedding material must be carried out and tested before the commencement of works to adequately select a mix that meets the strength requirement. Strength testing reports must be provided to the City's Representative for approval.

A slurry mix is to be applied on top of this bedding, with a latex additive before laying of pavers to increase bond and compressive strength.

6.4 CONSTRUCTION

6.4.1 ROAD CLASSIFICATION

6.4.1.1 MEDIUM TO HEAVY TRAFFIC

The City considers medium to heavy traffic to be:

- 15,000–25,000 vpd (vehicles per day)
- 500–1,500 hvpd (heavy vehicles per day)
- 60km/hr–80km/hr speed limit
- Roads with design traffic equal to or exceeding 107 Equivalent Standard Axle (ESA).

6.4.1.2 LIGHT TO MEDIUM TRAFFIC

The City considers light to medium traffic to be:

- $<$ 15,000 vpd (vehicles per day)
- $<$ 500 hvpd (heavy vehicles per day)
- $\leq$ 60km/hr speed limit
- Roads with design traffic less than 107 ESAs.

6.4.2 PREPARATION OF SUBGRADE

Refer to Section 2.6.5 in B2: Earthworks Construction for preparation of subgrade.

6.4.3 PREPARATION OF BASE COURSE LAYERS

Preparation of base course layers shall comply with *RMS R71 Construction of Unbound and Modified Pavement Course*. Where base course is specified to be bound such as cement-stabilised, the Works shall comply with *RMS R73 Construction of Plant Mixed Heavily Bound Pavement Course.*

NOTE: Bound or stabilised materials are not to be used unless authorised by the City's Representative and supported by calculation of additional asphalt concrete layer thickness to address reflective cracking. Both bound and unbound pavement courses shall comply with the compaction requirements as per the table below:

Compaction Requirements	
Layer	**Minimum Compaction** **(Standard Maximum Dry Density)**
DGS 40 Subbase	100%
DGB 20 Base	100%

6.4.4 FLEXIBLE ROAD PAVEMENT

6.4.4.1 FLEXIBLE ROAD PAVEMENT STRUCTURE, MATERIAL TYPES AND MINIMUM LAYER THICKNESSES

For new road construction works, refer to the standard drawings for detail.

6.4.4.2 REINSTATEMENT OF FLEXIBLE ROAD PAVEMENT

Reinstatement of asphalt road pavement shall match the existing layer thicknesses or those specified on the standard drawing, whichever is thicker. The asphalt surface shall be reinstated to the original level or the level on the approved design drawing or as directed by the City's Representative.

6.4.5 RIGID ROAD PAVEMENT

The concrete shall be supplied, placed, compacted and tested as described in B3: Concrete Works Construction. Note that A/C material supply and placement shall comply with flexible road pavement as outlined above.

6.4.5.1 RIGID ROAD PAVEMENT STRUCTURE, MATERIAL TYPES AND MINIMUM LAYER THICKNESSES

For new road constructions, refer to the standard drawings for detail.

6.4.5.2 REINSTATEMENT OF RIGID ROAD PAVEMENT

Reinstatement of concrete road pavement shall match the existing layer thicknesses or those specified on the standard drawing, whichever is thicker. The concrete surface shall be reinstated to the original level or the level on the approved design drawing or as directed by the City's Representative.

Grout steel dowels shall be epoxied into the adjacent concrete and reinforcement provided to prevent the reinstated concrete from subsidising or cracking. Refer to the standard drawings for details. Refer to B12 Road Opening and Restoration.

6.4.5.3 CONCRETE ROAD PAVEMENT JOINTS

Joints shall be constructed and located as detailed on the drawings. Joints shall be straight and plumb. Unless otherwise detailed on the drawings, transverse expansion and contraction joints shall be normal to the longitudinal joints, and continuous from edge to edge of the pavement throughout all paving slabs that are connected in a single paved area. Where kerbs are cast as part of the paving slab, joints of the same type shall continue through the kerb sections on the same alignment as those in the paving slab.

6.4.5.3.1 LONGITUDINAL CONSTRUCTION JOINTS

Longitudinal construction joints shall be provided at the locations shown on the drawings or where directed by the City's Representative. There will normally be no more than one longitudinal joint along each road segment. The joints shall be parallel to the kerb line and formed by laying and compacting the concrete up to a solid bulkhead. Joint sealer shall be silicone sealant, preformed elastomeric strips or preformed self-expanding cork strips as detailed on the standard drawings. Galvanised N12 dowels, 600mm long at 500mm centres, are to be centrally placed perpendicular to joint. The top surface of longitudinal construction joints shall be smooth across the joint.

6.4.5.3.2 TRANSVERSE CONSTRUCTION JOINTS

Transverse construction joints shall be provided only at a discontinuity in the placement of concrete determined by the Service Provider's operations. Transverse construction joints shall be constructed square to the kerb line and formed by either timber formwork or by cutting the previously placed concrete back to form an even, fully compacted vertical face up to which the new concrete can be abutted. Galvanised N12 dowels, 600mm long at 500mm centres, are to be centrally placed perpendicular to joint. All cut material and any loose material on this face shall be removed. The top surface of transverse construction joints shall be smooth across the joint.

6.4.5.3.3 TRANSVERSE EXPANSION JOINTS

Transverse expansion joints are to be formed at approximately 20m spacings and laid square to both gutter and/or longitudinal construction joints. The joints are to be formed with galvanised R28, 450mm long bars at 450mm centres, capped and with a bond-breaking compound at one end and an AFX10125 Ableflex Joint Board, complying with *RMS 3204,* and joint sealant installed in accordance with Specification *RMS R83* or otherwise approved by the City's Representative.

6.4.5.3.4 TRANSVERSE CONTRACTION JOINTS

Transverse contraction joints shall be constructed normal to the control line and to the dimensions and details shown on the drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors. Bays between transverse expansion joints shall be divided into four (4) separate bays by sawcuts at 5m spacings. The sawcuts shall be 45mm deep, or 1/3-1/4 of the slab thickness and cut square to both the kerb line and the longitudinal construction joint.

6.4.5.3.5 LONGITUDINAL CONTRACTION JOINTS

Longitudinal contraction joints shall be constructed continuously along the centreline of non-reinforced rigid pavement. The joints on the concrete shall be sawcut to an adequate depth. The depth should be typically 1/3 the depth of the slab. The sawing should be done late enough to avoid ravelling of the new concrete, but soon enough so that random cracking does not begin to occur. The sawcut joints shall be filled with backing rod and seal.

6.4.5.3.6 SAWN CONTRACTION JOINTS

Sawn contraction joints shall be constructed by cutting a groove in the hardened concrete. If uncontrolled cracking of concrete occurs, concrete placing shall be suspended. Sawcuts shall be at least 45mm deep or at such greater depth as detailed on the drawings and of uniform width in the range 3mm to 5mm for the full depth of the cut. The line of the transverse contraction joint shall be without any discontinuities. No edge shall deviate from a 3m straight edge by more than 10mm. The surface of the transverse contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300mm in any 1m length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

The time of sawing shall vary between 6 and 24 hours after initial paving, depending on existing and anticipated weather conditions, to prevent the uncontrolled cracking of the pavement. Sawing of the joints shall commence as early as possible, commensurate with the concrete having hardened sufficiently to permit cutting the concrete without excessive chipping, spalling or tearing. The sawn faces or joints will be inspected for undercutting or washing of the concrete due to early sawing. If this action is sufficiently deep to cause structural weakness or excessive cleaning difficulty, the sawing operation shall be delayed, and resumed as soon as the sawing can be continued without damaging the concrete slab. Nevertheless, all sawing will be completed no later than 24 hours after placement of the concrete. The joints shall be sawn, if the concrete is sufficiently hard, in the sequence of the concrete placement, initially at every fourth joint, then at the intermediate intervals.

Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawn if a crack has occurred near the location chosen for a joint. Sawing shall be discontinued if a crack develops ahead of the sawcut. Immediately after each joint is sawn, the sawcut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint, and the joint caulked with plastic or rubber tubing or suitable 'tee'-shaped extrusion which will remain in place and prevent the entry of foreign material into the joint.

6.4.5.3.7 JOINT TOLERANCES

The line of joints in the concrete base shall not deviate from a 3m straight edge placed along the joint by more than 10mm. The distance between kerb and longitudinal construction joints shall not vary by more than 100mm over the length of the joint, unless approved by the City's Representative.

6.4.5.3.8 JOINT SEALING

All concrete base joints are to be sealed in accordance with *RMS QA Specification R83 Concrete Pavement Base.*

6.4.6 CONSTRUCTION OF STONE ROADS

Prior to installation of stone setts, the Service Provider must note the following:

- The boundaries of all four sides of stone setts paving shall be tied into the base
- Concrete gutter poured separately to reinforced base on which stone setts are laid shall be reinforced to limit movement
- Stone setts shall be laid in bays which contain joints
- Curing should be a minimum 14 days for the slab and 21 days for the cobbles/setts
- Low-shrinkage concrete shall be used for slab
- Only the area that is capable of being done within the time limits of the materials (mortar or grout) shall be prepared
- Grout shall be installed full depth
- A steel plate shall be used to ensure that curing occurs before traffic loading is reintroduced
- Coloured oxide shall be used to eliminate colour variance
- A minimum joint thickness of not less than 10mm shall be used
- Mortar joints as follows shall be used where applicable and subject to the approval by the City's Representative:
    - Construction joints – 15mm
    - Between setts – 10mm
    - Edge joints – 30mm–40mm.

6.4.6.1 LAYING OF STONE SETTS IN GENERAL

Preparation of subgrade

Refer B2 Earthworks Construction for preparation of subgrade.

Working with concrete and mortar

Setts need to be laid onto a full bed of mortar over a reinforced concrete base at least 200mm thick. Refer to the standard drawings for details. For a mortar bed, mix 3 parts sharp sand with 1 part cement.

Sett pavements are traditionally edged with 'channel course' of setts laid lengthways and following the perimeter of the area. A sample panel of setts on sand or on flat ground shall be laid out beforehand to determine which arrangement best suits the project.

Channel courses are always laid first. They define the boundary of the pavement and act as a guide to level for the main area of paving.

Laying procedures – pattern

Stone setts/cobbles are to be laid in stretcher bond with the rows running across the street. Full-sized stones are to be used to start and finish each row. This means that the first one, two or three stones will appear as if they are in a stack bond. These first few stones are to be chosen carefully so that they introduce a stretcher bond quickly throughout the rest of the row. A rejection criterion is if the align in subsequent rows at any joint after the third stone.

For general laying procedure, refer to the standard drawings and B5 Footways Construction.

Laying of stone setts with mortar additive such as LATICRETE or equivalent

Mortar additive shall be used as approved by the City's Representative and laid as per manufacturer's instruction and guidelines.

Jointing

For cement mortar jointing, mix a mortar comprising three (3) parts soft or building sand and one (1) part cement to a consistency that is very wet, like that of a pea soup. Spread over the pre-wetted setts and sweep into the joints using a stiff brush. The excess shall be swept off, repeating the sweeping until as much as possible of the mortar is removed, and eventually switching to a soft brush to remove the finer particles. The surface needs to be gently sprayed with clean water throughout to help with the cleaning. Once the joints are filled, smooth it using the blade of a pointing trowel or a special pointing bar that will give a flat or semi-round profile to the joint. Cement mortar jointed setts should be kept free of foot traffic for at least three (3) days and vehicles are best kept off the paving for at least seven (7) days, and preferably longer.

6.4.6.2 ONSITE QUALITY CONTROL

For thoroughness of mixing, ensure that the mortar bed mix is of a consistent cement colour. No grains of sand shall be left without a cement coating. Failure to meet this acceptance criterion may result in rejection of the mix.

6.4.7 CONSTRUCTION OF ROADS WITH UNIT PAVERS

6.4.7.1 SUBGRADE PREPARATION

Refer to B2 Earthworks Construction for preparation of subgrade.

6.4.7.2 SUBBASE

Subbase materials shall be DGB20 unless specified otherwise. Granular subbase material shall comply with *RMS QA Specification 3051 Granular Base and Subbase Materials for Surfaced Road Pavements.*

6.4.7.3 BASE

The base shall be constructed to the specified thickness and depth below the finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the drawings and in accordance with B3: Concrete Works Construction. The base course shall extend in width to at least the rear face of kerb. The finished surface of the base course for road pavements to be overlaid with segmental paving shall be trimmed to within ±10mm of design levels. The deviation from a 3m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving shall not exceed 5mm. Sand bedding material shall not be used as a levelling material to compensate for base finishing outside the above tolerances. The finished surface of the base shall drain freely without ponding. The finished base shall be subject to the approval of the City's Representative.

6.4.7.4 EDGE RESTRAINTS

Edge restraints in the form of kerb and/or gutter or edge strips shall be constructed along the perimeter of all segmental paving as shown on the drawings. Concrete kerb and/or gutter and edge strips shall be constructed in accordance with B3 Concrete Works Construction and B4 Kerb and Gutter Construction.

Faces of edge restraints abutting paving units shall be vertical. Alternatively, silicone joint filler shall be applied between the paving unit and edge restraint. Edge restraints shall be supported on the compacted base and/or subbase of the thickness as shown on the drawings. Unless otherwise shown on the drawings, contraction joints 20mm deep shall be formed every 5m of the edge restraint length.

6.4.7.5 SAND BEDDING COURSE

Bedding sand shall be non-plastic and shall be free of deleterious quantities of soluble salts and other contaminants which may cause, or contribute to efflorescence. Bedding sand shall be of uniform moisture content when spread. It shall be covered when stored on site to protect it from rain penetration.

Where cement stabilised bedding is specified, 4 per cent to 6 per cent of cement by volume is to be thoroughly and evenly mixed in with the bedding sand prior to spreading. The volume of mixed material shall not exceed that required for the area of paving units to be laid in a period of four (4) hours. Adequate precautions shall be taken to protect the sand-cement mixture from adverse weather conditions.

The sand bedding course shall be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 20mm to 25mm layer following final compaction of the segmental paving. Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and rescreeded before laying paving units. Depressions for the manual placing of paving units in the bedding sand shall be maintained at a uniform loose density. For mechanised laying, the bedding sand shall be uniformly and firmly, but not fully, compacted. Compaction screeded sand left overnight or subject to rain shall be checked for level and rescreeded where necessary before paving units are placed. The sand shall not be screeded more than 2m in advance of the laying face at the completion of work on any day.

6.4.7.6 LAYING PAVING UNITS

The laying patterns must be approved by the City's Representative prior to installation on site. For general laying procedure refer to the standard drawings and B5 Footways Construction.

6.4.7.7 BEDDING COMPACTION

After laying the paving units, the sand bedding shall be fully compacted and the surface brought to design levels and surface profiles by not less than two (2) passes of a high-frequency, low-amplitude plate compactor which covers at least 12 units. Compaction shall continue until lipping between adjoining units has been eliminated.

Any units which are structurally damaged during bedding compaction shall be removed and replaced. The pavement shall then be recompacted for at least 1m surrounding each replacement unit.

The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction shall not be attempted within 1m of the laying face except on completion of the pavement against an edge restraint.

The finished surface level shall not vary from the design level at any point laid in any direction by more than 5mm. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, shall not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 5mm.

All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.

6.4.7.8 FILLING JOINTS

As soon as practical after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming. To ensure complete filling of the joints, both the filling sand and paving units shall be as dry as practical when sand is spread and broomed into the joints. Note that sand shall be covered when stored on site to protect it from rain penetration. The pavement shall then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

6.4.7.9 OPENING TO TRAFFIC

As soon as practical after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area of pavement to assist in the development of 'lock-up'. Excess joint filling sand shall be removed prior to opening to traffic. The pavement shall then be inspected by the Service Provider at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled.

6.4.8 CONSTRUCTION OF ROAD THRESHOLD

The service provider shall follow the Technical Specification and standard drawings for the construction of roadway threshold. The general installation procedures shall be as follows:

- Immediately prior to installation, thoroughly clean the designated locations of all dirt, loose stone and other debris to the satisfaction of the City's Representative
- Mill A/C as indicated in the approved plans or standard drawings
- For asphalt threshold components:
    - Spray a layer of binder across the road and heat it to bond the road and the new asphalt. (note: the designated locations shall be tacked, i.e. rate of application as per *AS 1160* and special care shall be taken to avoid spraying the bituminous tack coat on adjacent kerbs, driveways and miscellaneous structure. Unless otherwise directed by the City's Representative, the tack coat is to be applied to provide a uniform application rate of between 0.1L/m^2 and 0.2L/m^2. The Service Provider shall be responsible for all clean up should such overspray occur)
    - Once the binder is heated and ready for asphalt, tip the fresh asphalt onto the road surface and spread the asphalt as evenly as possible using rakers
    - Use the small steel roller to compress and flatten the asphalt
    - Tip the second layer of fresh asphalt to form the shape (grade) of the threshold as per the standard drawing and specification and compress as appropriate to maintain the configuration
    - Allow the asphalt to harden for reflective markings and for erection of other traffic control signs as per the drawing and specification
    - Apply stamped pattern and colouring as specified in the approved plan and line markings.
- For concrete threshold components, refer to B3 Concrete Works Construction
- For paver infill threshold components, refer to *Section 6.3.4 Unit Pavers* of this Technical Specification.

6.4.9 STAMPED ASPHALT (NOT TO BE USED)

6.4.10 PAINT FOR ASPHALT

The paint shall be in accordance with the manufacturer's recommendations.

Sufficient masking shall be used to ensure that the surface products are applied only where specified.

6.4.11 INLAYED THERMOPLASTIC PAINT

6.4.11.1 SURFACE IMPRINTING

The imprinted pattern in the asphalt shall be created in accordance with the design drawings. Patterning shall begin only after the asphalt has reached its final compacted density and while there is still sufficient heat in the asphalt to permit imprinting.

Alternatively, imprinting can be carried out at a later stage, on existing asphalt (no older than two (2) years), by applying heat to the asphalt surface to make the upper portion of the asphalt surface pliable enough to accept the imprint of the template. For proper imprinting success, the asphalt pavement must be adequately heat soaked (softened) to a depth of at least 6mm, without burning the asphalt. The asphalt surface temperature shall not exceed 163°C. Regular monitoring of the surface treatment during heating is recommended to prevent overheating.

If during the reheating process the surface is overheated and begins to emit black smoke, work shall stop immediately. All damaged pavement shall be replaced, prior to stamping continuing.

Patterning shall be achieved using plate compactors and shall be of a consistent depth of 3mm.

6.4.11.2 INSTALLATION AND BONDING OF PRE-FORMED THERMOPLASTIC PANELS

The thermoplastic shall be applied only in dry conditions. The thermoplastic shall be placed on the clean, dry asphalt in the imprinted pattern, prior to application of heat. Once the thermoplastic is in place, heat shall be applied using a reciprocal infrared heater. The asphalt surface temperature shall not exceed 163°C. If smoke is visible, that is an indication that the asphalt and/or the thermoplastic material is burning. Apply sufficient heat to liquefy the thermoplastic. This is achieved when the joints of the thermoplastic panels flow together. Bonding of the thermoplastic material to the asphalt surface can be monitored by carefully lifting a corner of the thermoplastic material before it completely cools. If asphalt is attached to the base of the thermoplastic material sufficient heat was applied. If not reapply heat.

6.4.12 SPECIAL REQUIREMENTS

The Service Provider may be required to take levels on top of the finished base course surface or milled-down surface prior to laying of the asphalt layer (two points at the edges and one point at the crown across the width of the pavement) and at 15m intervals along the length of the road. After laying the asphalt, the Service Provider shall again take levels on the same points and in a similar manner. The difference of the two levels shall determine the thickness of the asphalt surfacing. Any deviation from the designed grade and level shall have to be rectified by the Service Provider at their own cost. The cost of taking levels shall be borne by the Service Provider.

6.4.13 TRENCH CUT FOR INSTALLATION OF SERVICES AND TEMPORARY ROAD RESTORATIONS WORKS

All trenches cut for installation of services are to be restored to their existing road surface level and configuration. Refer to the standard drawings for temporary road restorations.

The general procedure for road cuts and trench restoration outlined below is to be followed unless otherwise specified by the City's Representative:

- Sawcut or mill existing pavement to the width of the proposed trench. Refer to B2: Earthworks Construction for sawcutting. The width of the trench will be agreed on site with the City's inspector.
- Remove existing asphalt/concrete, stone setts or unit pavers between sawcuts using an appropriate device and as per the methodology approved by the City's Representative.
- Excavate trench and install service(s) without damaging the edges of the remaining asphalt or concrete. Refer to B2: Earthworks Construction for excavation for trenches.

- Place and compact the pipe zone area with approved select fill or other material to be approved by the City's Representative and level the surface above the pipe zone. Refer to B12: Road Opening and Restoration for specifications, compaction materials and tolerances.
- The service provider shall provide subsoil drain where excavation is below the bed rock's surface levels. The subsoil drain shall be wrapped in geotextile and connected to the nearest stormwater pit.
- Backfill the trench from the top of the pipe zone to road formation or subgrade level in accordance with B12: Road Opening and Restoration.
- Following compaction and formation of subgrade, the trench has to be restored back to the original road surface level as per the trench restoration standard drawings for specific roads. Where standard restoration drawings are not available, the restoration shall follow the existing road configuration. Refer to the standard drawings for temporary road restoration for flexible and rigid pavements and the same shall follow for unit pavers or stone setts. All restorations shall be in accordance with B12: Road Opening and Restoration.

6.4.14 PERMANENT RESTORATION OF ROADWORKS

All permanent restorations shall be in accordance with B12: Road Opening and Restoration.

The City's Representative, following the completion of temporary road restoration works, shall closely monitor the performance and characteristics of the road for approximately six (6) months before proceeding on permanent restoration works. If the road has settled to a degree and warrants permanent restorations, the standard drawings and specifications are to be followed for specific road types as mentioned below:

- Flexible Pavement
- Rigid Pavement
- Stone Setts/Stone Road
- Unit Paved Road.

6.4.15 DRY ROLLED CONCRETE/SANDSTONE BALLAST

The City prefers to reinstate dry-rolled concrete/sandstone ballast surfaces with flexible road pavement configuration including the replacement of base course layers with a lean mix concrete having a 28-day compressive strength of 5MPa (with fly ash).

6.4.16 SITE TESTING EQUIPMENT

The road formation to be proof rolled with a minimum 10-tonne 3-point roller or alternative method to the City's satisfaction. All testing equipment is to be approved by the City's Representative before use.

6.5 QUALITY

6.5.1 HOLD AND WITNESS POINTS FOR FLEXIBLE PAVEMENT

1. Process Held	Use of each type or source of granular pavement material. (Section 6.3.1)
Submission Details	At least three (3) working days before each granular pavement material is proposed for use, the Service Provider shall submit all test results demonstrating conformance of materials
Release of Hold Point	The City's Representative will consider the submitted documents and may carry out surveillance and audit, prior to authorising the release of the Hold Point
2. Process Held	Sub-grade preparation and placement of overlaying base, subbase or select material layers. (Section 6.3.1)
Submission Details (CBR. DCPT and compaction test results such as dry density and per cent of moisture content)	At least one (1) day before the proposed overlay of base, subbase or select material layers, the Service Provider shall submit all test and survey results demonstrating conformance of the layer for material properties, compaction, level, surface trim and width
Release of Witness Point	The City's Representative will consider the submitted documents and shall carry out surveillance and audit to witness the compliance requirements of subsequent pavement layers, prior to authorising the release of the Hold Point
3. Process Held	(Section 6.4.4)
i) Preparation of subgrade (Provide photographic evidence including the methodology and other related documents)	Attend site to test roller pass, water truck and/or Benkelman beam test to *RMS T160*. The road formation to be proof rolled (at least 5 passes) with minimum 10 tonne 3-point roller (or alternative method to the City's satisfaction). Check level prior to placing of subbase material.
ii) Preparation of subbase (Provide photographic evidence including the methodology and other related documents)	Attend site to test roller pass, water truck and/or Benkelman beam test to *RMS T160*. The road formation to be proof rolled (at least 5 passes) with minimum 10 tonne 3-point roller (or alternative method to the City's satisfaction). Check level prior to placing base material.
iii) Preparation of base early stage (Provide photographic evidence including the methodology and other related documents)	Attend site to test roller pass, water truck and/or Benkelman beam test to *RMS T160*. The road formation to be proof rolled (at least 5 passes) with minimum 10 tonne 3-point roller (or alternative method to the City's satisfaction). Check level prior to placing asphalt.
4. Process Held	i) Delivery of materials for priming, primer sealing or sealing to be used in the works ii) Sprayed bituminous surfacing work for each work location
Submission Details	i) At least three (3) working days prior to proposed priming, primer sealing or sealing, the Service Provider shall submit all test results demonstrating conformance of the materials proposed ii) At least one (1) working day prior to the proposed sprayed bituminous surfacing works the Service Provider shall submit primer, primer binder, binder, aggregate lot details and target application rates and notification that the prepared surface to accept the sprayed bituminous surfacing is ready for inspection

Release of Witness Point	i) The City's Representative will consider the submitted documents and may carry out sampling, testing and audit, prior to authorising the release of the Hold Point ii) The City's Representative will consider the submitted documents and shall inspect the prepared surface and may carry out calculations and audit, prior to authorising the release of the Hold Point
5. Process Held	Binder application
i) Final stage of base course: Base surface dry, clean and free from deleterious material and ready for priming.	Attend site to inspect materials for priming, primer sealing or sealing
ii) Surface uniformly covered with a fine sprayed coat of bituminous emulsion as per approved rate of application (Provide photographic evidence including the methodology and other related documents)	Attend site following application of tack coat
6. Process Held	Use of each asphalt nominated mix in the works
Submission Details	At least 10 working days prior to proposed commencement of asphalt works, the Service Provider shall submit all designs, test results, certificates and other documentation that demonstrate conformance of the asphalt with the Technical Specification requirements for each asphalt mix proposed to be used
Release of Witness Point	The City's Representative will consider the submitted documents and may carry out testing, calculations and audit, prior to authorising the release of the Hold Point
7. Process Held	Placement of overlaying asphalt layers and surface course (Section 6.3.2)
Submission Details	At least one (1) working day before proposed overlay of asphalt layers the Service Provider shall submit all test and survey results demonstrating conformance of the layer for material properties, in situ voids, level and width
Release of Witness Point	The City's Representative will consider the submitted documents and may carry out surveillance and audit, prior to authorising the release of the Hold Point.
8. Process Held	
i) Laying of asphalt on the base surface and surface course (Provide photographic evidence including the methodology and other related documents)	Attend site to inspect laying of asphalt with no segregation allowed or to accumulate along the sides of the receiving hopper. Attend site during laying of surface course.
ii) Survey	Survey as outlined in Section 6.4.10 and as directed by City's Representative.
iii) Cleanliness of road surface prior to opening to traffic	Attend site prior to being opened to traffic.

6.5.2 HOLD AND WITNESS POINTS FOR RIGID PAVEMENT

The same hold and witness points determined for flexible pavement will be applicable for rigid pavement up to the base level and the rest, i.e. from base to surface level, are to be followed as per the table below.

1. Process Held	Production of concrete for concrete paving. (Section 6.4.5)
Submission Details	At least 20 working days prior to the commencement of concrete paving, the Service Provider shall submit details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport
Release of Witness Point	The City's Representative will review the submitted details, prior to authorising the release of the Hold Point
2. Process Held	Preparation of formwork and placement of re-bar for the base course layer (Section 6.4.5).
Submission Details (Photographic evidence including the methodology and test results of re-bar)	The City's Representative shall attend the site and witness the placement of re-bar and joints as per the drawing and specification
Release of Hold Points	The City's Representative will approve the formwork and re-bar prior to authorising the release of the Hold Point
3. Process Held:	Placement of concrete for paving. (Section 6.4.5)
Submission Details: (Photographic evidence of concrete pour including the methodology and test results of concrete)	Following inspection of re-bar placement, the Service Provider shall collect three (3) sets of cylinders in the presence of the City's Representative and send it to a NATA-registered laboratory for testing the compressive strength of the concrete
Release of Hold Point:	The City's Representative shall inspect the finished concrete surface, prior to authorising the release of the Hold Point
4. Process Held	Attend site to witness pouring of concrete for concrete paving (Section 6.4.5)
5. Process Held	Attend site to inspect sealing of joints Sealing of Joints. (At least two (2) days' notice is to be provided to the City's Representative.
6. Process Held:	Removal and disposal of non-conforming concrete. (Section 6.4.5)
Submission Details:	At least two (2) working days prior to commencement of work, the Service Provider shall submit details of the equipment and methods proposed for removal and disposal of concrete paving
Release of Hold Point:	The City's Representative will review the submitted details, prior to authorising the release of the Hold Point

Note: A/C shall comply with flexible pavement.

6.5.3 HOLD AND WITNESS POINTS FOR UNIT PAVERS/STONE SETTS

The hold and witness points for unit pavers/stone setts shall be the same as rigid pavement up to the top of concrete base.

1. Process Held	Commencement of paver placement (Section 6.4.6 and 6.4.7)
Submission details (i.e. test results for breaking load, slip/skid resistance and abrasive resistance and others)	At least five (5) working days prior to ordering segmental paving units, the Service Provider shall submit two (2) samples of each paver type and test results for each paver type stating source of paver and demonstrating conformance to Table 6.4.3.2.
Release of Hold Points	The City's Representative will examine each paver type and associated documentation prior to authorising the release of the Hold Point
2. Process Held	Commencement of bedding sand placement or mortar (Section 6.4.6 and 6.4.7)
Submission details	Survey top of concrete base for conformity with design levels. Submit survey result.
Release of Hold Points	The City's representative will consider the submitted documents and may carry out surveillance and audit, prior to authorising the release of the Hold Point.
3. Process Held	Finish surface prior to applying jointing sand (Sections 6.4.6 and 6.4.7)
Submission details	Two days' notice prior to the completion of surface levels.
Release of Hold Point	City's Representative to approve levels.
4. Process Held	Attend site for each phase from bed preparation to installation of unit pavers/ stone setts.

6.5.4 LIMITS AND TOLERANCES

6.5.4.1 UNIT PAVERS ROADS

Item	Activity	Tolerances
1.	Base a. Surface Level	• Finished level of base for road pavements to be within +10mm or -10mm of design levels • Finished level of base other than for road pavements to be within ±10mm of design levels • The top surface of the base for all segmental paving shall not deviate from a 3m straight edge, laid in any direction, by more than 5 mm
2.	Laying Paving Units a. Joint widths	• No more than 10 per cent of joints along any 10 metre line of joints along a major axis of the laying pattern shall have widths outside the range 2mm to 4mm
3.	Completed Segmental Paving a. Surface level	• Finished surface level of pavers shall not vary from design levels by more than ±5 mm • Finished surface of pavers shall not deviate from a 3m straight edge, laid in any direction, by more than 5mm

6.5.4.2 STONE SETT ROADS

Item	Activity	Tolerances
1.	Stone Shape	• Bottom face to be no less than 75 per cent of surface area of top face • Stones to have vertical sides
2.	Laying Stones a. Joint widths	• Joint thicknesses of between 8mm and 15mm are recommended • An absolute minimum width of 3mm is to be strictly enforced. The 3mm absolute minimum is only acceptable in a joint where the 8mm minimum is achieved throughout the majority of the joint and the 3mm minimum occurs only at a point.

B7
Street Furniture Construction

Contents

B7 STREET FURNITURE CONSTRUCTION

7.1 SCOPE

This Technical Specification provides the requirements for the removal, relocation, supply, installation and commissioning of street furniture. For the purposes of this Technical Specification, street furniture shall refer to all above-ground streetscape items, excluding street lighting, road signage and traffic signals.

7.2 STANDARDS 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 2159 Piling – Design and installation (including supplements and amendments)
- AS 2601 The demolition of structures
- AS 2700 Colour standards for general purposes (For paint colour standards and sealants; there is no separate code for sealants).
- AS 3600 Concrete structures (including supplements and amendments)
- AS/NZS 2865 Safe working in a confined place

Materials or operations not covered by the above shall conform to the appropriate Australian Standard.

7.3 FURNITURE ITEMS

7.3.1 APPROVED SUPPLIERS

All furniture items shall be supplied in accordance with the plans approved by the City. The following table lists the furniture items and the approved supplier/s. The Service Provider may apply for an equivalent product for approval by the City's Representative.

Furniture Item	Approved Supplier/s
Automated Public Toilets	JC Decaux Australia
Bench Seats	ABUD

Furniture Item	Approved Supplier/s
Bicycle Security Rings	City Infrastructure and Traffic Operations
Bollards	ABUD
Bus Shelters	JC Decaux Australia
Street Litter Bin	ABUD
Street Posting Box	Australia Post
Parking Meters	City of Sydney's Parking Services team
Telephone Kiosk	Telstra, Payphones JC Decaux
Vending Kiosk	JC Decaux

The contact details for the above approved suppliers are:

JC Decaux Australia

Units 2 & 3, 82–190 Euston Road,
Alexandria NSW 2015
City Relations Manager (02) 9565 9900

Telstra Payphones

Payphone Provisioning Manager
(02) 9397 4344

Australia Post

Hub Division,
PO Box 313,
Regents Park NSW 2143
Manager, Street Posting Boxes, Transport and Logistics
(02) 9838-8526 or (02) 8736-5322 for depot boxes (green boxes)

ABUD

Oak Rd N, Kirrawee NSW 2232
City Relations Manager (02) 9710 9501

City of Sydney's Parking Services team,

456 Kent Street, Sydney NSW 2000
Contract Coordinator (02) 9246 7771

City of Sydney's City Projects

456 Kent Street, Sydney NSW 2000
Program Manager (Streetscapes) (02) 9265 9055

7.4 HANDLING, STORAGE AND DISPOSAL OF EXISTING FURNITURE

7.4.1 NON-JC DECAUX AUSTRALIA FURNITURE ITEMS

All existing furniture identified for temporary removal and relocation in the approved documents is to be carefully removed, protected prior to removal, and carefully labelled and stored for re-use. A full inventory of stored goods is required to be provided by the Service Provider and delivered to a location nominated by the City's Representative. The existing furniture inventory should include photographic evidence of the quality of the furniture prior to protection and removal. All items should be clearly identified while in storage for correct reclamation. The City's Representative will inspect the furniture while in storage.

The costs of protection, removal identification, relocation and repair (if necessary) of existing furniture are to be borne by the Service Provider or Subservice Provider. Any additional protection and identification required to satisfy the City's Representative must be provided at the Service Provider's or Subservice Provider's cost. Note that bins will be maintained in working order, cleaned and repaired by the City.

The City's Representative may request the Service Provider to dispose of approved unwanted furniture. Disposal of approved unwanted furniture is to be undertaken at the Service Provider's or Subservice Provider's cost.

Unwanted furniture must be disposed in a manner that is ethical, efficient, and where practical maximises a value outcome for the City.

The Service Provider is to prioritise furniture re-use and materials recycling ahead of disposal to landfill, which is considered an undesirable outcome. The Service Provider must remove all City of Sydney visual identifiers such as logos and labels from any unwanted furniture before disposing of items by resale or auction.

All seats are to be maintained and repaired to a high-quality finish. The existing patina on the metal is to be protected and not cleaned.

7.4.2 JC DECAUX AUSTRALIA FURNITURE ITEMS

The Service Provider shall liaise with the City's Representative to coordinate the removal, storage and reinstallation of JC Decaux furniture. The Service Provider shall meet all costs associated with these Works.

7.5 SUPPLY AND INSTALLATION

7.5.1 GENERAL

The supply and installation of street furniture is to be coordinated by the Service Provider. The Service Provider shall liaise with the approved supplier(s) to coordinate delivery including lead times and installation arrangements.

Furniture items shall be installed in the positions shown on the approved plans or as directed by the City's Representative.

The Service Provider shall carry out the following activities as applicable to the approved work:

- Revise locations of furniture, whether new or existing, as part of the Works (where required), in accordance with the requirements of this Technical Specification. The Service Provider shall check that critical setback offsets have been adhered to as per the standard detail.
- Amend and finalise setout levels and locations, and coordinate for pavement works to ensure the correct and appropriate installation of furniture as directed by the City's Representative.
- All activities are required to comply with the standards, codes and guidelines (including current Australian Standards) referred to in this Technical Specification, and all other applicable standards that are not specifically referred to in this Technical Specification.

- Ensure setout of furniture does not restrict access or obscure sight-lines in front of the doors of businesses and premises, particularly glass shopfronts, where possible. The Service Provider shall liaise with tenants and private property owners to ensure that furniture is appropriately and discreetly located where possible. The Service Provider is also required to fully coordinate these actions with the City's Representative and other relevant authorities.
- Ensure setout of furniture does not obstruct cleaning, maintenance or the intended function of any existing street furniture.
- Ensure that relevant authority requirements for the location and maintenance of all street furniture items are achieved.
- Ensure that all street furniture is stable, safe, clean and fit for use.

All furniture shall be installed plumb and level unless specified otherwise, and shall be appropriately bolted and fixed according to the manufacturer's specifications. If fixing instructions are not available, the Service Provider shall confirm with structural consultants for the appropriate fixing methods in consultation with the City's Representative. All fixings, conduits, connections and foundations shall be concealed and vandal resistant.

The Service Provider shall complete all paving works surrounding the furniture installed, as required, including tactile pavers where specified.

7.5.2 SPECIFIC REQUIREMENTS

7.5.2.1 JC DECAUX

The Service Provider shall liaise with the City's Representative to coordinate the provision and supply of the furniture items. The Service Provider shall ensure that sufficient notice is given considering long-lead items, in order to ensure the items are available and ready to be installed. JC Decaux must be given a minimum of two months' notice of the order. The installation of all JC Decaux furniture is to be coordinated by the Service Provider.

The Service Provider is to refer to the JC Decaux standard drawings and jig set-up procedure.

The supply and installation shall be completed by JC Decaux, unless specified and approved otherwise by the City's Representative. Installation shall include the following activities:

- Construction of footings
- Fixing furniture
- Supply and connection of electrical service
- Supply and connection of communication service
- Final commissioning.

It is the Service Provider's responsibility to ensure that the construction works do not compromise JC Decaux's installation of the furniture. In any such instance, the Service Provider will be directed to rectify the matter at their own cost. The Service Provider shall provide safe access to the works site for the supplier, and coordinate their activities to meet the completion date.

7.5.2.2 TELSTRA

The Service Provider shall liaise directly with Telstra to coordinate the provision and supply of the furniture items. The Service Provider shall ensure that sufficient notice is given considering long-lead items, in order to ensure the items are available and ready to be installed. Telstra must be given a minimum of three (3) months' notice of the order. The installation of all Telstra furniture is to be coordinated by the Service Provider.

The Service Provider is to refer to the Telstra standard drawings and jig set-up procedure.

The supply and installation shall be completed by Telstra, unless specified and approved otherwise by the City's Representative. Installation shall include the following activities:

- Construction of footings
- Fixing furniture
- Supply and connection of electrical service
- Supply and connection of communication service
- Final commissioning.

It is the Service Provider's responsibility to ensure that the construction works do not compromise Telstra's installation of the furniture. In any such instance, the Service Provider will be directed to rectify the matter at their cost. The Service Provider shall provide safe access to the works site for the supplier, and coordinate their activities to meet the completion date.

7.5.2.3 PARKING METERS

The Service Provider shall consult with the City's Parking Services Contract Coordinator for the installation requirements of all parking meters to the approval of the City's Representative.

7.5.2.4 BICYCLE SECURITY RINGS

Refer to the City's Bicycle Parking Installation Manual – Incidental and Low Capacity Parking 'O' rings and 'U' rails.

7.6 QUALITY

7.61 INSPECTIONS

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

7.6.1.1 HOLD AND WITNESS POINTS

1. Process Held	Setout and approval of all furniture locations (marked on site), prior to fixing. (Section 7.5.1)
Submission Details	At least two (2) days before the new kerb 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 footings (Section 7.5.1)
Submission Details	At least two (2) working days prior to compaction of subgrade.
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	Erection of formwork and reinforcement for footings (Section 7.5.1)
Submission Details	At least two (2) working days prior to placing formwork.
Release of Hold Point	The City's Representative will inspect the formwork and reinforcement prior to authorising the release of the Witness Point unless advised otherwise.

4. Process Held	Subgrade and base preparation to finish levels (Section 7.5.1)
Submission Details	At least two (2) working days prior to preparing subgrade.
Release of Hold Point	The City's Representative will inspect the finished levels, prior to authorising the release of the Hold Point.
5. Process Held	Fixing of furniture (Section 7.5.1)
Submission Details	At least two (2) working days prior to fixing
Release of Hold Point	The City's Representative will inspect prior to authorising the release of the Witness Point unless advised otherwise

B8
Street Lighting Construction

Contents

B8 STREET LIGHTING CONSTRUCTION

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B8 STREET LIGHTING CONSTRUCTION

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B8 STREET LIGHTING CONSTRUCTION

8.1 SCOPE

This Technical Specification sets out the requirements for the provision of the City's street lighting, conduits for RMS traffic control and telecommunications cables.

The City provides street lighting within many city streets over and above those provided by the electricity authority Ausgrid. This Technical Specification only relates to those street lights that are under the direct control of the City.

8.2 STANDARDS AND GUIDELINES

Unless stated otherwise in the Technical Specification, the approved drawings or elsewhere in the construction documents, all work 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 work.

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

- AS1158 Lighting for roads and public spaces, Parts 1 to 6
- Sydney Light Design Code City of Sydney Public Domain Design Codes
- RMS QA Specification R151 Street Lighting
- AS 1049 Telecommunications cables – Insulation and sheath – Polyethylene
- AS 1052 Electromagnetic interference measuring equipment. Part 2 – Equipment for the frequency range of .015 MHz to 1000 MHz
- AS 1822 Earth and bonding clamps
- AS 3000 SAA wiring rules
- AS 3080 Integrated communications cabling systems for commercial premises
- AS 3108 Approval and test specification – Isolating transformers and safety isolating transformers
- AS 3439 Low-voltage switchgear and controller assemblies
- AS 3702 Diagrams, charts and tables for electro-technology
- AS/NZS 3000 SAA Wiring Rules
- AS 6059 Degrees of protection provided by enclosures for electrical equipment
- The service and installation rules Electricity Association of NSW
- Ausgrid local service and installation rules
- RMS Standard Installation Details.
- Ausgrid Network Standards:
    - NS 156 Working near or around underground cables
    - NS 130 Specification for laying of underground Cables up to 22Kv
    - NS 172 Design Requirements for cable jointing pits and vaults
- IEEE C62.41.2 Recommended Practise on Characterisation of Surges in Low Voltage AC Power Circuits
- IES LM-79 Electrical and Photometric Measurements of Solid State Lighting Products
- IES LM-80 Measuring Lumen Maintenance of LED Light Sources
- IEC 62612 Self-Ballasted LED Lamps for general Lighting services Performance Requirements.

8.3 MATERIAL

8.3.1 LIGHTS, POLES AND MASTS

The procurement of poles and luminaries shall be by the following arrangements:

Item	Procured By
Smartpole	May be procured by the City or Service Provider on a site-by-site basis.
Smartpole furniture	May be procured by the City or Service Provider on a site-by-site basis.
Other street lights	May be procured by the City or Service Provider on a site-by-site basis.
Pedestrian light poles	May be procured by the City or Service Provider on a site-by-site basis.
Floodlights	May be procured by the City or Service Provider on a site-by-site basis.

All redundant light poles shall be removed by the Service Provider and deposited to Ausgrid's or the City's storage as required in a manner that is ethical, efficient, and where practicable maximises a value outcome for the City.

The Service Provider is to prioritise re-use and recycling ahead of disposal to landfill, which is considered an undesirable outcome. The Service Provider must remove all City of Sydney visual identifiers such as logos and labels from any unwanted items before disposing of items.

8.3.2 DUCTS

Ducts and bends shall be coloured, heavy-duty rigid uPVC pipes in accordance with the requirements of *AS3000 Wiring Rules* and as shown in the street lighting details drawings.

Conduits and conduit fittings for all cabling must be category A orange heavy duty rigid uPVC manufactured in accordance with *AS/NZS 2053 Conduits and fittings for electrical installations* and with solvent welded joints. All the conduits must be of the sizes shown on the drawings.

Conduits shall:

- Be installed using the loop in and loop out system
- Be free from conduit fittings other than junction boxes, wall boxes, bends or couplings.

Be of a minimum diameter as noted on the drawings; oval conduits are unacceptable.

- Be provided with a 3mm diameter minimum nylon cord where specified for future wiring or wiring for other trades
- Comply with relevant sections of *AS/NZS 2053 Conduits and fittings for electrical installations.*

Flexible conduits shall:

- Be heavy duty uPVC (note: approved alternative materials are encouraged with lower energy impact, greater recycled content and easier recycling at end of life)
- Be provided between fixed conduit and equipment which is likely to be moved or subject to vibration
- Be fitted with brass or nylon terminators
- Be connected to a concealed fixed conduit via a flush mounted junction box with a terminator secured by locknuts to the cover plate
- Not be used in concrete walls or slabs unless otherwise approved by the City's Representative.

Conduit for underground wiring shall:

- Comprise heavy duty rigid uPVC conduit
- Be fitted with corrosion resistant fittings
- Be installed over approved routes.

8.3.3 PITS

In-fill lids are to be used for pits in granite footways.

Cable pits must be Australian Power Products or approved equivalent injection moulded plastic with reinforced concrete lids. The pit lids are to be labelled using stainless steel disc – 75mm "COS-Electrical" engraved – epoxied onto brick or paver or pit lid wherever applicable.

Pits installed on the pathways shall be of Class C infill PIT Lid and on the roads shall be of Class D Infill PIT lid.

8.3.4 ELECTRICAL CABLING

Light poles shall be connected to City of Sydney circuits originating from the main switchboard.

Main cables shall be a minimum of 16 sq.mm 4C+E XLPE. Refer to the street lighting single line diagram drawing for required cable sizes. The cable manufacturer shall be Olex or the equivalent.

All the cables from the base of the pole to the light fixtures shall be 2C+E 2.5 sg.mm PVC/PVC.

Separate electrical circuits shall be provided for power outlets in Smartpoles. All the cables for power outlets shall be minimum of 16 sq.mm 2C+E XLPE cable.

All cables shall:

- Be installed over routes which have been fully coordinated with other services
- Follow the basic routes as indicated on the street lighting plan drawings or as described herein
- Be identified at each end by approved labels, fixed to cable sheaths or conduit, and identifying the cable size, type and purpose.

8.3.5 MAIN SWITCHBOARDS (MSB)

MSB assemblies shall be:

- From an approved manufacturer as detailed further in this Technical Specification; City of Sydney Standard MSB (single phase/three phase) drawings shall be refereed for overall dimensions and details
- Designed to facilitate easy access to and removal of component parts and to facilitate the undertaking of a thermograph survey of all joints and terminations without the need to isolate any parts or circuits
- Constructed and with containing equipment to the approval of the local Electricity Distributor and Electricity Retailer
- Made to incorporate main protective devices with fusing or tripping characteristics which are coordinated with other protection devices of the Electricity Distributor and other protective devices on the line and load sides of the device.
- All assemblies shall comply with the requirements of *AS 3439.1 Low-voltage Switchgear and Controller Assemblies*, and the additional requirements of this Technical Specification.
- Certified type-tested components shall be used in the construction of all switchboards.

The installed position of assemblies shall allow adequate access for operation and maintenance when doors are open or equipment is in the 'operate' or 'test' position.

8.3.5.1 DIVERSITY FACTORS

Each individual circuit and busbar system shall be capable of carrying its full rated current as nominated.

Where busbar ratings are not nominated, the rated diversity factor of each assembly shall be in accordance with Table 1 in Clause 4.7 of *AS 3439.1 Low-voltage Switchgear and Controller Assemblies* with all spaces filled by circuits rated at 90 per cent of the aggregate of the maximum space ratings.

Assumed currents as noted on the drawings shall be used for temperature rise tests without further diversity factors.

8.3.5.2 FORMS OF SEGREGATION

The form of segregation for each assembly shall be as noted on the drawings.

8.3.5.3 PROSPECTIVE SHORT CIRCUIT CURRENT

The short circuit protection and short circuit strength of each assembly shall be suitable to withstand the thermal and dynamic stresses of the short circuit capacity specified herein.

Unless stated otherwise, a minimum 25 kA shall be adopted.

The main switchboard shall be designed to withstand a prospective fault level not less than the level at the point of supply or a higher level as specified herein. The assembly shall be detailed to withstand this short circuit strength for the period indicated without damage and shall do so without the inclusion of current protection devices.

8.3.5.4 DEGREE OF PROTECTION

A degree of protection shall be provided in accordance with *AS 1939 Degrees of protection provided by enclosures for electrical equipment* for switchboard assemblies and externally located assemblies at IP66.

Cable entries into switchboards shall not void the specified degree of protection.

8.3.5.5 TESTS

Routine tests of all assemblies shall be provided as required by *AS 3439.1 - Low-voltage Switchgear and Controller Assemblies,* and certified test results issued to the City's Representative prior to delivery.

Where assemblies incorporate components that are not type tested or partially type tested as defined in *AS 3439.1 Low-voltage Switchgear and Controller Assemblies;* the method of construction shall be type tested in accordance with the requirements of *AS 3439.1 Low-voltage Switchgear and Controller Assemblies.* Components used for type testing shall not be used in the construction of the assembly.

Partially type-tested arrangements may be derived by calculation as permitted *by AS 3439.1 Low-voltage Switchgear and Controller Assemblies.*

All assemblies shall be fully in accordance with Type Test Certificate, recognised by the relevant testing authority for temperature rise and short circuit withstand, to Australian Standard certifying compliance of construction and all equipment (including circuit breakers and busbars).

Type Test Certification for verification of short circuit requires withstand strength for all sections of busbars to be unconditional. No advantage shall be taken of short circuit protective devices in the assembly.

Temperature rise testing shall be carried out by an approved independently registered testing facility prior to delivery. Where mobile independently registered test facilities are available, testing may be carried out at the manufacturer's factory.

The proof of performance and verification that the assemblies comply with the Type Test requirements specified shall include, as minimum requirements:

- Verification by relevant NATA Type Test Certification to *AS 3439.1 Low-voltage Switchgear and Controller Assemblies* for short circuit withstand and temperature rise
- The provision of acceptable Type Test Certification and all the completed associated test data, which shall be NATA-endorsed for Type Tests to *AS 3439.1 Low-voltage Switchgear and Controller Assemblies* and which indicate that all parts of the assemblies do not exceed the limits of the values, as specified herein.

Type Test Certificate documentary evidence from a recognised NATA testing authority shall be submitted certifying that previous successful type in accordance with *AS 3439.1 Low-voltage Switchgear and Controller Assemblies,* and as specified have been carried out on switchgear and busbars of applicable assemblies for short circuit withstand and temperature rise and have successfully withstood the fault currents specified herein for the time specified.

All tests, as specified herein, shall have been carried out by a Testing Authority which holds a NATA accreditation certificate to carry out the testing, including a current accreditation certificate for quality assurance.

The type test characteristic values shall be the values specified for assemblies. The type test characteristic values specified are the minimum requirements that shall have been obtained for previous testing.

However, values that exceed the minimum requirements may be offered, but these higher values shall be subject to approval by the City's Representative.

8.3.5.6 DISCRIMINATION OF SWITCHGEAR

All switchgear shall be selected to provide discrimination between upstream and downstream devices (devices include circuit breakers and fuses). In general, discrimination shall be arranged so that in the event of a fault, only that switchgear immediately upstream of the fault shall operate to clear the fault. Switchgear manufacturers' proprietary interlock tripping systems shall be used to achieve discrimination where required.

All details of protection settings shall be submitted with shop drawings demonstrating the discrimination of selected devices, commencing from Ausgrid protective devices and/or alternate supply (generator) paths and finishing at final sub-circuit protection devices.

Final settings of all adjustable protective devices, and plotted curves demonstrating discrimination of devices, shall be provided within the operation and maintenance manual.

8.3.5.7 SERVICE CONDITIONS

The service conditions for all switchboards shall be as noted in *AS 3439.1 Low-voltage Switchgear and Controller Assemblies.*

A pollution degree of three (3) shall apply.

8.3.5.8 SWITCHBOARD DRAWINGS

Shop drawings of switchboard/assemblies shall be submitted that incorporate metered/unmetered conductors and/or Ausgrid equipment for their acceptance prior to approval submission.

Shop drawings and as-built drawings shall be in the approved pdf and/or Autocad format and show the following information:

- Manufacturer's name and type of any standard equipment
- The general arrangement of equipment
- Full details of cabinet construction and dimensions
- The method of supporting busbars and equipment
- A description of all materials to be used
- Clearances between live parts, and live parts and earth
- Busbar dimensions and ratings
- Internal wiring sizes and ratings
- The size and wording of labels
- Wiring diagrams and schematics of instrument protection and control circuits
- Front elevation
- Vertical section through each compartment
- Sheet metal details
- Finishing process details
- Weights of assemblies heavier than 500 kilograms
- Calculations where PTTA assemblies are being adopted
- Calculations verifying the maximum internal temperature ratings will not be exceeded

- Details of:
  - Compliance with *AS 3439.1 Low-voltage Switchgear and Controller Assemblies*
  - Maximum fault withstand ability
  - IP rating to *AS 1939 Degrees of protection provided by enclosures for electrical equipment*

8.3.5.9 MANUFACTURE

Assemblies shall be manufactured by an approved firm. The following manufacturers are currently approved by the City:

- KE Brown
- Relec
- Fuji SMBE Harwal Pty. Ltd.

8.3.5.10 CABINET CONSTRUCTION

This section shall only apply to the switchboard. Refer to Section 8.3.5.12 Switchboard Enclosures for overall enclosure details.

Cabinets shall have:

- 2mm sheet steel construction fitted with doors attached with lift-off pintle hinges. Where approved, small enclosures with all dimensions less than 450mm may be fabricated from 1.6mm thick sheet steel
- Edges concealed by folding
- Fully welded ground external joints
- Suitable means of securing the complete assembly to the building structure
- A separate compartment for Electricity Distributor equipment, where required, incorporating a means of fitting the Electricity Retailer's seals
- Flush fronted type with only toggles, handles, indicators, dials and like equipment for operational use protruding through the front panel
- Single core cables arranged such that they do not pass through individual holes in ferrous metal enabling eddy currents to be established
- Sets of cabling for incoming or outgoing circuits grouped together to minimise the magnetic field strength generated
- Outgoing cables arranged so they do not pass through busbar chambers
- A maximum height of 1800mm
- Adequate space for outgoing wiring, with consideration for the types of cables entering and leaving the assembly
- Cable entries and/or gland plates, sized to suit the cables and installation requirements
- Gland plates of insulating material unless required to be brass for mineral insulated metal sheathing (MIMS) cabling
- Sealed cut outs for busbar and cabling installation where cabinets are extendable
- Natural ventilation by means of louvered vents in the upper and lower sections, backed with fine bronze wire mesh for switchboards larger than 0.3 m^3 in volume. All vent locations shall encourage natural ventilation to limit temperature rise within the ambient conditions.

Assemblies exposed to weather or where situated in adverse environments shall contain:

- Thermostatically controlled anti-condensation heaters of fixed resistor type
- A ventilated cavity space at the top of assemblies to prevent condensation accumulating on the inside
- Note: approved alternative solutions such as improved ventilation are encouraged to lower energy impact.

Freestanding cubicle type assemblies shall have:

- Adjacent cubicles bolted together to provide a rigid structure

- A supporting base frame formed from 75mm galvanised channel sections
- Removable lifting eyebolts or equivalent facilities
- Rear access to each section by means of lift-off panels
- Sheet metal segregation barriers enabling arc fault containment between adjacent compartments or cubicles where required to suit the form of construction
- Sufficient cabling space at the rear for cables entering from above or below with vertical cable fixing inserts for cable anchorage
- Explosion vents at the top of each segregated compartment.

Floor-mounted assemblies shall have:

- An open base and a wiring compartment with a cover panel for access to cables and/or conduits that pass through the base of wall/floor mounted assemblies
- A full complement of conduit knockouts in a removable cover plate at the top and bottom of the enclosure
- Front access only with cable fixing inserts for cable anchorage for cables rated over 100A.

Doors shall:

- Be fabricated from 2mm minimum folded sheet steel
- Have a heavy duty tumbler type lock complete with two keys per cabinet which are common to all switchboard locks installed. A standard lock coding shall be adopted
- Be secured in the closed position by means of a minimum of two (2) large diameter, captive, knurled, cylindrical head screws for doors providing access to busbar and wiring components only
- Have folded metal stiffeners and bracing to achieve rigidity and prevent warping or sagging
- Have flush mounted escutcheons for recessed switchboard enclosures
- Have chromium-plated lift-off pintle type hinges
- Have latching bars on doors larger than one (1) metre high
- Have suitable lifting handles on doors larger than one (1) metre high
- Have compressible neoprene gaskets contained within a metal channel
- Be sized so that the weight of any door does not exceed 20 kilograms
- Be fitted with circuit schedules on the inside of the door for fuse and circuit breaker distribution switchboards which shall be typewritten and placed in transparent non-flammable pockets. Refer also to Section 8.3.5.18 Labelling of this Technical Specification.
- Be fitted with braided earthing straps in instances where equipment is fitted to doors.

Removable panels, escutcheons and cover plates shall:

- Be fabricated from a minimum 2mm folded sheet steel
- Be no larger than one (1) metre in height or width, and in no case exceed 0.6m^2 in area
- Be provided with two polycarbonate lifting handles
- Be secured with large head chromium-plated screws with larger diameter nylon washers for panels sized 0.2 m^2 and smaller
- Incorporate cut outs which:
    - Expose only toggles, handles, indicators, dials and similar items
    - Are adequately stiffened where long cut outs are provided for equipment groups.
- Allow multipole circuit breakers to be replaced with three (3) single pole breakers without requiring extra fill in sections containing proprietary plastic inserts or painted metal covers over unused openings
- Be provided with locating pins or hangers on the switchboard able to retain the panel in place when all fixings are released.

8.3.5.11 FINISHES

Ferrous metal shall:

- Be cleaned free from rust, corrosion, grease and scale
- Have rough surfaces filled and rubbed smooth
- Be finished with an electrostatically applied polyester thermoset powder coat oven-baked finish to give a minimum thickness of 0.07mm. As an alternative and where approved be painted using at least one (1) coat of rust-inhibiting self-etching primer, an undercoat of zinc-enriched paint and two (2) coats of gloss enamel.

The enclosure shall have:

- Surfaces finished in a colour selected by the City's Representative
- The interior finished in gloss white colour
- Internal mounting and gear trays finished in gloss white colour.

The Service Provider shall retouch minor chips or blemishes on site to the satisfaction of the City's Representative.

Ripple paint finishes will not be accepted.

The Service Provider shall submit a painted colour sample, approximately 300mm x 300mm for approval prior to painting.

Non-ferrous parts shall be passivated zinc-plated or tinned.

External handles, bolt heads, catches, locks, nuts and screws shall be stainless steel or chromium plated.

8.3.5.12 SWITCHBOARD ENCLOSURES

The complete switchboard shall be capable of being exposed to the weather with a minimum IP rating as previously noted.

For switchboard ventilation, approved alternative solutions are encouraged to lower energy impact.

Main switchboard

The main switchboard enclosure shall be a powder-coated colour: Storm Front Pearl by Dulux (subject to confirmation – Service Provider shall request from the City's Representative the colour four (4) weeks prior to the actual colour being required).

Refer to Council Main Switchboard General Arrangement: Elevation in Street Lighting Details drawing for the size of the main switchboard enclosure.

The main switchboard shall have two (2) compartments, one on top of the other. One compartment shall be assigned for meters and all Ausgrid-required equipment, and the second compartment shall contain all switch and control equipment for the City of Sydney.

The doors shall be fully lockable to prevent access by unauthorised people. The meter compartment shall be locked with a key to suit Ausgrid requirements. The City of Sydney compartment shall be locked with a key to suit City of Sydney asset requirements. The Service Provider shall request the type of key arrangement required from the City's Representative two (2) weeks prior to requiring such information.

The main switchboard shall be mounted on a concrete plinth. Refer to Council Main Switchboard General Arrangement: Elevation in Street Lighting Details drawing.

The panels will have logo plates (250mm x 150mm) with the necessary details to be confirmed with the City's Representative.

8.3.5.13 BUSBARS

Internal busbars shall:

- Comply with *AS/NZS 3439.2 Low-voltage Switchgear and Controller Assemblies*
- Be derated for the density of the conductor and for the temperature within the enclosure
- Be manufactured from high conductivity hard-drawn copper bar with radius edges
- The current rating of main busbars shall not be less than the current rating in the Single Line Diagram drawings. The main busbars shall have a diversity rating of one (1) for the current rating.
- Be of minimum size 25mm x 4mm except for tee offs to miniature circuit breakers
- Be arranged for miniature circuit breakers so that a multipole circuit breaker can be replaced with single pole breakers without disturbing the three-phase busbar assembly
- Have neutral busbars of the same current rating and size as the phase busbars
- Have neutral busbars installed with the phase busbars to reduce eddy current heating of adjacent ferrous materials
- Be provided for all connections carrying 100A or above
- Be arranged so that all joints, terminations and fixings are fully accessible
- Be disposed and supported so that under short-circuit conditions no busbar material is stressed to more than 25 per cent of its breaking load or 33 per cent of its elastic limit, whichever is the lesser, for a one-second fault current
- Have fully lapped joints finished, coated with acid-free petroleum jelly and bolted together with passivated zinc-plated steel bolts, washers, nuts and locknuts
- Be arranged for future extensions to adjacent assemblies where required
- Have a removable section where mounting current transformers so that transformers may be removed or replaced without disturbing the remainder of the assembly
- Be supported on synthetic resin-moulded type insulators, panels and cleats. Bobbin insulators secured through the busbar are not acceptable
- Have insulation with shrink on PVC phase identification on busbar sections rated over 200 amps. Should PVC sleeving be adopted for insulation purposes, a minimum of two (2) layers shall be used meeting a 1mm overall wall thickness
- Have busbar joints insulated with removable insulation fixed with ties of synthetic material suitable for 120°C applications and arranged so that the insulation is in permanent contact with the busbars and bolts
- Be identified as follows:
    - A phase – Red
    - B phase – White
    - C phase – Blue
    - Neutral – Black.
- Have PVC-dipped insulation, two coats, for three-phase busbar assemblies rated up to 250 amps for connection to miniature circuit breakers.

8.3.5.14 INTERNAL WIRING

All instrument, indicator and control wiring shall:

- Be of stranded copper conductors, minimum size 1.0mm^2 V75 grade 0.6/1 kV PVC insulated
- Be supported on the square grid form using approved ducting and channels for groups of cables and approved plastic clips for single circuits. Adhesive type cable clips shall not be used.
- Be identified using an engraved or moulded thimble suitably and securely fixed to the wire adjacent each terminal connection of the wire
- Be connected to a minimum approved 30A rating terminal blocks of moulded insulating material which are labelled and numbered for the termination of all external wiring and to be terminated using approved crimping lugs
- Comprise flexible conductors where connected to equipment mounted on doors or in positions subject to movement.

All other interconnection wiring not of copper bar shall:

- Be made with copper conductors sized for 120 per cent of the calculated demand
- Be installed having consideration to short-circuit capacity
- Employ full-section neutral conductors.

All wiring terminal blocks shall be screw type. Insulation displacement terminals are not acceptable.

8.3.5.15 CABLE TERMINATIONS

All terminals shall be of adequate size to accommodate the cable sizes specified irrespective of the rating of the switchgear.

Busbar stub connections shall be provided on terminals for cables rated at 100A and above suitable for the connection of bolted cable lugs.

- All termination connections shall be fully accessible for inspection and servicing, and identified as nominated within *AS 3439.1 Low-voltage Switchgear and Controller Assemblies.*

8.3.5.16 LINKS

Links for terminating neutral and earthing connections shall be:

- brass or copper and square or rectangular
- Provided with the same number of terminals as there are active poles and numbered to correspond
- Be fitted with tunnel type terminals for cables up to 6mm^2 and stud type terminals to accept cable lugs for other cables
- Installed over the full length of multi-compartment switchboards and be fully accessible.

8.3.5.17 HARDWARE

All bolts, screws and nuts shall:

- Have metric threads conforming to *AS 1275 Metric Screw Threads for Fastners*
- Have hexagonal-shaped heads
- Be non-ferrous metal, or alternatively passivated zinc-plated
- Be fitted with flat and spring washers
- Be chromium-plated where exposed to view.

Self-tapping screws and pop rivets will not be accepted.

Non-metallic bolts and screws may only be used to secure internal non-metallic segregation barriers.

8.3.5.18 LABELLING

Shop drawings of the labels shall be provided, approved and agreed by all prior to installation.

Shop drawing labels shall:

- Be adjacent every item on the front of the assembly
- Indicate the position of equipment which is concealed from view behind panels and doors
- Indicate the function of main controls, submain controls, relays, fault current limiters, links, contactors, relays, starters and switches
- Indicate the current rating of fuses for fault current limiters and the equipment protected by the fault current limiter
- Indicate the settings of adjustable tripping characteristics of circuit breakers

- Be positioned on the rear of main controls and submain controls of back connected assemblies so that the control can be identified from the rear
- Identify in the form of a numeral for each single pole of sub-circuit controls, including each pole of multi-pole controls
- Be located on each assembly and indicate:
- The assembly reference number as directed
- Supply mains, number, size and type
- The origin of supply mains
- The designed prospective fault level applicable
- Other requirements as indicated in *AS 3439.1 Low-voltage Switchgear and Controlgear Assemblies.*
- Be fixed onto the cover plate in front of fault current limiters which are mounted behind the cover plate and displaying the wording 'Fault Current Limiters Behind Panel'
- Indicate 'on/off' and other positions of all controls, switches, isolators and circuit breakers unless clearly indicated on the equipment
- Be fixed in position and indicate the circuit number and maximum rating where provision is made for the mounting of future equipment
- Indicate the purpose of the circuit breaker for sub-circuit circuit breakers to which frequent access is required for switching and testing purposes, e.g. light circuits, security lights and emergency lights.

Labels shall be arranged so that they can be readily replaced by fixing with a minimum of two (2) chromium-plated or stainless-steel screws, secured by spring washers or nuts or by drilling and tapping sheet metal. Self-tapping screws are not acceptable. Lettering shall be a minimum of 8mm high.

A line diagram of all connections and controls shall be mounted in a clear acrylic windowed frame located adjacent or on the rear of distribution switchboard doors.

Provide a label fixed to the front of the main switchboard indicating:

- The switchboard manufacturer
- Designed service conditions
- Weight
- Safety instructions, where applicable
- All information required by *AS 3439 Low-voltage Switchgear and Controlgear Assemblies.*
- Shop drawings of enclosure door labels shall be provided, approved and agreed by all parties prior to installation. The enclosure doors shall have white Traffolyte labels with black uppercase 10mm high lettering as per the following:

Enclosure	Text
Main Switchboard (Meter Compartment)	ENERGY AUTHORITY METER ENCLOSURE
Main Switchboard (City of Sydney Compartment)	CITY OF SYDNEY (INSERT SITE-SPECIFIC LOCATION)
Main Switchboard (Meter Compartment)	ENERGY AUTHORITY METER ENCLOSURE
Main Switchboard (City of Sydney Compartment)	CITY OF SYDNEY (INSERT SITE-SPECIFIC LOCATION)

8.3.5.19 EQUIPMENT

The requirements of these sub-sections, where appropriate, shall also apply to switchgear and control components mounted remote from an assembly.

8.3.5.20 CIRCUIT BREAKERS

Miniature circuit breakers shall incorporate the following features:

- Arc interrupting device
- Inverse time current characteristic
- Trip to operate when breaker is locked on
- Thermal and magnetic tripping mechanism
- Non-welding contacts
- Compliance with *AS 3111 Approval and Test Specification*
- Be interchangeable for single and multi-pole units used on final sub-circuits
- Have an interrupting capacity adequate for the maximum prospective fault current to which they may be subjected, and not less than 10 kA
- Incorporate similar features and uniformity of style regardless of frame size and rating.

Moulded case circuit breakers shall:

- Incorporate similar features as listed for miniature circuit breakers and be of the same manufacturer
- Be fitted with operating toggle extensions to limit the force required to operate
- Be labelled to indicate the trip unit model and settings where the trip unit is not clearly visible
- Comply with *AS 2184 Low Voltage Switch Gear.*

8.3.5.21 HRC FUSES

HRC fuse carriers and bases shall:

- Comply with *AS/NZS 60269 Low-voltage fuses general requirement*s
- Have a moulded plastic insulated fuse carrier of sufficient depth to prevent inadvertent contact with live parts
- Have a fuse indicator which is visible without the need to remove the fuse
- Have fully shrouded base contacts
- Be of BS88 style equal to GEC Redspot manufacture unless otherwise approved.

8.3.5.22 HRC FUSE CARTRIDGES

HRC fuse cartridges shall:

- Be class G for general purpose in accordance with *AS/NZS 60269 Low-voltage fuses general requirements*
- Be GEC Type T.

Three (3) spare HRC fuse cartridges of each rating and type used, including fault current limiting fuses, regardless of whether they are incorporated within a circuit breaker or not, shall be provided on a labelled panel adjacent to each switchboard or within a spares compartment of the switchboard.

8.3.5.23 SWITCHES AND ISOLATORS

All switches and isolators shall:

- Comply with *AS/NZS 3947.3 Low-voltage switchgear and controlgear switches and AS 3133 Approval and test specification – Air-break switches*
- Be rated for AC-23 utilisation category
- Be fault make and load break rated
- Be spring-assisted manual closing
- Be suitable for the prospective fault current specified in this Technical Specification
- Have double make and break contacts
- Include a mechanical on and off visual indicator linked directly to the main contact movement.

8.3.5.24 AUXILIARY AND CONTROL SWITCHES

Auxiliary and control switches less than 100A rating shall:

- Comply with *AS 3133 Approval and test specification – Air-break switches*
- Have contacts of minimum 10A continuous rating
- Be rotary snap action type
- Be of Kraus & Naimer manufacture, or an approved equivalent.

8.3.5.25 CONTACTORS

Contactors shall:

- Comply with *AS/NZS 3947.1 and 4 Low-voltage switchgear and controlgear switches* as appropriate
- Be suitable for AC3 utilisation category with Type 2 coordination duty
- Have IP20 protection to *AS 1939 Degrees of protection provided by enclosures for electrical equipment*
- Be rated for operation at 60°C
- Have a minimum current rating of that specified for the protective device immediately preceding where no rating is specified
- Be suitable for uninterrupted duty
- Be capable of withstanding the let through current of the protection device preceding it to ensure Type 2 protection
- Be of the block type
- Be of Sprecher + Schuh manufacture or approved equivalent, consistent and tested with circuit breakers
- Have renewable type main contacts, auxiliary contacts and operating coils
- Contain at least one spare set of normally open and closed contacts.

8.3.5.26 SURGE DIVERTERS

Suitable surge diverters shall be provided on each phase of the main switchboard incorporating the following features:

- Capable of withstanding surges to *ANSI C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage* Categories A, B and C
- Rated to 70kA
- Transverse and common mode protection
- Fitted with local indication visible on the front of the switchboard
- Fitted with voltage-free contacts for transmission of remote alarm
- Independent certification of performance.

A transient voltage surge suppression system shall be provided in accordance with Standards UL 1449 and UL 1283 on the inputs of consumers' mains to the main switchboard.

The system operating conditions shall be 400 VAC, 50 Hz, three-phase, neutral and earth.

Each system shall incorporate 70 kA transient voltage surge suppressors between each phase and earth, each phase and neutral, and neutral and earth.

The whole system shall be duty lifecycle tested to survive 10,000 surges at 20 kV, 10 kA, IEEE C62.41 Category C3 surge current with less than 5% degradation of clamping voltage.

All surge suppressors to provide external system monitoring for faults via voltage-free contacts.

8.3.5.27 MOUNTING OF EQUIPMENT

All equipment shall be mounted:

- Within the assembly cabinet with only toggles, indicators, handles and dials protruding
- On fixing rails or insulating panels
- To not rely on busbars for support
- To enable easy access for adjustment, replacement or maintenance
- So that arc discharges during faults are not directed towards live metal or insulating medium.

Equipment that is intended for future installation shall have mountings, studs, busbar connections and escutcheon openings provided with painted blanking covers.

Equipment shall be installed so that a unit can be simply replaced without disturbing adjacent units.

Circuit breakers rated above 100A shall:

- Be arranged for back connection where installed within free-standing cubicle type switchboards
- Be arranged for front connection where installed within wall-mounted switchboards
- Be installed with the supply connected to the top terminals where mounted vertically
- Be arranged so that the toggles operate in a vertical direction with all on and off positions in the same direction unless otherwise approved
- Be mounted so that the operating toggles of adjacent circuit breakers are in straight alignment
- Be provided with a 75mm air gap between circuit breakers rated up to 200 amps or a 100mm air gap for circuit breakers rated above 200 amps where more than two (2) circuit breakers are mounted adjacent each other
- Not be horizontally mounted in vertical stacks in common compartments where moulded case circuit breakers are used.

Miniature circuit breakers shall be:

- Secured by separate clip in type fixings as provided by the circuit breaker manufacturer
- Mounted on a lift-out chassis assembly
- Mounted so that the toggle operation to the on position is upwards for all vertically mounted breakers
- Separately mounted at the top of the switchboard where used as a main switch/isolator.

HRC fuses for fault current limiters shall not project through the cover plates.

Time switches shall be mounted so that they are accessible for adjustment without the need to remove switchboard covers.

Equipment which has a liquid crystal display (LCD) shall be mounted at a suitable height to enable clear reading of the instrument display and within 700mm to 1600mm above floor level.

All isolating switches and circuit breakers shall be mounted so that any interlock preventing the opening of the door when the equipment is on is defeatable for maintenance access (thermo-scanning or similar).

8.3.5.28 INSTALLATION OF SWITCHBOARDS

All switchboards shall be secured in position with masonry anchors and screws or bolts.

Cubicle-type switchboards shall be levelled with approved packing.

Entry holes into switchboard enclosures shall be cut only by means of hole saw or machine punching. Flame equipment for making entry holes is not acceptable.

The Service Provider shall provide a location plan of the main switchboard comprising a floor plan diagram on a photo-sensitive anodised aluminium sheet 0.8mm thick with black lining on a matte silver background and mounted at the fire indicator panel or other location as directed.

8.3.5.29 TESTING AND COMMISSIONING

8.3.5.29.1 FACTORY TESTING

The main switchboard shall be tested in accordance with the applicable parts of *AS 3439 Low-voltage Switchgear and Controlgear* Assemblies. All instrumentation and control functions shall be tested to prove their correct operation. The set points for adjustable devices, such as sensing relays, shall be recorded on test results and additionally marked within the switchboard, with adjustment points sealed to prevent movement and unauthorised tampering. Calibrated instruments shall be used for all tests.

Results of all tests including dielectric strength, and the instruments used to conduct tests, shall be recorded and a copy provided within the operation and maintenance manual. Where initial tests are unsuccessful, the results of these tests together with the corrective measures taken shall also be provided. All test results shall be signed and dated.

Upon completion of factory fabrication of the main switchboard and inspections by Authorities, where required, and prior to the switchboard being shipped to the site, pre-delivery inspections of the switchboard at the factory shall be arranged.

Proposed commissioning test schedules and protocols shall be submitted for approval by the City's Representative in conjunction with shop drawings. Protocols shall be fully detailed and include, but not be limited to, schedules in tabulated format covering:

- Proposed calibrated and where permissible non-calibrated instruments to be used and the tests for which each shall be used
- Functioning of all switch gear to confirm correct and uninhibited operations over all phases
- Injection tests for all meters with 0%, 50% and 100% of full-scale readings
- Set points for all adjustable devices such as sensing relays, timers and the like
- Space on each page for signature and date of witness tests.

Factory testing of controls shall be accomplished using a purpose-made and labelled test panel with all required inputs simulated by the operation of switches, and all required outputs indicated by lamps, or an equal arrangement as approved.

Factory testing shall include the demonstration of monitoring systems specified as part of this contract, in conjunction with metering, controls and function-testing detailed above.

Once testing has been completed, factory test results shall be verified and submitted for approval. Following that approval, a witness test shall be arranged with the City's Representative with one (1) week's notice allowed for the arrangement of witness testing.

8.3.5.29.2 ON SITE TESTING

Upon completion of the installation, complete testing of all switchboard controls with all internal and external interfaces and controls connected and operational shall confirm their functionality. Any functions requiring rewiring adjustment or modification shall be retested.

To verify the operations of all external controls and monitoring, it shall be coordinated and arranged for all trades to be present.

Signed test results shall be submitted in an approved format confirming the completion of the tests, prior to arranging witness testing by the City's Representative.

8.3.5.30 MAIN SWITCHBOARD MAINTENANCE

The following tasks shall be performed and written confirmation provided within one (1) month prior to the completion of the defects liability period:

- Tighten all busbar joints, cable terminations and connections during out-of-hours periods at a time as agreed
- Remove by vacuum cleaning all dust and debris from within the switchboard enclosure
- Wipe down and polish the exterior surfaces of the switchboard
- Replace nursery hardware items and ineffective dust seals.

8.3.6 CABLES

Unless otherwise detailed for a particular requirement, all cables shall:

- Have copper conductors
- Have stranded conductors
- Be of a minimum size of 2.5mm^2
- Be insulation-coloured as follows:
  - Actives of single phase: Red.
  - Actives of multi-phase:

A phase	Red
B phase	White
C phase	Blue
Neutral	Black.

  - Switchwires: As required, but same colour for similar functions.
  - Earthwires: Green/yellow.

8.3.6.1 THERMO PLASTIC INSULATED CABLES

Thermo Plastic Insulated (TPI) cables shall:

- Be insulated with 0.6/1 kV grade PVC compound type V75 or higher for cables larger than 25mm^2
- Be insulated with 450/750 V grade PVC compound type V90 or higher for cables equal to or less than 25mm^2
- Comply with *AS/NZS 5000 Electric cables - Polymeric insulated.*

8.3.7 LUMINAIRES

The Service Provider shall provide LED luminaires where specified and/or indicated on the drawings in compliance with approved solutions to minimise energy impact.

Service Providers must also provide details of the componentry and performance of the luminaires. This will include but not be limited to:

- LED chip manufacturer
- LED lamp functional life at 30% lumen depreciation
- LED lamp rated lumen output
- LED lamp binning
- Optical variation during life
- LED driver voltage range
- Luminaire illuminance at ground level (in lux)
- Luminaire operating temperatures
- Correlated Colour temperature

- Colour Rendering Index
- Photometric Data in IESNA & CIE format
- Aesthetics and appearance of the luminaires, including showing how the luminaires will appear mounted on lighting columns, brackets, walls and ceiling mountings by providing photographs or diagrams
- LM-79 and LM-80 compliance
- Component materials including housing.

Housing materials should be primarily constructed of metal. Finish should be powder-coated and rust-resistant. Drivers must be mounted internally, be replaceable and accessible without tools. All screws shall be stainless steel. Captive screws are needed on any components that require maintenance after installation. No parts should be constructed of polycarbonate unless it is UV stabilized (lens discoloration will be considered a failure under warranty). Ingress Protection shall be rated a minimum of IP65.

Prior to commencing installation, the Service Providers shall confirm that all luminaires proposed have been submitted to and approved by the Australian Energy Market Operator (AEMO), the body responsible for unmetered load table listings in Australia.

Lighting shall be controlled and switched as detailed on the lighting control schematic in the street lighting details drawing.

8.3.7.1 LUMINAIRE TYPE

All luminaires are to comply with the current City of Sydney LED supply contract.

8.3.7.2 LUMINAIRE LABELS

Labels shall:

- Be provided on all luminaires
- Comply with *AS 3137- Approval and test specification-Portable lamp standards and brackets*
- Indicate the manufacturer's name and lamp size. The type and colour are specified here.
- Be concealed from normal view where practicable, for example, behind the diffuser.

8.3.8 MCB + RCD AT BASE OF THE POLE

Electrical contractors shall supply and install a minimum of 10A MCB type C + 30mA RCD at the base of each pole.

8.4 INSTALLATION

The Service Provider must provide and carry out the following activities required for the work specified in this Technical Specification:

- Supply and install the City's freestanding main switchboard as indicated on the street lighting plan drawings including the detailed design of the board and the sizing of all sub-circuits from the board
- Install electrical connections from the main switchboard to the pits nominated by Ausgrid
- Supply all necessary materials and installation of ductlines in connection with electrical supplies to light poles
- Liaise and arrange with Ausgrid and the City's Representative regarding the removal of existing light poles, delivery of new poles and installation of new poles prior to initiating the removal of all Ausgrid redundant equipment
- Liaise and work in association or in conjunction with Ausgrid for the installation of underground ducts and pits

- Arrange attendance of Ausgrid inspectors for installation, inspection and acceptance of the work
- Supply all necessary materials and installation of new pits complete with conduits and pit lids. Install pit requirements to the relevant authority's installation requirements and those detailed in the stone paving section
- Supply all necessary materials and installation of concrete foundations for street lighting poles
- Complete foundations with conduits, reinforcing and galvanised steel rag bolt assembly to *AS 1798 Lighting poles and bracket arms*
- Provide new street lighting and LV power cabling from the City's main switchboards to all new street lighting and to high-level GPO outlet supply in Smartpoles
- Provide weatherproof outlets on the poles at high level for a future connection supplied from the phase circuit which is not controlled by PE cell
- Carry out tests on the completed ductline as described in this Technical Specification to demonstrate the acceptability of the ductline
- Arrange attendance of Ausgrid for installation of ducts and services into Ausgrid pits
- Pay for application and costs of establishing Ausgrid electrical supplies to the main switch boards
- Maintain temporary lighting and electrical supplies for the duration of the project
- Liaise and arrange with Telstra and other telecommunication providers regarding the route of conduits for telecommunications cabling
- Implement any other modification required to meet standards and to obtain the City's Representative approval
- Ensure that waste packaging materials for which a commercial recycling option is available are recycled as opposed of being disposed of as general waste to landfill. At a minimum, this includes cardboard/ paper, metals and soft plastic wrapping.
- Comply with the following:
    - The current statutory requirements in place
    - RMS and Ausgrid design standards for electrical design for traffic signals installations.
- No separate cabling dedicated for the supply of low-level GPOs is required to be installed in the reticulation conduits. GPOs are to be supplied specifically from the phase circuit, not controlled by the PE Cell at the Main Switchboard.

The notice specified in B1: Preliminaries and General Construction shall be provided so that inspection may be made of the following:

Hold Points

- Marked ductline route and the location of each pit and street light
- MSB delivered
- MSB fitted to plinth
- Lighting operational prior to decommissioning of Ausgrid lighting.

Witness Points

- Excavation with conduit and pits in place prior to backfill
- Poles prior to mounting on footing
- Survey check of pole position
- Draw wires and cables pulled in
- Electrical inspection and test.

8.4.1 STATUTORY AUTHORITIES – AUSGRID

The Service Provider shall make application and pay all costs for the procurement of the following electrical services:

- Main switchboards
- Special small services connections
- Temporary power connections.

The ductline route shall be coordinated with Ausgrid and conduits, cable and modify pits installed as required.

Plans and specifications for street light ductlines works shall be prepared to meet the standards and requirements of Ausgrid and be approved by Ausgrid prior to commencement of work.

The Service Provider shall ensure all Works comply with Ausgrid requirements (sub-section 8.4.1.1).

8.4.1.1 AUSGRID REQUIREMENTS

The Service Provider shall abide by Ausgrid Admittance to Premises Regulation, Electrical Safety Rules and Regulations for Working on the Sub-Transmission and Distribution Systems, where work is to be carried out near Ausgrid equipment or conductors which are in service.

The Service Provider shall ensure that the Works proceed with care in order to avoid damage to any existing service.

The City requires all lighting circuitry to be loop-in, loop-out (all phases for Smartpoles) to each light position.

The Service Provider shall be responsible for any damage caused to existing services, including pipes, cables or other works in or under the site.

Should any damage be caused to existing Statutory Authority services, repairs will be carried out by that Statutory Authority and the costs involved shall be charged to the Service Provider.

Where required, the Service Provider shall use an approved and accredited/authorised Service Provider to carry out works normally performed by the electricity distributor. Refer to the NSW Service and Installation Rules.

8.4.1.2 CONTINUITY OF SUPPLY AND SHUTDOWNS

The electrical supply shall not be shut down without the consent of the City's Representative. The Service Provider shall supply all temporary power for all power and lighting loads required to maintain statutory services, i.e. street and traffic lighting shall be maintained to statutory requirements and power to private properties (during the changeover to undergrounding works), throughout the contract.

8.4.2 TEMPORARY WORKS

8.4.2.1 TEMPORARY WORKS IN CONNECTION WITH STREET LIGHTING

The Service Provider shall maintain street lighting and pedestrian lighting as required by *AS 1158 Lighting for roads and public spaces* throughout the Works until such time as the new systems have reached Practical Completion. Note that Ausgrid existing lighting and power shall only be removed once the new City Of Sydney lighting network is operating and power to other services is commissioned through the new undergrounding network to be provided as part of this contract.

8.4.2.2 TEMPORARY ELECTRICITY SUPPLY

The Service Provider shall arrange with the Supply Authority to provide a temporary electricity supply (builders supply) as required during the construction stage of the Works. The temporary electricity supply and all associated equipment and wiring shall be removed on completion of the Works.

All necessary metering, equipment, wiring, connections, and the like shall be provided and installed as required.

The temporary electricity supply, equipment, wiring and the like shall comply with the requirements of the Supply Authority, WorkCover Australia and all other relevant Code and Authority requirements.

The Service Provider shall liaise with Ausgrid to ensure that there will be no disruption to tenants' electricity supply for the duration of the Contract.

The Service Provider shall pay all costs involved.

8.4.3 LIGHTS POLES AND MASTS

Smartpoles with cladding and without cladding are totally different types of poles and cladding cannot be retrofitted on the poles without cladding. The Service Provider is to ensure that the correct type of pole is installed.

All internal cabling and connections within the light pole shall be provided to the requirements of *AS/NZS3000*.

The Service Provider shall provide all below-ground works, erection of the light pole, street lighting electrical connection, small power services electrical connection, equipotential bonding and RMS signalling and electrical connection.

The Service Provider shall coordinate with the pole manufacturer to verify all power and signalling provisions, connections and testing at the time of installation.

The Service Provider shall provide all internal cabling and connections, earthing cabling and connections, RMS cabling and connections within the new light poles.

8.4.4 DUCTLINE TRENCH WIDTH AND DEPTH

Excavations shall be in accordance with B2: Earthworks.

The width and depth of the street lighting ductline shall comply with the minimum dimensions as Ausgrid details. It should be noted that at the termination of ductlines under road gutters, the minimum cover over the ductline is to be 750mm.

Trenches are to be excavated so that the ductlines can be laid with 300mm clearance all round from other obstructions, unless otherwise approved by the City's Representative and the relevant Utility Authority.

Twenty metres (20m) of fully excavated trench shall be maintained ahead of all incomplete ductlines to allow for deviation if required. The Service Provider shall allow for any costs incurred by having to carry out portions of the work at times outside normal hours or to avoid inconvenience to the public or occupiers of premises near the ductline route. The Service Provider shall liaise with the City's Representative prior to proceeding.

All other ductlines should be installed at a depth indicated by *AS 3000 Wiring Rules* Table 3.7 or by Ausgrid's local service and installation rules, whichever is the greater depth.

8.4.5 DUCTLINES

UPVC new ducts are to be installed as shown indicatively on the City-approved street lighting plan drawings. The Works shall include the supply of all necessary materials, labour and plant. Generally, the ducts shall be laid along the route in the positions and at the depths indicated by Sub-section 8.4.4 of this Technical Specification and the drawings. The final position and depth of the ducts may be changed on site with the approval of the City's Representative to avoid obstructions. The Service Provider shall lay the ducts at such

varied positions or depths and shall make no charge for such variation. The duct ends shall be smooth and cleanly cut with sharp edges removed. A socket shall be formed at one end of each pipe and bend. Additional pits shall be provided where necessary.

8.4.5.1 CONDUITS ENTERING SMART POLES

Refer to the street lighting details drawing and manufacturer's pole drawings for Smartpole conduit requirements. The Service Provider is to provide custom-made reducers to suit, and is to allow adequate lead time for their procurement. The class of conduit shall be in accordance with the method of installation as required by *AS 3000 Wiring Rules*. The conduits shall be run in a straight line from pit to pole with one 90-degree bend at the pole to accommodate the rag bolt assembly. Where this installation is not possible, the Service Provider shall obtain acceptance from the City's Representative prior to backfilling.

Electrical conduits shall be laid at a depth of 600mm in footways with the communications conduits at a depth of 250mm and laid directly above. Electrical conduits under the road shall be laid to a minimum depth of 750mm with the communication conduits at a depth of 300mm and laid directly above.

As-built details (drawings) shall be provided and submitted to the City's Representative showing the precise location and depth of burial of all conduits installed.

8.4.5.2 INSPECTION OF DUCTS PRIOR TO LAYING

The City's Representative shall be given notice to inspect all ducts before installation. The Service Provider shall ensure that all ducts are free from defects and foreign material, which could damage the cable and otherwise render the duct unsuitable for use, and notify the City's Representative the ducts are ready for their inspection.

The Service Provider shall obtain the City's Representative's approval if repairs to unsuitable ducts are to be attempted. Ducts which cannot be repaired to the satisfaction of the City's Representative shall be removed from the work site and replaced at no cost to the City.

8.4.5.3 JOINING OF DUCTS

All ducts shall be forced well into the socket and solvent welded. The joints shall be watertight and installed in accordance with the manufacturer's instructions.

8.4.5.4 TEMPORARY PLUGGING OF DUCTS

Where the laying of ducts is temporarily discontinued and at the end of street blocks (under road gutters) and Limits of Contract, the exposed ends of the ducts shall be plugged with approved duct plugs. The plugs shall remain in position until the work is resumed. A drawing of the duct plugs to be used is to be provided by the Service Provider for approval by the City's Representative and Ausgrid.

8.4.5.5 BEDDING OF DUCTS

The ductline shall be bedded with material complying with Bedding and Pipe Support Material of B10: Stormwater Drainage Construction.

Sand shall be placed around the ducts to the thickness shown on the Ausgrid standard trench detail. PVC pipeline and conduits shall not be covered until the pipe temperature has stabilised to no more than 1°C above that of the ground temperature.

8.4.5.6 INSTALLATION OF DUCTS INTO PITS

Installation of ducts into existing Ausgrid pits shall be carried out by Ausgrid at the Service Provider's cost.

Installation of ducts into all other pits shall be carried out by the Service Provider.

Where new conduits enter pits, the ends are to be cut off flush with the inside wall, slightly bell mouthed, and the entry finished off to the satisfaction of the City's Representative.

8.4.5.7 CUT LENGTHS OF DUCT

The duct installation will, wherever possible, comprise full lengths of duct as manufactured. Where it is necessary to cut lengths of duct at a particular location, the ends will be trimmed square, the edges deburred and the internal surfaces chamfered.

The length of ductline may be constructed from both ends towards the middle. In this case, a length of duct may be cut and inserted into the line to connect together the two ends approaching from opposite directions.

It will be necessary to use slip couplings supplied by the manufacturer for this purpose. The length of pipe to be installed will be measured and cut to length no less than 10mm shorter than the gap to be filled, and the joints made using the slip couplings in accordance with the manufacturer's instructions.

8.4.5.8 DUCT PLUGGING

After the ducts between adjacent existing vaults and at limits of each street block and Limits of Contract have been cleaned and tested to the satisfaction of the City's Representative, the Service Provider shall plug each duct with an approved duct plug. The Service Provider shall supply a drawing of the duct plugs intended to be used.

8.4.5.9 INSTALLATION OF WARNING STRIP

Polythene film warning strips to indicate the presence of the ductlines shall be laid in the trench at a depth shown on Ausgrid standard details and *AS 3000 Wiring Rules*

8.4.6 UNDERGROUND CABLE ROUTES

8.4.6.1 SURVEY

The Service Provider shall accurately record the routes of underground cables before backfilling and supply the drawing to the City's Representative.

8.4.6.2 PITS

- Construction of any utility pits shall be carried out to the specific requirements of that utility authority
- Soil shall be compacted to prevent settlement of the pits and associated cables
- The Service Provider shall take full responsibility for unrecorded obstructions in excavation sites. While the City's Representative has provided records of known obstructions, the accuracy of the information provided is limited and the City's Representative will not take responsibility for inaccurate records
- Any additional excavation required for the construction of a pit due to the presence of an obstruction shall be included in the contract work. This shall also include surface breaking, planking, backfilling and any associated temporary reinstatement.
- No payment shall be made for inconvenience or additional expense incurred by the Service Provider during the construction of a pit due to the presence of any obstructions
- Drainage shall be provided from the bottom of cable pits, either to absorption trenches filled with rubble or to the stormwater drainage system

- Pits shall be supplied and installed where indicated, or required for ease of cable installation. All pits shall be installed with the top of the cover flush with the finished ground level.
- All pits shall be installed as one unit in the same form that they are received from the manufacturer, i.e. pits are not to be disassembled for installation
- Plastic pits, where permitted for use, are outlined on the street lighting plan details drawing and shall be installed in accordance with the manufacturer's guidelines.

The Service Provider shall fix a 150mm x 150mm x 1.6mm brass plate for paver infill pit covers. The plate shall be suitably engraved according to the service cables within the pit, e.g. power, security lighting, telephone, public address, computer, miscellaneous services and the like. The engraving shall be legible and durable.

8.4.6.3 SMARTPOLE CABLING

Refer to the manufacturer's manual.

8.4.7 SWITCHBOARDS

8.4.7.1 SWITCHBOARD INSTALLATION WORKS

The Service Provider shall construct a concrete footing to support the cabinet as shown in the Council Main Switchboard General Arrangement: Elevation in the Street Lighting Details drawing.

Switchboards shall be located as indicated on street lighting plan drawings. The Service Provider shall submit details of the final intended location to the City's Representative for approval prior to the Works proceeding.

The Service Provider shall liaise with Ausgrid to include the connections from the substation to the main switchboard.

Conduits and cables are to be provided between the main switchboard and the existing Ausgrid pit as indicated in street lighting plan drawings.

8.4.7.2 POWER FOR TESTING

The Service Provider shall make all necessary arrangements and applications for full permanent power to be connected before the date of practical completion. The time of connection shall be arranged to suit the building program. The Service Provider shall ensure submains, controls and associated items for equipment and systems installed by others are connected prior to testing. Lighting shall not be connected to the supply for general usage before practical completion without prior approval.

The Service Provider shall arrange for the City's Representative to make all necessary applications to the Electricity Retailer for supply agreements which will be transferred to the City's name from the date of practical completion. Connection of a permanent supply prior to practical completion may be made in the name of others subject to approval.

8.4.7.3 EARTHING

The Service Provider shall provide an earth connection to all outlets regardless of whether it is required by the regulations or not. The main earth conductor shall be run to and connected to a bolted, labelled connection on the earth electrodes, and be PVC covered. Details shall be provided of the earthing installation at the main switchboard position.

8.4.8 CABLES

8.4.8.1 ELECTRICAL CONNECTION

The Service Provider shall comply with the Working Drawing section of this Technical Specification and liaise with Ausgrid and Telstra regarding their circuitry requirements where required.

8.4.8.2 SPECIAL SMALL SERVICES CONNECTION

Special small services connection requirements are detailed within the New South Wales service and installation rules.

All works to Ausgrid service pits shall be carried out under the supervision of Ausgrid field services personnel.

8.4.9 WEATHERPROOF SOCKET OUTLETS

Weatherproof outlets shall be supplied on the poles as per the Schedule of Smartpoles. All pole furniture and sockets are supplied by the City's Representative.

High-level GPOs shall be a weatherproof outlet mounted on the outside of the pole immediately below the outreach arm. The outlets shall be connected to a separately controlled City of Sydney supply. Power supply of these outlets shall be on, and not controlled by photoelectric cell. A circuit provided solely for this purpose shall be indicated in the street lighting single line diagram drawing.

8.4.10 STREET LIGHTING CONNECTION

Street lighting connection requirements are detailed within the New South Wales services and installation rules.

The Service Provider shall provide details of all busbars, fixings, studs and clearances required to be incorporated within equipment for the satisfactory connection of cables where equipment and/or switchboards are provided by others.

Written details shall be submitted of verified loadings and calculated maximum demand, fault level and voltage drop for the proposed route length and wiring method of respective sub-main cables.

No variation will be allowed for replacement of cables due to failure in verifying the proposed loads.

The core cable between light standards shall be looped via the City of Sydney pits and ductwork system.

The Smartpole lighting circuit shall be on a three-phase cable and utilize the alternative phase as cabling work is completed on the poles along the cable route as indicated in the street lighting details drawing.

The four core and earth cables shall be terminated at the respective City of Sydney Switchboard.

All redundant cable shall be removed by the Service Provider.

8.4.10.1 EARTHING

The Service Provider shall supply and install the earthing system for the installation including all cabling, clamps, test links and all associated accessories and equipment in accordance with *AS 3000 Wiring Rules*. All communications and technical system earths shall be adequately separated from power system cables.

8.4.10.1.1 CABLING ACCESSORIES AND APPLIANCES

Lighting fittings and socket outlets shall be earthed by means of the earth conductor, which forms part of the respective circuit cabling. A separate earthing conductor shall be used for each circuit. Earthing conductors shall be run back to the earth bar with the switchboard from where the supply originated. All exposed metal fittings, such as cable trays and ducts, associated with the Electrical Services shall be earthed.

8.4.10.1.2 EQUIPOTENTIAL BONDING

All street lighting poles shall be equipotentially bonded in accordance with *AS 1768 Lightning protection*. All equipotential bonding shall be connected to the earth bar within each street lighting pole. From this earth bar, reinforcement bars shall be connected within the footing to give a combined maximum of 10 ohms or less.

8.4.10.1.3 BALANCE OF LOAD

Unless otherwise indicated, the electrical installation shall be balanced as closely as possible between the individual phases of the supply cable.

8.4.11 WIRING METHODS

The Service Provider shall install all wiring so that it can be readily renewed, repaired or relocated without affecting finishes and construction.

8.4.11.1 INSTALLATION OF WIRING

All cables shall:

- Be installed between equipment without any joints
- Be installed on the loop in, loop out principle without the use of connectors for sub-circuit wiring
- Be installed so that they can readily be withdrawn for the purposes of relocation and/or rewiring
- Be installed such that they are not bent through a radius less than the minimum bending radius recommended by the manufacturer
- Be installed free of joints.

8.4.11.2 THERMO PLASTIC INSULATED CABLES

Thermo Plastic Insulated (TPI) cables shall:

- Be enclosed within conduits or cable troughing
- Not be drawn into conduit systems until the conduit run is complete and swabbed out
- Be jointed only at outlet or switch positions.

8.4.11.2.1 DERATING

The sizes of conductors as specified are the minimum size which shall be provided.

The size, grouping, spacing, enclosure and location of cables shall be installed so that the current rating of the conductors as permitted by *AS 3008 Electrical installations – Selection of cables* with the appropriate derating factors applied, is not less than the specified current rating of the circuit breaker or fuse which protects the conductor.

Where conductors are installed, grouped, spaced or enclosed in such a manner that their derated current rating is less than the specified current rating of the protective device, the size of the conductor shall be increased to provide a current rating of the conductor which is not less than the specified current rating of the respective protective circuit breaker or fuse.

8.4.12 LIGHTNING PROTECTION SYSTEM

The Service Provider shall provide, test and commission a complete lightning protection system as shown in the drawings and as described here:

The lightning protection system shall comply with the relevant recommendations of *AS/NZS1768 Lightning Protection* and the requirements in this Technical Specification for earthing and shall incorporate the following major components:

- Down Conductor System
- Earth Terminations.

All mounting, bonding and jointing of conductors within the lightning protection system shall be by means of approved purpose-made cleats, clamps, links and the like, equal to Furse or Erico manufacture.

8.4.12.1 DOWN CONDUCTORS

The steel lighting pole shall be used as the down conductor system.

8.4.12.2 EARTH ELECTRODES

The steel reinforcement of the concrete footings of each lighting pole shall be used as the earth electrodes for the system.

8.4.12.3 UNDERGROUND WIRING

All underground wiring is to be in accordance with the approved drawings.

8.4.12.3.1 ANTI-TERMITE TREATMENT

Treat the ground surrounding cables, pipe enclosures and cable pits forming part of the electrical installation, to provide protection against termite attack. Treatment distance shall be a maximum of 300mm from each item and in accordance with *AS 3660Termite management in and around existing buildings and structures*.

The method of laying and protecting the cables/pipes and the termite deterrent application shall be in accordance with the manufacturer's recommendations.

The anti-termite treatment shall be carried out by a firm specialising in the work. Prior advice shall be given so that the treatment undertaken may be witnessed by the City's Representative.

Alternative systems meeting the above requirements and complying with *AS 3660 Termite management in and around existing buildings and structures* may be submitted for approval by the City's Representative.

8.4.13 DISCONNECT AND REMOVE

All existing street furniture, traffic signals and lighting poles shall be surveyed and detailed in terms of positions, electrical supply requirement, intended usage within this contract (e.g. re-use or return to authority) and ownership.

Where street furniture is connected to the Ausgrid LV network or street lighting network, the following procedures shall be followed:

- The owner shall be contacted and notified in writing of the intent to demolish the service 20 working days prior to the Works commencing
- The Service Provider shall disconnect the electrical supply and make safe in accordance with Ausgrid's requirements
- The Service Provider shall remove and store equipment for four (4) weeks and notify the owner in writing of the intent to dispose of equipment after that period
- Where the LV or street lighting electrical supply is intended to be re-used, the Service Provider shall make the necessary changes to the Works to comply with street lighting or special small services detailed within this Technical Specification.

8.4.13.1 DEMOLITION

Disposal of removed luminaires shall involve component recycling whenever possible.

Unwanted luminaires must be disposed in a manner that is ethical, efficient, and where practical maximises a value outcome for the City.

The Service Provider is to prioritise re-use and materials recycling ahead of disposal to landfill, which is considered an undesirable outcome. The Service Provider must remove all City of Sydney visual identifiers such as logos and labels from any unwanted items before disposing of them.

8.4.13.2 METHOD STATEMENT

The Service Provider shall provide a written method statement of the disconnection and making safe of Ausgrid's LV and street lighting networks to any street furniture and lighting poles. This method statement shall be forwarded to Ausgrid and approved prior to any works of this nature commencing.

The method of retaining statutory street and traffic light arrangements during the Contract shall also be submitted. As part of the electrical undergrounding works being undertaken by Ausgrid, Ausgrid-appointed Service Providers will also be installing temporary poles and lighting and this needs to be accounted for within the method statement. The Service Provider shall allow for attendance of Ausgrid-appointed Service Providers for interfacing purposes.

8.4.13.3 DISCONNECTION OF STREET LIGHTING POLES

Removal and making safe of existing Ausgrid service to the lighting poles and masts shall be completed as part of undergrounding works under this contract by the Service Provider who shall also liaise with Ausgrid to carry out inspection of works and works to their street lighting/small power service.

8.4.14 PEDESTRIAN CROSSING LIGHTING

The provision of pedestrian crossing lighting is only included if it is nominated as a site-specific requirement. Refer to drawings for nominated luminaires.

Pedestrian crossing floodlights are required to provide compliant lighting for all pedestrian crossings and at intersections as indicated in street lighting plan drawings and to comply with the requirements of *AS 1158 Lighting for roads and public spaces* and the RMS guidelines.

The pedestrian crossing floodlight shall be mounted on the outreach of the street lighting pole as indicated on the street lighting details drawing. The mounting height is to be at the same height as the street lighting luminaire. Pedestrian crossing floodlights shall be orientated towards the pedestrian crossing and as indicated in the pedestrian crossing floodlight orientation schedule in the street lighting details drawing.

This new floodlight is required prior to the removal of any existing floodlight mounted on nearby existing Ausgrid poles. The floodlight shall be supplied from the same street lighting circuit as the street light pole which it is attached to. The floodlight shall be controlled by the same PE cell which controls the street lighting circuits and is to be installed by the Service Provider. Refer to the street lighting single line diagram drawing for further clarification.

8.5 INSPECTION, TESTING AND COMMISSIONING

8.5.1 WORKING DRAWINGS AND AS-BUILT DRAWINGS

The Service Provider shall provide working drawings as required.

Information required includes but is not limited to:

- Rating of cables
- General arrangement of ductlines and pits both in plan and longitudinal section.
- Cross-sections showing the locations of ducts.
- Plan location of the ductlines accurately specified by offset measurements from building lines to create ductline at 20m intervals, at each end of each duct run and at each change of direction of the ductlines
- Schematic connection details and circuit drawings for all Ausgrid and City supplies
- New lighting pole connection details for RMS, Telstra and Ausgrid incoming conduits and cables
- Switchboard metering and enclosure

- New main switchboard schematic control arrangements and metering arrangements
- Arrangement of keys and locks for required street furniture
- Amended Schedules.

8.5.2 TEST AND INSPECTIONS

8.5.2.1 TESTING ON-SITE DURING CONSTRUCTION

The Service Provider shall carry out all tests necessary to prove the correctness of the installation as the Works progress.

8.5.2.2 SITE TESTING

The Service Provider shall test the installation to the satisfaction of the City's Representative and the Statutory Authorities prior to the acceptance of the installation and the commencement of the defects liability period. The test shall comprise thorough inspection of the entire installation and the operational and performance tests required to confirm compliance with this Technical Specification.

The necessary facilities, labour, apparatus and instruments shall be supplied and properly calibrated for carrying out the tests. The City's Representative shall be given seven (7) working days' notice in writing of the tests.

8.5.2.3 TEST CERTIFICATES

Test certificates, dated and signed by a responsible person shall be supplied in duplicate to the City's Representative. All tests and test certificates required and as recommended by the appropriate Australian Standards and the details of new lighting installation inspection, test and completion certificate as listed at the end of this section, shall be undertaken, completed, approved and signed off.

8.5.2.4 COMMISSIONING

Witness testing of the entire lighting installation is required to be carried out by the Design Engineer. These tests are to be conducted during the evening.

8.5.2.5 ENERGISING

No component of the installation shall be energised until it has been inspected by the City's Representative and Ausgrid where required and a certificate of approval issued.

8.5.2.6 TESTING OF COMPLETED DUCTLINE

The Service Provider:

- Shall provide all necessary test equipment and operators to carry out the routine tests, specified below, after completion. Any other tests, which the Service Provider or the City's Representative may wish to have carried out to prove the fitness of the installation, shall also be carried out at this time.
- Will not be allowed any extension of time for the carrying out of these tests.
- Shall be entirely responsible for the proper performance of the equipment and material under test.
- Shall rectify any defect revealed by the tests and, at their own expense, shall repeat such tests as often as may be necessary to obtain the results required.

Ductlines must be clear and suitable for use.

8.5.3 TESTING

Where the structure is used as the earthing system, progressive testing of the earth system shall be undertaken to ensure that all components are within specified requirements and to provide notification to the City's Representative of any remedial works required early in the construction phases.

The following shall be tested:

- Each individual earth electrode structural footing after construction and before connection to other building elements
- Resistance readings for bonding between down conductor columns during construction prior to concrete pours
- Continuity testing of each light pole down conductor to the ground.

On completion of the system installation, a certificate of compliance shall be provided stating that the system has been satisfactorily installed and commissioned. In a report format, detailed test results of all tests undertaken and the method of testing used shall be provided to the City's Representative.

8.6 QUALITY

8.6.1 INSPECTIONS

At least two (2) working days' notice shall be given for all inspections.

8.6.1.1 HOLD AND WITNESS POINTS

Preliminaries	
1. Process Held:	Ductline Route and Pit/Streetlight Location
Submission Details:	At least two (2) working days prior to the commencement of excavation.
Release of Hold Point:	The City's Representative will inspect the marked out route and locations, prior to authorising the release of the Hold Point.
2. Process Held:	Main Switchboard
Submission Details:	At least two (2) working days prior to installation of the MSB
Release of Hold Point:	The City's Representative will inspect the MSB, prior to authorising the release of the Hold Point
3. Process Held:	Decommissioning of Lighting
Submission Details:	At least two (2) working days before decommissioning of Ausgrid lighting
Release of Hold Point:	The City's Representative will inspect the operational lighting, prior to authorising the release of the Hold Point
4. Process Held:	Ductline and Pit Placement
Submission Details:	At least two (2) days prior to backfill of the ductlines
Release of Witness Point:	The City's Representative will inspect the installations, prior to authorising the release of the Witness Point unless advised otherwise
5. Process Held:	Poles
Submission Details:	At least two (2) working days before mounting the poles on the constructed footing

Release of Witness Point:	The City's Representative will inspect the poles prior to releasing the Witness Point
6. Process Held:	Pole Location
Submission Details:	At least two (2) working days before installing the poles
Release of Witness Point:	The City's Representative will review the surveyed location of the pole positions prior to releasing the Witness Point
7. Process Held:	Draw Cables
Submission Details:	At least two (2) working days before backfill
Release of Witness Point:	The City's Representative shall inspect the draw wires and pulled cables prior to releasing the Witness Point
8. Process Held:	Electrical Inspection
Submission Details:	At least two (2) working days prior to commissioning of the service
Release of Witness Point:	The City's Representative shall attend the electrical inspection and test prior to releasing the Witness Pont

Additional Witness Points are as outlined below in Annexure 1 – Details of New Lighting Installation Inspection, Test and Completion Certificate.

8.6.2 TOLERANCES

Item	Activity	Tolerances
1.	Setout	• All street lights, pits, switchboards and the like shall be installed within 100mm of the location shown on the construction drawings
2.	Streetlight	• The offset at the top of the streetlight shall not vary by more than 25mm from the vertical measured on the centreline of the pole
3.	Pits	• Finished position of pits to be flush with the adjacent roadway or footway level

ANNEXURE 1

DETAILS OF NEW LIGHTING INSTALLATION INSPECTION, TEST AND COMPLETION CERTIFICATE

All commissioning and pre-handover inspections are to be carried out by the Service Provider and witnessed by an accredited representative from City of Sydney, City Infrastructure. All completed forms are to be submitted to the Manager, City Infrastructure and Traffic Operations, City of Sydney.

VISUAL INSPECTION

Location:
Service Provider:
Type of Installation: (e.g. public domain lighting, illuminated sign and the like)
Date of Inspection:

STRUCTURAL INSPECTION WITNESS POINTS

Mark ☑ Satisfactory or ☒ Unsatisfactory On Completion:

☐	1.	Location of Lighting Equipment as per Drawing
☐	2.	Planting Depth/Footing size of Lighting Equipment as per Specification
☐	3.	Location of Cable as per Drawing
☐	4.	Depth of Cable as per Specification
☐	5.	Location of Road Crossing as per Drawing
☐	6.	Depth of Road Crossing as per Specification
☐	7.	Column footing as per Specification
☐	8.	Verticality Correct
☐	9.	Optical Orientation Correct

ANNEXURE 1: DETAILS OF NEW LIGHTING INSTALLATION INSPECTION, TEST AND COMPLETION CERTIFICATE, CON'T

Mark ☑ Satisfactory or ☒ Unsatisfactory On Completion:

1.	☐	Correct termination of cables in the column, lantern and control gear
2.	☐	Circuit conductors identified correctly
3.	☐	Conductor size correct for normal operation (or as specified)
4.	☐	Single pole or fuse in the phase conductor only
5.	☐	Outer contact of ES lampholder is connected to the neutral conductor
6.		Method of Protection against Direct Contact
	☐	a) Insulation of live parts
	☐	b) Barrier or enclosure
	☐	c) Out of reach (overhead lines only)
7.		Method of Protection against Indirect Contact
	☐	a) Presence of Protective Conductors
	☐	b) Presence of main equipotential bonding conductor
	☐	c) Presence of supplementary equipotential bonding conductor including doors of steel columns but excluding that of concrete columns
8.	☐	Presence of method of local isolation
9.	☐	Fuse ratings correctly rated for their purpose
10.	☐	Labelling in control pillar/switchboard enclosure of isolators and fuses
11.	☐	Prevention of mutual detrimental influence. Proximity of non-electrical services (fences or safety barriers, etc.)
12.	☐	Selection of equipment and protective measures appropriate to external influences
13.	☐	Adequate access to installed equipment
14.	☐	Presence of danger notices or other warning notices
15.	☐	Presence of circuit diagrams enclosed within control pillars/switchboard enclosure
16.	☐	Installation method of cables
17.	☐	Deviation from the materials listed in the specification
18.	☐	Other

(All entries recorded on this sheet to be determined by measurement. All instruments must bear a current calibration label).

Date of Test: _____ / _____ / _____

ANNEXURE 1: DETAILS OF NEW LIGHTING INSTALLATION INSPECTION, TEST AND COMPLETION CERTIFICATE, CON'T

Instruments to be Used	Date when calibrated
Voltmeter 240/415V	
Ammeter 0–50 amp	
Megger 500V	
Loop Impedance Meter	
Prospective Short Circuit Tester	

Control Pillar

Installation de-energised (with all fuser carriers removed)

Continuity of Protective Conductors **Polarity** (Rph + Re):-

Mark ☑ Satisfactory or ☒ Unsatisfactory

Circuit 1	Ω	Circuit 1	☐
Circuit 2	Ω	Circuit 2	☐
Circuit 3	Ω	Circuit 3	☐
Circuit 4	Ω	Circuit 4	☐

Insulation Resistance
(Note: Remove neutral conductor from PME system)

Circuit 1	P-N	Ω
	P-E	Ω
	N-E	Ω
Circuit 2	P-N	Ω
	P-E	Ω
	N-E	Ω
Circuit 3	P-N	Ω
	P-E	Ω
	N-E	Ω
Circuit 4	P-N	Ω
	P-E	Ω
	N-E	Ω

Insulation Resistance (column wiring)
(All columns)

Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ
Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ
Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ
Circuit	Column No.	
	P-E	MΩ
	N-E	MΩ

METHOD OF EARTHING: TN-C-S

ANNEXURE 1: DETAILS OF NEW LIGHTING INSTALLATION INSPECTION, TEST AND COMPLETION CERTIFICATE, CON'T

Installation Energised

(Measurements taken under load at cut-out incoming terminals)

Voltage at Origin _____ V

Prospective Short Circuit Current at Origin _____ KA

Loop Impedance at Origin _____ Ω

No. of Phases _____

Load at Origin _____ A

Measured Load		**Voltage at end of circuit**	
Circuit 1	A	Circuit 1	V
Circuit 2	A	Circuit 2	V
Circuit 3	A	Circuit 3	V
Circuit 4	A	Circuit 4	V

Loop Impedance at end of each circuit		**Prosp. Short Circuit Current at end of Circuit**	
Circuit 1	Ω	Circuit 1	KA
Circuit 2	Ω	Circuit 2	KA
Circuit 3	Ω	Circuit 3	KA
Circuit 4	Ω	Circuit 4	KA

ANNEXURE 1: DETAILS OF NEW LIGHTING INSTALLATION INSPECTION, TEST AND COMPLETION CERTIFICATE, CON'T

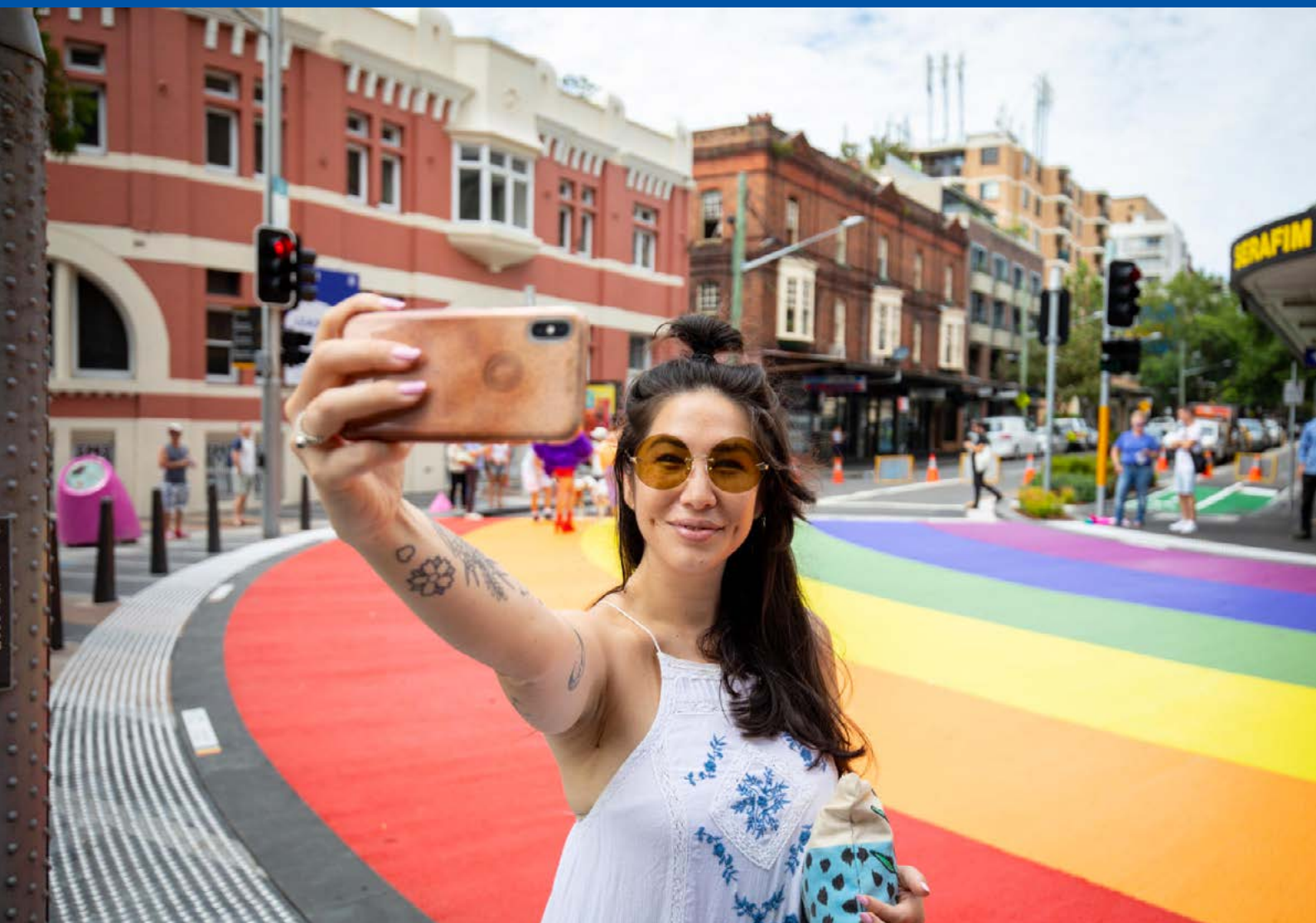
I/We being the person(s) responsible (as indicated by my/our signature(s) below) for the inspection and test of the street lighting and associated electrical installation particulars of which are described on the attached annexures of this form certify that the said work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with City of Sydney current Specification for the Installation of Public Domain Lighting and the Rules for Electrical Installations (AS3000) except for departure, if any, stated in this certificate.

The extent of liability of the signatory is limited to the work described above as the subject of this certificate.

For the inspection and test of the installation at:	
Name: (BLOCK Letters)	Position:
Licence No.:	
Company Name:	
Signature: (of Designer in BLOCK Letters)	Date:
For and ON Behalf of:	
Address:	
Witnessed by (Name) (BLOCK letters)	Position:
Signature:	Date:

Comments:

B9
Road Pavement Marking Construction



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B9 ROAD PAVEMENT MARKING CONSTRUCTION

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B9 ROAD PAVEMENT MARKING CONSTRUCTION

9.1 ROAD PAVEMENT MARKING

9.1.1 SCOPE

This section of the Technical Specification covers the removal of existing linemarking; the setting out, supply and application of road-marking materials, such as paint, thermoplastic pavement markings and raised pavement markers; and the maintenance and/or reinstatement of existing pavement marking works where required.

9.1.2 STANDARDS AND GUIDELINES

Unless stated otherwise in this Technical Specification, the drawings or elsewhere in the documents, the Works shall comply with the RMS Delineation Manual and its referenced RMS QA Specification documents, and relevant Australian Standards.

Any variations or ambiguity between standards, the Technical Specification and test methods shall be referred to the City's representative for decision before proceeding with the Works.

The following table indicates the RMS specifications, City of Sydney Manuals and Australian Standards applicable to this section. This table is not exhaustive and may not include all standards which may apply to the work to be undertaken.

RMS Delineation Guidelines	
RMS QA Specification R141	Pavement Marking
RMS QA Specification R142	Raised Pavement Markers
RMS R110	Coloured Surfacing Specification
RMS 3353	Glass Beads (for Application to Road Marking Materials)
RMS 3356	Waterborne Road Marking Paint
RMS 3357	Thermoplastic Road Marking Material
RMS 3360	Two Part Cold Applied Road Marking Material
RMS T805	Non-Volatile Content of Paint
RMS T806	Density of Paints
RMS T807	Fineness of Paint (Sieve Test)
RMS T808	Consistency of Paint by Flow Cup
RMS T815	Soluble Lead Content of Paints (Gravimetric Method)
RMS T820	No Pick-up-Time of Road Marking Paints
RMS T833	Application Properties of Paint by Brushing or Spraying Conventional and Airless
RMS T841	Field Measurement of Wet Film Thickness of Road Marking Paint
RMS T852	Degree of Settling of Paint
RMS T1203	Refractive Index (R.I.) of Glass Beads
RMS T1205	Flow Properties of Spherical Glass Beads
RMS T1207	Roundness (Shape) of Glass Beads
RMS T1208	Measurement of Rate of Application of Spherical Glass Beads
City of Sydney	Shared Pathways Pavement Guide
AS 1742	Manual of uniform traffic control devices
AS 1906.1	Retro-reflective materials and devices for road traffic control purposes
AS 1906.3	Raised pavement markers (retroreflective and non-retroreflective)

AS 2009	Glass beads for traffic markings
AS 2445	Methods of sampling and testing retroreflective materials and devices for road traffic control purposes
AS 2700	Colour standards for general purposes
AS 3554	Adhesives for raised pavement markers
AS 4049.2	Thermoplastic road marking materials
AS 4049.3	Paints and related materials – Road marking materials
AS 1742.9	Bicycle facilities

9.1.3 TYPES OF MARKINGS

Details of the various types of pavement markings such as longitudinal and transverse lines, and pavement arrows are as shown in the *RMS Delineation Guidelines*.

Shared pathways are detailed in the *City of Sydney Shared Pathways Pavement Guide*.

9.1.4 PAVEMENT MARKING MATERIALS

9.1.4.1 WATERBORNE PAINT

Waterborne paint must conform to the requirements of *AS 4049.3.- Paints and related materials – Road marking materials.*

Waterborne paint is the recommended temporary pavement marking for all wearing surfaces.

Waterborne paint shall be the final linemarking for all traffic islands and kerbs where specified.

9.1.4.2 LONG LIFE MATERIAL

9.1.4.2.1 NON-PROFILE THERMOPLASTIC

Non-profile thermoplastic pavement marking material must conform to the requirements of *AS 4049.2*.

Tack coat material shall be to the manufacturer's specification as approved by the City's Representative.

9.1.4.2.2 TWO PART COLD APPLIED PLASTIC

Two part cold applied material must comply with the requirements of *RMS 3360*.

9.1.4.3 PAVEMENT MARKING TAPE

Pavement marking tape is a temporary form of pavement marking and shall be a strippable type. All temporary pavement marking tape shall only be used where specified or approved by the City's Representative.

9.1.4.4 SPHERICAL GLASS BEADS

Reflective glass beads must be applied to all pavement markings, except pavement marking tapes or school zone markings, and must conform with the requirements of *AS 2009 Glass beads for traffic markings* for drop-on beads (when tested in the uncoated state).

Where possible, recycled glass is the preferred material for all spherical glass beads.

9.14.5 RAISED PAVEMENT MARKERS

Raised pavement markers, both reflective and nonreflective, shall comply with *AS 1906.3- Raised pavement markers (retroreflective and non-retroreflective)* and shall be installed at the spacing shown in the *RMS Delineation Guidelines*.

The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall comply with *AS 3554. Adhesives for raised pavement markers.*

9.1.5 COLOURED PAVEMENT

Unless approved by the relevant road authority, the only pavements that are to be coloured are bus lanes and bike lanes. These lanes shall be coloured red and green respectively.

RMS QA Specification R110 gives the specification for materials used for coloured surface coatings for bus lanes and bike lanes.

9.1.6 CAR SHARE PARKING BAYS

The Service Provider shall be required to mark all car share spaces with the words “CAR SHARE” and have green and white chevron markings as detailed in the standard drawings.

9.1.7 MATERIAL QUALITY

Prior to the programmed date for commencement of linemarking, the Service Provider shall submit to the City’s Representative the manufacturer’s technical data for the pavement materials proposed for use, together with certification from a NATA-registered laboratory so that the material is accepted, showing compliance with the requirements of this Technical Specification.

The certification supplied shall include evidence that the relevant RMS (NSW) tests have been carried out on the pavement materials supplied to prove compliance with the requirements of this Technical Specification.

9.1.8 APPLICATION OF PAVEMENT MARKING

9.1.8.1 SURFACE PREPARATION

Pavement markings shall only be applied to clean dry surfaces. The Service Provider shall clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement.

Pavement marking shall not be carried out during wet weather or if rain is likely to fall during the process.

Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled to remove fine mortar material (laitance).

9.1.8.2 SETTING OUT OF PAVEMENT MARKING

The Service Provider shall set out the work to ensure that all markings are placed in accordance with the drawings. The locations of pavement markings shall not vary by more than 20mm from the locations shown on the drawings.

The required position of all markings except symbols and legends shall be defined by a line of painted spots of minimum dimensions 50mm x 50mm.

Hooks are to be used to mark the start and finish of each type of line except for double white lines, hold lines and stop lines. The type of each line is to be marked with the line code in 150mm high lettering adjacent to the hook.

Upon completion of spotting, the Service Provider shall advise the City’s Representative, and a joint checking

procedure shall be undertaken prior to application of final markings.

9.1.8.3 APPLICATION OF PAVEMENT MARKING PAINT

9.1.8.3.1 MIXING (RUMBLING) OF PAINT

Paint shall be thoroughly mixed before use, including internal mixing where necessary to break up settled pigment.

9.1.8.3.2 SPRAYING

All longitudinal lines shall be applied by a self-propelled machine unless specified otherwise. The two sets of lines forming a one-way or two-way barrier line pattern shall be sprayed concurrently.

Hand spraying with the use of a template to control the pattern and shape will be allowed for transverse lines, zebra crossings, symbols and legends.

The paint shall be applied at a uniform thickness across the middle of the line with the wet film thickness from 0.36mm to 0.41mm.

Glass beads shall be pressure-applied to the surface of all longitudinal lines at an application rate of 0.30 kg/m^2. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

The application rates for paint and glass beads shall be as specified in Table 11.4 of the *RMS QA Specification R141 Pavement Marking*.

9.1.8.4 APPLICATION OF LONG-LIFE MATERIALS

Long-life materials, words and symbols shall be overlaid onto new or existing surfaces, or where specified, inlayed into new bituminous surfacing, all in strict accordance with the manufacturer's recommendation.

9.1.8.4.1 OVERLAY APPLICATION

Primer is to be applied at the recommended rate to the area of the markings on the pavement, extending at least 25mm beyond the outline of each marking. Markings must be applied to the primed area after the primer has achieved a tacky state and before the primer becomes contaminated by dirt, dust or other foreign matter.

Any areas which, in the opinion of the City's Representative, have become contaminated to a degree which will adversely affect the adhesion of the markings to the pavement, shall be left until completely dry, cleaned of excessive dust and dirt, and reprimed by the Service Provider.

Markings may be applied to the primed areas by manual means or with an approved applicator, following which they shall be thoroughly tamped with a rolling load of at least 90kg.

9.1.8.4.2 INLAY APPLICATION

Markings may be applied to the new bituminous surfacing by manual means or with an applicator as approved for use by the product manufacturer, following which they shall be embedded into the surface of the pavement with the finishing roller, using a minimum amount of water on the roller.

The new pavement shall be soft enough to allow the markings to be inlayed, but firm enough to prevent moving of the asphalt mat in front of the roller or excessive distortion of the markings.

Initial rolling of markings shall be in the same direction as the markings were applied. Additional passes of the roller shall be made until the markings are embedded at least 1mm into the pavement surface.

Any marking which is damaged such as to render it unsuitable for use, shall be removed and replaced.

9.1.8.4.3 APPLICATION RATES

9.1.8.4.3.1 NON-PROFILE THERMOPLASTIC

The application rates for non-profile thermoplastic materials and glass beads shall be as specified in *RMS QA Specification R141 Pavement Marking.*

9.1.8.4.3.2 TWO-PART COLD APPLIED PLASTIC

The application rates for two-part cold applied materials and glass beads shall be as specified in *RMS QA Specification R141 Pavement Marking.*

9.1.8.5 INSTALLATION OF RAISED PAVEMENT MARKERS

9.1.8.5.1 GENERAL

Raised pavement markers shall be fixed to the pavement in strict accordance with the manufacturer's recommendations. Markers of one manufacturer shall not be fixed with adhesive from another manufacturer without the approval of the City's Representative. In applying the markers, care shall be taken to achieve a continuous layer of adhesive on the base of each marker, and to avoid excessive areas of adhesive on the pavement beyond the outline of the marker.

Application procedures that in the opinion of the City's Representative may adversely affect the service life of the markers shall give cause for rejection of any or all areas of the work so affected.

9.1.8.5.2 FIXING OF MARKERS

Raised pavement markers shall be fixed with adhesive to the wearing surface of the pavement in accordance with the raised pavement marker and adhesive manufacturer's recommendations. The surface shall be clean and dry prior to the application of the pavement markers.

9.1.9 TEMPORARY ROAD PAVEMENT MARKING FOR EMERGENCY WORK

For all emergency works where permanent markings cannot be reinstated immediately, temporary markings are required to be applied to maintain vehicle and pedestrian safety. All messages and delineation provided by the permanent markings must be replicated in the temporary applications.

Pavement marking tapes may be applied as a temporary measure, and removed within six (6) months of application, unless otherwise advised by the City's Representative, so that they are not embedded in the surface and can be readily removed.

9.1.10 TEMPORARY BLACKOUT

Painted blackout or overlay may be applied as a temporary measure, and removed as soon as practically possible. Two-part, cold-applied blackout material with aggregate may be approved by the City's Representative as a permanent masking.

All temporary blackout shall be removed within one (1) month of initial application. On busy roads with high volumes of traffic, the blackout shall be monitored weekly and replaced as required.

9.1.11 REMOVAL OF PAVEMENT MARKING

The Service Provider shall check the extent of eradication with the City's Representative and all markings to be eradicated shall be clearly identified with red paint prior to the commencement of removal. Any markings incorrectly eradicated shall be marked again by the Service Provider.

The Service Provider shall eradicate the nominated road marking as specified on the construction drawings regardless of the colour, number of coats, type and age of the marking.

Blasting, grinding, scraping or other eradication activity shall not continue after the markings have been removed and any excessive damage to the pavement shall be repaired to the satisfaction of the City's Representative.

The Service Provider shall clean up and remove from the roadway all materials and debris from their operations and leave the roadway clear for use by the public.

Abrasive materials shall not be allowed to accumulate on any position of roadways open to traffic.

9.1.11.1 PAINTED ROAD MARKINGS

The removal of painted road markings shall be carried out by abrasive blasting techniques. No alternative methods will be considered. All numerals, letters, symbols and arrows will be marked or removed in such a way to avoid any possible confusion of motorists in any conditions.

Blasting of painted markings shall be carried out until at least 90 percent of the original area of each road marking has been removed. Any marking remaining shall not be concentrated in any one or two places of the original marking.

9.1.11.2 PLIANT POLYMER ROAD MARKINGS

The removal of pliant polymer markings shall be carried out by grinding or by a scraping and jabbing action using a suitable blade tool. Removal by burning will not be allowed.

Removal of pliant polymer markings shall proceed until all of the marking has been removed from the pavement.

9.1.12 QUALITY

9.1.12.1 INSPECTIONS

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

9.1.12.2 HOLD AND WITNESS POINTS

Pavement Marking	
1. Process Held	Pavement Marking Setout
Submission Details	At least two (2) working days before the new pavement marking is set out 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	Eradication of Pavement Marking
Submission Details	At least two (2) working days prior to commencement of pavement marking eradication
Release of Hold Point	The City's Representative will inspect the eradicated linemarking, prior to authorising the release of the Hold Point
3. Process Held	Application of Pavement Marking
Submission Details	At least two (2) working days prior to commencement of pavement marking
Release of Hold Point	The City's Representative will inspect the pavement marking, prior to authorising the release of the Hold Point
4. Process Held	Application of Raised Pavement Markers
Submission Details	At least two (2) working days prior to commencement of installing raised pavement markers
Release of Hold Point	The City's Representative will inspect the raised pavement markers, prior to authorising the release of the Hold Point

9.1.12.3 TOLERANCES

9.1.12.3.1 PAVEMENT MARKING

Lines: Horizontal alignment +/- 100mm

Symbols: Alignment +/- 100mm in any direction.

9.1.12.3.2 RAISED PAVEMENT MARKINGS

The location of all raised pavement markers shall not vary in the longitudinal direction by more than 100mm from that specified on the drawings, unless otherwise specified.

The location of raised pavement markers in the transverse direction relative to other pavement markings shall be in accordance with the tolerances set out in RMS QA Specification R142 Pavement Marking. Where there is no tolerance shown for the transverse direction, the location of the raised pavement markers in the transverse direction shall not vary more than 25 mm from that specified on the drawings and by not more than 25 mm from that of any other raised pavement marker in the same line within a distance of 1.5m.

Tolerance on direction shall be +/-4° rotational, i.e. the reflector pointed along the centreline.

9.2 ROAD SIGNAGE

9.2.1 SCOPE OF WORK

This section of the Technical Specification covers road signage from road construction projects, programmed replacement or modification to existing signposting not associated with construction projects, and reactive maintenance.

It sets out the requirements for:

- The manufacture, supply and installation of permanent and temporary traffic signs and parking regulatory signs
- The manufacture, supply and installation of sign support structures to support the signs
- The manufacture, supply and installation of street nameplates.

9.2.2 STANDARDS AND GUIDELINES

Unless stated otherwise in this Technical Specification, the drawings or elsewhere in the documents, the Works shall comply with the RMS online sign register, RMS QA Specifications and relevant Australian Standards.

Any variations or ambiguity between the Technical Specification, standards and test methods shall be referred to the City's representative for decision before proceeding with the work.

The following table indicates the RMS QA Specifications, City of Sydney Manuals and Australian Standards applicable to this section. This table is not exhaustive and may not include all standards which may apply to the work to be undertaken.

RMS QA Specification R143	Signposting
RMS QA Specification 3400	Manufacture and Delivery of Road Signs
City of Sydney	Smart Pole Product Manuals
AS 1163	Structural steel hollow sections
AS 1214	Hot-dip galvanised coatings on threaded fasteners
AS 1250	The use of steel in structures
AS 1379	Ready-mixed concrete
AS 1554	Welding of steel structures, Part 1
AS 1627.1	Cleaning using liquid solvents and alkaline solutions
AS 1627.4	Metal finishing – Preparation and pre-treatment of surfaces – Abrasive blast cleaning
AS 1627	Metal finishing – Preparation and pre-treatment of surfaces
AS 1650	Hot-dipped galvanised coatings on ferrous articles
AS 1734	Aluminium and aluminium alloys – flat sheet, coiled sheet plate
AS 1742.1-13	Manual of uniform traffic control devices
SAA HB 81	Field guide for traffic control at works on roads
AS 1743	Road signs – Specification
AS 1744	Forms of letters and numerals for road sign

AS 1866	Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes
AS 1906	Retroreflective materials and devices for road traffic control purposes
AS 1906.1	Part 1. Retroreflective materials
AS 1906.2	Part 2. Retroreflective devices (Non-pavement application)
AS 2700	Colour standards for general purposes
AS 3600	Concrete structures
AS 3678	Hot-rolled steel plates, floor plates and slabs
AS 3679	Hot-rolled structural steel bars and sections
AS 4506	Metal finishing – Thermoset powder coatings
AS 9002	Quality systems for production and installation.

9.2.3 MATERIALS FOR SIGNPOSTING

9.2.3.1 ROAD SIGN BLANKS

The dimensions, legend and background for each sign shall be in accordance with:

- this Technical Specification
- AS 1742 Manual of uniform traffic control devices
- AS 1743 Road Signs Specifications
- AS 1744 Standard alphabets for road signs
- RMS Signs and Markings Manual and the standard drawings.

Sign blanks, except for street nameplates, shall be either:

(a) 1.6mm thick aluminium sheet alloy; Type 5251 or 5052; temper H38 or H36 in accordance with AS 1743 Road Signs Specifications; and free of cracks, tears and other surface blemishes

(b) Another sustainable option approved by the City.

Sign blanks for permanent or temporary traffic signs shall be of a dimension and material specified in accordance with RMS guidelines or *AS 1743. Road Signs Specifications.*

Street nameplates shall be 6mm thick aluminium.

9.2.3.2 RETROREFLECTIVE MATERIAL

The retroreflective materials used in the background or legend of the signs shall conform in colour and grade to *Appendix C of AS 1743 Road Signs Specifications* for Class 1 and Class 2 materials and comply with *AS 1906, Part 1. Raised pavement markers (retroreflective and non-retroreflective).*

9.2.3.3 NON-REFLECTIVE MATERIAL

Non-reflective material specified for figures, letters, symbols and borders shall be of uniform density and compatible with the background material, both in application and durability.

All R5 series parking signs should be fully screen ink printed.

Screening ink shall be a high quality, full gloss, non-fade, non-bleed and scratch-resistant type, compatible with the material to which it is applied. Screening inks shall have durability at least equal to the material to which they are applied.

An alternative to the preferred screen printing is non-reflective sheeting (e.g. vinyl printing) which may be used with authorisation from the City of Sydney. Product details for the non-reflective sheeting (vinyl printing) must be provided to the City for approval. If the use of non-reflective adhesive sheeting is proposed, the Service Provider shall submit full details of the adhesive material methods to be used to the City's Representative for approval.

9.2.4 MANUFACTURE OF SIGNS

9.2.4.1 SIGN BLANKS

(a) Preparation

Sign Blanks shall be one piece except where the sign is of such a size as to require more than one full sheet of aluminium or plastic, in which case a multi-piece sign will be allowed.

The face of each sign blank shall be chemically cleaned and etched or mechanically abraded. The back of each sign blank shall be rendered dull and non-reflective either by mechanical or chemical means and shall be free of scratches and blemishes.

(b) Dimensions and tolerances

Sign Blanks shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth. The dimensions of the sign blanks shall be within +/- 1.5 mm of those specified and the finished sign shall be flat within a maximum allowable bow of 0.005(D) in any direction where (D) is the maximum dimension of the sign blank in any direction.

9.2.4.2 PROVISION FOR MOUNTING SIGNS

(a) Non-reinforced Signs

Non-reinforced signs shall be manufactured with square holes for mounting purposes.

The holes shall be cleanly punched 11mm square to accept 10mm diameter cuphead square neck bolts. Except where specified otherwise, two (2) holes at 520mm centres shall be placed on the nominal vertical centre line, so that the bolt heads do not obscure the legend.

(b) Reinforced signs

For normal use, all large signs over 750mm width (Size C and larger) and narrow signs with a width to height ratio of 2.5 or greater, shall have aluminium reinforcement extrusions fixed to the rear of the sign in accordance with *RMS QA Specification 3400*.

The sign shall be fixed to the sign structure in accordance with RMS QA Specification 3400.

9.2.4.3 FORMS OF LETTERS AND NUMERALS

The requirements for letter styles, shapes and letter heights are specified in *AS 1744 – Forms of Letters and Numerals for Road Signs*. Word and letter spacings are to be as specified on individual drawings. The stroke width of letters and numerals is to comply with *AS 1744 – Forms of Letters and Numerals for Road Signs* and all individual letters are to have neat, clearly defined edges with smooth curves on round letters.

9.2.4.4 RETROREFLECTIVE

(a) Sheet material

Retroreflective sheeting shall be applied in accordance with the manufacturer's instructions with pressure-sensitive adhesive or track-free, heat-activated adhesive and by a method such that it is securely fixed to the sign and the surface is free of any bubbles and blemishes.

(b) Screening ink

Transparent screening ink shall be applied over the retroreflective sheeting by the silk screening process, using the materials and techniques recommended by the sheeting and ink manufacturers. The ink shall be compatible with the background material, both in application and durability.

9.2.4.5 NON-REFLECTIVE

(a) Screening ink

The legend shall be applied by the screen printing process, using the materials and techniques recommended by the ink manufacturer. The legend shall be compatible with the background material, both in application and durability.

9.2.4.6 OVERLAYS OR STICK-ONS

Alterations to signs must not be carried out using overlays and/or stick-ons, nor will signs be produced using second-hand material (e.g. new overlay over old signs), unless otherwise directed and approved by the City's Representative.

9.2.4.7 STREET NAME SIGNS

For layout and colours of standard street name signs, refer to the standard drawings.

9.2.4.8 TRANSPORT AND STORAGE OF SIGNS

Signs shall be packaged and wrapped to prevent damage during storage, transit and handling. Interleaves of suitable material shall be provided between adjoining surfaces.

9.2.5 MANUFACTURE OF SIGN POSTS

9.2.5.1 MANUFACTURE

Sign support structures shall be standard round galvanised posts of 50mm, 65mm or 80mm nominal bore or purpose-designed steel structures as shown on the relevant drawings and manufactured in accordance with the requirements of *AS 1250 - Steel Structures Code.*

Splices in members shall be restricted to a maximum of one splice per member. Splices shall be full penetration butt welds.

All welding shall be in accordance with the requirements of *AS 1554.1.- Structural Steel Welding*.

9.2.5.2 PROTECTIVE TREATMENT

All steel components, including brackets, shall be protected by hot-dip galvanising after all fabrication processes are completed.

Prior to galvanising, the surface shall be treated in accordance with *AS 1627.1 Metal finishing - Preparation and pretreatment of surfaces and AS 1627.4 (Class 2.5 Blast)*.

The steel components shall be finished by the hot-dip galvanising process in accordance with *AS 1650 Metal finishing - Preparation and pretreatment of surfaces - Abrasive blast cleaning of steel* to provide a minimum thickness of 100 microns and a bright finished surface free from white rust and stains.

Splices in standard galvanised posts shall be painted by using a zinc-rich paint in accordance with Appendix G of *AS 1650 Metal finishing - Preparation and pretreatment of surfaces - Abrasive blast cleaning of steel* to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer.

Bolts, nuts, washers and brackets shall be galvanised in accordance with *AS 1214. Hot-dip galvanized coatings on threaded fasteners.*

9.2.5.3 ADDITIONAL COLOUR TREATMENT TO SIGN SUPPORT STRUCTURES

The City's Representative may direct the Service Provider to provide heritage green powder-coated steel posts.

Powder-coating applications shall be applied in accordance with *AS/NZS 4506:1998 Metal Finishing – Thermoset Powder Coatings*.

Prior to powder coating, the Service Provider shall submit a control sample of the proposed treatment for the City Representative's approval. Any unreasonable variation to the control colour sample approved by the City Representative shall be rectified by the Service Provider.

The finished product should be free of defects and smooth over the entire element with consistent appearance over the entire post.

9.2.5.4 CAPS ON TOP OF SIGN SUPPORT STRUCTURES

All new installations of posts are to be fitted with a galvanized post cap. Powder-coated posts should be fitted with a powder-coated post cap.

9.2.6 INSTALLATION OF SIGNS

All signs shall be precisely located and carefully fixed by a specialist tradesperson skilled in this work. Particular care shall be taken to fix all signs at the correct height and position.

The Works shall be carried out with care and practices necessary to prevent any damage to any building or property. In the event that any damage is caused as a result of the failure by the Service Provider to take necessary precautions, the Service Provider shall repair the damage at their own expense.

All components shall be accurately positioned and supported during installation.

9.2.6.1 SETTING OUT

The Service Provider shall set out the work to ensure that all signs and support structures are placed in accordance with the relevant drawings and/or schedule of notices as directed by the City Representative.

Signs shall be installed with a minimum 300mm from face of kerb to edge of sign and a pedestrian height clearance of 2.1m from the base of the sign face to the pavement surface in accordance with *AS 1742.2 Manual of uniform traffic control devices, Appendix D*.

Signs shall be aligned at appropriate angles to the direction of the traffic they are intended to serve in accordance to *AS 1742.2 Manual of uniform traffic control devices, Appendix D*. On curved alignments, the angle of placement should be determined by the course of approaching traffic under the orientation of the road at the point where the sign is located.

9.2.6.2 REPORTING OF OBSTRUCTIONS

Any trees and undergrowth within 3m of the sign support structure and along a motorist's line of sight to the front of the sign shall be noted and advice made to the City's Representative.

9.2.6.3 SIGN STRUCTURE FOUNDATIONS

The foundations for sign support structures shall be as shown on the relevant drawings.

The foundation footings shall be neatly excavated to the depth and width shown on the relevant drawings.

When anchor bolt assemblies are specified, they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure base plates to allow adjustment of the structure after installation.

Concrete placed in the foundations shall be normal class concrete with strength 20MPa in accordance with *AS 3600 Concrete Structures Code* and with a 20mm maximum nominal size of aggregate.

9.2.7 INSTALLATION ONTO GALVANISED POSTS

The top of each post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs.

In multi-post installations, the top of each post shall be at the same level.

During installation, the sign panels shall be suitably supported and braced with the sign face protected from damage. Signs damaged during installation shall be repaired to a standard equivalent to the original sign or replaced by the Service Provider.

Galvanised coatings which are scratched or slightly damaged during installation shall be renovated by using a zinc-rich paint in accordance with Appendix F of *AS 1650 Hot-dipped galvanized coatings on ferrous articles* - to provide a zinc-rich coating of a minimum of 100 microns thick. This method of renovation shall be restricted to areas not exceeding 2500mm^2. Any structure with total damaged coating areas exceeding 2500mm^2 shall be regalvanised by the Service Provider.

9.2.8 CORE DRILLING FOR SIGNPOSTING

The Service Provider may use a core drill to excavate for a pole footing if they are fully aware of the extent of underground infrastructure. The Service Provider is responsible for any service utility damage caused during excavation.

9.2.9 LOCK SOCKETS

Lock sockets are to be used at the base of all sign posts. The Service Provider may be requested to provide a sample of the lock socket prior to installation.

After poles and/or lock sockets are removed, the footpath surfaces are to be repaired to match the existing footpath level.

9.2.10 INSTALLATION ONTO ELECTRICITY OR LIGHT POLES

Installation of signs on steel electrical light poles is to be undertaken using the bandit fastening system and appropriate brackets. No drilling of steel poles is permitted.

9.2.11 INSTALLATION ONTO SMART POLES

Where signage is to be fixed to the main street, smart poles installation shall be in accordance with the *City's Smart Pole Manual*.

9.2.12 TREES

No signs are to be mounted to trees under any circumstances. Attaching a sign to a tree will be considered as vandalism and the Service Provider will be held liable for any damage to the tree.

9.2.13 SPEED REGULATORY SIGNS

All signs with speed limits shall be supplied and installed by the Roads and Maritime Services.

9.2.14 STREET NAME SIGNS

The height, location and orientation of street name signs shall be installed in accordance with *AS 1742.5 Manual of uniform traffic control devices*. Generally, street name signs shall be installed on galvanised poles, installed as detailed above in this Specification.

Where appropriate, street name signs shall be installed on main street smart pole installations to reduce clutter. Where a street name sign is to be fixed to a smart pole, it shall be in accordance with the *City's Smart Pole Manual*.

Street name signs installed on buildings and other structures are to be approved by the City's Representative.

9.2.15 LABELLING SIGNS

All signs shall be clearly and permanently marked with the date and time of installation.

9.2.16 CLEANING OF SIGNS

The Service Provider is required to remove all grime, grease and dust build-up on signs, in order to make all sign markings clearly visible. Where build-up material is removed and sign marking is found to be damaged or faded, the Service Provider is to report the location of damaged sign to the City's Representative.

The removal of build-up material is to be carried out with cleaning agents and tools approved by the City's Representative.

9.2.17 QUALITY

All new signs and poles shall be installed free from scratches, dents and any other defects.
Any signs or posts found by the City's Representative to have defects are to be replaced by the Service Provider.

9.2.17.1 SAMPLE SIGNS

If requested by the City's Representative, a sample of the acceptable standard that will be used for the work will be provided by the Service Provider prior to work commencing. Approved sign samples will be stored at the City of Sydney office and will be regarded as the acceptable standard against which other signs will be compared. These signs will be available for the Service Provider to see upon request.

9.2.17.2 INSPECTIONS

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

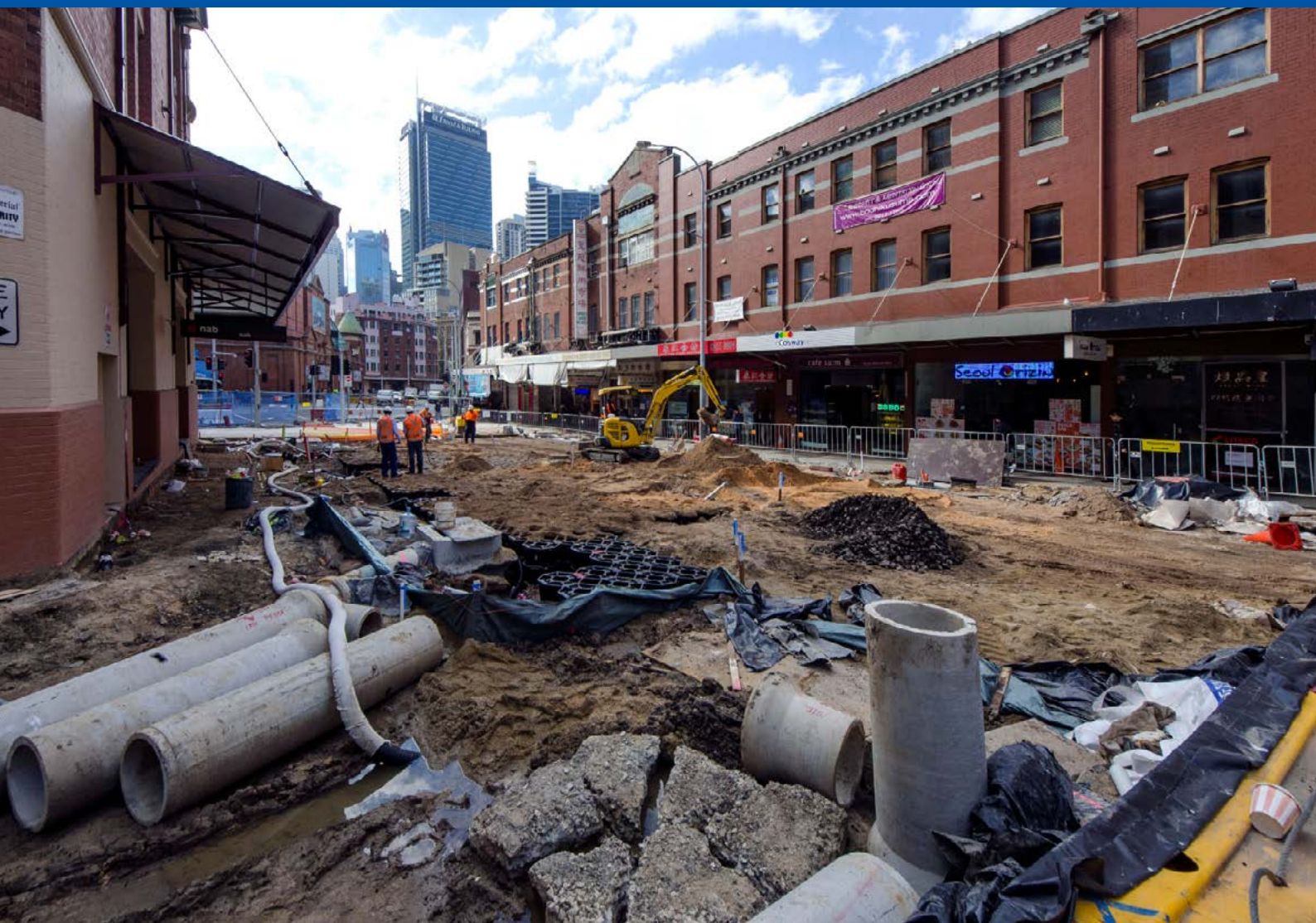
9.2.17.3 HOLD AND WITNESS POINTS

Installation of New Sign	
1. Process Held	Sign Post Setout (Section 9.2.6.1)
Submission Details	At least two (2) day before the new sign posts are set out 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	Construction of Footings (Section 9.2.6.3)
Submission Details	At least two (2) working days prior to construction of footings
Release of Witness Point	The City's Representative will inspect the footings, prior to authorising the release of the Witness Point unless advised otherwise
3. Process Held	Installation of Posts (Section 9.2.6)
Submission Details	At least two (2) working days prior to installations of posts
Release of Witness Point	The City's Representative will inspect the installed posts, prior to authorising the release of the Witness Point unless advised otherwise
4. Process Held	Installing Signs (Section 9.2.6)
Submission Details	At least two (2) working days prior to installing new signs.
Release of Hold Point	The City's Representative will inspect the new signs, prior to authorising the release of the Hold Point
5. Process Held	Installing Signs onto any Structure other than Poles (Section 9.2.6)
Submission Details	At least two (2) working days prior to installing new signs
Release of Hold Point	The City's Representative will inspect the new signs, prior to authorising the release of the Hold Point

9.2.17.4 TOLERANCES

Item	Activity	Tolerances
1.	Setout	• All signs shall be installed within 100mm of the location shown on the construction drawings

B10 Stormwater Drainage Construction



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B10 STORMWATER DRAINAGE CONSTRUCTION

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).

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.

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 ≤ 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 (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 ENCASEMENT

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 (birdsmouthing). Birdsmouthing 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 wielded 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	• Finished horizontal position +/- 50mm from design drawings • Finished vertical position +/- 25mm from design levels • Finished grade +/- 0.5% from design grades greater than 3% and +/- 0.2% from design grades less than or equal to 3%
2.	Manhole, Field Inlet, Property Pit, IO Structure and GPT	• Finished horizontal position +/- 50mm laterally and +/- 100mm longitudinally from the design drawings • Finished vertical position +/- 25mm from both the surface and invert design levels
3.	Inlet Gully	• Finished position of an inlet gully to match the adjacent kerb and gutter both horizontally and vertically

B11
Survey Marks Construction

Contents

B11 SURVEY MARKS CONSTRUCTION

11.1 SURVEY INFRASTRUCTURE

11.1.1 WHAT IS SURVEY INFRASTRUCTURE?

Survey infrastructure includes a variety of structures, monuments, hardware and engraved markings located in the public domain (roads and footpaths), placed by Registered Land Surveyors for various purposes and as required by State Law.

They are generally known within the surveying profession as either:

- Permanent Survey Marks
- Cadastral Reference Marks.

11.1.2 TYPES OF SURVEY INFRASTRUCTURE

Permanent Survey Marks generally consist of a hardware fitting, set into a foundation, in one of the following forms (as prescribed in Schedule 4 of the *Surveying & Spatial Information Regulation 2017*):

- A uniquely numbered brass or stainless-steel disk, set into concrete in the kerb, gutter or footpath (Types 1, 2, 15 and 16 State Survey Marks (SSMs))
- A stainless-steel pin, lead plug or brass bolt, set into a concrete foundation under a steel cover box in the footpath or carriageway, together with a uniquely numbered plate affixed to the underside of the lid (Type 4 Urban (PM)).

The network made up of these items and their spatial positions make up the State Control Survey and also form the basis of the State's cadastral (property boundary and land titling) system, both of which are key elements of the State's infrastructure, supporting billions of dollars of investment, property rights and infrastructure projects.

Cadastral Reference Marks are generally less substantial than Permanent Survey Marks and may be found in one of several forms (as prescribed in Schedules 2 and 3 of the *Surveying & Spatial Information Regulation 2017*), including:

- A drill hole with or without a chiselled wing placed in a kerb, gutter, footpath or wall
- A non-corrodible nail with or without a chiselled wing placed in a kerb, gutter, footpath or wall
- A metal spike, galvanised iron pipe or reinforced concrete block placed below the natural surface (generally within 1m of a property boundary corner)
- A timber peg (usually placed at a boundary corner)
- Alignment pins or stones, set into the kerb, gutter or carriageway
- Any other approved mark, as outlined in the Regulations.

Cadastral Reference Marks support the State's cadastre (property boundary and land title framework) and provide legally traceable evidence of the position of property boundaries.

11.1.3 ACTS, REGULATIONS AND PENALTIES

All items of survey infrastructure (including Permanent Survey Marks and Cadastral Reference Marks) are protected under Section 24 of the Surveying and Spatial Information Act 2002 and penalties of $2,750 per mark may be levied for unlawful damage or destruction. In addition you may also be ordered to pay up to $10,000 in compensation to the State for reinstatement costs and up to $10,000 compensation to any other person towards loss or damage suffered as a consequence of the offence.

In addition to any penalty that may be imposed by the State, the City of Sydney may also levy a fee for recovery, repairs and/or replacement of destroyed marks in accordance with our Revenue Policy.

11.2 PROCEDURES FOR WORKING WITH SURVEY INFRASTRUCTURE

11.2.1 INVESTIGATION FOR SURVEY INFRASTRUCTURE

Early investigation for survey infrastructure is advised. If possible, the information should be available at the design stage of development to enable identification of possible conflicts and to prevent possible delays to the project and/or fines being imposed for illegal mark destruction.

At least four (4) weeks prior to the commencement of any works on site, the service provider must engage a Registered Surveyor to investigate the "works zone" (comprising the site itself and the adjoining public domain within five (5) metres of each side of the site frontages and all other areas where works are likely to be undertaken) for the presence of survey infrastructure.

The investigation must consult all relevant Deposited Plans on public record and include all existing:

i) Cadastral Reference Marks (boundary or reference marks) as defined in Schedules 2 and 3 of the Surveying and Spatial Information Regulation 2017

ii) Permanent Survey Marks as defined in Schedule 4 of the Surveying and Spatial Information Regulation 2017

iii) City of Sydney alignment marks (a brass bolt, or a lead plug holding a brass tack, covered by a cast iron box and used to define the alignment of a street), whether or not it is registered as a Permanent Survey Mark in the Survey Control Information Management System operated by NSW Spatial Services.

iv) Walls, buildings or other survey monuments shown on Deposited Plans on the public record.

At the conclusion of the investigation and at least two (2) weeks prior to the commencement of any works on site, the following documentation (in digital or hard copy format) must be supplied to the City's Surveyors:

i) A copy of a current detail survey plan clearly showing the extents of the "works zone" and all survey infrastructure within clearly shown in red; OR

ii) A line plan prepared and signed by a Registered Surveyor clearly showing property boundaries, the extents of the "works zone" and all survey infrastructure within clearly shown in red.

This documentation shall be supplied together with a letter, signed by a Registered Surveyor, stating either:

i) That all existing survey infrastructure has been accurately identified on the plan and collected to sufficient accuracy to enable preparation of a Plan of Survey Information or to recover the marks if necessary; OR

ii) That there is no survey infrastructure within the "works zone".

An exemption from this requirement will be permitted where this information has already been obtained and supplied to the service provider by the City's Surveyors.

11.2.2 PRESERVATION OF SURVEY INFRASTRUCTURE

Under Section 24 of the *Surveying and Spatial Information Act 2002*, it is an offence to remove, damage, destroy, displace, obliterate or deface any survey mark unless authorised to to so by the Surveyor-General. Accordingly, all works within the "works zone" must, where possible, ensure the preservation of existing survey infrastructure, undisturbed and in its original state.

Where survey infrastructure has been identified in the "works zone" and may be destroyed or disturbed by the proposed works, the service provider must engage a Registered Surveyor to ensure that:

i) For all Permanent Survey Marks, City of Sydney alignment marks and Cadastral Reference Marks, that all requirements of *Surveyor-General's Direction No.11 – Preservation of Survey Infrastructure* are complied with, including obtaining all relevant approvals and complying with those procedures that are appropriate to the project.

ii) In addition to this, for all City of Sydney Permanent Survey Marks and alignment marks, at least 14 days prior to the commencement of any works in the public domain within one (1) metre of a City of Sydney alignment mark, contact must be made with the City's Surveyors (surveyors@cityofsydney.nsw.gov.au). If a mark cannot be retained undisturbed and in its original position, then the City's Surveyors will determine an acceptable replacement method, including whether the Contractor or the City will undertake the replacement work, in whole or in part. A fee must be paid to the City for any work it undertakes in relation to the replacement of any such alignment mark removed, damaged or disturbed, in accordance with the City of Sydney's schedule of Fees and Charges.

At the completion of works, all documentation required by an approval granted under *Surveyor-General's Directions No. 11 – Preservation of Survey Infrastructure* is to be submitted to the Surveyor-General (and/or registered at NSW Land Registry Services) and a copy of the same submitted to the City's Surveyors in one of the following forms:

i) A written statement prepared by a Registered Surveyor verifying that all requirements under the *Surveyor-General's Direction No.11 – Preservation of Survey Infrastructure* have been met and that all required documentation (sketch plan, proof of position documents, etc.) has been forwarded to the appropriate authority, together with copies of said documentation

ii) A registered copy of any Plan of Survey Information Only (or any other Deposited Plan) prepared to satisfy an approval by the Surveyor-General to remove survey marks

iii) A letter, signed by a Registered Surveyor stating that all survey infrastructure within the designated zone has been retained undisturbed.

11.2.3 WORKING NEAR SURVEY INFRASTRUCTURE

Due to the nature of survey infrastructure and its sensitivity to disturbance, works must be undertaken near any item of survey infrastructure with caution and every effort made to prevent disturbance. Accordingly, the following clearances must be adhered to when excavating or operating plant:

500mm when operating pneumatic tools (jackhammers, vibrating plates, and the like)

1000mm when operating mechanical excavators.

11.3 MATERIALS

11.3.1 PERMANENT SURVEY MARKS

11.3.1.1 PERMANENT SURVEY MARK COVER BOXES

Permanent survey mark cover boxes are installed over a sub-surface mark to preserve it from damage or deterioration due to traffic loading, impact, weathering and other causes of degradation. They may be exposed to heavy traffic loads including repetitive bus and truck movements and therefore need to be solid, yet remain easy to open with a hammer and cold chisel.

The acceptable design of a cover box is generally flexible and the location (carriageway versus footway) will dictate the standard required; however, the following specifications must be met (see Diagram 8.1.1):

- The axle holding the lid to the frame should be made of stainless steel to inhibit rusting and must be strong enough to avoid bending under the expected traffic loads.
- The seat on which the lid will rest must be solid enough to withstand the expected traffic loads (carriageway or footway). For lids installed in the carriageway, a minimum of 10mm contact is to be provided all round between the underside of the lid and the frame seat, to prevent the lid sinking into the frame.
- The fit should be reasonably loose to prevent the unit seizing shut. A gap of 2mm to 3mm between the lid and the frame should be allowed for on all sides when in the closed position.
- The top of the lid must sit flush with the top of the frame in the closed position. The lid must have a pattern applied to reduce slip and have “SURVEY” or “COS SURVEY” or similar stamped on the upper face.
- The base of the unit must have a 20mm to 30mm flange to aid stability.
- A lip should be incorporated at the back of the hinge to reduce ingress of dirt.
- A 25mm to 30mm wide slot should be provided in both the base and the lid to enable the unit to be opened with a hammer and cold chisel.
- The internal opening of the unit is to be a minimum of 150mm x 150mm.
- Allowance must be made to enable the fixing of a standard permanent mark number plate (approx. 95mm x 20mm) to the underside of the lid with the following specifications:
    - Two 6.5mm drilled holes at 76mm centres, to a depth of 15mm.
    - Both holes tapped to 6.5mm metric gauge to maximum depth possible.

Existing cover boxes are of various ages and sizes. The three most common sizes (in terms of height) are 70mm, 100mm and 120mm. It is imperative that like be replaced with like where possible to avoid damage to the mark foundations. For marks that don’t match these three sizes, the use of steel packing (in either 5mm or 10mm increments as necessary) or bricks is permitted to ensure that the final surface level of the box matches the surrounding road or footpath level.

11.3.1.2 PERMANENT SURVEY MARK COVER BOX SUPPLIERS

Any service pit lid manufacturer who can meet the above specifications will be deemed an acceptable supplier.

For cover boxes that are to be installed in the footway and will not be subject to high volume vehicle loading, suitable cover boxes may be obtained from the NSW Spatial Services offices at Level 14 of the McKell Building, 2-24 Rawson Place, Haymarket, NSW 2000.

11.4 CONSTRUCTION AND INSTALLATION OF PERMANENT SURVEY MARKS

This section provides guidelines for the replacement of Permanent Survey Mark cover boxes and for the construction of new Permanent Survey Mark foundations. Each mark consists of:

- A suitable foundation material, such as a discrete concrete block, a concrete slab or bedrock
- A lead plug, brass bolt or stainless-steel pin set into this foundation
- A steel cover box centred over the plug, bolt or pin
- A brass number plate affixed to the underside of the cover box lid.

In the course of undertaking any works on a Permanent Survey Mark, it is critical that:

- The bolt or pin and foundation is not disturbed
- The number plate remains with the pin (i.e. it is removed from the old box and installed on the new one).

11.4.1 REPLACEMENT OF LID (EXISTING MARK TO BE RETAINED)

The Contractor will be expected to:

- Obtain all relevant authorisations, permits and DBYD search and the like necessary to complete the task at each location.
- Procure replacement cover boxes that meet the supplied specifications.
- Check that the numberplate specified in the brief matches the installed numberplate and report any discrepancies to the City's Surveyors.
- Replace lids and make good surrounds in all surfaces, including but not limited to bitumen, concrete and granite.
- Ensure lids are seated on a concrete base to ensure stability and prevent ingress of dirt and the like.
- Ensure that the upper surface of installed lids is level with the surrounding surface to prevent trip hazards.
- Ensure lids are centred over each mark, so that when the box is opened, the mark below remains accessible.
- Ensure lids are rotated so that the hinge side of the box is nearest to oncoming traffic.
- Remove the brass numberplate from the old box and affix it on the underside of the new box. The contractor should use existing screws where possible or new screws will be supplied by the City's Surveyors on request.
- Remove and dispose of existing lids and spoil.
- Report to the City's Surveyors after each day's work with the following information:
- List of marks successfully replaced.
- Any problems encountered (e.g. bolt or pin missing, numberplate mismatch with supplied information)
- Make good any defects at own expense.

11.4.2 CONSTRUCTION OF NEW PERMANENT SURVEY MARKS

The Contractor will be expected to:

- Obtain all relevant authorisations, permits and DBYD search and the like necessary to complete the task at each location.
- Procure cover boxes that meet the supplied specifications.
- Install footings or foundations that meet the supplied specifications.
- Install lids and make good surrounds in all surfaces, including but not limited to bitumen, concrete and granite.
- Ensure lids are seated on a concrete base to ensure stability and prevent ingress of dirt and the like.
- Ensure that the upper surface of installed lids is level with the surrounding surface to prevent trip hazards.

- Ensure lids are centred over marked set out point (locations to be marked and identified appropriately by the City's Surveyors).
- Ensure lids are rotated so that the hinge side of the box is nearest to oncoming traffic.
- Remove and dispose of spoil.
- Report to the City's Surveyors after each day's work with the following information:
  - List of lids successfully installed.
  - Any problems encountered.
- Make good any defects at own expense.

11.4.3 RAISING A COVER BOX OVER AN EXISTING MARK

The Contractor will be expected to:

- Obtain all relevant authorisations, permits and DBYD search and the like necessary to complete the task at each location.
- Procure cover boxes that meet the supplied specifications, or if the existing cover box is deemed functional, remove this and set aside for re-use. The numberplate on the underside of the lid is a unique identifier and must remain with the same mark. If a lid needs to be replaced, unscrew the numberplate from the old box and fit it to the underside of the new one.
- Hand excavate to the concrete block containing the survey mark, taking care that the block and pin remain undisturbed.
- Place a vertical 150mm diameter plastic pipe on the concrete block so that the survey mark is in the centre of the pipe.
- Concrete or grout the outside of the plastic pipe to the concrete block.
- Fill the hole (but not the pipe) with road base or a similar buffer course up to the underside of the cover box and tamp firmly to ensure minimal settling under traffic loading.
- Trim the top of the pipe to approximately 10mm above the upper surface of the buffer course (or underside of the cover box).
- Install lids and make good surrounds in all surfaces, including but not limited to bitumen, concrete and granite.
- Ensure lids are seated on a concrete base to ensure stability and prevent ingress of dirt and the like.
- Ensure that the upper surface of installed lids is level with the surrounding surface to prevent trip hazards.
- Ensure lids are rotated so that the hinge side of the box is nearest to oncoming traffic.
- Remove and dispose of spoil.
- Report to City Surveyors after each day's work with the following information:
  - List of lids successfully installed.
  - Any problems encountered.
- Make good any defects at own expense.

CONTACTS

General contact:
Surveyors@cityofsydney.nsw.gov.au

Erol Tekin (Survey Technician)
ph.: (02) 9265 9134 email: etekin@cityofsydney.nsw.gov.au

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B12
Road Opening and Restoration

Contents

B12 ROAD OPENING AND RESTORATION

12.1 INTRODUCTION

This Road Opening and Restoration specification sets out quality and intervention standards for restoring civil infrastructure assets.

It stipulates quality specifications, measurements and tolerances. If work does not conform to the quality specifications, we will deem it unsatisfactory and ask the service provider to rectify it.

If a quality specification for a particular type of work or material is not detailed in this document, then industry best practice applies.

You can amend a specification for a particular project only if you have agreement from us before work starts. City of Sydney may also amend a specification when assessing the quality of a particular project.

Please read this chapter alongside the other chapters in the City's Sydney Streets Technical Specifications and Standard Drawings.

We may review and update this document from time to time. If you are unsure about this document and its requirements, please contact City of Sydney.

12.2 STANDARDS AND GUIDELINES

Unless stated otherwise in this document, work must comply with current Australian Standards and Roads and Maritime Services (RMS) Standards.

If you find any variations or ambiguity between this document and these standards, please check with a City officer for approval before starting work.

The table below shows the main Australian Standards and RMS Standards that apply to this section.

RMS QA M208	Road Openings and Restoration (Low Risk)
RMS QA M209	Road Openings and Restoration
AUS-SPEC 1152	Road openings and restorations (Utilities)
AS 1742.3	Traffic control
AS 2150-2005	Asphalt Mix-Guide to best practice
RMS Specification M211	Crack sealing
RMS QA 3201	Concrete for Maintenance;
RMS QA 3204	Joint Fillers for Concrete Pavement and Structures;
Local Government Act 1993	Sections 101 ,142 and 146

12.3 RESTORATION SCOPE – SPECIAL REQUIREMENTS

12.3.1 HERITAGE SPECIFICATIONS

Each local government area has different requirements to protect and preserve heritage items. If your work site is near a heritage item, you must check the City of Sydney's requirements before work begins.

Heritage elements include:

a) Footpaths with the names of streets or local features
b) Footpaths and kerbs constructed from brick
c) Kerb stones made of sandstone, trachyte or blue stone
d) Kerb stones with street names
e) Brick barrel pipe drains
f) Sandstone retaining walls
g) Brick retaining walls
h) Plaques, memorials and public art
i) Heritage and significant trees
j) Timber pavements.

12.4 TEMPORARY RESTORATION

12.4.1 EXCAVATION OF ROAD OPENING

Before excavation, you must have:

- A road opening permit
- DBYD for locating of the underground service
- A traffic control plan
- A road occupancy permit from RMS if relevant.

You must send us photographic evidence of the state of the footway or road before work starts. This should be a minimum of:

- Three photos showing a close-up of the work area
- Two long shots from either end of the work.

Contractors must ensure the embankments of the excavation are safe and stable or provide an adequate shoring system to secure these.

The completed sides of the excavation must be straight, vertical and neatly trimmed. Ends of trench excavations must be square to the line of the trench.

The width of the trench will be agreed on site with the City's representative.

The excavated area must be appropriately and adequately secured to prevent unauthorised access while work is in progress.

You must remove all surplus excavated material from the site after works are complete.

Any assets such as permanent survey marks found in the footway or roadway during the work shall be protected. Permanent survey marks are protected by legislation and if there is a possibility of interference with such marks, prior contact must be made with the relevant public authorities, e.g. land and property information NSW and or the Council.

Particular care must be taken to protect street trees and heritage items within the work area and to observe all environmental conditions under which the work has been authorized.

Where temporary steel plates are to be used, very particular attention is to be given to avoid trips or hazards for both pedestrians and cyclists. The surface of steel plates should be treated to ensure a level of roughness (friction) is maintained to minimise accidents for motorcycles and pedal cyclists.

If steel plates are to be used, or the trench depth is greater than 500mm, shoring may be required. In this instance, reference shall be made to RMS QA Specification M209 - Road Opening and Restoration, Clauses 2.4-2.6.

All requirements for traffic control must comply with AS 1742.3 and the RMS manual for traffic control at the workplace. This will include pedestrian and vehicular traffic.

A prominent sign shall be displayed identifying the contractor or body responsible for the work. A 24-hour contact phone number should be provided on the sign. Similarly, 24-hour contact phone numbers should be provided to and obtained from the Council.

12.4.2 BACKFILLING

Excavated material should not be used under any circumstances.

Placing of suitable material and compaction shall be carried out strictly in accordance with the B2: Earthworks Construction. Refer to City of Sydney standard drawings 9.1.1–9.1.4.

Sand filling around the services shall be compacted to the requirement of the Utility Authority.

Sand/cement filling above the service shall be thoroughly compacted in layers not exceeding 150mm in thickness, using appropriate equipment such as a vibrating plate or a roller where the width of trench permits.

For backfill above the protective layer of a buried utility or services or pipe, place and compact the backfill material as follows:

Sand/cement mix plant mixed material up to the temporary wearing surface shall be placed and compacted using at least three passes with a vibrating plate compactor.

Sand/cement mix for road pavement and driveways is 8:1. The sand/cement mix for footpaths is 14:1.

Any natural seepage zones shall not be cut off by the impervious sand/cement material. Natural seepage shall be provided for by the provision of a pervious drainage layer or subsoil drainage.

12.4.3 FINAL LAYER

Place and compact minimum 50mm of asphalt (cold mix temporarily if unavailable) to match the existing surface. Any loose material must be swept away.

12.5 PERMANENT RESTORATION

12.5.1 ROAD PAVEMENT – FLEXIBLE

Prior to excavation, sawcut to the dimensions shown in the "Permanent Restoration Minimum Area Definition" in Annexure A.

Temporary cold mix/asphalt shall be removed to subgrade level and the surface levelled and compacted.

- The type, thickness and required compaction of the reinstated subbase is specified in Drawing 9.1.3 of the City's standards drawings.
- Backfill material must have adequate moisture to achieve the specified compaction. Moisture must be uniformly distributed within each layer at the time of compaction.
- The thickness of the asphalt wearing course is to be at least the same thickness wearing course of the existing pavement.
- The asphalt pavement material types are to match the existing pavement.
- All edges to the restoration are to be square or perpendicular to the path of travel and generally in accordance with Annexure A.
- Preparation of pavement must be completed prior to tack coating and placing asphalt and must include cleaning the surface so that it is free of loose stones, dirt or foreign material.
- Prior to laying asphalt, apply a tack coat to the vertical sides and bottom (i.e. over the restored road base or concrete base course) of the pavement restoration.
- The asphalt layer thicknesses, laying temperatures and compaction shall be completed to the requirements of AS 2150-2005 Hot mix asphalt – A guide to good practice.
- Compaction must be a continuous operation and must commence as soon as practicable after spreading the new material. The full depth of the material must be compacted over the entire area of placement. Uniformly compact each layer before the next layer is commenced. No surface indentations are permitted after compaction.
- Joints and edges must be compacted to avoid reduced density along the edges of the pavement restoration.
- All cold joints shall be sealed with a 50mm wide bitumen joint seal in accordance with RMS specification M211.
- Any permanent restoration of flexible pavements shall be in accordance with City of Sydney standard drawing 9.1.3.
- Joints must be constructed by:

i) Removing uncompacted or cracked material along the edge of the adjoining existing pavement prior to placing asphalt adjacent to the edge.

ii) Providing a positive bond by tack coating to the adjoining pavement material.

12.5.2 ROAD PAVEMENT – RIGID PAVEMENT

Prior to excavation, sawcut to the dimensions shown in the "Permanent Restoration Minimum Area Definition". Additionally, temporary cold mix/asphalt shall be removed to subgrade level and the surface levelled and compacted. Note as follows:

- The type, thickness and required compaction of the reinstated subbase is specified in the City's standards drawing 9.1.3.
- The thickness of the concrete pavement is to match the existing pavement thickness.
- Place reinforcement mesh using bar chairs to which it is tied and above tie bars and dowels.
- Provide at least 50mm top cover to the mesh.
- Horizontally termination is at 50mm from joints or slab edges.
- N12 tie bars shall be used at 600mm intervals (construction joints).

- N12 tie bars shall be installed with the debonded end on one side as per Council's technical specification (expansion joints).
- Place and spread concrete (minimum 40MPa) into its final position using shovels. Internal vibrators should not be used to spread concrete.
- The finished surface must match the surface of the adjoining concrete pavement slab. Neatly trim all joints with adjoining slabs.
- All expansion and control joints shall match existing joints.
- Immediately after finishing and texturing, apply a sprayed film of curing compound, so as to form a continuous uniform and unbroken film.
- Where possible, cover the concrete surface with plastic sheeting immediately after applying curing compound to minimise temperature losses and related cracking. Covers must be secured and weighed down to prevent trip hazards and air movement under the cover.
- Protect newly placed concrete from damage at all times until the road is reopened to traffic.
- The finish of the concrete pavement is to match the finish of the existing pavement for texture, pattern, colour and joint pattern. Wearing course on rigid road pavement should be minimum three times the size of the stone.
- Any permanent restoration of the rigid pavement shall be in accordance with City of Sydney standard drawing 9.1.3.

12.5.3 FOOTPATH

Prior to excavation, sawcut to the dimensions shown in the "Permanent Restoration Minimum Area Definition". Additionally, temporary cold mix/asphalt shall be removed to subgrade level and the surface levelled and compacted.

Note as follows:

- The thickness of the concrete pavement is to match the existing pavement thickness.
- The type, thickness and required compaction of the reinstated subbase is specified in City of Sydney standard drawing 9.1.2.
- Concrete strength, expansion joints and control joints should be in accordance with Council's Technical Specifications.
- Any permanent restoration of the footpaths shall be in accordance with City of Sydney standard drawing 9.1.2.

12.5.4 VEHICULAR CROSSINGS

- Subgrade and subgrade preparation are the same as for the footpath (see 12.5.3 above)
- For Single Residential, use 32MPa concrete and 150mm thick with SL82.
- For Multi Residential, use 32MPa concrete and 200mm thick with SL 82.
- For Commercial, use 32MPa concrete and 250mm thick with SL 82 (two layers)
- Refer to standard drawings 2.2.10, 2.3.9, 2.4.6-2.4.8, 2.5.5-2.5.7, 2.6.8 for more guidance.

12.5.5 KERB AND GUTTER

Refer to standard drawing 1.1.16 for more guidance.

12.5.6 VERGES AND LANDSCAPE AREAS

Backfill material must be material that can pass through a 75mm sieve and not contain any organic or deleterious material or reactive clay. In landscape areas, topsoil should be placed on the subgrade to the same thickness as the surrounding topsoil.

Backfilling, for a minimum 300mm thickness, around tree roots should be made of a topsoil mixture, placed and compacted in layers of 150mm depth to a dry density equal to that of the surrounding soil.

No backfill shall be placed above the natural ground surface around a tree trunk or over the root zone unless approved by the Council's officer.

Notes

i) Any line marking and RPMs removed to conduct the utility work shall be reinstated.

ii) Service manholes shall be replaced flush with final surface levels.

iii) Reinstated pavers shall be set on the new base in the same pattern, level and finish to match existing pavers.

iv) Where pavers were mortared to the base, they should be reinstated on a mortar bed.

v) The thickness of the concrete pavement is to match the existing pavement thickness.

vi) Where the existing footpath or cycleway is reinforced, reinstate the pavement using SL72 reinforcement. Where the existing pavement is fibre-reinforced concrete (FRC), reinstate the pavement with FRC.

vii) The asphalt colour coating and pattern is to match the existing pavement.

viii) Reinstated pavers are to match the existing paver colour and texture and be set on the new base in the same pattern, level and finish to match the existing surface pattern. If the paver cannot be matched, paver selection shall be in consultation with Council.

ix) Where pavers were mortared to the base, they should be reinstated on a mortar bed.

x) Tiles are to be reinstated on a rigid concrete base slab with sawcuts in the base slab to align precisely with tile joints. Tile joints in the base slab are to be filled using a flexible silicon joint sealer.

xi) Any signs or street furniture removed to conduct the utility work should be reinstated.

xii) The finish of the kerb, gutter and dish gutter concrete surface should be a steel trowel finish.

xiii) The kerb ramp finish should match the existing pavement for texture, pattern, colour and joint pattern.

xiv) Where concrete work abuts asphalt paving, an asphalt restoration 0.5m wide shall be undertaken along the concrete edge.

xv) Where the existing vehicular crossing is reinforced, reinstate the pavement using one layer of SL72 reinforcement mesh for residential properties, a layer of SL82 reinforcement mesh for residential flat buildings and two layers of SL82 reinforcement mesh for commercial properties.

12.5.7 ROAD PAVEMENTS WORK QUALITY SPECIFICATIONS

Table 12.5.7.1 – Road Pavements – Flexible (Asphaltic Concrete)

	Quality Specifications	Tolerance
1	Restoration has clean unbroken edges along the trench or patch	<5% (not continuously) of the length of the trench has edge breaks
2	Reinstatement surface levels along the edge are flush with the adjacent pavement	No step greater than 5mm
3	The shape of the reinstatement surface matches the road cross section	*The restoration follows the existing road cross section profile to within ±10mm *The work does not create vehicular scraping at vehicular crossings
4	No depression in the restoration surface	Departure of surface from a taut string lineplaced across the trench does not deviate by ±10mm
5	The restoration wearing course is free of rutting	<1% of restoration affected and not greater than an area exceeding 10m^2
6	The restoration wearing course is free of ravelling	<1% of restoration affected and not greater than an area exceeding 10m^2
7	The restoration wearing course is free of shoving	<1% of restoration affected and not greater than an area exceeding 10m^2
8	The restoration wearing course is free of potholes	100% compliance
9	The restoration wearing course is free of cracks wider than 1mm	*No single crack longer than 0.5m *No block cracking or crocodile cracking
10	The restoration asphaltic concrete wearing course specification matches the existing wearing course surface	*Aggregate size matches adjacent pavement
11	No joint separation between the new and existing asphalt	Width of joint not to exceed 2mm
12	Pavement markings including RPMs are reinstated to the same standard and as per the removed pavement markings	100% compliance
13	Signal detectors are reinstated correctly including sealant	100% compliance
14	The service manholes are seated flush with the road surface	No step greater than 5mm on a constant grade
15	All sign posts removed during the work are reinstated	100% compliance

Table 12.5.7.2 - Road Pavements - Rigid
(Plain Concrete, Coloured Concrete, Patterned Concrete or Asphaltic Concrete Surface)

	Quality Specifications	Tolerance
1	Restoration has clean sawcut edges along the trench or patch	<5% (continuously) of the length of the trench has an edge break of greater than 30mm
2	Surface levels along the edge are flush with the adjacent pavement	No step greater than 5mm
3	The shape of the trench follows the road cross section	*The restoration follows the existing road cross section profile to within ±10mm *The work does not create vehicular scraping at vehicular crossings
4	No depression in the restoration surface	When measured with a 3m straight edge across the trench, departures are less than ±10mm
5	The restoration surface finish matches specifications and/or adjacent concrete surface finish	90% compliance
6	The restoration surface is free of cracking	<1% of restoration affected and crack length not to exceed a total length of 25m
7	Severity of cracks present is moderate	Width of cracks does not exceed 3mm
8	Concrete joints are present as per the existing surface specifications including placement of an elastic sealant	90% compliance and <1% of joint seal defective
9	Concrete surface is free of dusting	90% compliance
10	No spalling at joints and cracks	<5% of spalling of up to 30mm in size throughout restoration
11	Concrete strength specification is adequate	Certificates provided to confirm the use of 32MPa concrete as per RMS specifications
12	Pavement markings including RPMs are reinstated to the same standard and as per the removed pavement markings	100% compliance
13	Signal detectors are reinstated correctly including sealant	100% compliance
14	All sign posts removed during the work are reinstated	100% compliance

Table 12.5.7.3 - Road Pavements - Segmental Paving Surface

	Quality Specifications	Tolerance
1	Surface levels where restoration meets existing road surface are flush with adjacent road levels	No step greater than 5mm
2	The shape of the reinstatement surface follows the road cross section	*The restoration follows the existing road cross section profile to within ±5mm *The work does not create vehicular scraping at vehicular crossings
3	No depression in the restoration surface	When measured with a 3m straight edge across the trench, departures are less than ±5mm
4	The reinstated paver matches the adjacent pavers	*90% compliance *100% where matching pavers available
5	Concrete base layer is reinstated	100% compliance
6	Pavers installed on a mortar bed are reinstated on a mortar bed	100% compliance
7	Joints are grouted as per the existing paving surface	<5% of joints have spalling mortar joints
8	No broken, cracked or painted pavers placed in the restored area	100% compliance
9	Any pre-existing joints including elastic sealant are reinstated	100% compliance
10	Paving adjacent to kerb and gutter is finished flush	No step greater than 5mm
11	Service manholes are installed flush with the surface	No step around the manhole greater than 5mm
12	Pavement markings including RPMs are reinstated to the same standard and as per the removed pavement markings	100% compliance
13	Signal detectors are reinstated correctly including sealant	100% compliance

12.5.8 FOOTPATHS WORK QUALITY SPECIFICATIONS

Table 12.5.8.1 - Footpaths and Cycleway - Concrete

	Quality Specifications	Tolerance
1	Full width slab is restored where existing footpath width is less than or equal to 1.5m, or remaining width is less than 1m	100% compliance
2	The footpath has a cross fall gradient of 2.5% towards road carriageway	Match existing
3	The footpath cross fall gradient does not exceed 5%	Match existing
4	Expansion joints are present at the extent of work and at 12m (max) spacing longitudinally	100% compliance
5	The reinstatement has clean sawcut edges	<2% of the length of the trench has an edge break of greater than 30mm
6	The surface levels where the reinstatement meets the existing footpath are flush with adjacent footpath	No step greater than 5mm
7	No water ponding on the footpath surface unless at a sag point	90% compliance
8	The surface finish is a broom finish or wooden float finish in direction of longest edge.	100% compliance
9	Transverse contraction joints (dummy joints) are installed at the lesser of 6m or 1.5 times the pavement width spacings	90% compliance
10	Concrete surface is free of dusting	90% compliance
11	No spalling at joints	<5% of spalling of up to 30mm in size throughout restoration
12	Concrete strength specification is adequate	Certificates provided to confirm the use of 32MPa concrete
13	The restoration surface is free of cracking	<1% of restoration affected
14	Severity of cracks present is moderate	Width of cracks does not exceed 2mm
15	The restoration work has not damaged adjacent property fencing, paving or tiled steps	100% compliance
16	Service manholes are installed flush with the surface	No step around the manhole greater than 5mm
17	The nature strip or boundary strip adjacent to a new concrete footpath or cycleway is backfilled and matches the top of the new concrete surface	No step greater than 10mm
18	The extent of disturbed nature strip or boundary strip is reinstated with turf rolls and the turf established. Note: "When reinstating disturbed nature strips consideration should be given to an integrated water-sensitive urban design (WSUD). The design should including an integrated approach for stormwater, groundwater and wastewater management and water supply, to minimise environmental degradation and improve aesthetic and recreational appeal"	100% compliance

Table 12.5.8.2 - Footpaths and Cycleways - Segmental Pavers

	Quality Specifications	Tolerance
1	Surface levels where the reinstatement meets the existing footpath are flush with adjacent footpath	No step greater than 2mm
2	The footpath has a cross fall gradient of 2.5% towards road carriageway	Matching
3	Footpath cross fall gradient does not exceed 5%	Matching
4	Existence of expansion joints at extent of work and at 12m (max) spacing	100% compliance
5	Concrete base layer is reinstated	100% compliance
6	Pavers installed on a mortar bed are reinstated on a mortar bed	100% compliance
7	Joints are grouted as per the existing paving surface	<5% (not continuous) of joints have spalling mortar joints
8	No broken, cracked or painted pavers placed in the restored area	100% compliance
9	A sealant is applied if adjacent surface is sealed	100% compliance
10	No depression in the restoration surface	When measured with a 3m straight edge in both directions, departures are less than ±5mm
11	Any pre-existing joints including elastic sealant are replaced	100% compliance
12	Paving adjacent to kerb and gutter is finished flush	No Step greater than 2mm
13	Restoration work has not resulted in damage to adjacent private property assets	100% compliance
14	Service manholes are installed flush with the surface	No step around the manhole greater than 2mm
15	The nature strip or boundary strip adjacent to a new concrete footpath or cycleway is backfilled to match the top of the new concrete surface	No step greater than 10mm
16	The extent of disturbed nature strip or boundary strip is reinstated with turf rolls and the turf established	100% compliance
17	Asphalt around power poles is reinstated	100% compliance
18	Street furniture is reinstated	100% compliance
19	Sign posts are reinstated	100% compliance

Table 12.5.8.3 - Footpaths and Cycleways - Asphaltic Concrete

	Quality Specifications	Tolerance
1	Full width footpath is restored where existing footpath width is less than or equal to 1.5m, or remaining width is less than 0.60m	100% compliance
2	The restoration has clean unbroken edges along the trench	<5%(continuous) of the length of the trench has edge breaks
3	Surface levels along the reinstated edge are flush with the adjacent pavement	No step greater than 2mm
4	The shape of the trench cross section follows the footpath cross section prior and following the work	*The restoration follows the existing footpath cross section profile to within ±10mm *The work does not create vehicular scraping at vehicular crossings
5	No depression in the restoration surface	Departure of surface from a taut string line placed across the trench does not deviate by ±10mm
6	The restoration surface is free of rutting	<1% of restoration affected and not greater than an area exceeding 10m^2
7	The restoration surface is free of raveling	<1% of restoration affected and not greater than an area exceeding 10m^2
8	The restoration surface is free of shoving	<1% of restoration affected and not greater than an area exceeding 10m^2
9	The restoration surface is free of potholes	100% compliance
10	The reinstated wearing course is free of cracks wider than 1mm	No single crack longer than 0.5m No block cracking or crocodile cracking
11	The restoration asphaltic concrete stone specification matches the existing surface	Aggregate size matches adjacent pavement
12	No joint separation between the new and existing asphalt	Width of joint does not exceed 2mm
13	Pre-existing line marking is reinstated using the same type of materials	100% compliance
14	Outdoor dining markers (other councils use brass plates) are reinstated	100% compliance
15	The nature strip or boundary strip adjacent to a new concrete footpath or cycleway is backfilled and matches the top of the new concrete surface	No step greater than 5 mm
16	The extent of disturbed nature strip or boundary strip is reinstated with turf rolls and the turf established	100% compliance
17	Service manholes are installed flush with the footpath surface	No step greater than 2mm
18	All sign posts removed during the work are reinstated and orientated correctly	100% compliance
19	Signs damaged during the work are replaced	100% compliance

Table 12.5.8.4 - Footpaths - Kerb Ramps

	Quality Specifications	Tolerance
1	Kerb ramp profile matches council specification, Australian standards and provisions of the Disability Discrimination Act 1992	100% compliance
2	Existing tactile paving is reinstated	100% compliance
3	The kerb ramp surface matches other kerb ramps in the footpath segment	100% compliance

Table 12.5.8.5 - Footpaths - Stairs

	Quality Specifications	Tolerance
1	Step treads and risers comply with the Australian Standards	100% compliance
2	The full flight of stairs is replaced	100% compliance
3	Concrete strength specification is adequate	Certificates provided to confirm the use of 32MPa concrete
4	The handrail is reinstated using the same material and complies with the Australian Standards for location and height	100% compliance

Table 12.5.8.6 - Footpaths - Unformed Grass Surface

	Quality Specifications	Tolerance
1	Surface levels where restoration meets existing unformed footway are flush	No step greater than 5mm
2	Surface is top dressed, turfed using turf rolls and established for the entire disturbed area	100% compliance
3	No depression in the restoration surface	The deviation from a 3m straight edge placed across the restoration in both directions does not vary by ±20mm

12.5.9 KERB AND GUTTER

Table 12.5.9.1 – Kerb and Gutter – Integral Concrete

	Quality Specifications	Tolerance
1	The height and profile of the kerb and gutter is uniform and consistent with Council specifications	95% compliance
2	The height and profile of the layback is uniform and consistent with Council specifications	95% compliance
3	The surface finish is a steel float finish	100% compliance
4	All private roof water outlets are connected flush with the face of the kerb and the invert matches the gutter invert	100% compliance
5	The start and end of segments have been sawcut	100% compliance
6	Expansion joints are present at the start, end and at maximum spacing of 6m	100% compliance
7	Expansion material consists of bituminous filler 10mm thick	100% compliance
8	Any hard stand pavement at the rear of the kerb is separate from the new kerb, flush and includes an expansion joint	100% compliance
9	Contraction joints (dummy joints) are present at a maximum spacing of 3m	90% compliance
10	Water does not pool in the new gutter	100% compliance
11	The nature strip at the back of the kerb is backfilled and matches the top of the kerb level	No step greater than 5mm
12	The extent of disturbed nature strip is reinstated with turf rolls and the turf established	100% compliance
13	Nature strip batter at rear of the kerb is restored with a suitable transition that does not exceed 12% between new and existing grades.	90% compliance
14	The kerb and gutter is free of cracks outside the contraction joints	<3 cracks per 10m
15	The severity of cracks is moderate	Cracks no wider than 2mm
16	An asphalt restoration 0.6m wide (for minimum compaction plate) along the new gutter is present	100% compliance
17	Asphalt restoration is flush with the lip of gutter and to the quality standards outlined in 6.5.7 Road Pavements	No step greater than 5mm
18	The concrete road pavement has been restored flush with the lip of the gutter	No step greater than 5mm

Table 12.5.9.2 - Kerb and Gutter - Sandstone/Brick

	Quality Specifications	Tolerance
1	The sandstone kerb stone or brick kerb is flush with the adjacent kerb	No step greater than 2mm
2	The sandstone gutter stones are flush with the adjacent gutter	No step greater than 2mm
3	No ponding is present along the restored gutter	100% compliance
4	The nature strip at the back of kerb is backfilled and matches the top of the kerb level	No step greater than 10mm
5	Nature strip batter at rear of the kerb is restored with a suitable transition that does not exceed 12% between new and existing grades	90% compliance
6	The extent of disturbed nature strip is turfed with turf rolls and the turf established	100% compliance
7	An asphalt restoration 0.5m wide (for suitable compaction plate) is done along the new gutter	100% compliance
8	Asphalt restoration is flush with the lip of gutter and to the quality standards outlined in road pavements	No step greater than 5mm
9	The concrete road pavement has been restored flush with the lip of gutter	No step greater than 5mm
10	All private roof water outlets are connected flush with the face of the kerb and the invert matches the gutter invert	100% compliance

12.5.10 VEHICULAR CROSSINGS

Table 12.5.10 – Vehicular Crossings – Concrete

	Quality Specifications	Tolerance
1	The restoration surface finish matches Council specifications and/or adjacent surface finish	95% compliance
3	Thickness of the concrete is as per Council's standard, corresponding to domestic, commercial or heavy duty specifications	100% compliance
4	Sawcutting is straight, clean and undertaken along an expansion or contraction joint	90% compliance
5	The restoration surface finish is a broom finish or wooden float finish	100% compliance
6	The height and profile of the layback is uniform and consistent with Council specifications	95% compliance
7	The surface finish of the layback is a steel float finish	100% compliance
8	The restoration surface levels match the adjacent/ existing surfaces	No step greater than 2mm
9	There are no depressions in the surface	Deviation from a straight edge placed across the restoration in both directions does not vary by ±5mm
10	The nature strip or boundary strip adjacent to new concrete footpath or cycleway is backfilled and matches the top of the new concrete surface	No step greater than 10mm
11	The extent of disturbed nature strip or boundary strip is reinstated with turf rolls and the turf established	100% compliance

Table 12.5.10.2 - Vehicular Crossings - Segmental Pavers

	Quality Specifications	Tolerance
1	The restoration surface levels match the adjacent/existing footpath	No step greater than 2mm
2	The footpath has a crossfall gradient of 2.5% towards road carriageway	Match existing
3	The footpath crossfall gradient does not exceed 5%	Match existing
4	Existence of expansion joints at extent of work and at the interface with the footpath	100% compliance
5	Concrete base layer is reinstated	100% compliance
6	Pavers previously installed on a mortar bed are reinstated on a mortar bed	100% compliance
7	Joints are grouted as per the existing paving surface	<5% of joints have spalling mortar joints
8	No broken, cracked or painted pavers placed in the restored area	100% compliance
9	A sealant is applied to the new pavers if the surface was previously sealed	100% compliance
10	No depression in the restoration surface	When measured with a 3m straight edge, departures are less than ±5mm
11	Any pre-existing joints including elastic sealant are replaced	100% compliance
12	Paving adjacent to the kerb and gutter matches the top of the kerb levels	No step greater than 2mm
13	Restoration does not damage adjacent property fencing or tiled steps	100% compliance
14	Service manholes are installed flush with the surface	No step around the manhole greater than 2mm
15	The nature strip or boundary strip adjacent to a new concrete footpath or cycleway is backfilled and matches the top of the new concrete surface	No step greater than 10mm
16	The extent of disturbed nature strip or boundary strip is turfed with turf rolls and the turf established	100% compliance
17	Asphalt around power poles is reinstated	100% compliance
18	Street furniture is reinstated	100% compliance
19	Sign posts are reinstated	100% compliance

Table 12.5.10.3 - Vehicular Crossings - Asphaltic Concrete

	Quality Specifications (per vehicular crossing)	Tolerance
1	Restoration has clean unbroken edges along the trench/cut	<5% of the length of the trench has edge breaks
2	Surface levels along the edge match the adjacent pavement	No step greater than 2mm
3	The shape of the reinstated surface cross section follows the footpath cross section prior and following the work	*The restoration follows the existing footpath and vehicular crossing cross section profile to within ±10mm *The work does not create any vehicular scraping
4	No depression in the restoration surface	Departure of surface from a taut string line perpendicular to the direction of vehicular travel does not deviate by ±10mm
5	The restoration surface is free of rutting	<1% of restoration affected and not greater than an area exceeding 1m^2
6	The restoration surface is free of raveling	<1% of restoration affected and not greater than an area exceeding 1m^2
7	The restoration surface is free of shoving	<1% of restoration affected and not greater than an area exceeding 1m^2
8	The restoration surface is free of potholes	100% compliance
9	The restoration wearing course is free of cracks wider than 1mm	*No single crack longer than 0.5m *No block cracking or crocodile cracking
10	The restoration asphaltic concrete stone specification matches the existing surface	Aggregate size matches adjacent pavement
11	No joint separation between the new and existing asphalt	Width of joint does not exceed 2mm
12	Pre-existing line-marking is reinstated using the same type of materials	100% compliance
13	Outdoor dining markers (some councils use brass plates) are reinstated	100% compliance
14	The nature strip or boundary strip adjacent to a new concrete footpath or cycleway is backfilled and matches the top of the new concrete surface	No step greater than 2mm
15	The extent of disturbed nature strip or boundary strip is reinstated with turf rolls and the turf established	100% compliance
16	Service manholes are installed flush with the surface	No step greater than 2 mm
17	All sign posts and/or signs removed during the work are reinstated and orientated correctly	100% compliance
18	Signs and/or sign posts damaged during the work are replaced	100% compliance

Table 12.5.10.4 - Vehicular Crossings - Unformed Grass Surface

	Quality Specifications	Tolerance
1	Surface levels where the restoration meets the existing unformed footway match existing levels	No step greater than 10mm
2	Surface is top dressed, turfed using turf rolls and established for the entire disturbed area	100% compliance
3	No depression in the restoration surface	When measured with a 3m straight edge across the surface, departures are less than ±10mm

12.5.11 TRAFFIC FACILITIES

Table 12.5.11 – All Traffic Facilities

	Quality Specifications	Tolerance
1	The height and profile of median kerbs and barrier kerbs gutter is uniform and consistent with RMS and Council specifications	95% compliance
2	The surface of the kerb is painted with white reflective thermoplastic paint to match the existing	100% compliance
3	The start and end of segments of the kerb have been sawcut	100% compliance
4	Expansion joints are present at the start and end of the reinstated kerb segment	100% compliance
5	Expansion material consists of bituminous filler 10mm thick	100% compliance
6	The reinstated kerb is doweled or keyed into the road pavement	95% compliance
7	The kerb is free of cracks outside the contraction joints	95% compliance
8	The reinstated island infill surface finish matches specifications and/or adjacent concrete surface finish	95% compliance
9	The island infill at the rear of kerb is separate from the new kerb, flush and includes an expansion joint	100% compliance
10	The restoration surface finish is a broom finish or wooden float finish	100% compliance
11	The restoration surface levels match the adjacent kerb and existing surfaces	No step greater than 2mm
12	The reinstated apron of the roundabout centre island has a matching lip and profile consistent with the existing island	95% compliance
13	There are no depressions in the surface	Deviation from a straight edge placed across the restoration in both directions does not vary by ±5mm
14	The reinstated surface is free of cracking	<1% of restoration affected
15	Severity of cracks present is moderate	Width of cracks does not exceed 3mm
16	Concrete joints are present as per the existing surface specifications	90% compliance
17	Concrete surface is free of dusting	90% compliance
18	No spalling at joints	<2% of spalling of up to 30mm in size throughout restoration
19	Concrete strength specification is adequate	Certificates provided to confirm the use of 32MPa concrete

12.5.11 TRAFFIC FACILITIES, CON'T

Table 12.5.11 – All Traffic Facilities

	Quality Specifications	Tolerance
20	Concrete strength specification is adequate	Certificates provided to confirm the use of 32MPa concrete
21	Pavement markings including RPMs are reinstated to the same standard as per the removed pavement markings	100% compliance
22	All sign posts and signs removed during the work are reinstated	100% compliance
23	Landscaped islands – the reinstated soil level matches the top of the kerb	No step greater than 20mm noting the need for rainfall to be retained within the island so it does not spill to adjacent paved areas.
24	Landscaped islands – the number and type of plant species is the same as prior to disturbance	100% compliance
25	Landscaped islands – the restoration area is mulched	100% compliance
26	Landscaped islands – the planting is established	100% compliance

12.5.12 OPEN SPACE ASSETS

Table 12.5.12.1 – Open Space Assets – Unformed Grass Surface

	Quality Specifications	Tolerance
1	Restoration surface levels match existing surface levels	No step greater than 5mm
2	Surface is top dressed and turfed with turf rolls for the entire disturbed area	100% compliance
3	The turf is established	100% compliance
4	No depression in the restoration surface	When measured with a 1m straight edge across the top of any part of the restoration, departures are less than ±15mm

Table 12.5.12.2 - Open Space Assets - Landscaping

	Quality Specifications	Tolerance
1	The reinstated soil is at the level of the landscaping prior to disturbance	No step greater than 20mm
2	The restoration area is mulched	100% compliance
3	The number and type of plant species is the same as prior to disturbance	100% compliance
4	The planting is established	100% compliance

Table 12.5.12.3 - Open Space Assets - Street Furniture

	Quality Specifications	Tolerance
1	Street furniture is replaced and is secured properly	100% compliance

Table 12.5.12.4 - Open Space Assets - Handstand Areas

	Quality Specifications	Tolerance
1	The quality meets standards set out for footpaths	100% compliance

12.6 CONFORMITY

- The contractor shall provide photographic evidence of the work in progress, such as placing material, layer thickness and compaction.
- Freshly mixed sand/cement mix must be from a commercially approved batch plant and hand mixing is not permitted for more than one square meter area.. A certificate/docket from the supplier to certify that the mix complies with this specification should be submitted. Material found to be unsuitable must not be used.
- The City reserves the right to undertake any audit inspection and testing deemed necessary to confirm the conformity of the work. The contractor is to pay the cost of all testing if the test fails.

ANNEXURE A
TEMPORARY RESTORATION

A1 TEMPORARY RESTORATION REQUIREMENTS

Refer to B12: Road Opening and Restoration for full details. Note the works shall be undertaken to the following key requirements:

- The excavation shall be backfilled with approved material and compacted to the required standard according to City of Sydney standard drawing 9.1.1.
- The surface level of the entire temporary restoration will match the surrounding levels. This surface level must be maintained until at least (a) three months, or (b) when the permanent restoration occurs. The restoration surface material shall either be hot mix or cold mix asphalt, of at least 50mm in depth. Note the preference for approved cool/cold mix as it is an offsite energy/GHG initiative – see below the specification for cold mix asphalt.

A1.1 COLD MIX ASPHALT

Joints in General

- Joints are the weakest part of the pavement. Cold joints should be minimised by planning of works to achieve a minimum number of construction joints and, where practicable, maximum use of hot or warm joints.

Cold Joints

- Where asphalt is placed against the edge of a preceding lane that has cooled below 60°C it is considered a cold joint. Asphalt placed against a cold edge should overlap the previous edge by 25 mm to 50 mm.
- The overlap should be pushed back using lutes, immediately after spreading, to form a slight ridge that is compacted with the steel wheel roller.

Mix temperatures

- Mix Temperatures apply to hot mix Classes 170, 320 and AR450 bitumen binder. Use of Class 600, Multigrade, or PMBs may require minimum temperatures 5°C to 10°C higher than those shown.
- Warm mix shall be supplied with a minimum temperature of at least 20°C below the temperatures nominated above.

Warm mix asphalt additive

If required, include warm mix asphalt additive to asphalt to reduce the asphalt manufacturing temperature and/or to improve workability during the paving and compaction operations.

A2 PERMANENT RESTORATION MINIMUM AREA DEFINITION

Refer to B12 Road Openings and Restorations for full details.

Note: The permanent restoration area will include any assets affected by the works beyond the minimum area nominated above. This includes damage caused by equipment used for the works. The City requires that a pre- works dilapidation record is made to demonstrate any asset damage which existed prior to the works.

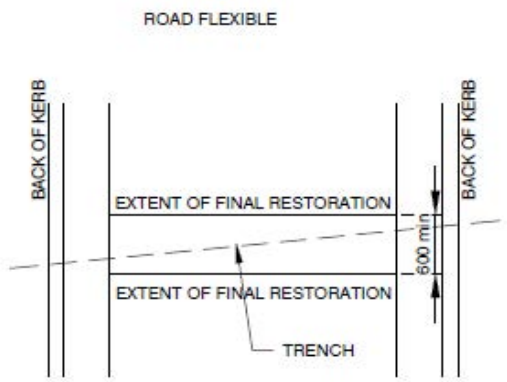
Asset	Restoration Area Condition
All surfaces (note some exceptional/ additional requirements below may also apply)	The minimum area shall: • Extend 0.2m horizontally beyond the edge of the excavated works in all directions • Have edges that are parallel or perpendicular to the roads alignment • Be a minimum of 0.6m in all directions Based on the above, if the edge of the restoration is within 0.6m of a joint or any existing crack control, it shall extend to this location. For stamped pattern surfaces, it shall be further extended to the nearest line in the stamp pattern where relevant. For specially coloured or polished concretes, architectural finishes and art, it shall fully replace the nearest joint or expansion control joint.
Concrete roads, driveways, roundabout infills/apron and traffic island infills	As per all surfaces requirements, except these shall: • Be a minimum of 1m in all directions • Be perpendicular to the path of travel for edges crossing a vehicle lane • Be full lane width for roundabout traffic lanes Based on the above, if the edge of the restoration will be within 1m of a joint or any existing crack control then it shall extend to this location. Where line marking exists, and the restoration is located in a vehicle travel lane, then the longitudinal joint shall be further extended to be located either at the centre or edge of a travel lane.
Asphalt roads	As per all surfaces requirements, except these shall: • Be perpendicular to the path of travel for edges crossing a vehicle lane • Be full lane width for roundabout traffic lanes Where line marking exists, and the restoration is located in a vehicle travel lane, then the longitudinal joint shall be further extended to be located either at the centre or edge of a travel lane.
Cycle ways	As per all surfaces requirements, except any longitudinal edge shall be extended to the edge of a cycle lane.
Concrete pedestrian ramps	The minimum area shall be to the nearest expansion joint or crack control line.

Asset	Restoration Area Condition
Segmental paving/tiles (footways, roads, kerb ramps, etc.)	The minimum area shall: • Extend 0.2m horizontally beyond the edge of the excavated works in all directions • Be a minimum of 0.6m in all directions Based on the above area, any affected pavers are to be full pavers.
Stone kerb and/or gutter	Full stone element
Concrete kerbs, gutters, medians, laybacks, dish drains	The minimum area shall be: • The width of the whole element • Extend 0.2m horizontally beyond the edge of the excavated works in all directions • Have edges that are parallel or perpendicular to the roads alignment • Be a minimum length of 1.8m, with one end located on an existing expansion joint or crack control line Based on the above, if the length of the restoration will be within 1.8m of a joint or any existing crack control then it shall extend to this location.

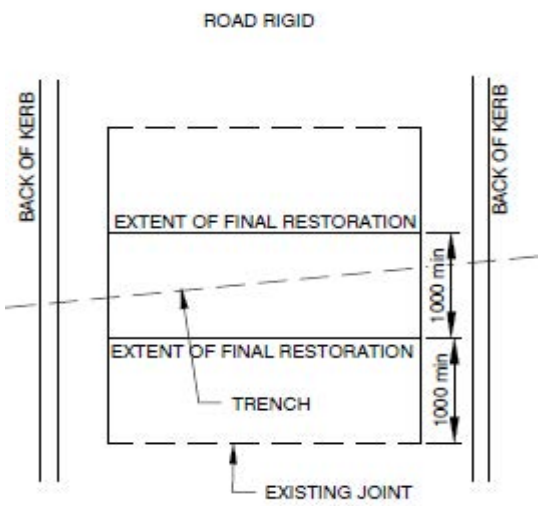
A3 PERMANENT RESTORATIONS AREA DEFINITION – EXAMPLE APPLICATIONS

ROAD PAVEMENT

Example 1 – Trench diagonally across flexible road travel lane

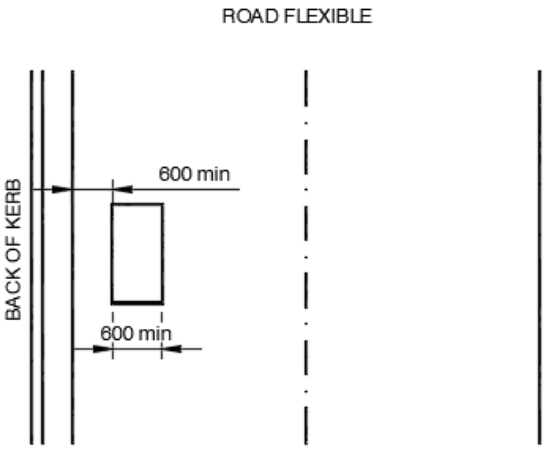


Example 2 – Trench diagonally across rigid road travel lane



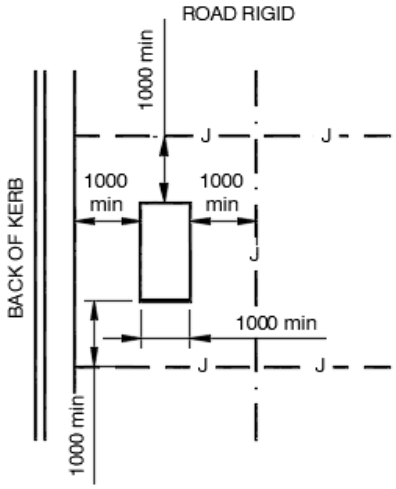
A3 PERMANENT RESTORATIONS AREA DEFINITION – EXAMPLE APPLICATIONS

Example 3 – Trench part way into flexible road travel lane



AREA = 1m² (min)

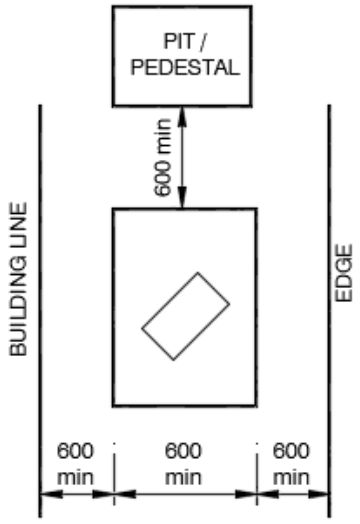
Example 4 – Trench part way into rigid road travel lane



AREA = 1m² (min)

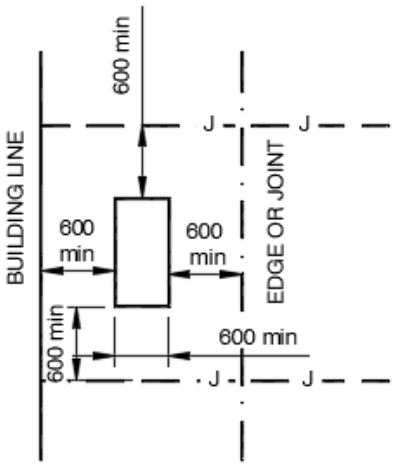
FOOTWAY

Example 5 – Trench in an asphalt footway



AREA = 1m² (min)

Example 6- Trench in concrete footway

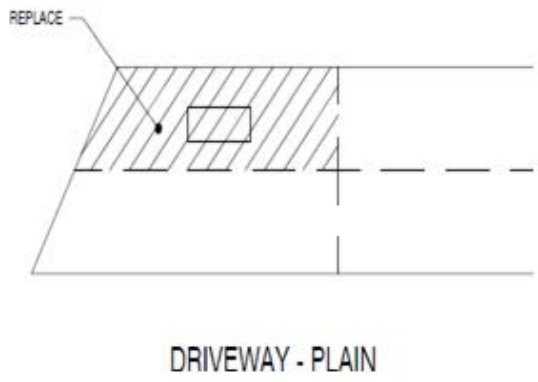


AREA = 1m² (min)

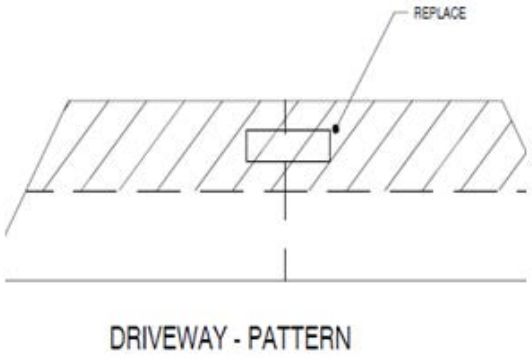
A3 PERMANENT RESTORATIONS AREA DEFINITION – EXAMPLE APPLICATIONS

DRIVEWAY

Example 7 – Driveway-Plain



Example-8-Driveway-Pattern



ROUNDABOUT

Example-9- Trench across roundabout