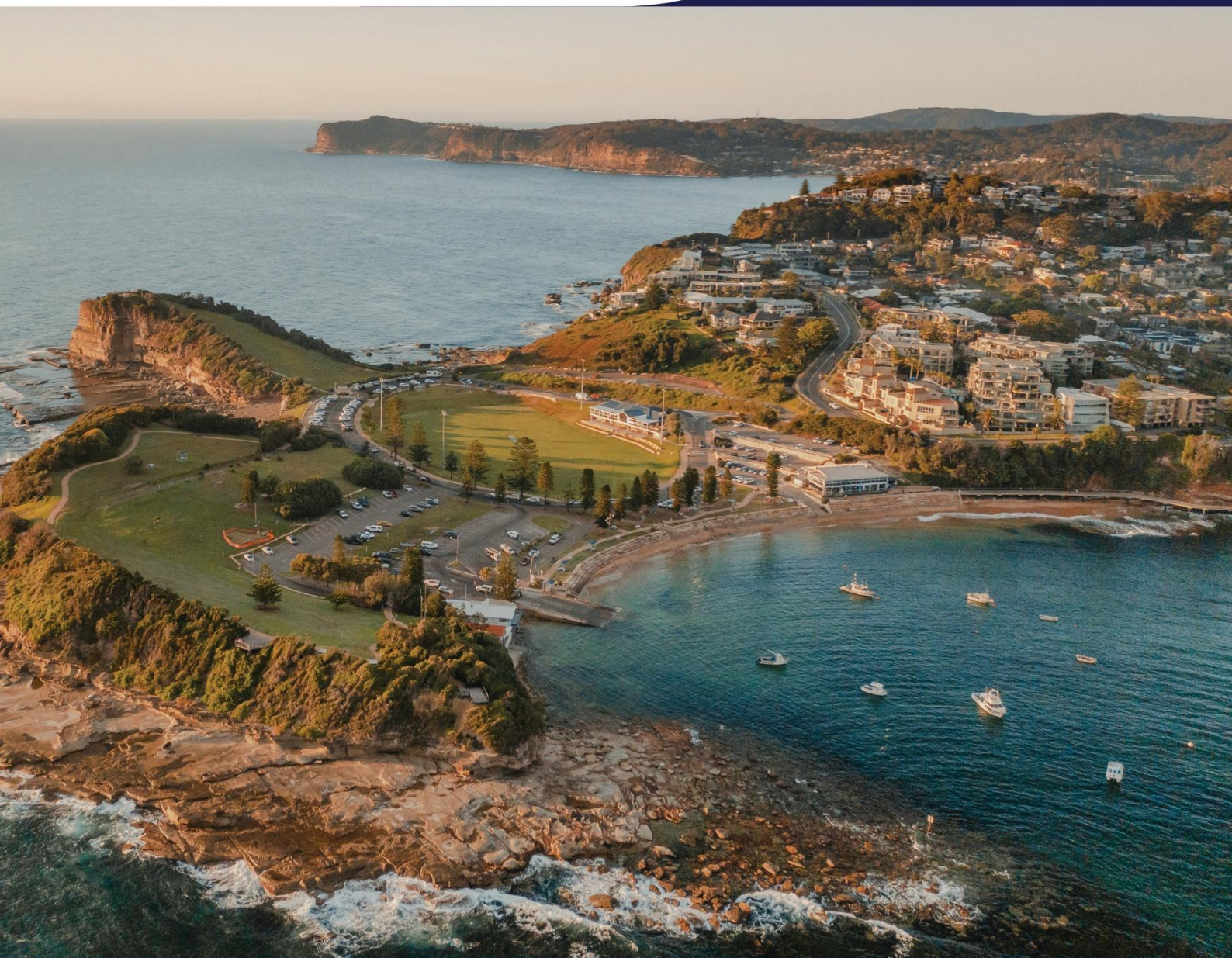


Civil Works Specification

Construction Specification 2026

Roads, Transport, Drainage and Subdivisions
Design and Construction



Civil Works Specification prepared by:
Central Coast Council
Roads and Drainage Infrastructure Unit

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Table of Revisions

Revision	Date	Remarks
Version 1.0	July 2018	Final review by Central Coast Council
Version 2.0	July 2020	Final review by Central Coast Council
Version 3.0	June 2026	Final review by Central Coast Council

Acknowledgement, Disclaimer and Limitations of Liability

Elements of the former Wyong Shire Council's *Design Guideline, Construction Specification and Standard Drawings* and Gosford City Council's *Civil Works Specification* have been adapted in the preparation of Central Coast Council's *Civil Works Specification*.

Central Coast Council does not guarantee that these documents are free from errors and does not accept responsibility for any claims by any person or organisation resulting from the use or application of these documents and drawings or the originating documents and drawings.

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Section 1 - Application of Civil Works Specification - Construction Specification

The *Civil Works Specification* has been compiled to outline Council's requirements for the planning, survey, design, construction and maintenance of public infrastructure assets, subdivisions and various private site works within the Central Coast Local Government Area.

The *Civil Works Specification* is referenced in the *Central Coast Development Control Plan* and consists of the following volumes, which shall be read in conjunction with one another as required and not in isolation. These documents are available on Council's website:

1. Design Guideline
2. Construction Specification
3. Standard Drawings

The *Construction Specification* has been prepared to assist Council's Construction Unit and various Service Providers by informing them of Council's requirements with respect to the construction of infrastructure assets, which will eventually be vested in and maintained by Council and to ensure that such works are provided to appropriate, safe and environmentally sustainable standards, ensuring that the principles of ecologically sustainable development are appropriately considered in accordance with the *Local Government Act 1993*.

This *Construction Specification* and referenced documents provide minimum requirements and references for the construction and maintenance of civil works within the Central Coast Local Government Area. Works may include (but are not limited to) the following:

- Roads
- Intersections
- Pavements
- Pavement restorations
- Paths
- Cycleways
- Traffic facilities
- Earthworks
- Stormwater drainage
- Water supply
- Sewerage systems
- Water quality facilities
- Parks and reserves

Section 2 - Glossary of Terms

For the purpose of this Specification, the following definitions apply:

Access Road - Minor road which carries a low volume of traffic, providing direct access to a limited number of allotments.

Accredited Certifier - Person who holds a certificate of accreditation under the *Building Professionals Act 2005* in relation to particular matters. An Accredited Certifier in general may issue Compliance Certificates for matters within their area of accreditation.

Note: An Accredited Certifier may not certify construction in respect of water and sewer works pursuant to Section 306 of the Water Management Act 2000. Works on public roads under the Roads Act 1993 may preclude an Accredited Certifier from being appointed. In the case of the provision of water and sewer servicing, Council will issue a Section 307 Certificate of Compliance under the Water Management Act 2000 when requirements have been met.

AEP - Annual Exceedance Probability.

Ancillary Road Asset - Road elements including kerb and gutter, drainage pits, drainage lines, subsoil drainage lines, pavement markings and street furniture.

Applicant - Person or corporation making application to Council for approval for a proposed development.

Asset - Physical component of a road system or network. An asset is considered worthy of separate identification if it delivers services or benefits to the community of sufficient current or future value to warrant control and management on an individual basis. Typical assets include sections of pavements, bridges, culverts, traffic signals, signs, road furniture, road reserves, etc.

Australian Height Datum (AHD) - Datum surface approximating mean sea level as adopted by the National Mapping Council of Australia in May 1971.

Authorities - Authorities such as Telstra, Optus, Ausgrid, Department of Planning, Transport for NSW, Jemena, Sydney Water, etc.

ARR - Australian Rainfall and Runoff (latest online edition).

Blue Book - *Managing Urban Stormwater: Soils and Construction*, 4th Edition, Landcom, 2004.

BYDA - Before You Dig Australia.

Carriageway - The portion of road or bridge used by vehicles (including shoulders and auxiliary lanes or between the face of kerbs).

CBR - California Bearing Ratio.

Certifying Authority - A Certifying Authority may be Council or an Accredited Certifier approved by Council.

Collector Road - Road linking access roads to major roads, possibly providing bus routes and giving road access to allotments.

Consulting Geotechnical Engineer - An experienced and qualified person or company who holds an appropriate level of professional indemnity insurance, engaged by the Service Provider to provide advice, inspection reports and recommendations and testing as required by various parts of this Specification in relation to geotechnical matters.

Contractor - Person, private sector entity or consortium engaged by a Developer or Service Provider to execute a contract.

Council - Central Coast Council. Council may also be referred to as the Principal under a Construction Contract.

Council's Representative - Staff member nominated by Central Coast Council to act on Council's behalf in the discharge of its contractual responsibilities and/or the person responsible/delegated to make a decision for Council. This person may be referred to as the Superintendent under a Construction Contract.

CPI - Consumer price index.

Cycleway - Portion of a road or footpath devoted to the use of bicycles.

DA - Development application.

DCP - Development Control Plan.

Design - In relation to plant or a structure, it includes a design of part of the plant or structure and redesign or modification of the design.

Detention Basin (Retention/Retarding Basin) - Storage pond, basin or tank used to reduce and attenuate the peak discharge within a drainage system.

Driveway - Part of an access to/from a road or road related area, which is completely within the adjacent land.

Engineer - (Structural, Geotechnical, Civil, etc) - Where used in this document refers to a person of suitable experience (as a guide not less than 10 years industry experience), who holds an appropriate level of professional indemnity insurance and qualifications to undertake the relevant elements of the work and are eligible for corporate membership of the Institution of Engineers, Australia (or equivalent professional industry body).

Floodplain - As defined by the current *NSW Floodplain Development Manual*.
Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.

Floodway Areas - As defined by the current *NSW Floodplain Development Manual*. Those areas of the floodplain where a significant discharge of water occurs during floods. They are often

aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood level.

Floodway - As defined by Austroads. A longitudinal depression in a carriageway specially constructed to allow the passage of floodwater across it without damage. The cross section of a stream in flood plus a nominated area for freeboard.

Footpath - Path or paved area reserved for the movement of pedestrians and manually propelled vehicles and motorised mobility devices.

Geocentric Datum of Australia (GDA) - Datum surface approximating the shape of the earth's surface as adopted by the Intergovernmental Committee for Surveying and Mapping in May 1990.

Handover Documents - All documents provided by the Service Provider to Central Coast Council on Practical Completion as specified, including WAE drawings.

IPWEA Specification - *Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010.*

Kerb and Gutter - Combined roadside element forming an open drain to capture and discharge runoff. The term kerb and channel was adopted by TfNSW to align with Austroads and other Australian States and Territories and may be used interchangeably with the term kerb and gutter.

Lane - Portion of the paved carriageway marked out by kerbs, painted lines or barriers, which carries a single line of vehicles in one direction. A lane is generally between 3.0 and 3.5 m wide. A single carriageway road normally has at least one lane in each direction.

Late Fee - Any unauthorised work will incur a late fee in accordance with Council's Fees and Charges.

LEP - Local Environmental Plan.

LGA - Local Government Area. This refers specifically to the Central Coast Local Government Area which is defined by Frazer Park and Crangan Bay in the north, Wisemans Ferry in the south and Kulnura in the west and the Pacific Ocean in the east.

Local Distributor Road - Road linking access roads to major roads, providing bus routes and giving restricted access to allotments.

Local Road - Minor road which carries a higher volume of traffic than an access road but still provides direct access to allotments.

Map Grid of Australia (MGA) - Rectangular co-ordinate system using a Universal Transverse Mercator (UTM) projection based on the Geocentric Datum of Australia (GDA).

NATA - National Association of Testing Authorities, Australia.

NCC - *National Construction Code*, which comprises of the *Building Code of Australia* (BCA) as Volumes 1 and 2 and the *Plumbing Code of Australia* (PCA) as Volume 3.

NSWRFS - NSW Rural Fire Service.

Obstruction - Any object which could impede or prevent the free and/or safe passage of pedestrians and/or vehicles.

Path - Footpath or shared path (refer to each respective definition).

Permanent Restoration - Restoration in accordance with Council's Specification is applied to the road or path after a temporary restoration has completed and left exposed to the public for a specified period of time.

Permanent Survey Mark (PSM) - Survey mark in the style or form for a permanent survey mark as described in the *NSW Surveying and Spatial Information Regulation 2017*.

PMP - Project Management Plan.

Practical Completion - That stage in the execution of work under a Contract or capital works project when the works are complete except for minor omissions and minor defects that do not prevent the works from being reasonably capable of being used for their intended purpose, as determined by Council's Representative. This definition excludes Developer-constructed works as approved by a Development Consent.

Principal Certifier - For subdivision work, means the certifier appointed as the Principal Certifier under section 6.12(1) of the *Environmental Planning and Assessment Act 1979*. A Service Provider must appoint a Principal Certifier for each development project involving a subdivision. For the purposes of this Specification, Principal Certifier could also mean the Principal Certifying Authority.

Principal Contractor - Under the *Environmental Planning and Assessment Act 1979* for building work is that person responsible for the overall co-ordination and control of the carrying out of the building work. A Principal Contractor may also be required under the *Work Health and Safety Regulation 2017*. The Service Provider shall advise Council prior to commencement of any works who is the Principal Contractor in respect of both. In this Specification the Principal Contractor may also be referred to as the Service Provider.

The Service Provider undertaking construction work for Central Coast Council shall be appointed as the Principal Contractor and accepts all the obligations associated with this role under the *Work Health and Safety Regulation 2017*.

Private Property - Property outside of the project, site boundary or road reserve. This is generally neighbouring property owned or leased by private owners and tenants.

Project Manager - The Service Provider shall appoint a person as the Project Manager for the Project. This person must be readily available and have sufficient authority and ability to discuss and resolve problems and act as the principal contact with Council's Representative. A Service Provider who chooses to adopt this role must be aware that Council does not become involved in co-ordinating activities or giving advice beyond Council responsibilities.

The Service Provider's Project Manager may also be referred to as the Service Provider in this Specification. This person may be referred to as the Contractor's Representative under a Construction Contract.

Proponent - Person or Service Provider that puts forward a proposal to undertake work.

Restoration Order - Request to Council to undertake permanent restoration on behalf of a Service Provider.

Risk - The effect of uncertainty on objectives, as defined in AS/NZS ISO 31000:2009.

Roads Authority - National or state roads authority, municipality, other body or individual responsible for the care, control and maintenance of road infrastructure.

Road Opening - Any form of excavation or digging of the road reserve including test bores for Geotechnical investigation purposes.

Road Opening Permit - Permit authorising the holder to undertake a road opening activity.

Road Pavement - Refer to definition for **Carriageway**.

Road Reserve - Legally defined area of land between the legal road boundaries within which facilities such as roads, paths and associated features may be constructed for public travel. Where roads have not been formed, it also refers to so called 'paper roads'.

Safety Barrier - Physical barrier separating roadside hazards or opposing traffic and the travelled way, designed to resist penetration by an out-of-control vehicle and as far as practicable, to stop or redirect colliding vehicles.

Sediment Basin - Open water pond designed and constructed as a stormwater detention system to intercept, capture and settle coarse sediment from stormwater flows.

Service Provider - Any parties such as contractors, suppliers, consultants (accredited certifier), developers, authorities, or Council staff responsible for planning, designing and constructing the works.

Shared Path - Paved area particularly designed (with appropriate dimensions, alignment and signing) for the movement of cyclists and pedestrians, but on which cyclists must give way to pedestrians.

Site - Land and structures within the extent of works area/site boundary, including storage areas. The site area includes privately owned property that shall be dedicated to Central Coast Council as a public asset.

Specification - Detailed statement of materials, dimensions and quality for all work that shall be built, installed, or manufactured for Central Coast Council or for work which shall be dedicated to Central Coast Council as a public asset.

State Survey Mark (SSM) - A form of Permanent Survey Mark as described in the *NSW Surveying and Spatial Information Regulation 2017*.

Stakeholder - An individual or group of individuals such as employees, directors, developers, service providers, consultants and external organisations who have an interest in the project whether through their involvement with the project or because they will be impacted by its outcome.

Sub-contractors - Contractors engaged by the Principal Contractor. The identity of proposed sub-contractors and their proposed scopes of works shall be provided to the Certifying Authority prior to engagement. Council reserves the right to not accept any sub-contractor working on a site based on previous poor compliance with Council's requirements. Sub-contractors may also be suppliers of materials to be incorporated into the works. Sub-contractors who supply materials for the works, may also be referred to in this Specification as Suppliers.

Surveyor - A registered Land Surveyor as defined in the *NSW Surveying and Spatial Information Act 2002* and/or an Engineering Surveyor qualified to carry out civil works surveying projects.

SWMS - Safe Work Method Statement.

Temporary Restoration - Restoration in accordance with Council's *Civil Works Specification* is applied to roads or paths following completion of a road opening activity or trenching. Temporary restorations must be safe and trafficable at all times until permanent restorations are carried out.

TMP - Traffic Management Plan (including Pedestrian Management Plan (PMP) to *Austroads Guide to Temporary Traffic Management* and TfNSW's *Traffic Control at Worksites Manual*).

Unauthorised Works - Works that are carried out without a permit or approval from Council.

Utility Authority - National or state roads authority, municipality, other body or individual responsible for the care, control and maintenance of utility infrastructure.

Utility Services - Public infrastructure services including water, sewerage, drainage, gas, electricity, telephone, telecommunication or other like service.

Vehicle Access Crossing - Part of an access to/from a road, which crosses a footway, verge or other road related area and connects a road to an adjoining driveway within adjacent land.

Verge - Area between the carriageway and the property line. It allows provision for services, footpaths, shared paths, cycle paths, street trees and street furniture.

WAD - Works Authorisation Deed.

WAE - Work-as-executed.

Works - All works required to complete the project as specified and approved.

WSAA - Water Services Association of Australia.

Section 3 - General Matters

3.1 General

The *Civil Works Specification* has been compiled to outline Council's general procedures and practices in respect of design and construction requirements for future public infrastructure assets and various private site works in the Central Coast Council Local Government Area (LGA).

Project specific requirements shall be provided by Council's Representative where applicable. Where specifications that are contrary to all or part of this Specification are contained in a Development Consent or Tender/Contract document then those specifications shall be applied.

If this Specification does not cover a requirement for a particular construction activity, then the provisions of the current Australian Standard shall apply unless otherwise instructed by Council's Representative.

When this Specification makes reference to specifications published by other organisations, such as Transport for NSW (TfNSW), only the technical requirements of those specifications apply unless otherwise stated. Clarification shall be obtained from Council's Representative when a technical requirement is not provided within any specification.

When a specification for a particular item of construction is not defined by this Specification or Australian Standards then Council's Representative shall determine the appropriate specification to be applied.

This Specification is not for the purposes of providing an interpretation of what the Service Provider is required to comply with in regard to various Acts and Regulations. It is expected that the Service Provider is familiar with their obligations to comply with various Acts and Regulations.

3.2 Reference Documents

Reference documents include (but are not limited to) the following:

- Austroads publications.
- Transport for NSW documents including manuals, guidelines, specifications and test methods.
- AUS-SPEC and Council's amendments.
- Australian Standards.
- Engineers Australia Publications.
- Institute of Public Works Engineering Australasia (IPWEA) Specifications.
- Water Services Association of Australia documents relating to supply of water and sewerage services and their respective Supplements.
- Australian Road Research Board *Sealed Local Roads Manual 2005*.
- NSW legislation and Acts, such as, the *Roads Act 1993*.

- NSW Government *Floodplain Development Manual*.
- NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*.
- *Managing Urban Stormwater: Soils and Construction*, 4th Edition, Landcom, 2004 (commonly known as "*The Blue Book*").

In any instance, where because of terminology, the interpretation of this Specification is in dispute, definitions shall be clarified by Council's Representative.

3.3 Conflicting Standards and Guidelines

Refer to Section 3.3 Conflicting Standards and Guidelines in Council's *Civil Works Specification - Design Guideline*.

3.4 Pre-construction Information

3.4.1 Co-ordination of Pre-construction Planning Activities

The Service Provider shall ensure that all Development Consent requirements prior to the issuing of a Construction Certificate and requirements for gaining statutory approvals are met prior to the start of any Construction Activities.

This includes the integrating of undertakings made in the Development Application proposal, accompanying environmental and other report recommendations, State or Federal Authorities approvals requirements, Utility Suppliers information, further Council approvals under the *Roads Act 1993*, *Local Government Act 1993* and *Water Management Act 2000* and Development Consent Conditions.

Consent to work on privately owned land, other than that owned by the Service Provider shall be obtained in advance of the commencement of construction.

3.4.2 Pre-construction Site Activities

The Developer and their Survey Consultant are responsible for the Preservation of Survey Infrastructure with reference to the *Surveying and Spatial Information Act* and the *Surveying and Spatial Information Regulation*, all centre line pegging, boundary pegging, provision of suitable survey control marks for construction and providing survey marks information.

The Service Provider is responsible for all survey required for construction.

Recovery marks shall not to be placed in locations that present a hazard to pedestrian or vehicular traffic.

All pre-construction site activities shall be carried out under the authority and supervision of the Service Provider. All pre-construction activities shall be carried out in accordance with all approval conditions pertaining to the site.

3.4.3 Works Subject of Approvals by Other Authorities

Where conditions have been imposed under an integrated approval or where the Service Provider is required by legislation to obtain approval from others the following applies:

- The design and construction of works shall be carried out to meet the relevant Authority's specifications in addition to those of Council.
- The Service Provider is responsible for obtaining authorisation to remove survey marks within the scope of the works, from the Surveyor General of NSW.
- The Service Provider is responsible for obtaining any permits and licences, obtaining required inspection(s), achieving work standards and gaining final approval of relevant Approval Authorities.
- Copies of approvals, permits and licences shall be obtained from Approval Authorities by the Service Provider and shall be provided to Council's Representative prior to commencement of site activities.
- Copies of final approvals of works and documentation verifying compliance of requirements from Approval Bodies shall be provided to Council by the Service Provider before Council's final inspection and approval of the works.

The Service Provider shall notify the Approval Authorities and Council of all changes and obtain any additional approvals that may be required.

3.4.4 Approved Construction Drawings

Approved Construction Drawings are drawings that have been endorsed or approved by Council for the purposes of civil construction. These may include drawings issued with a construction certificate, approval for works under the *Roads Act 1993* and other relevant Acts, or Council Quotation or Tender.

Construction specifications shall be Council's current construction specifications.

Should developer works not commence within 5 years of Council approval of the civil construction drawings, the drawings shall be revised by the Service Provider to meet Council's current *Civil Works Specification* and then resubmitted to Council for construction approval.

Where details or specifications shown on approved drawings are different to the requirements of this Specification then the requirements of this Specification shall be applied to the works. Departures from this requirement may be made only with approval from Council's Representative.

3.4.5 Extent of Approved Works

The approved works are those works covered by a Construction Certificate and/or Council approved Construction Drawings and shall include any ancillary works required to complete the works.

Ancillary works are those works which are necessary for the new works to safely and effectively function on a sound engineering basis. Ancillary works may not be detailed or fully shown. Ancillary works may involve temporary and permanent protection works about the interface of new works

and existing site conditions and works to transition the new works existing site conditions. All ancillary works shall be carried out to the same standards as required by this Specification.

3.4.6 Further Applications to Council During Works

During the course of construction, it may become necessary to make applications to Council where approvals have not already been given for:

- Temporary and permanent road closures.
- Works within the road reserve.
- Tree removal not covered by existing approval.
- Connection to or adjustment and relocation of water and sewer mains and installations.
- Modification of the Construction Certificate to carry out different works.
- Modification of the Development Consent to vary the Development Consent conditions.

Council's consideration of these applications may involve periods of advertising and referral to other authorities.

3.5 Pre-commencement Requirements

Works on any subdivision or works within the road reserve, shall not commence until the Service Provider holds Compliance Certificates confirming pre-commence conditions of Development Consent have been satisfied; and shall not commence until Council confirms in writing that works can commence; and the conditions of the Surveyor General's Approval to Remove Survey Marks have been satisfied.

Follow confirmation of compliance for pre-commence conditions of Development Consent, the persons having the benefit of the Development Consent shall lodge a Notice of Intention to Commence Subdivision Works with Council/Principal Certifier with a minimum notice of 2 working days.

Once the Notice of Intention to Commence Subdivision Works is acknowledged by Council/Principal Certifier, a mandatory On-site Pre-commence meeting between the persons having the benefit of the Development Consent, their contractors and Council/Principal Certifier shall be held.

3.6 Departure from Approved Works

Departures from approved works shall result in an instruction from Council's Representative to rectify the works to comply with the approved drawings.

If the approved drawings are inadequate or do not reflect site conditions or prove to be impracticable, additional or alternative and or remedial works maybe necessary. **Such works shall be approved by Council's Representative or Accredited Certifier prior to their commencement. Approval may involve the submission of plans, reports and or a range of**

applications to Council and other Authorities. In some cases, it shall be necessary for the Service Provider to lodge an Application for Modification of the approved Construction Certificate.

3.6.1 Departure from the Specification

Consideration may be given for products or work methods which do not comply with Central Coast Council's *Civil Works Specification*. Details of the proposed departure from the Specification need to be submitted to Council's Representative for approval prior to construction or use.

3.6.2 Unapproved Works

Where unapproved works are undetected during construction, the work-as-executed drawings shall be accompanied by a report(s) and calculations prepared by the Service Provider's Consultants providing justification for acceptance of the unapproved works.

The report(s) shall include an explanation as to how the unapproved works comply with Council's *Civil Works Specification* or adequately satisfies the intent of this document.

Where the report(s) are not approved by Council's Representative, the Service Provider shall rectify the non-compliance to the satisfaction of the Council's Representative.

Approval from Council's Representative or Accredited Certifier of any remedial works is required prior to their commencement. Approval may involve the submission of a range of applications to Council and other Authorities.

3.7 Environmental and Heritage Protection

3.7.1 General

Environment and heritage protection requirements apply to all works which will disturb the soil surface, vegetation (including grasses, shrubs and trees), horticultural features, relic or site materials. These requirements are covered by various Acts and Regulations including the *Heritage Act 1977*, *Threatened Species Conservation Act 1995* and the *Protection of the Environment Operations Act 1991*.

3.7.2 Environmental Requirements Prior to Site Works

Before any clearing begins, Council's approval to remove trees must be obtained as required by conditions of the Development Consent and in accordance with Council's DCP.

The protection of vegetation or other environmental or heritage items must be complied with during construction. The works to be carried out must be consistent with:

- Any specific Development Consent conditions.
- The approved Environmental Management Plan and/or the Erosion and Sediment Control Plan, Soil and Water Management Plan and other approved documentation.
- Any site induction information provided by the Environmental Consultant or Consultant Ecologist.

Construction details and methods must be selected to ensure that the requirements of the approved Environmental Management Plan and Development Consent are complied with.

The location of all trees and vegetation to be preserved should be identified on the Environmental Management Plan or the approved Construction Drawings. The Service Provider shall not proceed with any work until this information has been made available to the Council. In the absence of specific details relating to tree protection being described in consent approval documentation or Construction Certificate drawings or reports, then the requirements of AS 4970 - *Protection of trees on development sites* shall apply.

The Service Provider is to erect approved protective fences around all trees and patches of native vegetation to be retained and protected prior to commencing any works. Access into such areas for any purpose will not be permitted unless approved by Council.

Council reserves the right to enter onto the land and carry out protection measures in the event they are not implemented prior to commencement of works. The cost of any such protection measures will be required to be fully reimbursed to Council by the Service Provider prior to any further development works proceeding.

A performance bond in the form of a bank guarantee shall be lodged with Council by the Service Provider to ensure effective environmental control and protection measures are implemented. This bond will be required to be lodged prior to the commencement of Construction and will be released following submission of the maintenance/defects bond and after a satisfactory final inspection has been completed. The value of this bond will be in accordance with Council's current Fees and Charges. The Environmental performance bond may not be required on some development works where the risk of environmental damage is minimal. Council may recover costs from the bond if works need to be done in an emergency or through lack of response to instructions issued to the Service Provider.

3.7.3 Heritage Conservation and Protection

Measures for the protection of heritage items identified in the Development Consent and Approved Plans and drawings are to be completed prior to any clearing or earthworks. The Service Provider is responsible for ensuring that arrangements are in place for any ongoing requirements such as the reporting of additional items of Aboriginal Heritage.

Where a known item or site is affected by or adjacent to a development, specific conditions of consent will require protection measures during construction.

Where during the undertaking of development works a person uncovers or discovers a relic (within the meaning of the *Heritage Act 1977*) or Aboriginal relic or place, they are to:

- Cease work on the site.
- Take appropriate measures to secure and protect the site or relic, including fencing.
- Contact Council's Representative.

- Notify either the Heritage Council and the Office of Environment and Heritage, as appropriate, of the discovery as required under the *Heritage Act 1977* or the *National Parks and Wildlife Act 1974*.

3.7.4 Fire Restrictions

Burning including burning of cleared vegetation and wastes is prohibited except with approval under the Protection of the *Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation 2002*.

Where conditions of Development Consent require the carrying out of bush fire hazard reduction works, a certificate is to be obtained under the *Rural Fires Act 1997* for any hazard reduction burning. Requirements for this certificate should be determined through the Integrated Development process.

The Service Provider is to address any bushfire risks associated with his construction activities and implement any mitigation measures identified in the risk assessment.

3.7.5 Noise Control

All construction equipment is to be fitted with the recommended noise suppressor in accordance with statutory requirements. The Service Provider is to comply with the statutory regulations and take all practical precautions to minimise noise levels from the development site.

3.7.6 Waste Management

All construction wastes are to be stored on-site in a secure manner until they can be removed off-site. Containment or covering of wastes which may be spread by wind or rain is required.

Refer to other chapters of Council's Development Control Plan for specific requirements on Controls for Site Waste Management.

Disposal of construction wastes on site is not acceptable.

3.7.7 Final Site Cleaning

Upon completion of works, all buildings, plant, spoil, debris, excess material and wastes arising from the development works shall be removed and the site left in a safe, clean and tidy condition.

All roads, drains, signs and other infrastructure are to be free of sediment, dust, grime and other pollutants. Structures are to be in a ready to use condition.

3.7.8 Council Reserves and Council-Controlled Lands to be Dedicated to Council

Reserves to be dedicated to Council, with the exception of specified Heritage items, shall be left in a safe and tidy condition, free of all hazards to public safety. These hazards include, but are not limited to, wells, shafts, dangerous ruins, building remnants, spoil, stockpiles and waste.

Landscaping and embellishment works shall be carried out in accordance with the approved Landscape Design Plan and Report where required.

3.7.9 Transportation of Materials

Transportation of earth, sand, road construction material, loose debris and any loose materials to or from the development site shall be in a manner that will prevent the dropping of material on surrounding roads. The wheels, tracks and body surface of all vehicles and plant leaving the site shall be free of material that may be unknowingly deposited during operation.

All loads shall be covered to prevent loss of materials during transportation.

3.7.10 Work On or Near Trees

3.7.10.1 Tree Removal and Work on Trees

Council's approval in accordance with DCP (Tree Management) must be obtained before removing or performing any work on trees, including trimming, pruning, root cutting or repairs. Any work permitted to be carried out on trees is to be performed by an Arborist approved by Council, in accordance with Council's specifications for tree works.

Trees to be removed are to be clearly marked onsite with a yellow tape to correspond with those approved for removal.

Removal of trees is to be undertaken so that there is no damage or injury to trees or other native vegetation to be retained. Council may nominate an appropriate felling method by way of consent conditions where damage to remnant trees is likely to occur during felling. This may mean that precision felling by chainsaws is necessary instead of machine felling.

Road and drainage works involving the removal of trees will require replanting at a ratio of at least 2:1 (2 replacement trees for 1 tree removed). Refer to the applicable Development Control Plan, Council's *Greener Places Strategy* and *Street Design Guideline*.

3.7.10.2 Working Near Trees

Existing trees are legally protected by Council's Tree Preservation Order. The Service Provider shall inspect and mark all trees for preservation, complying with Council's Representative's directions.

Prevent damage to tree bark. Do not attach stays and guys to trees. Do not remove topsoil from or add topsoil to the area within the dripline of trees.

Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If it is necessary to excavate within the drip line, use hand methods or trenchless methods, to preserve root systems intact and undamaged.

Be aware of the restrictions on work near trees and if required seek direction from Council's Representative.

Do not cut tree roots exceeding 50mm diameter. If it is necessary to cut tree roots, use means such that the cutting does not unduly disturb the remaining root system. Immediately after cutting, water the tree and apply a liquid rooting hormone to stimulate the growth of new roots

Backfill excavations around tree roots with a mixture consisting of three parts by volume of topsoil and one part of well-rotted compost with a neutral pH value, free from weed growth and harmful materials. Place the backfill layers, each of 300mm maximum depth, compacted to a dry density similar to that of the original or surrounding soil. Do not backfill around tree trunks to a height greater than 200mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.

3.7.10.3 Habitat Trees

Habitat trees shall only be felled where approved and under the supervision of the Service Provider's Consulting Ecologist or other Environmental Consultant acceptable to Council.

3.7.11 Working Hours

Where not specified in a Development Consent or required by other Authorities, working hours for works shall be based on the Environment Protection Authority's *Environmental Criteria for Road Traffic Noise* and the related NSW Office of Environment and Heritage's *Interim Construction Noise Guideline*. No work shall take place on Sundays or public holidays.

The Service Provider shall consider limiting working hours either throughout the works, in particular instances or timeframes in the vicinity of sensitive developments e.g. hospitals, schools, during public events, etc.

Exceptions may be made for works on existing roads where traffic conditions make works hazardous or would result in unacceptable traffic delays. Arrangements for these works shall be made with Council and/or Transport for NSW (TfNSW) (if applicable) in conjunction with applications under the *Roads Act 1993* for the subject works.

3.8 Haulage, Storage and Quality of Materials

3.8.1 Haulage Routes

Details for approval of haulage routes shall be supplied at the request of Council's Representative. Details to be provided may include (but is not limited to) the following: type, number, weight of vehicles, planned routes, road condition report and vehicle management plan.

Visual assessments of the approved haulage route(s) will be carried out by Council prior to, during and on completion of works to determine if the haulage associated with the development has caused any specific damage to the route.

Damage to roads by haulage plant shall be satisfactorily repaired at no cost to Council. Damage, which in Council's view presents a hazard or will accelerate more damage, is to be repaired as it becomes apparent. Any temporary restoration works on the haulage route necessary during the course of construction shall be carried out in accordance with this Specification or as agreed between Council's Representation and the Service Provider.

3.8.2 Storage of Materials

All materials shall be stored in a safe, tidy and nonhazardous manner. Safety fencing, barricades, signposting and sediment controls shall be provided as required to ensure such sites are in accordance with *Work Health and Safety Regulation 2017*, relevant environmental requirements and this Specification. Reinstatement of stockpile areas shall be approved to the satisfaction of Council's Representative.

Storage of pipes, gravel and other materials on public roads or reserves is not permitted unless approval by Council's Representative is provided. The request for approval shall contain supporting documentation to ensure satisfactory restoration is achieved. This shall include (but not limited to) a survey accurate level and detail plan with spot levels and contours, adequately depicting the existing surface topography covering the proposed stockpile and surrounding areas. Following surface restoration of the stockpile site to requirements of this Specification for disturbed areas, a work-as-executed survey covering the stockpile and surrounding area shall be submitted to Council for review. Refer to **Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements**.

3.8.3 Materials Quality

Materials used shall comply with relevant standards and the following requirements:

- In 'as new' condition.
- Free of structural damage.
- Free of contamination.
- Defect free.

If required, the Service Provider shall provide to Council's Representative full information describing the source of supply, mode of supply and place of manufacture of any material.

Processed recycled material may be used in pavement, earthworks and drainage construction provided that the properties of the material meet the requirements of the material as required by this Specification or confirmed to be suitable by the Consulting Geotechnical Engineer and Council's Representative.

Recycled material shall conform to the requirements of the *IPWEA Specification for Supply of Recycled Materials for Pavements, Earthworks and Drainage 2010* and the applicable TfNSW Specification(s). Documentation shall be submitted to Council confirming that the recycled material supplied to site shall have a resource recovery exemption.

When required by this Specification or requested by Council's Representative, test results of the particular materials proposed shall be submitted to Council's Representative or the Accredited Certifier for approval prior to use and delivery to site. Council's Representative may accept materials for which Council holds current acceptable test results. Specific material requirements are detailed in the relevant sections of this Specification.

3.9 Safety, Access, Public Utilities and Damage

3.9.1 Safety

The Service Provider shall be responsible for adequate safety precautions during progress of the works, in accordance with the relevant legislation, regulations, standards and codes of practice. This includes but is not limited to the safety of the public, employees and contractor personnel. The provision and erection of any signs, lights and barricades necessary for pedestrian and traffic safety in public roads or places are also part of the responsibility for adequate safety precautions.

3.9.2 Private and Public Amenity

Uninterrupted access and utility servicing must be maintained to all properties throughout the development works unless otherwise approved by Council or other relevant utility authorities. Applications may be made to Council under the *Roads Act 1993* and *Water Management Act 2000* seeking disruptions to access and servicing. Assessment of these applications may involve landowner notifications and referrals to other authorities.

3.9.3 Damage to Property

The Service Provider shall take adequate precautions to prevent deterioration and damage to private property, public roads, public utilities and reserves during construction.

The Service Provider shall organise preconstruction inspections by adequately qualified independent persons to identify the condition of private fences, driveways, landscaping, structures and other property improvements that are within proximity to the proposed development works.

Council's Representative may direct the provision of temporary works or restrictions on construction methods considered necessary to protect private lands and improvements. Council shall take into consideration any written agreement with the landowner obtained by the Service Provider gaining permission to undertake works on or adjacent to the private lands before any direction is issued.

Damage to the adjacent road by haulage plant shall be satisfactorily repaired at no cost to Council. Any temporary road restoration works necessary during the course of construction shall be carried out in accordance with this Specification or as agreed between Council's Representative and the Service Provider.

3.9.4 Public Utilities in the Work Area

The Service Provider shall ensure that accurate information is obtained in relation to the location of utilities within the work area and the requirements of all Utility Authorities in regard to working near their assets.

A BYDA enquiry shall be made by the Service Provider prior to any excavation work in accordance with the requirements of the *Energy Legislation Amendment (Infrastructure Protection) Act 2009*.

The Service Provider shall immediately inform the relevant Utility Authority and Council's Representative of any damage occurring to utility mains, services and installations.

Adjustments, relocations and replacement of public utilities shall only be undertaken following approval from the appropriate Utility Authority. The cost of all works associated with this shall be the responsibility of the Service Provider.

3.9.5 Permanent Marks, State Survey Marks and Cadastral Reference Marks

Precautions shall be taken to protect and preserve any Permanent Marks (PM) and State Survey Marks (SSM) and Cadastral Reference Marks relative to or affected by the works. The Service Provider shall be responsible for the replacement of any disturbed marks to the conditions of the Surveyor General's Approval to Remove Survey Marks using a Land Surveyor Registered in NSW.

3.9.6 Private Property and Council-Controlled Lands

3.9.6.1 Private Landowner's Permission

The Service Provider is responsible for gaining written consent to enter or carry out works within private property. Council also requires the Service Provider to obtain the landowners consent for works within Council and interallotment easements over private lands.

The Service Provider shall ensure that this consent is not withdrawn prior to the works being completed. Council's Representative shall be informed immediately upon the withdrawal of consent by a landowner.

The Service Provider shall ensure that the landowner's consent and any conditions are clear. The Service Provider shall make a photographic record of the site prior to the commencement of work to minimise the possibility of any dispute over the effects of construction on the private property.

3.9.6.2 Permission for Works on Council Roads, Lands and Reserves

Under the *Roads Act 1993*, approval to work within a public road reserve is required to be obtained from Council or TfNSW in the case of classified roads.

For works required within a Council road reserve as part of a Development Consent, the Service Provider shall obtain a *Roads Act 1993* approval prior to commencement of work. All other works required within a Council road reserve shall obtain a road opening permit.

Access onto, use or performance of works on Council owned private land, drainage reserves, public reserves, Crown Land under Council care and any other land or easements controlled by Council may not be carried without specific Council approval.

3.9.6.3 Access to Adjacent Property

The Service Provider shall maintain safe and convenient passage for pedestrians and vehicles to and from property entrances and buildings at all times unless otherwise negotiated by the Service Provider with the property owner and all property tenants. Temporary connections to intersecting roadways shall be provided and maintained as necessary.

Prior to the commencement of construction, the Service Provider shall provide written notice to all traders and occupants of adjacent properties where access to or from those properties may be affected by the works to be undertaken.

3.9.7 Use of Explosives

The Service Provider shall not use explosives for any works.

3.10 Compliance Inspections, Testing and Documentation

3.10.1 Construction - Testing, Inspections and Documentation

It shall be the responsibility of the Service Providers to present to the Principal Certifier work-as-executed data, drawings and documentation demonstrating compliance with the following:

- Development Consent.
- Subdivision Works Certificate (Subdivision Works Construction Certificate).
- Civil Works Approvals issued by Council.
- This Construction Specification.
- Requirements from any other authorities.

3.10.1.1 Mandatory Inspections

Council as the Principal Certifier for subdivisions and associated works, require mandatory inspections by Council as the Certifier or an accredited Certifier of the following:

- **On-Site Pre-Commence Meeting** with Council as the Principal Certifier and/or the relevant authority - prior to construction commencing.
- **Earthworks:**
 - Subgrade - proof roll once ready for placement of subsequent material layer.
 - Unsuitable Subgrade - following the removal of unsuitable subgrade.
 - Unsuitable Subgrade Rectification - proof roll following the replacement of suitable subgrade and prior to placing subsequent material layer.
- **Flexible Pavement:**
 - Subgrade - proof roll once ready for placement of subsequent pavement layer.
 - Unsuitable Subgrade - following the removal of unsuitable subgrade.
 - Unsuitable Subgrade - proof roll following the replacement of suitable subgrade and prior to placing subsequent pavement layers.
 - Select Material Layers - proof roll once ready for placement of subsequent pavement layer.
 - Sub-base - proof roll once ready for placement of subsequent pavement layer.
 - Base - proof roll once ready for placement of subsequent pavement layer and prior to the Benkelman Beam test being conducted.
 - Unbound granular base - Benkelman Beam.
 - Seal - inspection of pavement layer condition prior to sealing.

- Seal - during sealing works.
- Asphalt - inspection of seal condition prior to asphalt.
- Asphalt - during asphalt works.

- **Rigid, Semi-Rigid, Full Depth Asphalt and Other Pavements:**

- Details of the full pavement design by a Consulting Geotechnical Engineer with material specification and proposed compliance testing and mandatory construction inspections shall be submitted to Council's Representative for acceptance at the design approval stage.

- **Subsurface Drainage:**

- Subsoil Trench Foundation - before placement of bedding and pipes after trenching.
- Subsoil Bedding - before backfilling.
- Subsoil Laying and Jointing - before backfilling.
- Subsoil Backfill - prior to placement of subsequent layer.
- Subsoil Flushing - during final flushing at completion of works.

- **Stormwater Pipelines and Drainage Structures:**

- Foundation - following excavation and prior to bedding being installed.
- Bedding - following the placement of pipes and drainage structures prior to covering.
- Concrete Drainage Structure Cast-In-situ - pre-pour formwork and reinforcement inspection ready for placement of concrete.

- **Minor Concrete Works** - footpaths and shared paths, pedestrian ramps, driveways and accessways, vehicle access crossings, kerb and dish/v-drains:

- Subgrade.
- Sub-base.
- Pre-pour formwork and reinforcement inspection ready for placement of concrete.

For driveway and accessway subgrade and sub-base mandatory inspections, refer to flexible pavement construction inspections.

- **Major Concrete Works and Other Structural Elements** - details of material specifications and proposed compliance testing and mandatory inspections for major concrete works and other structural elements is to be provided by the design and certifying engineer during the design approval stage for Council's acceptance. Structural elements for specification, includes (but is not limited to) the following:

- Buildings and building elements.
- Bridges.
- Rigid road pavements.
- Retaining walls.
- Cast in-situ drainage structures with a specific structural engineering design including box culverts, box culvert base slabs, open channels and non-standard stormwater pits.

- **Pre-final completion inspection**

The Service Provider shall request a pre-final completion inspection to identify all items that are incomplete or defective.

- **Final Completion Inspection**

The Service Provider shall request a final completion inspection upon completion of all rectified or completed items previously identified during the pre-final completion inspection.

- **End of Maintenance and Defects Inspection**

The Service Provider shall request an inspection at the end of the Maintenance and Defects period. Any items identified as requiring rectification must be repaired prior to the release of the Maintenance and Defects Bond.

It is the Service Providers responsibility to book a mandatory inspection providing a minimum of 48 hours' notice to Council as the Certifier for the works.

Construction must not proceed to subsequent works prior to obtaining written confirmation or notification from Council or the Accredited Certifier that the mandatory inspection demonstrated compliance.

3.10.1.2 Inspection and Testing

Inspections and testing shall be undertaken in accordance with this Specification and all costs shall be met by the Service Provider.

Copies of all inspection reports and test results are to be provided to Council's Representative or the Accredited Certifier.

3.10.1.3 Other Inspections

Council as the Principal Certifier for subdivisions and works on lands and roads under Council control may carry out other inspections of the following:

Sediment Control, Environmental, Vegetation and Heritage Protection:

- Installation of protection measures.
- To confirm ongoing maintenance of protection measures.
- To confirm restoration, stabilisation and suitability of site for removal of protection measures.

Clearing:

- Prior to commencement of clearing but after set out or marking of trees to be retained and/or delineation of "No Go" areas.
- During clearing works.
- When clearing is completed.

Earthworks:

- At commencement.

- During works.
- At completion of works.

Miscellaneous inspections:

- Other inspections as detailed in this Specification or as required by Council's Representative.

It should be noted that the pre-final completion inspection needs to be carried out over a number of days depending on the size of the site. Pre-final inspections shall not be started until works are complete unless it is possible to carry out inspections where there is no opportunity for damage to items being inspected from ongoing construction activities to occur. The time when the pre-final completion inspection begins will be up to the discretion of Council's Representative.

When items identified in the pre-final inspection are not rectified or completed at the time of the final completion inspection then additional fees will be charged to the Service Provider for any additional inspection required to complete the final completion inspection.

A satisfactory inspection or approval to proceed from one component of works to the next in no way absolves the Service Provider from the responsibility for remedying defects or uncompleted items of works identified at any time up to the end of the maintenance/defects period.

During the progress of works the following persons:

- Council's Representative.
- Accredited Certifiers.
- Principal Certifier.
- Consultants or specialists employed or engaged by the Service Provider, Council, an Accredited Certifier or the Principal Certifier.

Acting only within their role shall at any time:

- Have uninterrupted access to the works.
- Require the Service Provider's equipment or personnel be made available for examination or testing purposes.
- Instruct the removal or amendment of any such work or material not in accordance with the approved plans, appropriate specifications, standards or best industry practice.

3.10.1.4 Work-as-Executed Data and Drawings and other Compliance Documentation

The provision of work-as-executed data, drawings and other compliance documentation form part of the approved works. For the preparation of work-as-executed drawings refer to **Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements**.

3.10.2 Council as the Certifier for Subdivision Works**3.10.2.1 Notice for Inspections**

Forty-eight hours' notice shall be given for mandatory inspections to Council's Representative or the Accredited Certifier.

Failure to request or comply with mandatory inspection requirements may lead to the affected portion of work not being accepted.

3.10.2.2 Inspections Outside Normal Council Hours

It may be acceptable in the particular case to arrange inspections of work outside of Council's normal working hours. The cost of these inspections shall be borne by the Service Provider. This cost will be determined by Council and shall be paid prior to the issue of a subdivision certificate, a Compliance Certificate or other documentation confirming completion of the subject works.

3.11 Compliance Certificates, Maintenance, Defects and Bonds

3.11.1 Compliance Certificates under the Environmental Planning and Assessment Act 1979

When Council is the Principal Certifier, compliance certificates required to be issued by the Principal Certifier are not required to accompany an application for a subdivision certificate.

A Compliance Certificate may be issued for subdivision works when requested by the Service Provider and the following shall apply:

- A satisfactory final inspection.
- The work-as-executed data, drawings and associated documentation including all test results are submitted, assessed and accepted by Council.
- Written acceptances of other authorities to relevant aspects of the works have been submitted to Council.
- Development Consent conditions relating to the works being satisfied.

It is the Service Provider's responsibility to obtain Compliance Certificates from any Accredited Certifiers used to certify satisfaction of conditions or aspects of the Development Consent.

Compliance Certificates may be issued for identifiable components or aspects of the development or for compliance with a Development Consent condition.

3.11.2 Local Approvals under the Local Government Act 1993

Where Council has given a local approval in relation to works required under a Development Consent, Council will not normally advise of compliance with that Local Approval specifically, unless requested by the Service Provider.

3.11.3 Maintenance/Defects Period and Bond

The Service Provider remains responsible for remedying defective work up to and throughout the Maintenance/Defects Period. The Maintenance/Defects Period for all Subdivision and Development related works shall be 12 months.

Damage or nuisance arising from defective works including that caused by eroded soils which should have been stabilised as part of the development works shall be rectified during the maintenance period without delay.

The Maintenance/Defects Period will commence upon:

- The satisfactory completion of works as evidenced by the final inspection, excepting any bonded uncompleted works as agreed by Council.
- The payment of the Maintenance/Defects Bond.
- The submission of satisfactory work-as-executed data, drawings, test results and when applicable other Authorities' written approval of the works.
- Council issue of a Subdivision Certificate where applicable.

A Maintenance/Defects Bond shall be lodged as an unconditional Bank Guarantee with no termination date or cash only.

The value of this Maintenance/Defects Bond shall be in accordance with Council's current Fees and Charges or where not covered by the current Fees and Charges as determined by Council's Representative.

The Maintenance/Defects Bond is provided to cover any Council incurred costs of abnormal maintenance and/or rectification of any work found to be defective within a period of 12 months from the date of commencement of the Maintenance/Defects Period.

To secure release of the Maintenance/Defects Bond, it is the responsibility of the Service Provider to arrange an inspection with Council's Representative approximately 4 weeks before the end of the Maintenance/Defects Period and to rectify any defects identified at that time or prior to that time.

After 1 month from the end of the Maintenance/Defects Period or the notification of defects, whichever is the later, Council may expend bond monies to remedy defects and recover any additional costs from the Service Provider.

Council will not expend bond monies without giving 14 days' notice to the Service Provider of the intended rectification works. This notice does not apply to emergency maintenance works carried out by Council at any time.

The cost of any emergency remedial work carried out by Council during the Maintenance/Defects Period shall be borne by the Service Provider where the remedial work is the result of a defect.

Any temporary repairs carried out by Council shall be removed and the defect(s) satisfactorily rectified by the Service Provider along with any additional works necessary to prevent any reoccurrence.

Where defects are substantial a further Maintenance/Defects Period and Bond may also be applicable to the completed remedial works as determined by Council's Representative.

Where there is a delay of greater than 2 months from the time of issue of a subdivision certificate and registration of a linen plan the maintenance period may be extended by Council's Representative.

3.12 Provision of Utilities

The Service Provider shall make pre-construction arrangements with appropriate Authorities regarding the installation of new infrastructure.

Approved Utility installation diagrams shall be provided for comment to Council's Representative at the time of Construction Drawing assessment, if diagrams are available at that time, or to Council's Representative if they become available after issue of construction approvals.

The following utilities are normally required:

- Electricity supply including street lighting to roads and other public areas.
- Communication services.
- Gas mains if required by the relevant provider.
- Water supply.
- Sewerage systems.

The Service Provider shall give adequate notice and make satisfactory arrangements with Authorities for the installation of new infrastructure. All works shall be carried out to the requirements of the relevant Authority and any Council requirements.

Services shall be located within Council's footway allocation in accordance with the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*.

The Service Provider shall be fully responsible for the repair of any damage caused by other Authorities in providing services to a development.

All trenching is carried out to the Utility Authorities requirements. Backfill shall be adequately compacted to the adjacent natural ground condition to prevent subsequent settlement. Road crossings shall be backfilled in accordance with the requirements of this Specification.

Utility infrastructure works shall be completed to enable connections and supply prior to the release of a Subdivision Certificate or an Occupation Certificate.

3.12.1 Existing Utility Services

The Service Provider, subject to their negotiations with the Utility Authority, is responsible for all costs associated with adjustment and protection of existing utility infrastructure.

3.12.2 Works by other Authorities

Some Authorities may wish to have full control over some works by undertaking the works themselves, e.g. traffic signal installation, connections to live water supply. The Service Provider is

responsible for arrangements with the relevant Authority for the co-ordination of these works with their works program.

Council requires written acceptance from the Authorities of the completed works. Acceptance of the works may include the payment of fees, costs or bonds by the Service Provider to those Utility Providers.

Section 4 - Traffic Management

4.1 Requirements

4.1.1 General

The Service Provider shall provide a Traffic Management Plan (TMP) including Traffic Guidance Scheme (TGS) and Pedestrian Management Plan (PMP) where required for all works that may affect any public place or road where traffic control will be needed regardless of the extent of works being carried out. For all Council-controlled roads, the TMP shall be submitted to Council for review and comment, prior to the commencement of any works.

The Service Provider shall satisfy all requirements of TfNSW for roads under the responsibility of TfNSW.

For works affecting road or pedestrian traffic the Service Provider shall apply to Council for a Road Occupancy Licence (ROL), which is available from Council's website. The ROL shall be accompanied by the aforementioned TMP and TGS. Where occupation of the road is a requirement for works approved under a *Roads Act 1993* Works Approval, then a 'Notice of Intention to Commence' form is to be submitted to Council.

A Road Occupancy Licence (ROL) only relates to occupation of the road space, and does not grant permission for, or approval to the actual/physical work being undertaken.

The TMP shall include and address the following issues where relevant. Other site-specific issues not included below may also be relevant to the TMP:

- The total area of works showing all existing adjacent features affected by traffic management proposals.
- Identification of the various construction stages resulting in changed provisions for both pedestrian and vehicular traffic.
- Information for all construction stages detailing signposting, barricading, pavement marking, temporary works, etc.
- Design Drawings for any temporary roadways and detours showing pavement, wearing surface and drainage details.
- Details of arrangements for construction under traffic.
- Traffic Guidance Scheme (TGS) for during and outside work shifts.
- Vehicle movement plans.
- Special consideration of the safety of pedestrians, cyclists and workers.
- The names, addresses and means of communicating with personnel nominated for contact outside normal working hours to arrange for adjustments or maintenance of traffic control devices and temporary roadways. With confirmation that this has been supplied to the local Police.
- Whether the use of variable message signs (VMS) is required.
- Detour routes.

- Heavy traffic congestions resulting in increased travel times. Detours may alleviate congestion and include special purpose strategic signs (e.g. variable message signs).
- Any impacts on public transport, local residents and businesses, shopping centres, churches, industrial areas, parking stations, public facilities (e.g. football oval) schools, hospitals, etc.
- In the event of an emergency, or unacceptable levels of congestion, you may be ordered to cease works and restore the road to trafficable condition. The amount of time it would take to do this should be considered and communicated in the TMP.

The Service Provider shall advise all affected parties such as emergency services, waste services, adjacent residents and public transport providers with a minimum of 7 days prior to commencement of works. Information provided shall include notification of works and Service Provider contact details.

A Traffic Guidance Scheme (TGS), which may form part of the TMP, must be prepared by a person suitably qualified by TfNSW as defined by the applicable *Traffic Control at Worksites Manual*. The TGS must include the name of the persons preparing the plan along with their level of certified qualification and certificate number.

The Austroads Guide to Temporary Traffic Management (AGTTM) Part 8: Temporary Traffic Management Categories and the National Training Framework is the preferred national practice for traffic control operations. The purpose of updated content within AGTTM Part 8 is to bring the guide in line with National Harmonisation of Temporary Traffic Management, which includes the National Training Framework.

The TGS must satisfy all the requirements of the current TfNSW *Traffic Control at Worksites Manual*, or its successor document, and AS 1742.2 *Manual of uniform traffic control devices: Traffic control devices for general use*, subject to the above requirement (in bold text).

The TGS shall include and address the following issues where relevant:

- Types and locations of permanent regulatory (R series) and warning (W series) signs.
- Types and locations of temporary signs (T series) including advance warning signs and variable message signs (VMS).
- Locations of permanent and temporary traffic signals.
- Locations of any required Traffic Controllers.
- Locations and lengths of taper and safety buffer areas.
- Locations of safety barrier systems including end terminals.
- Pedestrians and cyclist paths.
- Locations of entry and exit gates to work areas, individually numbered and signposted.
- Details of access to adjoining properties, car parking areas, and side roads.

- Pavement marking details, including types of delineation required, turning arrows, stop/holding lines and other road markings, types and positions of raised pavement markers and other delineation devices.
- Locations of temporary lighting.

Traffic control measures shall be installed and maintained by persons appropriately qualified by TfNSW. Traffic Controllers shall be persons appropriately qualified by TfNSW.

The implementation and ongoing maintenance of traffic control measures are the responsibility of the Service Provider carrying out the works.

If it comes to the attention of Council that Traffic Control Devices (TCD) are insufficient or not operational (particularly in an after-hours situation), then Council may arrange to reinstate the TCD. The cost of all such work shall be charged to the Service Provider.

Changes to any TGS as reviewed by the Roads Authority shall be carried out by a person suitably qualified as noted above. Council acknowledges that changes to TGSs need to be made from time to time to suit site conditions and work staging. The Service Provider carrying out the works is responsible for making appropriate changes to the Traffic Guidance Scheme and implementing those changes on site.

The Service Provider shall conduct operations to offer the least possible obstruction and inconvenience to the public. The length or amount of work under construction at any one time shall not exceed that which can be properly managed having due regard for the rights of the public. Unless otherwise specified or permitted, all traffic (both vehicular and pedestrian) shall be allowed to pass through the works. Signposting and control of the work site shall separate motorists and pedestrians from the workers and machinery.

Other works shall not commence prior to the installation of all traffic management controls as shown on the plans that have been provided by the Service Provider. The Service Provider shall ensure that the required traffic signs, lights, barriers, etc are available for the time works are to commence.

4.1.2 Side Tracks and Working Under Traffic

The Service Provider shall be responsible for the design, construction and operation of any side tracks, detours and working under traffic. These shall be maintained in good condition, removed when works are finished, and the area restored in accordance with the approval or contract. The minimum restoration shall be as per preconstruction conditions.

Installation of all sign posting, pavement marking, safety barriers and traffic control devices shall be completed before the opening of side tracks to traffic.

Maintenance of side tracks shall ensure that:

- The road surface and pavement are kept in a sound condition.
- Any potholes or other failures are repaired without delay.
- Signs, markings and delineators remain intact and are clearly visible.

- All temporary lighting functions effectively.

Where construction under or adjacent to traffic is approved:

- Operation and control of obstructions in existing carriageways shall be planned in accordance with the requirements of the current version of TfNSW's *Traffic Control at Worksites Manual*, or its successor document, subject to the above requirement.
- The Service Provider shall ensure all carriageways are restored to a safe and trafficable state for through traffic prior to cessation of work each day.
- All permanent sign posting, pavement markings, safety barriers and traffic signals where required shall be completed or reinstated prior to opening completed work to traffic.

4.1.3 Monitoring

The Service Provider shall undertake daily inspection of all TCDs and temporary deviations and detours to ensure all measures are in accordance with their TGS or TMP. These inspections shall include monitoring congestion levels and implementing measures to address unacceptable levels of congestion.

A diary recording of installation dates, operation times, and subsequent removal of temporary speed zones shall be kept by the Service Provider on a daily basis. All changes made to the TGS on site shall be recorded. These records shall be made available to Council's Representative upon request.

4.1.4 Traffic Incidents

Council's Representative shall be notified of any traffic incidents that occur within the work site not more than 24 hours after the Service Provider becomes aware of the incident.

A Traffic Incident Report shall be prepared by the Service Provider providing full details of the traffic incident. The Traffic Incident Report shall be submitted to Council's Representative and shall include the following information:

- Time, date and exact location within the work site.
- Weather conditions at the time of the incident.
- TGS in use at the location and time of the incident.
- A written statement that at the time of the incident all traffic control devices were in accordance with the TGS and if not, details of any non-compliance.
- The number of vehicles, pedestrians or workers involved, injuries if any and actions taken by the Service Provider after the incident.

Section 5 - Site Clearing and Bulk Earthworks

5.1 General

5.1.1 Description

This section of the Specification provides required standards for carrying out earthworks for development-related works, general road works and subdivision construction.

The works covered by this section of the Specification include requirements for:

- The clearing and grubbing.
- Excavation, including stripping and stockpiling of topsoil.
- Filling.
- Road pavement subgrade preparation.
- Table drains, catch drains and shoulder drains.
- Testing and inspection.

Where this Specification does not cover a particular aspect of the earthworks being constructed requirements of AS 3798 - *Guidelines on earthworks for commercial and residential developments* shall apply. Confirmation of any requirement shall be obtained from Council's Representative in any case.

The construction of levees, detention basins and walls of temporary sediment basins (if approved) are not covered by this Specification. Specifications for these and similar water retaining works shall be prepared for the site-specific conditions by a Consulting Geotechnical Engineer engaged by the Service Provider. Any specification for these works shall include construction of these works to Level 1 geotechnical control in accordance with AS 3798.

5.1.2 Soil and Water Management, Erosion and Sediment Control

No clearing, grubbing or earthworks shall occur until the contractor has provided to Council, or the Principal Certifying Authority, an updated Soil Water Management Plan reflecting the proposed staging of work.

Soil and Water Management Plans and/or Erosion and Sediment Control Plans shall be prepared in accordance with the requirements of *Managing Urban Stormwater: Soils and Construction*, 4th Edition, Landcom, 2004 known as "*The Blue Book*". The Service Provider shall have a new plan prepared by a suitably qualified and experienced person in accordance with the requirements of "*The Blue Book*" should Council's Representative or the Accredited Certifier considers this to be necessary. The new plans shall be subject to acceptance by Council's Representative or the Accredited Certifier.

All soil and water management and erosion and sedimentation control measures and devices shall be installed and maintained in accordance with the accepted plan and in accordance "*The Blue Book*" and the documents referenced therein prior to and during earthworks and until all

rehabilitation and revegetation has been established to Council's or the Accredited Certifier's satisfaction.

All earthworks shall be progressively vegetated and/or landscaped in accordance with "*The Blue Book*" and approved Landscape plans.

A vegetative cover shall be established on all affected areas prior to issue of final acceptance of works, Occupation Certificate and Subdivision Certificate.

It is the Service Provider's responsibility to ensure best practice Soil Water Management and Erosion Control are maintained to comply with their obligations under the *Protection of the Environment Operations Act 1997*.

5.1.3 Preservation of Existing Trees and Native Vegetation

Trees and native vegetation communities outside the approved construction footprint are to be preserved by approved means to prevent the destruction normally caused by placement of conventional filling and by other earthworks within the critical root zone. All works shall be carried out in accordance with AS 4970 - *Protection of trees on development sites*.

Prior consultation with and approval(s) from Council's Representative shall be required before works begin where the project may affect trees. These trees may be within the same property as the project or within the adjoining property.

The Service Provider shall ensure that all trees and other vegetation identified for retention, including important habitat(s), (that may include dead or fallen trees) are not disturbed or removed. When requested from Council's Representative and/or nominated in the conditions of Development Consent, a Consulting Arborist and/or Ecologist shall be engaged by the Service Provider to provide advice and compliance reporting during the works.

Trees, stands of trees and areas of vegetation which are to be retained shall be fenced off and protected in accordance with requirements specified in documentation that may form part of the approval documentation.

The Service Provider shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified on the approved drawing or other approved documentation.

5.1.4 Consulting Geotechnical Engineer

The Service Provider shall engage the services of a qualified Geotechnical Engineer to provide advice, testing, supervision and reporting during earthworks as requested by Council's Representative. The advice of the Geotechnical Engineer, where in conflict with the requirements of this Specification, shall not be implemented until concurrence with the geotechnical engineering advice has been obtained from the Council's Representative.

5.2 Clearing and Grubbing

5.2.1 General

The Service Provider shall carry out a Before You Dig Australia search prior to commencement of works and the Service Provider shall implement measures to prevent damage to existing underground and overhead utility services.

Locate and mark existing underground services at the site prior to commencement. Locate any survey marks in the area of interest by contacting the NSW Government Spatial Services Department or Council's Team Leader Survey prior to commencement or contact any other appropriate authority responsible for survey records. If there are survey marks, the Service Provider shall meet all protection and relocation requirements from the relevant Authority.

The Service Provider shall implement measures to prevent timber from falling on private property and the Service Provider shall dispose of any timber so fallen or produce the written consent of the owner to its remaining there.

Any trees, branches or vegetation, in the opinion of Council's Representative that are unsound, could become unsound, present a hazard as a result of the works or cause maintenance issues and negative performance of the works, shall be cut down and removed to the satisfaction of Council's Representative.

Damage of any kind, including damage to trees and fencing occurring during clearing operations shall be repaired by the Service Provider to the satisfaction of Council's Representative.

5.2.2 Areas to be Cleared

The areas to be cleared shall be limited to, the areas occupied by the completed road formation, stormwater drainage works, site regrading areas and water reticulation and sewer reticulation works. No other areas shall be cleared unless specifically approved by Council's Representative or shown in the approved drawings.

Unless otherwise detailed on the approved drawings, limits of clearing are defined as lines 1m outside the intersections of excavation or fill embankments with the natural surface.

Service trenches outside the general limits of clearing shall only be under scrubbed. Where slashing of lower shrubs and ground cover is sufficient to permit the works the slashed material shall be retained on site for soil conservation purposes. Alternatively, the slashed vegetation may be stockpiled for use in vegetation regeneration works.

Unless otherwise specified, remove all vegetation, logs, stumps, boulders, roots, scrub, debris, dumped material and items within the limits of clearing. Demolish and dispose of any minor man-made structures (such as fences and livestock yards), all rubbish and other materials that are unsuitable for reuse onsite. All natural landscape watercourses and natural rock outcrops shall be undisturbed unless approved by Council's Representatives.

All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Service Provider shall be removed by grubbing. Stumps and roots over 75mm diameter shall be grubbed out to a minimum depth of 500mm below the natural surface or 1.5m below the finished surface level, whichever is the lower. Backfill grub holes with suitable spoil from excavations compacted in layers to the density of the surrounding undisturbed soil.

5.2.3 Disposal of Cleared Materials

All materials cleared and grubbed, other than those being chipped for reuse, shall be removed from the site.

Sections of felled trees may be required to be retained on site in accordance with Council's conditional requirements of an approved Vegetation Management Plan.

5.2.4 Chipping or Grinding of Cleared Vegetation

Cleared vegetation shall be chipped or ground where possible. The chippings may be stockpiled for re-use as mulch in accordance with the approved drawings or for Soil Water Management during construction.

Protection of stockpiles shall be provided to ensure leachate does not contaminate any area.

Each stockpile of chipped or ground vegetation shall be limited in size to 400m² and 2.5m high.

Excess material that is not to be used on site shall be immediately removed and disposed of at an approved waste management facility or by other lawful means.

Spreading of mulch in isolation over disturbed areas is not accepted to satisfy establishment of a full vegetative cover as required and referred under this Specification.

5.3 Earthworks Excavation

5.3.1 General

All earthworks excavations shall conform to the lines, grades, cross sections, dimensions and allowances for pavement thicknesses, landscaping requirements and other surface finishes shown on the approved drawings.

All rocks and boulders which protrude above the proposed finished surfaces shall be removed.

Materials obtained from excavations that meet specification requirements for fill material shall be used in the upper layers or filled road subgrades and shall be confirmed by the consulting Geotechnical Engineer for suitability.

Rock surfaces shall be left clean and free of spilled soil or debris.

5.3.2 Stripping and Stockpiling of Topsoil

Earthworks shall commence with the stripping of topsoil within the limits of the area for earthworks including areas on which underground servicing, paving, structures or filling are to be constructed. The depth of stripping shall be to a depth determined by the Consulting Geotechnical Engineer. Grass shall be stripped together with topsoil.

Soils shall not be stripped from around existing trees closer than a distance equal to twice the distance from the trunk to the drip line without the approval of the Consulting Arborist or Ecologist. In the case that no Consulting Arborist or Ecologist has been appointed, approval shall be obtained from Council's Representative.

Stockpile locations for topsoil shall be located where shown on the approved drawings. Alternative locations for topsoil stock piles nominated by the Service Provider which are required due to site conditions or staging of works must first be accepted by Council's Representative before using that location.

Topsoil stockpiles shall not exceed 2.5m in height and have a maximum batter slope of two horizontal to one vertical (2:1).

Erosion and sediment control of soil stockpiles shall be managed in accordance with Section 5.1.2 Soil and Water Management, Erosion and Sediment Control of this Specification.

5.3.3 Disposal of Surplus Material

Surplus material from excavations shall not be disposed of onsite other than in accordance with the approved Construction Drawings.

Spoil sites shall be cleared and grubbed to the extent necessary before any material is deposited. Stripped topsoil as specified above shall be stockpiled for respreading over the placed spoil at the completion of site earthworks.

On completion of stockpiling, the stockpile site shall be rehabilitated in accordance with the approved Erosion and Sediment Control Plan/Soil and Water Management Plan and/or surface restoration requirements of this Specification.

If suitable disposal areas have not been approved on site, the surplus material shall be immediately disposed to a Council approved site or disposal facility.

5.3.4 Unsuitable Material

The Service Provider shall make available rollers and other plant for the test rolling of stripped surfaces, natural pavement subgrade and floors of excavations/cuttings in the presence of the Consulting Geotechnical Engineer and Council's Representative or the Accredited Certifier.

Any unsuitable material identified onsite during any stage of the earthworks shall be excavated to the extent recommended by the Consulting Geotechnical Engineer and agreed to by Council's Representative. Material removed may be incorporated into the works elsewhere on the site if that material is approved for its proposed use by the Consulting Geotechnical Engineer or Council's

Representative. If the material is not approved for use elsewhere on the site, it shall be removed from the site.

Unsuitable material which is removed from below proposed fill areas or from the face of cuttings shall be replaced with fill material confirmed by the Consulting Geotechnical Engineer and approved by Council's Representative for use as fill material and compacted in accordance with the requirements of this Specification.

Unsuitable material which is removed from below pavement subgrade level shall be replaced with approved select fill material. The material shall be compacted in accordance with the requirements of this Specification for subgrade preparation.

5.3.5 Transitions from Excavation Cuttings to Fill

Following the removal of topsoil and before the excavation of any cutting commences the Service Provider shall survey and mark the position of the intersection line between the excavation cutting and fill embankments occurring at the underside of the pavement.

Following excavation to the excavation cutting floor, a terrace shall be excavated for the width of the pavement to a depth of 600mm below and parallel to the cutting floor or as directed by the Consulting Geotechnical Engineer.

In addition, the terrace shall extend into the cut for a distance as recommended by the Consulting Geotechnical Engineer from the line resulting from the intersection of the planes of the Designed Floor Level and the stripped surface.

5.3.6 Retaining of Excavated Cuttings

Stability of excavated cuttings shall be designed in accordance with Section 5.6 Retaining Wall and Batters of Council's *Civil Works Specification - Design Guideline*.

Stability of excavated cuttings shall be ensured by:

- Battering to a maximum of four horizontal to one vertical (4:1) slope angle or as recommended by a qualified Geotechnical Engineer, or
- Installation of a retaining structure as designed by a Qualified Civil or Structural Engineer.

Construction of retaining walls shall be inspected and certified by a Qualified Civil or Structural Engineer who is registered on the National Engineers Register (NER), as meeting the requirements of AS 4678 - *Earth-retaining structures*. Certificates and reports confirming the compliance of the construction with the design shall be provided to Council's Representative.

When there is no retaining wall design, the Service Provider shall design the retaining wall in accordance with Section 5.6 Retaining Walls and Batters of Council's *Civil Works Specification - Design Guideline*.

5.4 Earthworks Filling

5.4.1 General

Filling shall not be placed until clearing and stripping of the area has been test rolled, surveyed to AHD levels, inspected and the suitability of the proposed fill material confirmed by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

Filling shall be placed and compacted to conform to the lines, grades, cross sections and dimensions shown on the drawings and to the requirements of this Specification or other requirements as agreed between Council and the Geotechnical Consultant.

Foundations of shallow fill embankments (depth less than 1m from the top of pavement to the natural surface) shall be inspected and tested by the Consulting Geotechnical Engineer and agreed to by Council's Representative where required to determine if the material meets road subgrade requirements.

Material in the foundations for shallow fill embankments which does not meet the requirements for road subgrade requirements shall be removed and replaced by material of the specified quality as recommended and approved by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

Foundations for shallow embankments shall be prepared for fill embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as required by this Specification. The Service Provider shall use equipment and techniques to minimise surface heaving or other foundation damage.

For all other fill embankments, the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as required by this Specification.

Where filling is to be placed on hillsides or against existing fills with slopes which are less than ten horizontal to one vertical (10:1), the slope shall be roughened across the slope to allow placement of filling in layers and to prevent slip failures at the interface.

Where filling is to be placed on hillsides or against existing fills with slopes which are greater than ten horizontal to one (10:1), benching shall be constructed prior to the placement of filling. No fill shall be placed until benching has been inspected and confirmed as suitable by the Consulting Geotechnical Engineer and/or Council's Representative. If fill is placed on a surface with slopes steeper than 4H:1V, bench the surface to form a key for the fill. As each layer of fill is placed, cut the existing ground surface progressively to form a series of horizontal steps greater than 1m in width and greater than 100mm deep. Re-compact the excavated material as part of the filling. Shape to provide free drainage.

Where a lot is to be filled in isolation, the toe of the batter shall merge with the existing surface a minimum of 1m from the adjoining property boundary and within the approved development site unless otherwise approved.

All inspections and testing shall conform to Level 1 inspection and testing of AS 3798 - *Guidelines on earthworks for commercial and residential developments*.

Aesthetics shall be an important consideration to the finished appearance of earthworks filling.

5.4.2 Retaining of Fill

Fill shall be retained by either:

- Stabilised batters to slopes recommended and designed by the Consulting Geotechnical Engineer, approved by Council's Representative and accepted by Council's Representative; or
- As shown on the approved Construction Drawings in accordance with the Consulting Geotechnical Engineer's recommendations; or
- By the installation of retaining walls as certified in design and construction by a suitably qualified Civil or Structural Engineer.

Stability of fill shall be ensured by:

- Battering to a maximum of four horizontal to one vertical (4:1) slope angle or as recommended by a qualified Geotechnical Engineer; or
- Installation of a retaining structure as certified in design and construction by a suitably qualified Civil or Structural Engineer.

All completed fill batters shall be inspected and confirmed to have been stabilised in accordance with the recommendations by the Consulting Geotechnical Engineer and approved by Council's Representative.

Construction of retaining walls shall be inspected and certified by a Qualified Civil or Structural Engineer who is registered on the National Engineers Register (NER), as meeting the requirements of AS 4678 - *Earth-retaining structures* and any other relevant standards, guidelines and best practice requirements. Certificates, inspection records, photos and reports confirming the compliance of the construction with the design shall be provided in accordance with requirements under **Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements**.

When there is no retaining wall design, the Service Provider shall design the retaining wall in accordance with Section 5.6 Retaining Walls and Batters of Council's *Civil Works Specification - Design Guideline* and obtain Works Approval or Construction Certificate prior to commencing construction of the retaining structure.

5.4.3 Filling of Verges

Verges shall be finished true to design levels and the surface raked smooth and free of all rubble, stones, sticks or other such matter. Rocks within verges shall be removed to a depth of 100mm below finished surface level and the verge topsoiled with an approved fill such as a clay/loam material containing less than 40% clay. Minimum thickness of topsoil shall be 75mm and a maximum of 200mm. Refer to AS 4419 *Soils for landscaping and garden use* for topsoil requirements.

Fill containing rock greater than 40mm diameter or clay lumps will not be permitted within 600mm of the finished surface within the verge.

5.4.4 Lot Filling

All lot filling shall be undertaken in accordance with AS 3798 - *Guidelines on earthworks for commercial and residential developments*.

The Consulting Geotechnical Engineer shall supervise, inspect and carry out all testing and monitoring of lot filling employing a Level 1 inspection and testing regime to achieve a desirable lot classification in accordance with AS 2870 - *Residential slabs and footings*.

Relative compactions requirement will conform to the requirements of Table 5.1 Earthworks Relative Compaction Requirements below.

The aforementioned criteria shall apply to all filled lots including lots presenting as a P Classification.

Regardless of the final achievable lot classification, all lot filling shall be compacted to provide ongoing support for ancillary works to buildings and services. This requirement shall be confirmed by the Consulting Geotechnical Engineer and included in the final report.

Road fill batters that extend into lots are considered lot fill under this clause.

A final Geotechnical report including (but not limited to) compaction test certificates, proof rolling verification, lot classifications and recommendations for the minimum foundation requirements required for future buildings of each lot in accordance with AS 2870 - *Residential slabs and footings* shall be submitted to Council's Representative or the Accredited Certifier prior to the issue of the Subdivision Certificate.

5.4.5 Fill Material – General

All fill material shall be a sound, clean, generally homogenous material, free from large rocks, stumps, organic matter and other undesirable material. All proposed fill material shall require prior approval for its intended use by a Geotechnical Engineer and agreed to by Council's Representative.

Suitable fill materials shall firstly be obtained from excavations on the site. Imported material shall only be used when the site material is of an unsuitable nature for the intended fill or the quantities obtained from the site are not sufficient. The Service Provider shall be required to manage and sort the materials obtained from excavations to ensure that the best available material is used in locations that require higher quality material, such as road embankments.

Rock material shall be broken down and evenly distributed through the fill material. Individual rocks shall not be larger than two thirds of the layer thickness. Sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and to produce dense and adequately compacted filling. Any rocky patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended.

5.4.6 Imported Fill Material

Natural materials imported for filling from an offsite source shall be certified by a qualified Geotechnical Engineer as being Excavated Natural Material (ENM) or Virgin Excavated Natural Material (VENM). Certificates shall be provided to Council's Representative, the Accredited Certifier or any other Authority upon request.

Materials with a resource recovery exemption as issued by the Environmental Protection Authority will also be accepted for imported filling subject to documentation of the exemption being provided to Council's Representative prior to its use and endorsement by the Consulting Geotechnical Engineer that the material is suitable for the proposed purpose.

5.4.7 Approved Fill / Backfill

Approved fill/backfill shall be defined as fill material including sand, soil or broken rock obtained from site excavations or approved borrowed areas remote from site.

Such material shall:

- Have maximum Plasticity Index of 20 in that fraction passing 0.425mm sieve.
- Be free of material greater than 150mm in size.
- Contain less than 2% organic matter.
- Be capable of being brought to a moisture content suitable for compaction as specified elsewhere herein.
- Have a CBR value in excess of 10% when tested in accordance with TfNSW *Test Method T117* following a minimum of 10 days soaking and the fraction passing 19mm AS sieve.
- Have a PI value not exceeding 25%.

Approved fill/backfill material obtained shall only be imported from sites having the necessary development approvals to operate, or from such sites where the Service Provider has approved plans.

5.4.8 Selected Fill / Backfill

Select fill/backfill shall meet the requirements of approved fill/backfill with the exception that it shall:

- Be free of material greater than 53mm in size.
- Have a CBR value in excess of 20% when tested in accordance with TfNSW *Test Method T117 California Bearing Ratio of Remoulded Specimens of Road Construction Material*.

5.4.9 Compaction of Fill Material

Fill material shall be placed and compacted in uniform layers of thickness appropriate to the nature of material and the compaction equipment being used. Layers shall extend for the full width of

embankments and shall be placed in horizontal layers. Fill material shall be compacted in a minimum 150mm layer uncompacted thickness. However, greater thicknesses up to 300mm will be permitted subject to the ability of compaction equipment to achieve specified densities in that location.

Each layer shall be compacted to the appropriate density prescribed in this Specification. Where an area is to be planted or ground covered with grass, the top 300mm of the filling shall be compacted to a level not exceeding 95% of the standard maximum dry density.

The moisture content of filling material shall be adjusted by the Service Provider to a level that allows specified densities to be achieved quickly and without excessive effort or compacting of the material. The Service Provider shall seek advice from the Consulting Geotechnical Engineer in regard to appropriate moisture content for compaction if problems are experienced in achieving the specified densities.

Rain-affected material shall be reworked to provide the required density. Any dispute over the requirement for reworking shall be resolved by demonstration of minimal movement during proof rolling and retesting for density and moisture content.

5.4.10 Backfilling of Structures

No filling shall be placed against concrete bridge abutments, wing walls or retaining walls within 28 days of casting or if the 85% design strength has been achieved, unless advice from the designing and certifying Engineer for the structure otherwise allows. Fill shall be placed and compacted to avoid unbalanced loading or movement of the structure.

Unless otherwise detailed on the approved Construction Drawings, the abutments and wing walls of bridges shall be back filled with a select material in accordance with this Specification. Filling outside this area shall be in accordance with other filling requirements in this Specification.

Material placed adjacent to weepholes must be clean, graded, hard and durable crushed stone or river gravel, wrapped in a geotextile, conforming to the following requirements:

- Maximum particle dimension of 53mm; and
- No more than 5% by mass passes the 9.5mm AS sieve.

5.4.11 Geotextiles, Geogrids or Similar

Geotextile fabric, geogrids or the like used in conjunction with filling shall be in accordance with recommendations provided by a Consulting Geotechnical Engineer as shown on the approved drawings and specifications. These recommendations shall include materials specification and placement requirements.

5.5 Road Pavement Subgrades

5.5.1 Subgrade Level

Subgrade level shall be the level that allows the approved design pavement to be constructed on top of the subgrade to achieve the approved finished design levels.

All subgrades shall be compacted, graded and trimmed parallel to the designed surface grade and crossfall. The subgrade shall be trimmed to a level of not more than 0mm above or 50mm below the design subgrade level.

5.5.2 Subgrade Assessment

The Consulting Geotechnical Engineer or Council's Representative shall inspect all subgrades when earthworks have progressed to a stage where the nature of subgrade material can be assessed. The Consulting Geotechnical Engineer shall review the pavement design at this stage and arrange for further CBR and other relevant testing if subgrade conditions do not reflect the subgrade condition that the pavement design was based on. The Consulting Geotechnical Engineer shall confirm in a report to be provided to Council's Representative or Accredited Certifier that the subgrade as inspected was suitable for construction of the pavement as designed. If this confirmation cannot be provided, then further recommendations on the treatment of the subgrade or changes to the pavement design must be made and submitted to Council's Representative for acceptance prior to any continuation of the pavement works.

Rain affected subgrade material shall be reworked to provide the specified density. Any dispute over the requirement for reworking shall be resolved by demonstration of minimal movement during proof rolling and retesting for density and moisture. No further pavement works shall proceed until rain affected areas have been confirmed suitable by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

5.5.3 Subgrades in Cut

All material in the subgrade surface shall be ripped, loosened and compacted to a minimum depth of 150mm below the design subgrade level for the width of the pavement to 150mm behind back of kerb. The maximum dimension of particles in the ripped or loosened zone shall not exceed 100mm after compaction.

After ripping, loosening and compacting the subgrade shall be trimmed parallel with the finished wearing surface so that their levels do not vary from the designed floor levels by more than the tolerances specified above.

All unsuitable material, as determined by the Consulting Geotechnical Engineer and agreed to by Council's Representative shall be removed and replaced with approved material and compacted to the required density and any specific geotechnical advice arising as a result of onsite investigations and inspections at the time of excavation.

5.5.4 Subgrade Replacement

Subgrade replacement layers shall be placed and compacted to achieve densities and moisture contents specified for subgrades. Materials to be used for subgrade replacement shall be in accordance with the approved pavement design and confirmed as being suitable by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

The completed subgrade or subgrade replacement shall extend a minimum of 150mm behind the rear of the proposed kerb.

The excavation floor or natural surface below subgrade replacement material shall be prepared, compacted and trimmed as specified for subgrades.

5.5.5 Rock Subgrade

Rock at subgrade level shall be thoroughly ripped to a minimum depth of 300mm below the subgrade level and shall as a minimum extend to the sides of the formation to provide drainage away from the pavement. Ripped material shall conform to the size requirements described for fill material. Ripped material shall be compacted to form the subgrade construction and present as a tight homogenous surface layer, unless the ripped material is deemed unsuitable for the subgrade. CBR tests may be required on the ripped material should the material be considerably different in nature to the assumed subgrade condition.

5.5.6 Filled Subgrades

Material used in the top 150mm below road pavement subgrade level shall be free of particles larger than 75mm, conforming to the requirement of Select Fill material. Material used from 150mm to 600mm below road pavement subgrades shall be free of particles larger than 150mm, conforming to the requirement of Approved Fill material. Material used from 600mm to 1.0m below road pavement subgrade shall be free of particles larger than 300mm. In any case, the maximum particle size shall be two thirds of the layer thickness.

Where practicable, avoid placing public utility services in fill zones due to the increased risk of water ingress and subsequent slip failure.

5.5.7 Clay Subgrades

Clay materials, which are moderate to highly expansive, should have a moisture content between 90% and 110% of optimum moisture content for standard compaction when being compacted. To prevent drying out and to limit possible surface heave, clay subgrades shall be covered by the first select fill or pavement layer as soon as practical after compaction and moisture testing has been confirmed.

5.5.8 Unsuitable Subgrade Material

Subgrade materials may be deemed as unsuitable for placement of pavement material over the subgrade surface at any stage up to including the final trimming compacting and compaction testing of the subgrade surface. Subgrades may be deemed unsuitable by the Consulting Geotechnical Engineer or Council's Representative. Treatment of the unsuitable subgrade shall be recommended by the Consulting Geotechnical Engineer and accepted by Council's Representative.

5.5.9 Services Trenching in Subgrades

Trenches for services shall be excavated when earthworks have reached finished subgrade level unless otherwise approved by Council's Representative. Trench dimensions shall be in accordance with Section 6.3.5 Trench Dimensions, and Section 7 - Utility Services Installation, Road Opening and Utility Restorations of this Specification.

Compaction tests shall be undertaken to confirm that the trench has been compacted to the subgrade compaction requirements.

5.6 Earthworks Drainage

5.6.1 Table Drains

This clause normally applies to non-urban roads or the side of an urban road opposite the kerb and gutter in construction designated Half Width Road Constructions.

Table drains shall be aligned and graded parallel to the shoulders of the roadway and shall be constructed to conform to the requirements of Austroads *Guide to Road Design Part 5B: Drainage - Open Channels, Culverts and Floodways* and particularly Section 2.13.

Unless otherwise shown on the Drawings or directed by the Principal, line open drains with:

- Organic fibre mat and vegetation, where the longitudinal grade of the completed drain is between 1% and 5% inclusive; or
- Concrete, where the longitudinal grade of the completed drain is less than 1% or greater than 5%.

Concrete lining must have a minimum compacted thickness of 100mm measured at right angles to the surface of the lining and must be colour matched with that of its surroundings unless otherwise approved by Council's Representative.

5.6.2 Catch Drains

Catch drains shall be provided at the top of cuttings with:

- A cross section not less than 300mm deep and at least 300mm wide.
- Side slopes not steeper than the batter of adjacent road cutting.
- Minimum 1% grade to ensure a free flow of water.
- Minimum distance of 1m from the edge of cutting, and no further away than necessary to maintain fall for the drain.

The cutting of catch drains shall be carried out before or during excavation for the roadway.

Where trees occur in the line of a drain, the drain may be neatly diverted.

Outlet drains shall be provided to direct catch drains into drainage structures or water courses. Outlet drains leading down slopes and batters shall be constructed to minimise scour.

5.6.3 Shoulder Drains

Shoulder drains are provided to drain the subgrade through the shoulder to prevent pavement saturation.

The pavement boxing shall be drained by cutting the shoulder at sags in the longitudinal grade and at locations directed by Council's Representative.

Shoulder drains shall be cut at an angle of 60 degrees with the road centre line on grades steeper than 3% and at right angles to the road centre line on grades up to 3% and shall be of depth equal to the depth of the boxing and 200mm wide and shall be evenly graded to a free outfall. Each drain shall be firmly packed with clean, durable stone of mixed gauges not exceeding 75mm gauge free from material passing a 25mm screen.

5.7 Earthworks Compliance Testing

5.7.1 Compaction Testing Requirements

A Geotechnical Inspection and Testing Authority (GITA) shall be employed by the Service Provider to carry out all testing and inspecting required confirming earthworks compliance with this Specification and any other specification required by the Consulting Geotechnical Engineer. A Level 1 Inspection and Testing regime as described in Section 8 of AS 3798 - *Guidelines on earthworks for commercial and residential developments* is required. The Authority shall hold a current National Association of Testing Authorities (NATA) registration for the relevant tests. All test results certificates/reports shall be forwarded to Council's Representative.

Copies of the test certificate reports shall clearly describe:

- The date the test was taken.
- The location and layer or level of each test.
- The compaction conformance requirement of this Specification.
- If the test is a retest and what test it is a retest of shall be stated.
- All other information as required by NATA.

Compaction compliance requirements for work carried out under Section 5 - Site Clearing and Bulk Earthworks of this Specification are itemised in Table 5.1 below.

A successive layer of earthworks fill shall not be commenced until the underlying layer has proved to be conforming to this Specification as determined by testing.

All compaction testing shall be carried out in accordance with the Method of Testing Section of AS 3798 - *Guidelines on earthworks for commercial and residential developments*. Lot filling shall be in accordance with the Compaction Criteria Section of AS 3798. The Compaction Criteria for all other earthworks shall be in accordance with Table 5.1.

Table 5.1 Earthworks Relative Compaction Requirements

Item	Compaction Requirement - Minimum Relative Compaction	
	Minimum Density Ratio (at standard compaction)	Minimum Density Index
	(Cohesive Soils)	(Cohesionless Soils)
Backfilling of grub holes	≥95%	≥70%
Replacement of unsuitable material in cuttings other than subgrades	≥95%	≥70%
Replacement of over excavated material	≥95%	≥70%
General fill and foundation of embankments	≥95%	≥70%
Top 300mm of road embankments or 0 to 300mm below subgrade	≥100%	≥75%
Backfill within 2m of structures	≥100%	≥75%
	Pavements in accordance with pavement requirements	
Replacement of unsuitable subgrade material	≥100%	≥75%

Notes for Table 5.1: At the time of relative density testing moisture contents are to be 60% to 90% of optimum for standard compaction except for moderately to highly expansive clays which shall be 90% to 110% of optimum for standard compaction.

5.7.2 Proof Rolling of Subgrades

In addition to the required compaction testing, road pavement subgrades shall be proof rolled in the presence of the Geotechnical Consultant, Council's Representative, or the Accredited Certifier.

The roller shall be capable of generating sufficient loading as recommended by the Geotechnical Consultant.

5.7.3 Earthworks Level Tolerances

Before the placement of covering materials and on completion of cutting, filling and all incidental operations, the finished surfaces shall conform to the tolerances in level and shape as itemised in Table 5.2 below.

Testing of earthworks tolerances in terms of levels is to be carried out by a Registered Land Surveyor, exemption to this requirement may be provided by Council's Representative. The results of levels taken to confirm level tolerance shall be presented on the work-as-executed drawings.

Testing of earthworks for straightness shall be carried out by the Service Provider in the presence of Council's Representative at a time suitable for Council's Representative to attend the site.

Table 5.2 Earthworks Level Tolerances

Item	Tolerance
Cut subgrade	Level: 0mm above design and 50mm below design Straightness: 20mm maximum departure from 3m straight edge both ways
Fill subgrade	Level: 0mm above design and 50mm below design Straightness: 20mm maximum departure from 3m straight edge both ways.
Unpaved areas in cut or fill	Level: ± 15 mm in existing road verges Level: ± 25 mm in subdivision road verges Level: ± 100 mm in batters
Lot regrade areas	Level: ± 100 mm

5.7.4 Test Method for Compliance

Test methods used for the determination of compaction compliance shall be in accordance Section 7 of AS 3798 - *Guidelines on earthworks for commercial and residential developments*. Field densities are to be determined by Direct methods. Approval of Indirect methods to determine field densities will be considered following a submission to Council's Representative from the Geotechnical Consultant and/or the Geotechnical Testing and Inspection Authority detailing the use of the method and correlations with backfill materials.

5.7.5 Frequency of Testing

The frequency of testing shall be in accordance with Table 5.3 below. If Table 5.3 does not cover a particular situation the Consulting Geotechnical Engineer or Council's Representative shall specify the required frequency of testing.

Table 5.3 Earthworks Methods and Frequency of Testing

Characteristic Analysed	Test Method for Compliance	Frequency of Testing whichever requires the most tests: (minimum of 1 test per isolated area in any case)
Compaction and moisture content of general fill material outside of lot areas	See 5.7.4	1 per layer per 1000m ² or 1 test per 500m ³
Compaction and moisture content of	See 5.7.4	In accordance with Table 8.1 in

Characteristic Analysed	Test Method for Compliance	Frequency of Testing whichever requires the most tests: (minimum of 1 test per isolated area in any case)
fill on lot areas for depths in excess of 300mm		AS 3798
Compaction and moisture content of fill material in footpaths areas (kerb line to boundary or proposed boundary)	See 5.7.4	1 test per 500m ² per layer or 1 test per 50 linear metres per layer
Compaction and moisture content of backfill to structures; replacement of unsuitable subgrade; replacement of unsuitable foundation or other confined operations	See 5.7.4	1 test per 100m ³ distributed evenly through-out full depth and area or 1 test every layer
Compaction and moisture content of top layer of fill (subgrade); cut subgrade and foundation of shallow fill	See 5.7.4	1 test per 500m ² or 1 test per 50 linear metres
Compaction and moisture content of foundation for fill embankments other than shallow fill embankments	See 5.7.4	1 test per 2000m ² per layer or 1 test per 200 linear metres
Material properties - CBR of fill and cut subgrade	AS 1289.6.1.1	1 per 800m ² where subgrade does not reflect design assumptions
Level tolerances of cut and fill batters not associated with roads	Level and co-ordinated position by Registered Land Surveyor	1 full cross section per 50m length. Provide levels at all changes in grade and at intermediate points no more than 5m apart
Straightness of subdivision road verges	3m straight edge	1 location on the left hand and one 1 on the right-hand side verges every 50m apart
Level tolerances of cut subgrade and fill subgrade	Level and co-ordinated position by Registered Land Surveyor	1 full cross section per 20m minimum linear length. Provide levels at all changes in grade and at intermediate points no more than 3m apart
Compaction requirements of service trenches greater than or equal to 300mm wide in road subgrades	See 5.7.4	1 test per trench 1 test per 200m ³ distributed evenly through-out full depth and area 1 test every two layers per 20 linear metres of trench
Straightness of cut and fill batters	3m straight	At 1 location to the left and right of the centre line every 50m apart,

Characteristic Analysed	Test Method for Compliance	Frequency of Testing whichever requires the most tests: (minimum of 1 test per isolated area in any case)
	edge	both perpendicular and parallel to the centre line
Straightness of subgrade	3m straight edge	1 per 20m road length

5.7.6 Determination of the Location of Field Compaction Tests and Field Sampling

For all Earthworks testing the Geotechnical Inspection and Testing Authority (GITA) shall determine the location where sampling and testing will be taken independently of any advice or request by the Service Provider(s) responsible for the earthworks. Any evidence of tests and sampling locations being determined by the GITA in collaboration with the Service Provider(s) responsible for the earthworks shall be deemed as non-complying tests. In this case a new set of tests shall be required to be carried out in locations nominated by Council's Representative.

5.7.7 Non-complying Earthworks and Retesting Requirements

5.7.7.1 General

A non-compliance report shall be submitted to Council's Representative for any non-complying works for which the Service Provider is requesting acceptance. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

5.7.7.2 Non-complying Tolerances

For non-complying tests for straightness, the Service Provider shall immediately rectify the non-compliance and retest the entire area of rework prior to covering up of the subject area.

The Service Provider shall confirm with the Registered Land Surveyor that the levels fall within the compliant tolerances. If the level tolerances are non-compliant, the Service Provider shall rectify the non-compliance and have the Registered Land Surveyor re-level the entire area of rework prior to covering up. All complying levels shall be confirmed on the work-as-executed drawings prepared by the Registered Land Surveyor.

5.7.7.3 Non-complying Relative Compaction Test Results and Retesting Requirements

Where compaction does not comply on the basis of an inspection or test results the Service Provider shall rework the layer tested in an area in accordance with the following:

- **Lot fill**
Rework and retest as required by the Consulting Geotechnical Engineer and/or the Geotechnical Inspection and Testing Authority (GITA).
- **General fill (outside lot areas)**
An area of 1,000m² evenly surrounding the failed test location shall be reworked. A

retest in the failed test location plus an additional test in the rework area will be required.

- **Verge area fill**

Rework 25m either side of the failed test location for the full width of the kerb to boundary or proposed boundary. A retest in the failed test location plus an additional test in the rework area will be required.

- Backfill to structures, isolated replacement of unsuitable subgrade, replacement of unsuitable foundation or other confined operations
Rework total area. One retest anywhere in the reworked area.

- **Top layer of subgrade (cut or fill) and foundation of shallow fill (<1m)**

Rework 25m either side of failed test location for the full width of the subgrade or 500m² surrounding the fail test location in the case of shallow fill foundation. A retest in the failed test location plus an additional test in the rework area will be required.

- **Foundations for fill embankments other than shallow fill embankments**

An area of 2,000m² evenly surrounding the failed test location shall be reworked. A retest in the failed test location plus an additional test in the rework area will be required.

Areas shall not be accepted as complying for compaction until the test results from the retests and additional tests required above confirm compliance.

Section 6 - Stormwater and Subsurface Drainage Construction

6.1 General

Works covered by this section of the Specification include construction of all piped and box culvert stormwater drainage and subsurface drainage. The construction of open earth drains shall be in accordance with the requirements for earthworks in Section 3 - Site clearing and bulk earthworks.

6.2 Acceptable Materials for Stormwater Pipes and Box Culverts

6.2.1 General

All stormwater drainage conduits that **are to become** Council's asset following completion of the works shall be any of the following:

- Reinforced concrete pipe (RCP) minimum 375mm diameter with rubber ring joints.
- Precast reinforced concrete box culverts (RCBC) minimum 600mm x 300mm internal dimensions with cast in-situ or precast (preferred) base slabs.

Fully cast in-situ box culverts may be approved for construction. Full construction specification and details shall be provided on the Construction Drawings and approved by Council's Representative.

Any proposed alternative materials shall be approved by Council's Drainage Asset Management Team before installation.

Conduit systems that **are not to become** Council's responsibility for maintenance, including interallotment stormwater drainage shall be:

- RCP of any size with rubber ring joints.
- FRC of any size with rubber ring joints.
- Polyvinyl chloride (PVC) pipes maximum 300mm diameter.
- Interallotment pipe to be rubber ring jointed.
- Polypropylene pipes (PP) or high-density polyethylene (HDPE) pipes maximum 600mm diameter with rubber ring joints.
- Reinforced concrete box culverts.

All stormwater conduits subject to continual submergence, particularly at stormwater system outlets into waterways, coastal locations or other potentially corrosive environments, shall have a marine grade durability classification.

6.2.2 Pipes

RCPs shall comply with the requirements of AS 4058 - *Precast concrete pipes*. RCPs shall be of the class detailed on the approved drawings.

FRC pipes shall comply with the requirements of AS 4139 - *Fibre reinforced concrete pipes and fittings*. FRCs shall be of the class detailed on the approved drawings and are only permitted for conduit systems that will not become Council's responsibility.

PVC pipes shall comply with the requirements of AS 1260 - *PVC-U pipes and fittings for drain, waste and vent application* and AS 1254 - *PVC-U pipes and fittings for stormwater or surface water applications* as applicable. 100mm diameter PVC pipes shall be Class SN6 to AS 1260, solid walled, solvent welded. PVC pipes larger than 100mm diameter shall be Class SN8.

Polypropylene pipes (PP) shall comply with the requirements of AS 5065 - *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications*.

Use of rubber ring joints with all pipes shall comply with the requirements of AS 1646 - *Elastomeric seals for waterworks purposes*.

Cutting of pipes on site shall only be carried out by a method that is specified or acceptable to the manufacturer and Council's Representative.

Where stormwater drainage conduits are to become Council assets following completion of the works, and where relining has been approved by Council's Representative, all pipe relining works shall comply with **Appendix C - Structural Lining of Stormwater Pipelines, End Sealing and Sealing of Junctions Technical Specification**.

6.2.3 Precast Reinforced Concrete Box Culverts

Precast reinforced concrete box culverts (RCBC) shall comply with the requirements of AS 1597 - *Precast reinforced concrete box culverts*.

Starter bars, where required, shall be cast into or set into units with an epoxy binder specifically made for this purpose where specified on the approved Construction Drawings.

Any penetrations required in precast RCBC units required to connect stormwater drainage pipes shall be provided in the precast unit at the time of manufacture. Any modifications or penetrations required to box culvert units after delivery to site shall be approved and certified by the manufacturer. The certification shall state that the design adequacy of the precast unit will not be affected in any way by the modification.

6.2.4 Compliance Documentation for Supplied Pipes and Box Culverts

The Service Provider, when requested by the Accredited Certifier or Council's Representative shall obtain copies of test certificates and any other documentation that may be required to verify that the supplied stormwater pipes and/or box culverts comply with the specified standards.

6.3 Trench Excavation and Bedding

6.3.1 General

All conduits shall be laid in trench conditions except where otherwise specifically shown on the approved drawing. This may require the completion of filling earthworks in the area of the trench prior to trench excavation. The requirement to complete filling to finished surface levels or road pavement subgrade level may be relaxed with the approval of Council's Representative where conduits are located in deep fill embankments.

Pipes, if shown on the approved drawings, shall be laid under embankment conditions and laid in accordance with full details to be provided by the designing Engineer or a suitably qualified Engineer engaged by the Service Provider. The details shall be submitted to Council's Representative for acceptance prior to construction.

The Service Provider shall set out the trench alignment clearly marking the specified end points, changes in directions and pit locations with pegs and stakes. The depth to invert shall be clearly marked on the stakes for all stormwater drainage construction.

All trench alignments shall be cleared and/or stripped of topsoil prior to commencing trench excavation in accordance with Section 5 - Site Clearing and Bulk Earthworks.

6.3.2 Trenches across Road Reserves

Where it is necessary to construct drainage across road reserves refer to Section 7 - Utility Services Installation, Road Opening and Utility Restorations of this Specification.

Where final surfacing of the trench will not be carried out immediately following backfilling, a temporary surface consisting of cold mix asphaltic concrete shall be installed and maintained in a trafficable and safe condition by the Service Provider until final surfacing can be installed. As a minimum, temporary cold mix asphalt surfacing shall be installed to form a slight raised hump to allow for compaction by traffic. The Service Provider shall monitor the performance of the cold mix installed and if the surface level of the cold mix compacts to create a step of more than 20mm to the top of the existing pavement level the Service Provider shall add more cold mix as appropriate.

Final surfacing shall overlap existing pavement material by a minimum of 300mm either side of the trench wall. The line where the new surfacing matches the existing surfacing shall be saw cut parallel to the line of the trench

6.3.3 Trench Floors

Trenches shall be excavated to the depths and widths specified to allow installation of conduits, pipes or box culverts to the line, levels, grade, and cover specified on the approved drawings. A uniform fall to the discharging end of the pipelines or box culverts shall be achieved in the trench floor.

Unsuitable material which includes soft soils, irregular or fragmented rock and saturated soil, shall be removed from the trench invert and replaced with compacted granular material to provide uniform support.

Where rock is encountered for the full formation area it shall be neatly excavated to the underside of the bedding material.

Where rock is found in an isolated section of trench floor it shall be removed and replaced with compacted granular material to a depth of 300mm below the base of the bedding layer.

Over excavation or uneven surfaces in rock foundations shall be corrected with mass concrete to provide a uniform surface at least 50mm above the highest points of rock.

For pipes with sockets protruding beyond the barrel outside surface, chases shall be cut into the bed of the foundation as necessary, in the appropriate positions, so that each pipe is supported along the full length of the barrel and the socket is not subjected to point loading.

For all box culverts, the trench floor or foundation shall be inspected by Council's Representative and where considered necessary the Consulting Geotechnical Engineer shall confirm that adequate bearing capacity exists for support of the box culvert structure. The Consulting Geotechnical Engineer's confirmation of adequate bearing capacity shall be documented in a report and submitted to the Council's Representative.

The foundations shall be compacted so that the relative compaction as determined by TfNSW *Test Method T166 Relative Compaction of Road Construction Materials* is not less than 95% for standard compaction effort.

6.3.4 Surface Restoration

Where the excavation of trenching has removed and/or disturbed an existing surface, that surface shall be reinstated with new materials to the requirements of Section 7 - Utility Services Installation, Road Opening and Utility Restorations and Section 15 - Restoration and Finishing of Surfaces.

6.3.5 Trench Dimensions

Trench dimensions and conditions for pipe, conduit or box culvert installation shall generally be in accordance with the requirements of:

AS 3725 - *Design for installation of buried concrete pipes.*

AS 2566 - *Buried flexible pipelines.*

AS 2032 - *Installation of PVC pipe systems.*

AS 1597 - *Precast reinforced concrete box culverts.*

Council's *Civil Works Specification - Standard Drawings*

The standard width of trenches for subsurface drainage shall be 300mm.

The width of trenches for curved pipelines shall be adequate to allow correct jointing of rubber ring jointed pipes while providing the minimum clearances from the pipe to the trench walls as required by the above standards.

For box culverts the trench width shall be the width of the culvert base slab plus 150mm minimum each side.

Trench excavation shall include the required depth to achieve minimum bedding thickness.

6.3.6 Pipe Cover

Pipes of the type and class shown on the approved drawings shall be used and laid to the invert levels as shown on those drawings except where the design invert level nominated on the drawings does not provide sufficient cover for either the class of pipe being used or to enable works above the pipe to be completed without encroachment of the pipe into those works. Should this occur

the pipes shall not be laid, and the contractor shall seek clarification or further advice from Council's Representative.

The cover provided at property access should where possible meeting the requirements as specified above, but a reduction in the cover may be acceptable following approval from Council's Representative.

The requirements of AS 3725 - *Design for installation of buried concrete pipes* shall be satisfied for cover, load, pipe class and bedding in relation to reinforced concrete pipes (RCP) or fibre-reinforced concrete (FRC) pipes. FRC pipes are only permitted for conduit systems that will not become Council's responsibility.

Cover for all other pipe-types shall be in accordance with the requirements of AS 2566 - *Buried flexible pipelines* or AS 2032 - *Installation of PVC pipe systems*. In any case the standard or the requirement providing the largest cover shall be used.

TfNSW has specific requirements for stormwater drainage systems within their road network - refer to TfNSW QA *Specification R11 Stormwater Drainage* for further details.

6.3.7 Protection and Drainage of Works

The Service Provider shall provide for the diversion and control of stormwater during construction of stormwater drainage. Where trenches cannot be drained by gravity, the Service Provider shall provide pumping equipment to keep the excavation dewatered and the discharge shall be located and controlled so as not to cause erosion or damage to the environment.

Concurrence of Council's Representative is required for the construction of any temporary damming or diversions of watercourses or drains entering or passing through the works site. Council's Representative may require the submission of a Geotechnical Engineer's design or limit the period that the temporary dam or diversion may stay in place and impose other conditions or requirements relevant to the particular case. Approvals from other Authorities may also be required.

Where compaction of backfill is required and the trench has been externally dewatered, the dewatering equipment shall remain operating until the compaction of the trench backfill has been completed.

If any material in the trench excavation has been damaged by water, it shall be removed and replaced with suitable backfill material. If any excavated material has been excessively moistened by uncontrolled inflowing water, or has been contaminated, the material shall be removed from the work site and replaced with suitable backfill material.

Water in trenches shall be lowered to the bottom of the trench during bedding, pipe laying and backfilling operations to allow the foundation, bedding and backfilling material to be compacted to the specified relative compaction.

6.4 Trench Material

6.4.1 Bedding, Haunch, Side Zone and Backfill Material

Unless otherwise indicated by this Specification, bedding, haunch, side zone and other backfill materials shall be in accordance with the following applicable Australian Standards:

- AS 3725 - *Design for installation of buried concrete pipes.*
- AS 2566.1 - *Buried flexible pipelines - Structural design.*
- AS 2566.2 - *Buried flexible pipelines - Installation.*
- AS 2032 - *Installation of PVC pipe systems.*
- AS 1597.1 - *Precast reinforced concrete box culverts.*
Small culverts (not exceeding 1200mm span and 1200mm height).
- AS 1597.2 - *Precast reinforced concrete box culverts -*
Large culverts (exceeding 1200mm span or 1200mm height and up to and including 4200mm span and 4200mm height).

Recycled materials may be used, provided they meet the requirements of the relevant standards and specifications. The Service Provider shall obtain sample coarse particle size distributions from the manufacturer which is representative of the material to be used on site and submit them to Council's Representative for approval prior to use.

Refer to the IPWEA *Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010* for further information; and TfNSW QA *Specification 3154 Granulated Glass Aggregate* and TfNSW QA *Specification 3580 Aggregate Filter Materials for Subsurface Drainage* for the applicable material and subsurface application requirements.

6.4.2 Compliance Testing for Bedding, Haunch and Side Zone Material

Test results (not more than 3 months old) provided by the suppliers of bedding, haunch, side zone material and other backfill materials shall be obtained by the Service Provider and submitted to Council's Representative prior to delivery of the material to site. Council's Representative may request further testing in accordance with Table 6.1 below on material delivered to site to confirm compliance of the delivered material. All test results shall be submitted to Council's Representative.

Table 6.1 Stormwater Trench Bedding and Backfill Material Testing

Characteristic Analysed	Test Method	Minimum Frequency of Testing
Backfill Material Grading	AS 1289.3.6.1	1 per 100m ³ or part thereof for bedding, haunch and side zone material
Backfill Material Plasticity	AS 1289.3.3.1	1 per 200m ³ or part thereof for bedding and haunch zone material

AS 1289.3.6.1 - *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.*
 AS 1289.3.3.1 - *Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil.*

6.4.3 Non-complying Test Results for Bedding, Haunch and Side Zone Material

6.4.3.1 General

A non-compliance report shall be submitted to Council's Representative for any non-complying works that the Service Provider is requesting acceptance of. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

6.4.3.2 Non-complying Material Test Results

In any case where material grading and plasticity does not comply on the basis of test results the Services Provider shall remove the non-complying material from the site or use it elsewhere on the site as general fill. Council's Representative may request further testing on material to confirm the extent of non-compliance.

6.5 Bedding

Pipe bedding shall not be placed if the trench foundations do not have suitable bearing capacity. The Service Provider shall confirm the suitability of foundation material from the Consulting Geotechnical Engineer or Council's Representative.

Bedding material shall comply with the grading in Table 6.2 below.

Table 6.2 Bedding Material Criteria

Sieve Size (mm)	Mass Passing (%)
19.0	100
2.36	100 - 50
0.6	90 - 20
0.3	60 - 10
0.15	25 - 0
0.075	10 - 0

Any material passing the 0.075mm sieve shall have low plasticity as described in Appendix A of AS 1726 - *Geotechnical site investigations*.

Bedding and backfilling of Buried Flexible Pipelines and PVC Pipe Systems shall be carried out in accordance with AS 2566 - *Buried flexible pipelines* and AS 2032 - *Installation of PVC pipe*

systems respectively unless the Utility Authority that will take over the pipe or conduit as their asset specifies other backfilling requirements.

Bedding and backfilling of box culverts shall be in accordance with the requirements of AS 1597 - *Precast reinforced concrete box culverts*. Material within 1m of road pavement subgrade levels shall be compacted to road pavement subgrade compaction requirements described in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

Bedding and backfilling of reinforced concrete pipes or fibre-reinforced concrete pipes shall be in accordance with the requirements of AS 3725 - *Design for installation of buried concrete pipes*. Pipe class shall be calculated assuming a HS support condition for pipes under road pavements and for pipes not under a road pavement, except that all pipe backfill consisting of granular material complying to the requirements for Select Fill in Side Zones in accordance with AS 3725 shall be provided to at least 150mm above the top of the pipeline or in the case of a pipe laid below a road pavement the material shall extend to the pavement subgrade level.

The bedding material shall extend over the full width of the trench and shall be compacted by tamping, rolling and/or vibration to a minimum Density Index (DI) of 60 under non trafficable areas and minimum Density Index (DI) of 70 under trafficable area in accordance with AS 2566.

The bed level shall be graded to provide for a uniform fall to the discharging end of the pipeline, with line and level as shown on the approved drawings.

For pipes with sockets protruding beyond the barrel outside surface, chases shall be dug into the bed and foundation, if necessary, in the appropriate positions so that each pipe is supported along the full length of the barrel and the socket is not subjected to point loading.

6.6 Laying and Jointing of Pipes, Conduits and Installation of Box Culverts

6.6.1 Pipes

Laying and jointing of all pipe types shall be in accordance with the manufacturers' recommendations. Failure to follow manufacturer's recommendations will result in the pipeline being deemed non-compliant.

Unless otherwise specified, commence laying pipes at the outlet end and proceed upstream.

Pipes shall be laid and jointed to the lines, grades and levels shown on the approved drawings. Pipe barrels shall bear uniformly on the prepared bedding over their full length. Pipelines shall be cleaned of debris and obstructions as laying and jointing proceeds.

The design levels or alignment for stormwater drainage culverts shall not be varied without the approval of Council's Representative.

Pipes shall be laid in straight lines between pits/headwall and on a uniform vertical grade such that no ponding of water occurs unless otherwise shown on the approved drawings.

For pipe laying tolerances, refer to 6.6.4 Construction Tolerances.

Where shown on the approved Construction Drawings stormwater pipes shall be laid to a curved alignment, concentric with the curved line. For curved pipelines, the minimum radius achieved by pulling joints shall be in accordance with the manufacturer's recommendations. When splayed pipes are used the splays shall be factory formed.

Rubber ring joints shall be fitted in the manner described by the manufacturer.

Materials and jointing requirements for PVC pipes shall be in accordance with AS 2032 - *Installation of PVC pipe systems*.

Deflections of rubber ring joints on PVC pipes are not permitted. Curvature shall be obtained by bending the pipe whilst maintaining the position of the joint in the trench. In any case jointing shall comply with the manufacturer's recommendations.

All constructed pipelines shall be cleaned of foreign matter, soil and construction materials prior to inspection.

Lifting holes in pipes shall be fitted with purpose manufactured plugs before commencing backfilling.

At the discharge end of pipes terminating at gully pits or headwalls a 3m length of 100mm diameter subsurface pipe shall be laid in the bottom of the trench discharging through the wall of the gully pit or headwall at 50mm above the invert level of the drainage pipe. The subsurface pipe shall be enclosed in a seamless tubular filter fabric, and the subsurface pipe shall be sealed at the upstream end. When the discharging pipe is 1200mm diameter or larger, two 3m lengths of subsurface pipe shall be provided.

6.6.2 Box Culverts

Reinforced concrete cast in-situ base slabs and walls (if applicable) shall be constructed in accordance with the structural details and specification shown on the approved Construction Drawings. Should cast in-situ base slab and/or wall details not be shown on the approved drawings the Service Provider shall engage the services of a qualified Structural Engineer to provide the required drawing details and specification. The details and specification shall be accepted by Council's Representative prior to base slab construction.

Precast Crown and floor slabs may be acceptable to Council's Representative, Crown Units to be designed to AS 1597.2 - *Precast reinforced concrete box culverts - Large culverts* and precast floor slabs designed by a qualified structural engineer.

Concrete for cast in-situ box culvert elements shall not be poured until the reinforcement and formwork has been inspected and approved by the Structural Engineer and accepted by Council's Representative. A certification report shall be prepared by the Structural Engineer. This report shall confirm the construction of all cast in-situ elements is in accordance with the design requirements. A copy of this report shall be provided to Council's Representative.

Precast box culvert crown units are not to be placed on the base slab until it has cured for a minimum of 14 days and all formwork removed. This requirement shall only be changed at the request of the Structural Engineer and with approval of Council's Representative.

Precast box culvert units shall be installed in accordance with the requirements of AS 1597.1 *Precast reinforced concrete box culverts - Small culverts* and AS 1597.2 - *Precast reinforced concrete box culverts - Large culverts* and the following additional requirements:

- All mortar joints shall be protected from the sun and cured in an approved manner for a minimum of 48 hours.
- External crown unit cell joints shall be covered with a centrally located strip of approved bituminous impregnated fibre material a minimum of 200mm in width which shall be adequately bonded to the box culverts.
- Precast base unit slab joints shall be placed on a strip of geotextile A44 or equivalent with a minimum of 250mm lap to each unit. Once base units are in place, the geotextile fabric is wrapped up the base slab side and placed under the outermost crown unit legs to ensure no infiltration of surrounding soil or sand through the joint.
- All lifting hooks shall be removed, and exposed steel treated with an epoxy sealant.
- Construction vehicles and plant shall not place load on the box culvert until 28 days after casting of the base slab unless otherwise specified by the Structural Engineer responsible for the design and certification of the base slab.

6.6.3 Connection of Stormwater Pipe or Box Culverts to Existing Structures

Where stormwater drainage conduits are shown to be connected to existing junction pits, inlet pits or other box culverts and details of the connection are not provided on the approved Construction Drawings, the existing structure shall be cored where possible or otherwise saw cut and walls broken out to the minimum extent necessary. The area of the breakout or coring shall be reinstated to the satisfaction of Council's Representative.

If more than one wall of an existing stormwater pit is required to be broken out or cored, then the entire pit shall be reconstructed unless otherwise approved by Council's Representative.

6.6.4 Construction Tolerances

Stormwater Pipelines and Box Culverts shall be constructed within the tolerances shown in Table 6.3 below.

Table 6.3 Construction Tolerances for Stormwater Drainage Lines

Grade Line (vertical alignment)	Tolerance (per pipe length or part thereof deviation from the design grade line level)
Less than 1%	± 10mm
1.01 to 4.0%	± 15mm

Grade Line (vertical alignment)	Tolerance (per pipe length or part thereof deviation from the design grade line level)
4.01% to 7%	± 20mm
7.01% upwards	± 25mm
Horizontal alignment	± 50mm

Notwithstanding the above vertical tolerances, each length shall fall in the direction of the design grade line. No adverse grades shall be permitted on any section of the pipeline or box culvert. Notwithstanding the above horizontal tolerances, where pipe joints are pulled to suit curved kerb alignments, the maximum deflection recommended by the manufacturer shall not be exceeded.

Within mine subsidence areas the manufacturer's recommendations regarding maximum pipe deflections is to apply based on design ground strains. Design ground strains can be obtained from the Mine Subsidence Board.

Construction tolerances shall be demonstrated by work-as-executed levels and positions confirmed on site by a Registered Land Surveyor and shown on the work-as-executed drawings. Refer to **Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements** for details.

6.6.5 Compliance Inspections and Documentation

Compliance with Sections 6.2 to 6.6 of this Specification will be demonstrated by:

- Observations made during site inspections by the Council's Representatives during the installation of pipes, box culverts and conduits.
- Work-as-executed information confirming compliance with level and position tolerances.
- Provision of Structural Engineer's certification where applicable.
- Provision of Closed-Circuit Television (CCTV) camera video file(s) and report(s) by a NATA accredited organisation, of all stormwater lines to demonstrate correct jointing, no structural damage to pipes or box culverts and all pipes and box culverts have been cleaned. CCTV camera video recording shall be taken following the pre-final inspection, but before the final inspection. Refer to **Appendix B - CCTV Survey Inspections Technical Specification** - Drainage Assets for specific inspection and data capture requirements.
- Provision of the results of testing as specified.

All documentation demonstrating compliance shall be provided to Council's Representative prior to the final inspection.

6.7 Backfilling

Under this section of the Specification, backfilling is the remainder of filling in the trench above the bedding to finished surface level or pavement subgrade level.

Backfilling shall be carried out in a manner which shall not cause damage to or move the pipes or box culverts.

6.7.1 Pavement Areas

Where pipes are laid under road pavement or kerb and gutter, backfill shall extend from the top of the bed zone up to pavement subgrade level and shall be fill material complying with the requirements shown in Table 6.2 Bedding Material Criteria for the bed zone.

The material shall be placed over the full width of the trench in layers not exceeding 150mm compacted thickness and compacted by vibration to achieve a minimum Density Index (DI) of 70%. The top 200mm shall be compacted to achieve a minimum DI of 80% or as specified in Table 5.1 Earthworks Relative Compaction Requirements.

6.7.2 Paths, Easements and Reserves

Where pipes are laid in areas not subject to vehicular loading, backfilling of reinforced concrete pipes or fibre-reinforced concrete pipes shall be in accordance with the requirements of AS 3725 - *Design for installation of buried concrete pipes* for a minimum H2 support condition. The backfill shall extend from the top of bed zone up to the designed surface level less any allowances for landscaping. Backfill material shall consist of fill material complying with the requirements for bed zone material placed to a level halfway up the pipe barrel and compacted to achieve a minimum DI of 50%. The remainder of the backfill shall consist of Imported Fill/Backfill as specified Section 5.4.6 Imported Fill Material compacted to achieve 95% standard relative compaction.

Refilling of sheeted trenches shall be carried out to the following requirements:

- No struts, walling or other supports shall be removed until the top of compacted refilling has reached the level of these supports.
- No wall sheeting shall be totally removed from the trench until the level of the compacted refill is within 1.5m of the surface.
- No wall sheeting shall be removed, in dewatered trenches, until the level in water table between natural ground and refill material is less than 500mm.
- The wall sheeting shall be withdrawn or removed in such a manner that the pipe and compacted bed and haunch support are not disturbed during such withdrawal or removal.

Bedding and backfilling of box culverts shall be in accordance with the requirements of AS 1597 - *Precast reinforced concrete box culverts*. Material within 1m of road pavement subgrade levels shall be compacted to road pavement subgrade compaction requirements described in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

6.8 Trench Backfilling Compliance Testing

6.8.1 Compaction Testing Requirements

A Consulting Geotechnical Engineer shall be employed by the Service Provider to carry out all testing and inspections required to ensure backfilling compaction and material grading comply with this Specification. All samples shall be tested by a National Association of Testing Authorities (NATA) Registered Laboratory. All test results certificates/reports shall be forwarded to Council's Representative.

Copies of the test certificate/reports shall clearly describe:

- The date the test was taken.
- The location and layer or level of each test.
- The compaction conformance requirement of this Specification.
- If the test is a retest and what test it is a retest of.
- All other information as required by NATA.

Compaction conformance requirements for work carried out under Section 6 - Stormwater and Subsurface Drainage Construction of this Specification are itemised in Table 6.4 below.

A successive layer of trench backfill shall not be placed until the underlying layer has been proven to be conforming to this Specification as determined by testing. If the Service Provider decides to place successive layers and the underlying layer does not conform to the compaction criteria all successive layers or work above the non-conforming layer shall be removed and the non-complying layer reworked and retested.

Table 6.4 Trench Bedding and Backfill Relative Compaction Requirements

Item	Compaction Requirement (Minimum Relative Compaction)	
	Minimum Density Ratio (at standard compaction) (Cohesive Soils)	Minimum Density Index (Cohesionless Soils)
Box culvert bedding	≥95%	≥70%
All other bedding, haunch zones, side zones	In accordance with: AS 3725, AS 2566, AS 2032 and AS 1597.1 or AS 1597.2	
150mm above pipe to 150mm below subgrade level under pavement areas	≥95%	≥70%
Within 150mm road subgrade under pavement areas	≥100%	≥75%

Item	Compaction Requirement (Minimum Relative Compaction)	
Backfill using site excavated material or suitable imported material from 150mm above the pipe to finished surface level not under a road pavement	≥95%	≥70%

AS 3725 - *Design for installation of buried concrete pipes*

AS 2566 - *Electric resistance welded steel air heater tubes*

AS 2032 - *Installation of PVC pipe systems*

AS 1597.1 - *Precast reinforced concrete box culverts - small culverts*

AS 1597.2 - *Precast reinforced concrete box culverts - large culverts*

6.8.2 Test Method for Compliance

Test methods used for the determination of compaction compliance shall be in accordance with Section 8 of AS 3725 - *Design for installation of buried concrete pipes* and AS 1289 - *Methods of testing soils for engineering purposes*. Field densities shall be determined by Direct methods. Approval of Indirect methods to determine field densities will be considered following a submission to Council's Representative from the Consulting Geotechnical Engineer detailing the use of the method and correlations with backfill materials. In the case of penetrometer testing being used as an Indirect method of testing the frequency of testing shall be as described below.

The specified testing shall be taken at random test locations established in each trench in accordance with the specified minimum testing frequency stipulated in Table 6.5 below. Prior to testing the Service Provider shall work the trench foundation, bedding or backfill to ensure uniform moisture content and compaction of all material within the trench.

Compaction testing of the bedding layer may not be required provided the Service Provider has demonstrated that bedding material has been consistently compacted by mechanical means where trenches are 700mm or wider and the bedding material has a moisture content that allows optimum compaction. The Consulting Geotechnical Engineer, the Accredited Certifier, or Council's Representative may direct compaction testing on the bedding to confirm compaction should there be any doubt that the compaction effort provided is not achieving the compaction requirement.

Compaction testing of interallotment stormwater trench backfill may not be required for pipe diameters of 300mm diameter or less provided the Service Provider has demonstrated that backfilling material has been consistently compacted for the full depth of the trench.

6.8.3 Indirect Penetrometer Testing

Indirect Penetrometer testing of backfill, where approved by the Council's Representative, shall be used in accordance with the following.

6.8.3.1 Trenches Below Pavements and Kerb and Gutter

This testing shall consist of:

- For pipe diameter less than 900mm - penetrometer testing at subgrade level shall be required to the depth of the trench both sides of the pipe.
- For pipe diameter greater than 900mm - penetrometer testing at top of pipe to the bottom of the trench both sides of the pipe and at subgrade level to the top of pipe level.
- For multi-celled lines - additional penetrometer testing between cells shall be required for the full depth of the trench in accordance with the dot points above.

6.8.3.2 Trenches in Areas Outside of Road Pavement and not under Kerb and Gutter

This testing shall consist of:

- For pipe diameter less than 900mm - penetrometer testing at finished level less any surface treatment shall be required to the depth of the trench one side of the pipe.
- For pipe diameter greater than 900mm - penetrometer testing at top of pipe to the bottom of the trench one side of the pipe and at finished level less any surface treatment to the top of pipe level.
- For multi-celled lines - additional penetrometer testing between cells shall be required for the full depth of the trench in accordance with the dot points above.

Direct density testing shall be carried out sufficiently in the opinion of the Consulting Geotechnical Engineer to correlate penetrometer test results with densities.

For penetrometer testing a maximum spacing of 50m between tests on each side of the pipe applies with a minimum of 2 tests on each side of the pipe being taken between pits/drainage structures/outlets.

Penetrometer test results shall be presented by a Consulting Geotechnical Engineer with supporting information, including correlations to indicate the adequacy of the results.

6.8.4 Frequency of Testing

The method of testing shall be in accordance with Section 8 of AS 3725 - *Design for installation of buried concrete pipes*. The frequency of testing shall be in accordance with Table 6.5 below. If Table 6.5 does not cover a particular situation the Consulting Geotechnical Engineer or Council's Representative shall specify the required frequency of testing.

Table 6.5 Trench Bedding and Backfill Relative Compaction Method and Frequency of Testing

Characteristic Analysed	Minimum Frequency of Testing
Compaction and moisture content of backfilling for transverse trenches less	1 test in haunch zone, side zone or up to 150mm above pipe; and

Characteristic Analysed	Minimum Frequency of Testing
than 1200mm wide (under roads, paths and driveways)	1 test between 150mm above pipe and subgrade or finished surface
Compaction and moisture content for transverse trenches greater than 1200mm wide (under roads, paths and driveways)	1 test in haunch zone, side zone or up to 150mm above pipe; and 1 test between 150mm above pipe and subgrade or finished surface
Compaction and moisture content for longitudinal trenches (under roads, paths and driveways)	1 test in haunch zone, side zone or up to 150mm above pipe; and 1 test between 150mm above pipe and subgrade, or finished surface every 50m, or at least 1 set of tests between pits or structures greater than 10m spacing
Compaction and moisture content for trenches elsewhere	1 test in haunch zone, side zone or up to 150mm above pipe; and 1 test between 150mm above pipe and subgrade, or finished surface every 100m, or at least 1 lot of tests between pits or structures greater than 50m spacing

6.8.5 Determination of the Location of Field Compaction Tests and Field Sampling

For all trench backfill testing the Consulting Geotechnical Engineer shall determine the location within the length of the trench where sampling and testing will be taken independently of any advice or request by the Service Provider(s) responsible for the works. Any evidence of tests and sampling locations being determined by the Consulting Geotechnical Engineer in collaboration with the Service Provider(s) responsible for the earthworks will be deemed as noncomplying tests. In this case a new set of tests shall be required to be carried out in locations nominated by Council's Representative. Noncomplying Trench Compaction Results and Retesting Requirements.

6.8.5.1 General

A noncompliance report shall be submitted to Council's Representative for any noncomplying works the Service Provider is requesting acceptance. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

6.8.5.2 Non-complying Compaction Test Results and Retesting Requirements

Where compaction does not comply on the basis of an inspection or test results the Service Provider shall rework the layer inspected and/or tested for a length of 25m either side of the test location or the total length between pits/structure if that length is less than 50m. Retest of the layer shall be taken anywhere in the reworked area. The retest report shall be clearly labelled as a retest.

6.9 Concrete Drainage Structures

6.9.1 General

This section covers the requirements for structures that are cast in-situ or precast concrete required as part of stormwater drainage systems. Drainage structures include inlet pits, junction pits, headwalls, open concrete channels, and other structures associated with the stormwater drainage construction. This section does not cover concrete kerb and gutter.

Before any work is commenced on a particular drainage structure under an embankment, the area occupied by the structure and 5m either side of the structure shall:

- Be cleared and grubbed (refer Section 5.2 Clearing and Grubbing); **and**
- Have topsoil removed in accordance with Section 5.3 Earthworks Excavation of this Specification; **and**
- Have the embankment foundations prepared in accordance with Section 6.7 Backfilling of this Specification, including removal of unsuitable material.

All drainage structures contained in the body of an embankment shall be installed in the normal trench conditions.

Generally, all drainage structures, other than those detailed in Council's *Civil Works Specification - Standard Drawings*, shall be designed and specified with a B1 exposure classification in accordance with the requirements of AS 3600 - *Concrete structures* as a minimum. However, a greater exposure classification shall be required to be adopted where the location of the structure dictates, for example in a tidal zone or coastal exposure situation.

All drainage structure designs arranged by the Service Provider shall be submitted to Council's Representative for acceptance.

All drainage structures shall be designed and constructed to address all safety related issues including (but not limited to) the following:

- Pit openings.
- Access and bicycle/pedestrian friendly grates.
- Requirement for guardrail.
- Safety fences or railings.

Council's Representative may instruct the Service Provider to address safety issues through additional works should safety issues not be adequately addressed on the drawings.

At the discharge end of pipes terminating at gully pits or headwalls, a 3m length of 100mm diameter slotted subsurface pipe shall be laid on the pipe bedding layer and cast into the wall of the gully pit or headwall at the same invert level as the drainage pipe. The slotted subsurface pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric. When the discharging pipe is 1200mm diameter or larger, two 3m lengths of subsurface pipe shall be provided on each side of the pipe.

All drainage structures shall be constructed on foundations that provide adequate bearing support for the structure. Council's Representative may direct the Service Provider to have a Consulting Geotechnical Engineer confirm that the foundation bearing capacity for a structure is adequate.

Drainage structures shall be constructed to the applicable level tolerances for adjacent pipe or box culvert grades. The more conservative tolerance shall be adopted where differing grades enter the same structure.

The location for drainage structures shall be constructed within $\pm 100\text{mm}$ from the designed locations unless otherwise approved by Council's Representative.

All drainage structures, other than those located in road pavements or other paved areas shall be provided with a turf surround at the finished adjacent surface as shown in Council's *Civil Works Specification - Standard Drawings* unless otherwise detailed or a different treatment is required to comply with environmental considerations, landscaping requirements or vegetation management.

All grated surface inlet pits including interallotment drainage pits shall be constructed so the grate inlet is 80mm below the surrounding surface level.

Pits and headwall dimensions, unless covered by a standard drawing in Council's *Civil Works Specification - Standard Drawings*, shall be in accordance with the sizes shown on the approved drawings. The required dimension of the pit shall be confirmed with the person(s) that prepared the design if the depth of the pit varies from that shown on the drawings. Any changes in pit sizes shall be brought to the attention of Council's Representative.

Using a proprietary epoxy-based repair mortar may be accepted for use in minor defect repairs or to make a smooth connection of inlet and outlet pipes to pit walls, subject to approval by a Council Representative. A sand and cement mix shall not be used for construction of drainage structures.

Stormwater pits positioned adjacent to vehicle access crossing laybacks shall be located so that the kerb inlet lintel is offset 500mm minimum to the top of the layback wing.

6.9.2 Standard Drawings

Standard drawings relating to drainage structures are contained in Council's *Civil Works Specification - Standard Drawings*.

Any variations to the requirements of the Standard Drawings must be accepted by Council's Representative prior to construction/installation.

Headwalls with concrete aprons shall be constructed in accordance with the latest TfNSW Standard Drawings incorporating the requirements as noted below. TfNSW Standard Drawings can be obtained from the [Transport for NSW website](#).

6.9.3 Precast Pits and Structures

Details of precast structures shall be submitted to Council's Representative for acceptance prior to the Service Provider ordering these products.

Precast pits shall not be accepted for any stormwater drainage pits to be constructed in the road reserve without prior approval from Council's Representative. Precast pits that are accepted for use in the road reserve shall have a minimum wall thickness of 100mm unless otherwise approved and have pre-formed openings for the pipe sizes being used.

Integral precast kerb inlet and grate units shall be placed on a 150mm minimum N20 concrete/kerb mix bed and are acceptable provided they conform to the requirements of Council's *Civil Works Specification - Standard Drawings*. All lintels and grates in road reserves shall be **Load Class D** in accordance with AS 3996 - *Access covers and grates*.

Cracked precast structures shall not be accepted at any stage of the works.

Where precast pits are accepted for use by Council's Representative, all other requirements applying to cast in-situ stormwater pits shall apply.

6.9.3.1 Interallotment Stormwater Drainage Pits

Only wet cast precast pits are acceptable for use as interallotment stormwater pits. Inlet and outlet pipe penetrations shall be cut using a concrete saw or core drilled to minimise the extent of concrete bandage used to seal the connection between pipe and pit wall.

Where the depth of interallotment stormwater pits needs to be altered on site to suit site levels the pit size requirement shall also be altered to reflect the design requirements of Council's *Civil Works Specification - Design Guideline*.

Interallotment stormwater pits shall have a galvanised steel grated inlet fitted flush to the top of the pit. The grate shall be secured to the pit with a galvanised chain to prevent removal.

6.9.4 Cast in-situ Stormwater Pits

All cast in-situ concrete drainage structures, other than those shown in Council's *Civil Works Specification - Standard Drawings* or shown on TfNSW Standard Drawings referred to in this Specification, shall be designed and constructed in accordance with the requirements of AS 3600 - *Concrete structures*.

Where required by Council's Representative, the Service Provider shall engage a Civil or Structural Engineering Consultant to provide a detail and specification for the required drainage structure if design details of cast in-situ drainage structures are not either of the following:

- Shown on the approved Construction Drawings.
- Approved to be a precast structure from a recognised precast concrete manufacturer.
- Detailed in Council's *Civil Works Specification - Standard Drawings*.

Internal and external surfaces of walls of all cast in-situ structures shall be formed, unless the depth of the structure, nature of the ground or any existing constraints permit walls to be cast without external forms, subject to the approval of Council's Representative. The ground strata providing the external form must be undisturbed and trimmed to an even vertical surface so that resulting wall

thickness is increased by at least 50mm, but not more than 100mm over that detailed on the approved drawings. In any case external formwork shall be used for the top 300mm of all walls.

Any concrete poured for cast in-situ drainage structures shall be vibrated during placement. Following the removal of formwork, concrete visually displaying insufficient compaction by evidence of excessive surface honeycombing shall be removed and reconstructed unless an alternative method of repair is accepted by Council's Representative.

For all cast in-situ pits the base shall be poured first to allow the walls to be fully supported on the base. Walls shall be bonded to the base by cement grout to form a tight joint. The minimum base, wall and lid thickness for cast in-situ pits shall be 150mm. Pits poured in multiple height sections shall require N12 starter bars of minimum length 400mm and at 300mm centres to be placed in the walls of preceding lift.

Cast in-situ pits shall be constructed from concrete strength grade N25 minimum if no reinforcement is required in the pit. If reinforcement is required, the concrete strength grade shall be N32 minimum.

Where required by Council's Representative, the invert of all pits, regardless of being cast in-situ or precast, shall be benched and streamlined using N20 concrete as a minimum, to provide a smooth finish and minimise turbulence of flow from inlet pipes to outlet pipes. Care shall be taken with benching and streamlining not to block subsurface drainage outlets.

Where drainage structures abut concrete paving, kerb and gutter or other concrete structures, a 10mm wide expansion/isolation joint shall be provided. The joint shall consist of preformed jointing material complying with TfNSW *QA Specification 3204 - Preformed Joint Fillers for Concrete Road Pavements and Structures* unless otherwise shown on the approved drawings. Total isolation of drainage structures is required where they are located within or abutting rigid pavements.

The class of grate used for all pits, unless specified on the approved drawings or on Council's *Civil Works Specification - Standard Drawings*, shall be suitable for the intended use in accordance with AS 3996 i.e. **Load Class D heavy-duty for roads** and **Load Class C medium-duty in reserves** to suit maintenance plant.

All grates shall be hot-dip galvanised after fabrication.

Concrete to support grates shall have a slump of 70-80mm and vibrated into place. Kerb mix is unacceptable for this work.

Sealed or covered junction pits shall be constructed to the same standard as inlet pits except a sealed cover shall be provided as described below in this Specification.

6.9.5 Headwalls, Wing Walls and Energy Dissipaters

Headwalls, wing walls and energy dissipaters shall be constructed as detailed and shown on the approved Construction Drawings. Any adjustment to the location of these structures to suit site conditions shall be accepted by Council's Representative.

Headwalls and wing walls shall be constructed to retain batters effectively and shall be extended if required to minimise adjacent batter slopes resulting in easily maintainable slopes. Such extensions may require additional structural details to be obtained by the Service Provider. Any additional details obtained by the Service Provider shall be submitted to Council's Representative for acceptance.

Headwalls, where not detailed on the approved Construction Drawings or Council's *Civil Works Specification - Standard Drawings*, shall be constructed to comply with TfNSW Standard Drawings for concrete headwalls with concrete aprons, except that the following shall be applicable:

- Concrete strength grade shall be N32 minimum.
- Cover to all reinforcement shall be 40mm minimum, subject to the applicable exposure classification applicable to the subject location of the works.

Suitable requirements, in accordance with the requirements of AS 3600 - *Concrete structures*, for concrete strength grade and cover to reinforcement shall apply in coastal tidal and splash zone.

Where rock is encountered at the bottom of excavations for wing walls and headwalls, the depth of cut-off walls in uniform rock over the full width of the foundations may be reduced to less than that shown on the approved Construction Drawings or the Standard Drawings but must not be less than 150mm deep into sound rock.

Minimum scour protection or energy dissipater requirements shall include D₅₀ 200mm rock size over "C" strength grade geotextile to TfNSW *Specification D&C R63 Geotextiles (Separation and Filtration)* requirements in the absence of a specifically designed scour protection measure.

6.9.6 Access Opening Covers for Junction Pits and Drainage Structures

Circular sewer access chamber covers shall not be used on any stormwater drainage structure. Other circular covers specifically for the purpose of stormwater pit or structure shall require approval from Council's Representative. Where a circular type of lid is approved it shall be clearly inscribed or marked in a permanent fashion with the letters "SW".

In path areas, road pavements and other paved areas and elsewhere if detailed, junction pits shall have Class E extra heavy-duty or Class D heavy-duty in accordance with AS 3996, as applicable, Gatic or equivalent type covers. In other areas not likely to be subject to vehicular traffic precast concrete covers and surrounds may be used.

Finished surface levels shown for drainage structures on the drawings shall be taken as a guide only. The Service Provider shall be responsible for the establishment of accurate levels so that covers shall be finished as follows:

- Flush and sloped to match adjacent pavement levels in paved areas and surface shape shall be such that surface water cannot accumulate at any point.
- 25mm above finished surface in landscaped areas.
- 75mm above natural surface elsewhere.

Stormwater drainage junction pits shall be raised to the surface and fitted with an access cover suitable for the required traffic loading and future maintenance activities. Buried or blind junction pits shall not be accepted by Council.

6.9.7 Backfilling of Drainage Structure Excavations

Backfilling of drainage structures shall not commence with 14 days of concrete being placed or until the compressive strength of concrete has reached at least N20 unless otherwise shown on the approved drawings.

Where external formwork has been used for any drainage structures, stabilised sand (3% to 5% cement) shall be used for backfilling excavations around drainage structures when located in the road reserve. In areas of existing or proposed road pavement, stabilised sand shall be used to the natural pavement subgrade level.

In other areas selected granular backfill shall be placed and compacted against the full height of the vertical faces of structures for a minimum width of 500mm. Selected backfill shall consist of a granular material meeting the same requirements as side zone material in AS 3725 - *Design for installation of buried concrete pipes* and as specified in Section 6.9.3 Precast Pits and Structures of this Specification.

Where the sides of the excavation are steeper than four horizontally to one vertically (4:1), they shall be cut back in the form of successive horizontal terraces at least 500mm in width, as the backfill is placed.

Backfill to drainage structures shall be carried up to level in layers simultaneously. Compaction shall be in accordance with the requirements for backfilling of structures in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

6.9.8 Modifications to Existing Structures

In the case of minor modifications to existing structures not being shown on the approved drawings the following shall apply. Where existing structures are to be raised or lowered, break out sufficient parts of the walls to expose reinforcement and to allow at least 150mm of new concrete below the new cover or frame. Splice new reinforcement to old as necessary, form and place concrete as specified for new structure.

In the case of major modifications to existing structures where details of the modification are not shown on approved Construction Drawings then the Service Provider shall engage a qualified Structural Engineer to provide advice on the modification of the structure. Copies of the advice shall be provided to Council's Representative. The qualified Structural Engineer shall inspect all aspects of the modification construction and provide certification that the modification construction has been carried out in accordance with their recommendations.

6.9.9 Galvanising of Steel Fixtures

All steel fixtures including grates, frames, step-irons, ladders, etc shall be hot-dip galvanised. Galvanising shall comply with the requirements of the appropriate following standard(s):

- AS/NZS 1214 - *Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series).*
- AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.*
- AS/NZS 4534 - *Zinc and zinc/aluminium-alloy coatings on steel wire.*
- AS/NZS 4792 - *Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process.*

The average galvanising coating to items other than threaded fasteners shall be in accordance with the above standards. Threaded fasteners shall have an average galvanising coating of 375g/m². Surplus material shall be removed from threads of bolts so that no recutting is required.

6.9.10 Compliance Inspections and Documentation for Drainage Structures

6.9.10.1 Precast Drainage Structures

The Service Provider shall, when requested by the Accredited Certifier or Council's Representative, provide copies of test certificates, Certification of structural adequacy, and any other documentation that may be required to verify that the supplied drainage structure complies with the specified standards and is suitable for the location in which it is being used.

6.9.10.2 Cast in-situ Drainage Structures

The Service Provider, when requested by the Accredited Certifier or Council's Representative shall provide copies of test certificates and any other documentation that may be required to verify that the supplied materials comply with the specified standards.

The Service Provider shall provide copies of all structural designs and certification reports as required by this Specification to Council's Representative. When a standard drawing is not used for the construction of a drainage structure, the Service Provider shall have the Designing Engineer inspect the structure during construction and certify that the construction is in accordance with the design and shall perform structurally as intended by the design.

The Service Provider shall provide to Council's Representative, when requested, copies of reports by the Consulting Geotechnical Engineer verifying the foundation bearing capacity and backfill compaction of drainage structures are adequate for the proposed structure.

6.10 Subsurface Drains

6.10.1 General

Subsurface drainage lines shall be installed along both sides of the road pavement, integral with stormwater drainage where stormwater drainage is under kerb and gutter and with stormwater drainage road crossing. Subsurface drainage shall also be required at the interface of new pavements and existing pavements where the new pavement material and/or depth is not consistent with the existing pavement material. Subsurface drainage lines may also be required in other areas as detailed on the approved drawings, such as both sides of box culverts, under kerb and gutter in road pavements, or as described in geotechnical reports and Pavement Design Reports, or if required to control subsurface water that becomes evident during construction.

Where the road shoulders are unsealed, the trenches for the subsurface pipes shall be placed 300mm clear of the outer edge of the pavement. If the shoulders are to be bitumen seal e.g. where concrete kerb and gutter, gutter, lined or pitched table drains are used, subsurface pipes shall be placed adjacent to the gutter or drain and beneath the outside edge of the sealed shoulder.

If transverse drains are also required to control water which collects beneath the pavement from springs, or by penetration through the pavement, these drains shall be laid to intersect the longitudinal drains at approximately 45° to their direction of fall.

All subsurface drainage shall be installed in a trench backfilled with filter material in accordance with this Specification.

This section of the Specification does not apply to subsurface drainage to be installed as part of a water treatment device such as a bio-filtration basin or swale or similar. Details for these types of subsurface drainage shall be shown on the approved drawings or contained within other specifications referred to on the approved drawings.

6.10.1.1 Standard Drawings

The general location, arrangement and other requirements for subsurface drainage are described in Council's *Civil Works Specification - Standard Drawings*.

6.10.2 Subsurface Drainage Materials

6.10.2.1 Pipes

Pipes for subsurface drains shall be 100mm diameter corrugated flexible PVC perforated drainage pipe class SN20 complying with the requirements of AS 2439 - *Perforated plastics drainage and effluent pipe and fittings*. A filter sock shall be required on all pipe installed with sand filter type material.

Other pipe types may be accepted for use following submission of documentation to Council's Representative confirming their compliance with AS 2439 - *Perforated plastics drainage and effluent pipe and fittings* and suitability for the proposed use. Other pipe types that will be considered are perforated or slotted pipes of other material including PVC, PP and geo-composite plastic filter strips. The filter strip may be either a rigid or flexible plastic core with slots or openings and shall be totally encased in a specially manufactured and fitted geo-textile fabric.

Joints, couplings, elbows and tees shall conform to the manufacturer's specifications using the manufacturer's appropriate accessory fittings unless otherwise approved by Council's Representative.

6.10.2.2 Aggregate Filter Materials

Aggregate filter materials shall conform to the requirements of TfNSW *QA Specification 3580 Aggregate Filter Materials for Subsurface Drainage*.

Filter Material shall conform to the following grading requirement (TfNSW *Test Methods T201 - Particle distribution of aggregates (by washing)* and *T203 - Particle distribution of aggregates finer than 75µm (by washing)* shall determine the grading):

Table 6.6 Subsurface Drainage Aggregate Filter Material

AS Sieve Size (mm)	Passing by Mass (%)
9.5	100
4.75	90 - 100
2.36	75 - 100
1.18	50 - 90
0.6	30 - 60
0.3	10 - 30
0.15	2 - 10
0.075	0 - 3

6.10.2.3 Sand Filter Material

Sand filter material shall conform to the particle size distribution requirements in Table 6.7 below after pre-treatment in accordance with TfNSW *Test Method T102 - Pre-treatment of Road Construction Materials by Compaction, Method A*.

Table 6.7 Subsurface Drainage Sand Filter Material Grading Requirements

AS Sieve Size (mm)	Passing by Mass (%)
4.75	100
2.36	95 - 100
0.425	20 - 50
0.3	0 - 30
0.15	0 - 10
0.075	0 - 1

Particle size distribution shall be in accordance with TfNSW *Test Method T201 - Particle distribution of aggregates (by washing)* with the addition of the 425µm AS sieve. The percentage passing the 75µm AS sieve shall be determined by TfNSW *Test Method T203 - Particle distribution of aggregates finer than 75 µm (by washing)*.

After pre-treatment, sand filter material must have a coefficient of saturated permeability of at least 8m/day when compacted to 100% of standard compaction and tested in accordance with TfNSW *Test Method T1311 - Determination of Permeability of a Soil - Constant Head Method*.

6.10.2.4 No Fines Concrete Filter Material

No fines concrete shall only be used for subsurface drainage filter material when specified by the Consulting Geotechnical Engineer or required by Council's Representative. The no fines concrete shall have an aggregate to cement ratio between 6:1 and 8:1 by mass. The water cement ratio shall be 0.35 to 0.45 by mass. The aggregate size distribution shall conform to Table 6.8 below and shall have minimum 98% by mass of aggregate with one fractured face.

Table 6.8 Subsurface Drainage No Fines Concrete Aggregate Grading Requirements

AS Sieve Size (mm)	Passing by Mass (%)
26.5	100
19.0	95 - 100
9.5	0 - 5

6.10.2.5 Alternative Filter Material

The use of filter materials not meeting the specified grading requirements may also be approved for use subject to adequate grading and permeability testing and a report from the Consulting Geotechnical Engineer confirming suitability as a filter material for road pavement subsurface drainage.

6.10.2.6 Geotextile

Geotextile filter/separation layer when used in the subsurface drainage trench with aggregate filter material shall meet the requirements of TfNSW *D&C Specification R63 Geotextiles (Separation and Filtration)*.

6.10.3 Compliance Testing

The Service Provider shall provide a copy of filter material grading and aggregate size distribution test results prior to the supply of the material to the site.

Following delivery of filter material to the work site, the Service Provider shall arrange for the Consulting Geotechnical Engineer to carry out a minimum of 2 random particle size distribution tests on filter material per 500 linear metres of subsurface drainage lines or part thereof for material delivered to the site. The requirement for site testing of filter material shall be relaxed where there is less than 100m of subsurface drainage being constructed.

The Consulting Geotechnical Engineer shall determine where sampling and testing shall be taken independently of any advice or request by the Service Provider(s) responsible for the works.

6.10.4 Trenches

Subsurface drainage trenches shall be:

- A minimum 300mm wide unless otherwise described in the approved Pavement Design Report; and
- A minimum 300mm below the subgrade base; and
- Excavated after pavement construction has reached pavement subgrade level or following placement of subgrade replacement and select layers.

Filter material shall extend from the bottom of the subsurface trench through to the bottom of pavement sub-base material.

Trenches shall generally be graded at the same grade as the road. Trenches shall be graded such that the subsurface drains can discharge into a drainage structure. Where discharge is not to a drainage structure the subsurface drain shall be tailed out at minimum 1% grade until it is able to discharge at finished surface level.

The bottom of the trench shall be graded to remove any localised ponding greater than 20mm. If the trench is over excavated or localised ponding could occur, the trench floor shall be filled with non-porous natural subgrade material and compacted to 100% minimum density ratio (at standard compaction), to prevent ponding from occurring.

Unsuitable material in the base of the trench shall be removed and replaced with non-porous natural subgrade material compacted to 100% minimum density ratio (at standard compaction).

6.10.5 Bedding, Laying, Jointing and Placing Filter Material

Filter material shall not be used if it is contaminated by other soil or other deleterious matter.

The minimum grade for subsurface drainage lines shall be 1% unless otherwise approved by Council's Representative. The filter material shall be used as bedding material and shall be placed below the pipe 50mm thick.

Pipe joints shall be made using a purpose made external joint coupling.

Filter material shall be placed in the trench to avoid segregation.

Filter material shall be compacted to Density Index of 70. The first layer above the pipe shall be 300mm deep. The filter material shall be placed and compacted in such a way as to ensure that the pipe does not move and is not damaged.

All faces of filter material in contact with topsoil or similar fine-grained material shall be covered with geotextile material.

In trenches with hard rock bases, the requirement for trimming the base shall be relaxed subject to there being no adverse effect on overall drainage performance.

6.10.6 Flushing Points and Outlets

6.10.6.1 High Ends and Flushing Points

High ends and flushing points of drains shall be turned up and capped at the surface for final inspection. Once approved by Council's Representative, the end shall be capped and buried a minimum 300mm under the finished surface.

6.10.6.2 Outlets

Subsurface drains shall discharge into stormwater inlet pits and stormwater junction pits, where possible above the hydraulic head of the stormwater pipe. Outlets directly connected to pipes or to the surface shall only be used where absolutely necessary. Outlets to the surface shall have a purpose made precast or cast in-situ headwall and a stabilised tailout drain to direct any flow to the stormwater drainage system. Treatment of the tailout drain shall be confirmed on site with Council's Representative.

Direct connection to existing subsurface drainage lines shall be the Service Provider's or contractor's responsibility to confirm that the existing subsurface drainage line is free draining prior to subsequent pavement construction. Council shall not be held liable if direct connection is carried out on the assumption that the existing subsurface drainage line is free flowing and functional.

6.10.7 Compliance Testing, Inspections and Documentation

Compliance with this Specification shall be demonstrated during site inspections by the Accredited Certifier or Council's Representatives during the installation of subsurface drainage.

The Service Provider shall supply to Council's Representative test result documentation that verifies that the supplied materials relating to subsurface drainage comply with the specified standards. Work-as-executed drawings shall show the location of subsurface flushing points and outlets.

6.10.7.1 Pre-final Inspection

Subsurface drainage lines shall be cleaned of debris, silt and the like before the pre-final inspection. All flushed material shall be captured prior to it leaving the site system.

During the pre-final inspection all subsurface drainage lines shall be flushed whilst Council's Representative is on site. Flushing shall demonstrate that the subsurface drainage line flows freely without any obstruction.

6.10.7.2 Final Inspection

All compliance documentation shall be submitted to Council's Representative prior to the final inspection.

All uncompleted items and defects found during the pre-final inspection shall be completed and/or rectified prior to the final inspection.

Subsurface lines found to be defective by flushing at the pre-final inspection shall be flushed again in the presence of Council's Representative during the final inspection.

6.11 Stormwater Outlets to Kerb and Gutter

For the installation of stormwater outlets to kerb and gutter, refer to Council's *Civil Works Specification - Standard Drawings*.

For new subdivisions 2 outlets shall be provided for each proposed lot that drains to the kerb and gutter. Outlets shall be located at the point in the kerb and gutter that is perpendicular to the front boundary from a point on the front boundary that is 1m offset from each side boundary. One outlet on the low side of the lot shall be supplied for small lot housing lots.

A 90mm diameter uPVC stormwater pipe shall be provided from the kerb outlet to a minimum 500mm within the proposed lot boundary at 1% grade. The end of the pipe within the proposed lot shall be fitted with a tee fitting and riser to 300mm above the finished surface level. Both the open end of the tee and riser shall be capped. The cap on the riser shall be marked with the letters "SW".

In existing residential areas where kerb and gutter exists, stormwater outlets shall be provided where required. The existing kerb shall be neatly saw cut and removed a minimum of 75mm either side of the heavy-duty galvanised steel outlet. The outlet unit shall be set in place using locking tabs and a proprietary epoxy-based repair mortar. Sand cement mix shall not be acceptable.

For road upgrades, the Service Provider shall extend and connect existing property stormwater outlets to the new kerb and gutter with a heavy-duty galvanised steel kerb adaptor with locking tabs.

6.12 Demonstration of Final Compliance for Stormwater Works

6.12.1 Inspections and Documentation

Confirmation of compliance of stormwater works shall only be given at a final inspection for the whole of the works for a development or staged release of the development. However, use of sections of stormwater lines for the control of stormwater within the works may commence upon completion of sections of the stormwater works provided that erosion and sediment control measures including scour protection in outlet drains is provided.

Work-as-executed drawings shall be prepared prior to the final inspection in accordance with the requirements in **Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements**. These drawings shall show the following:

- Finished surface levels at all pits and structure and between pits and structures.
- Finished invert levels and pipe or box culvert grades.
- Changes to the horizontal position of any stormwater line, pit or structure.
- Confirmation of the installed pipe diameter, pipe type and class of pipe.
- Confirmation of the size of installed box culverts.

Work-as-executed information shall demonstrate compliance with the specified level tolerances.

6.12.1.1 Pre-final Inspection

No section of the stormwater system shall be given a pre-final inspection until all contributing lines have been completed and connected, bituminous surfacing of contributing roads has been completed and all unpaved areas of the site have been adequately stabilised to prevent sediment entering the stormwater system.

Pipes and structures shall be cleaned of debris, sediment and the like before the pre-final inspection. Flushing of stormwater systems to clean the system is only allowed where there is no other practical method. All flushed material shall be captured prior to it leaving the site system.

6.12.1.2 Final Inspection

All uncompleted items and defects identified during the pre-final inspection shall be completed and/or rectified prior to the final inspection.

All compliance documentation relating to stormwater drainage and associated structures shall be submitted to Council's Representative prior to the final inspection.

Section 7 - Utility Services Installation, Road Opening and Utility Restorations

7.1 General

This section of the Specification provides minimum technical standards and requirements for the opening and restoration of Council-controlled land including road pavement and ancillary road reserve assets to preserve the integrity and long-term serviceability of the road reserve.

For drainage installations see Section 6 - Stormwater and Subsurface Drainage Construction.

Utility Authorities, Council, contractors and private individuals may from time-to-time be required to open Council's road for the installation, accessing and/or repair of various public utility services including electricity, water and sewerage, gas and telecommunications.

When a road is to be opened or excavated, Council requires appropriate notification of such proposals to be provided by the proponent and where necessary seek approval through the completion of a Road Opening and Restoration Permit Application form, available on Council's website, or consent under Section 138 of the *Roads Act 1993*.

At all times, utility services shall be installed within the Council footway allocation as per the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*. Any situations where deviation from footway allocation is unavoidable, specific approval as a non-conforming application must be sought from Council's Representative prior to commencement of works (emergency works excluded).

When road openings are restored, the permanent restoration works are required to be inspected by Council's Representative to ensure that the road has been returned to its previous state (or better) and a condition consistent with Council's required reinstatement standards.

Where practicable, avoid placing public utility services in fill zones due to the increased risk of water ingress and subsequent slip failure.

This section applies to Utility Authorities, Contractors, Private individuals and Council staff.

7.2 Responsibility and Process for Council

In this Section, Council includes any Service Provider engaged to carry out the required works on behalf of Council.

Council, being a Roads Authority, is responsible for maintaining its road pavement and ancillary road reserve assets in a good and safe condition.

The *Roads Act 1993* Section 101 empowers the Roads Authority to direct persons who dig up public roads to make restoration of those roads or to take action to recover costs associated with the restoration of disturbed roads.

The *Roads Act 1993* Section 101 (in part):

101 Restoration of public road following excavation, etc

(1) A roads authority may direct any person by whom a public road is dug up to restore the road to its previous condition.

(2) If a public road is damaged as a result of a leakage from, or breaking or bursting of, any object or work placed in, on or over the road, the appropriate roads authority may direct the person:

(a) who was responsible for placing the object or work in, on or over the road, or

(b) who has the care or control of the object or work, or

(c) whose act or omission caused the leakage, breaking or bursting, to restore the road to its previous condition.

(3) A direction under this section may specify:

(a) the manner in which or the standard to which, and

(b) the period (being at least 14 days) within which, the direction must be complied with.

Unless exempt under relevant legislation, such as the *Roads Act 1993*, *Electricity Supply Act 1995*, or *Telecommunications Act 1997*, undertaking works within Council's road reserve requires obtaining an approval from Council under Section 138 of the *Roads Act 1993* in the form of a Section 138 approval or a Road Opening Permit. If works involve impacting traffic, including pedestrian and motorised traffic, a Road Occupancy Licence needs to be obtained from Council.

Water and Sewer works undertaken by Council or its contractors within the road reserve shall be carried out in accordance with the Infrastructure Services Directorate | Water and Sewer Directorate Service Level Agreement (SLA). This SLA sets out the processes, responsibilities and accountabilities for the delivery of various services between Council's Infrastructure Services and Water and Sewer Directorates.

Council is responsible for undertaking all searches and obtaining necessary approvals associated with their proposed works. Other requirements to be addressed shall include:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

Where a road activity affects any State Roads, TfNSW shall also be consulted about their specific requirements.

All utility services should be installed within the Council's footway allocation in accordance with the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*.

Council's Representative shall be consulted where deviation from footway allocation is unavoidable.

Council is required to take into account any issues raised, requirements and conditions of approval prior to commencing a road opening activity.

Council's Representative shall also be consulted regarding requirements for road reinstatement.

Council shall ensure works are being undertaken in accordance with this section of the *Civil Works Specification*. Council shall quality assure their excavation, backfilling and restoration works.

A quality assurance checklist shall be completed for the execution of all works including excavation, backfilling and restoration. Copies of quality checklists including all inspection and testing results shall be forwarded to Council's Representative within 7 days of practical completion of works. At any time, Council's Representative may undertake random inspection of the works being carried out on site.

At least 7 days prior to commencement of physical work, Council shall notify:

- All relevant stakeholders including Council's Representative.
- All affected residential frontage properties.

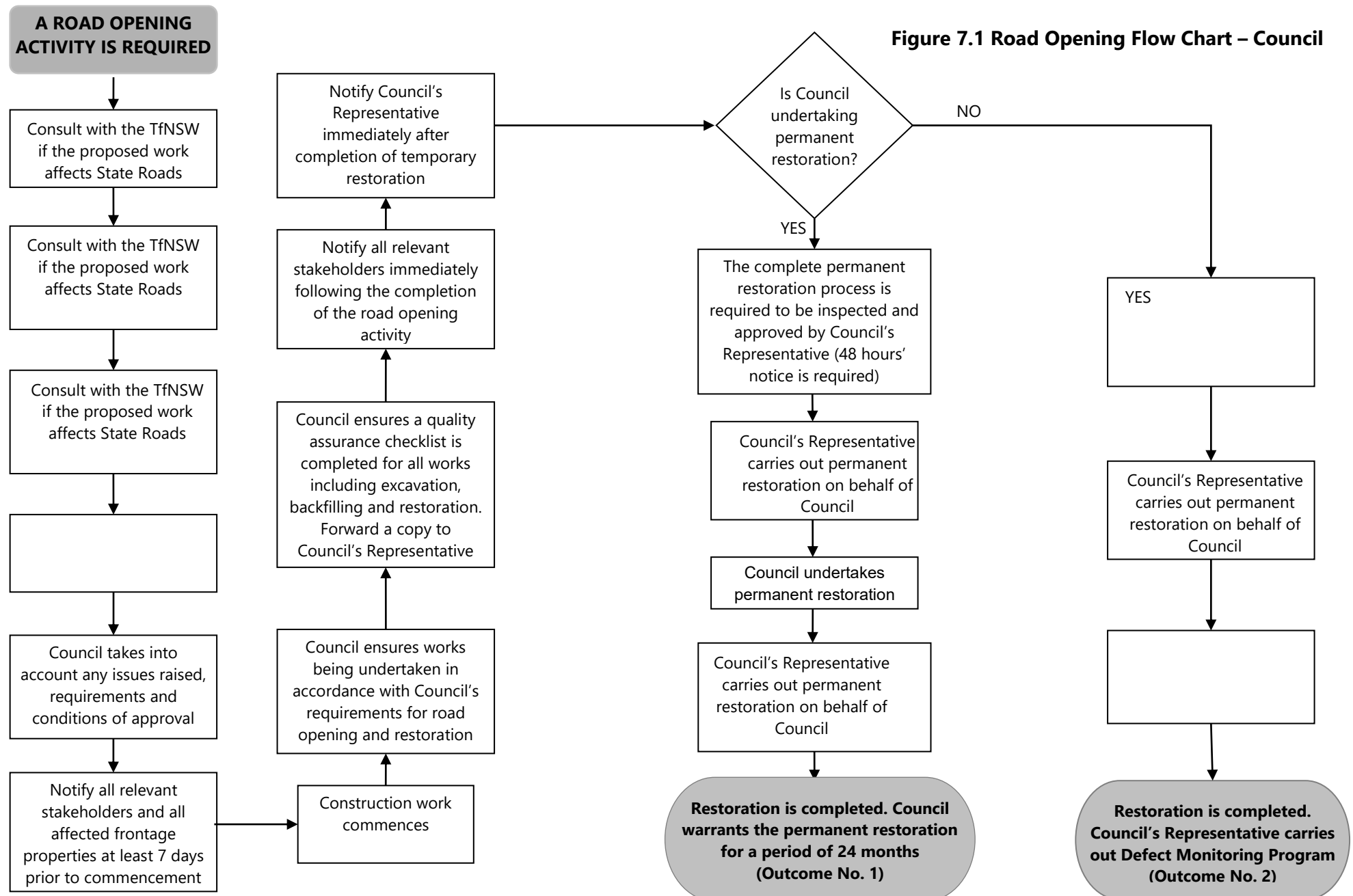
Council's Representative shall be notified immediately following the completion of all temporary and permanent restoration works.

Council shall maintain any temporary restoration in a safe and trafficable condition.

Council's Representative shall be consulted regarding who will be undertaking permanent restoration for the proposed works as well as any permanent restoration arrangement on behalf of the Council. If it is decided that Council shall be undertaking permanent restoration, the complete permanent restoration process shall be inspected and approved by Council's Representative. Forty-eight hours' notice is required prior to permanent restorations being undertaken.

The permanent restoration is required to be warranted for a period of 24 months by Council. During this period, the repair of defects such as subsidence and surface deterioration shall be the responsibility of Council.

Figure 7.1 Road Opening Flow Chart – Council



7.3 Responsibility and Process for Utility Authorities

In this Section, Utility Authorities includes any Service Provider or contractor engaged to carry out the required works on behalf of a Utility Authority.

Before commencing a road opening activity, it is the responsibility of utility authorities to provide a Notice of Proposed Works to Council in accordance with the provisions of the following:

- *Electricity Supply Act 1995* (Section 45).
- *Telecommunications Act 1997* (Schedule 3).
- *Gas Supply Act 1996* (Section 47).

Such notice shall contain relevant information including (but not limited to) the following:

- Works description.
- Location details.
- Anticipated commencement date.
- Proposed start/finish dates.
- Design Drawings.

In situations where a road opening activity has been carried out without notifying Council, the utility authority will be charged with a late fee in accordance with Council's Fees and Charges (available on Council's website). Council shall also be notified when the original proposal has been altered.

Utility Authorities are responsible for undertaking all searches and obtaining necessary approvals associated with their proposed works. Other requirements to be addressed shall include:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

Utility Authorities are required to notify Council's Representative of any proposed work and allow sufficient time for Council's Representative to carry out detailed assessments of the proposal with respect to Council's assets and services to the community. The utility authority is required to provide as much notice as possible with a minimum of 4 weeks for major works and a minimum of 2 weeks for minor maintenance work.

Council shall commence its assessment of a proposal once all relevant information is submitted. The utility authority shall be advised of the outcome and any requirements and/or conditions for the proposed works following the completion of the assessment.

The utility authority is required to take into account any issues raised, requirements and conditions of approval prior to the commencement of the proposed work.

All utility services shall be installed within the Council's footway allocation in accordance with the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*. Council's Representative shall be consulted where deviation from footway allocation is unavoidable.

Utility authorities shall ensure works are being undertaken in accordance with Council's requirements, standards and specifications for road opening and restoration. Additionally, utility authorities shall quality assure their excavation, backfilling and restoration works.

A quality assurance checklist shall be completed for the execution of all works including excavation, backfilling and restoration. Copies of quality checklists including all inspection and testing results shall be forwarded to Council's Representative within 7 days of practical completion of works. At any time, Council's Representative may undertake random inspection of the works being carried out on site.

At least 7 days prior to commencement of physical work, the Utility Authority shall notify:

- Council's Representative.
- All affected residential frontage properties.

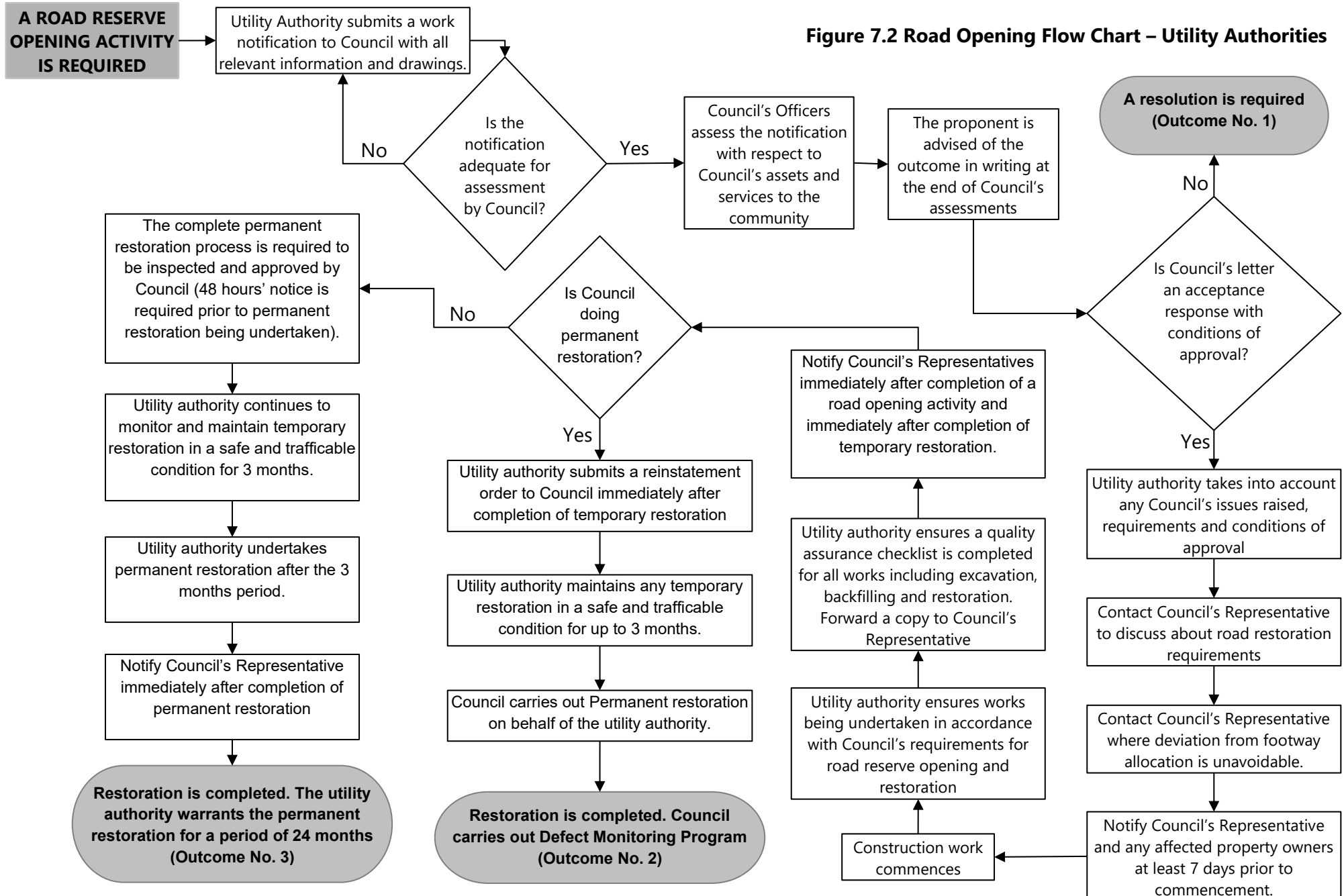
Council's Representative shall be notified immediately following the completion of all temporary and permanent restoration works.

Council shall be informed about who shall undertake permanent restoration for the proposed works. If it is decided that Council will not be undertaking permanent restoration on behalf of a utility authority, the complete permanent restoration process shall be inspected and approved by Council's Representative. Forty-eight hours' notice is required prior to permanent restorations being undertaken. Any inspection carried out by Council's Representative may be subject to an inspection fee.

The utility authority is required to warrant its permanent restoration for a period of 24 months during which time Council will carry out routine defect monitoring program for all completed restorations. During this period, the repair of defects such as subsidence and surface deterioration is the responsibility of the utility authority. Where works carried out are considered by Council to be unsatisfactory, the utility authority will be given 14 days' notice to rectify the fault. Where works are not rectified within this time frame Council may elect to undertake the rectification with costs being charged to the utility authority.

Where Council is engaged or required to undertake permanent restorations on behalf of utility authority, reinstatement orders shall be submitted to Council, immediately after completion of work. The utility authority is responsible for maintaining any temporary restoration in a safe and trafficable condition for up to a period of 3 months after Council has been formally engaged to undertake a permanent restoration. After which time, the maintenance of temporary restoration becomes the responsibility of Council relieving the utility authority of future liability.

Figure 7.2 Road Opening Flow Chart – Utility Authorities



7.4 Responsibility and Process for Private Individuals

In this Section, Private Individuals includes any Service Provider or contractor engaged to carry out the required works on behalf of a Private Individuals or other parties who are not Council or Utility Authorities.

Before commencing a road opening activity, it is the responsibility of private individuals to obtain a Road Opening permit, which is available on Council's website. A Road Opening Permit form must be completed, and associated permit fee and restoration charges shall be paid by the private individual in accordance with Council's Fees and Charges. The permit will be valid for 6 months from the date of issue. In situations where private individuals have carried out a road opening activity without a Road Opening Permit, they will be charged with a late fee in addition to the standard Fees and Charges.

Where a road opening activity is associated with a current Development Consent, the applicant is required to complete a *Roads Act 1993* application form in place of a Road Opening Permit application. A *Roads Act 1993* application form is available on Council's website.

The private individual is responsible for undertaking all searches and obtaining necessary approvals associated with their proposed works. Other requirements to be addressed shall include:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

All utility services shall be installed within the Council's footway allocation in accordance with the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*. Council's Representative shall be consulted where deviation from footway allocation is unavoidable.

The private individual is required to take into account any issues raised, requirements and conditions of approval prior to commencing a road opening activity.

The private individual shall ensure works are being undertaken in accordance with Council's requirements, standards and specifications for road opening and restoration. The private individual shall quality assure their excavation, backfilling and restoration works.

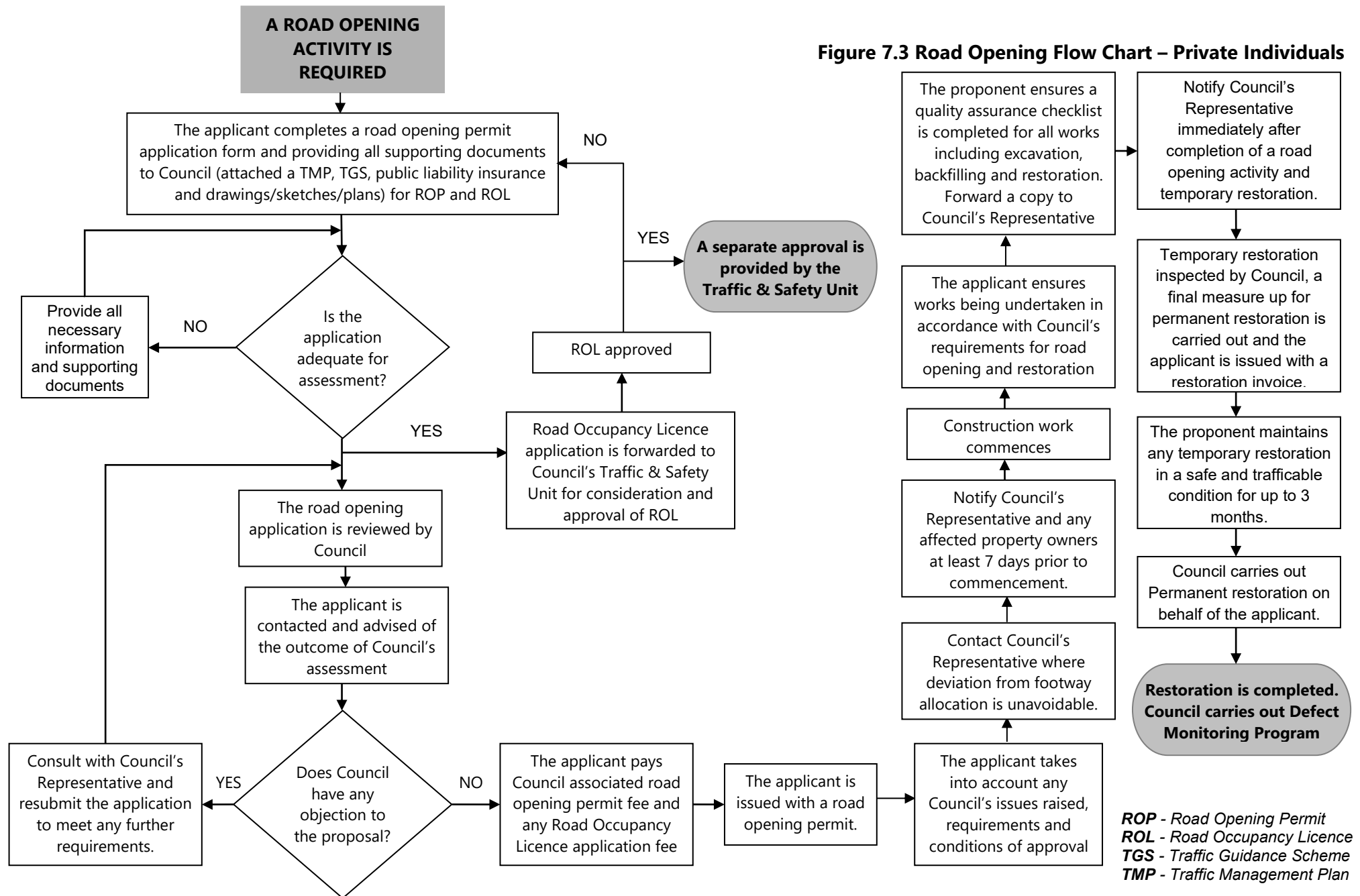
A quality assurance checklist completed by the private individual shall be completed for the execution of all works including excavation, backfilling and restoration. Copies of quality checklists including all inspection and testing results shall be forwarded to Council's Representative within 7 days of practical completion of works. At any time, Council's Representative may undertake random inspection of the works being carried out on site.

At least 7 days prior to commencement of physical work, the Private Individual shall notify:

- All relevant stakeholders including Council's Representative.
- All affected residential frontage properties.

Council shall undertake all permanent restorations on behalf of the private individual. However, the private individual is required to maintain any temporary restoration in a safe and trafficable condition for a period of up to 3 months after Council has been formally engaged to undertake a permanent restoration. After which time, the maintenance of temporary restoration becomes the responsibility of Council.

Prior to Council undertaking permanent restoration works, any temporary restoration shall be inspected by a Council's Representative, a final measure up for permanent restoration shall be required and a restoration invoice shall be issued to the applicant.



7.5 Utility Service Installation within the Road

7.5.1 Allocation of Spaces in Footways

There are no allocations for utility services within road carriageways. All utility services shall be installed within the Council's footway allocation in accordance with the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*.

The first 300mm parallel to the property alignment shall be utilised at all times for the placement of utility structures such as cabinets, pillars, and pedestals in accordance with the NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening* unless other utility services already occupy this space.

Any above ground structure placed very close to the roadway may pose safety hazards to vehicular traffic. In no circumstance shall any above ground utility structures be installed within 500mm from the back of kerb without Council's approval.

The Service Provider cannot utilise the Water Authority's defined street allocation services corridor for installation of utilities infrastructure including cables, conduits, kiosks, pillars, poles, street lighting columns without written consent of the Water Authority (Central Coast Council).

Any situations where deviation from footway allocation is unavoidable, specific approval as a non-conforming application must be sought from Council's Representative prior to commencement of works.

7.6 Services Conduits Installation

Prior to excavation of trenches for services conduits, the Service Provider shall liaise with the Service Authorities and the Accredited Service Provider Contractor to confirm the servicing trench and co-ordination requirements of the Service Authorities.

The locations of all road crossing and longitudinal conduits and cables shall be recorded and shown on WAE drawings to be provided upon request to Council's Representative.

All services conduits, pits and other materials shall be supplied as specified by each of the Service Authorities.

The Service Provider shall set out the location of all trenching for conduits, pits and bends.

Any conflict between proposed service conduits or pits and approved civil works shall be brought to the immediate attention of Council's Representative. Changes to approved civil works shall not be made without the acceptance of Council's Representative.

All trenches shall be graded at a minimum of 0.5% fall, unless prior approval is given by Council's Representative. Conduits under roads and other objects shall project at least 1000mm beyond obstructions such as kerb, subsurface drains, stormwater and water mains, and otherwise clearances to obstructions are as required by the Service Authority specified by Council's representative. The trench shall be excavated beyond these obstructions.

The installation of service conduits under existing road pavements shall be carried out by a trenchless method such as under boring unless otherwise approved by Council's Representative. Full details of any road under bore must be provided to Council's Representative for acceptance prior to any the under bore proceeding.

Conduits shall be capped with a non-perishable removable cover prior to backfilling to prevent the entry of foreign material.

Warning tape/protection mat installed above installed services, will be as specified by the utility asset owner.

7.6.1 Compliance Inspections and Documentation

The Service Provider shall provide copies of letters from each of the Service Authorities confirming installation relating to servicing complies with their requirements.

Work-as-executed drawings shall show the plan location and type of all service road crossings.

Compliance to this Specification is to be demonstrated during site inspections by Council's Representative during the installation of all services conduits.

Where there is doubt that trenches in existing road pavements have not been restored in accordance with this Specification, the Service Provider will be required to core the restoration to demonstrate compliance.

7.6.2 Non-complying Work

Where utility service conduit installation observed by Council's Representative to not comply with this or any section of this Specification the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying item(s) must be required to be rectified prior to the final inspection.

7.7 Clearances to Council's Underground Assets

7.7.1 Water and Sewer

Minimum clearances to Council's existing water and sewer reticulation mains shall be to the Water Services Association of Australia (WSAA) *Water and Sewer Design Codes of Australia* standards or Council's minimum clearance standards, whichever is greater.

The following conditions including minimum horizontal and vertical clearances to water and sewer assets have been compiled to assist utility providers with clearances required to Council's assets.

Table 7.1 Utility Clearances from Water and Sewer

	MAIN SIZE	GAS Minimum Clearance (mm)		TELECOMMUNICATION Minimum Clearance (mm)		ELECTRICAL Minimum Clearance (mm)	
		H	V	H	V	H	V
WATER	≤ 200	300	150	300	150	500	300
	>200≤450	600	150	600	300	1000	300
	>450	1000	500	1000	500	1000	500
SEWER	≤300	300	150	300	150	500	300
	>300	600	150	600	150	1000	300
	RM≤200	300	150	300	150	500	300
	RM>200	600	150	600	150	1000	300

A minimum 1000mm horizontal (H) and 500mm vertical (V) clearance applies on large major trunk mains, sewer rising mains and larger gravity mains critical to the operation of the water and sewer systems.

Utility services shall not to be installed on the same vertical alignment as the Water Authority's main.

The proponent cannot utilise the Water Authority's defined street allocation services corridor for installation of utility services without written consent of the Water Authority (Council).

The pipe material of Council's assets may also present additional considerations for any proposed installation. Clearances may need to be increased to ensure disturbance does not incur damage to existing water and sewer assets. Compaction of trenching within close proximity to asbestos cement (AC) and cast iron (CICL) assets is restricted to methods not incorporating mechanical vibration.

Service poles located within 1.5m of water and sewer mains are to be embedded below the invert of the mains. Where poles are to be placed with reduced horizontal clearances to mains, placement shall not incur damage to mains or destabilisation of pipe support. Additionally, poles shall not to be placed within 1.5m of sewer maintenance structures.

7.7.2 Stormwater Drainage

Minimum clearances shall be provided to Council's existing and/or proposed stormwater drainage assets in accordance with requirements shown in the Table 7.2 and Figure 7.4 below.

Table 7.2 Utility Clearance from Stormwater

Council Stormwater Drainage Assets		Proposed Underground Utility Installations		
		Minimum Clearances* (mm)		
Category	Sub-category	Ca ¹	Cb ²	Ch ³
Pipe	$\varnothing \leq 900$	300	200	300
	$900 < \varnothing \leq 1500$	600	300	500
	$\varnothing > 1500$	600	500	1000
Box Culvert	Any size	The same as the pipe with equivalent cross-sectional area		
Pit/ Headwall	Any size	Not Acceptable	The same as the largest conduit connecting to it	
Channel/ Table Drain	Lined (concrete or similar)		500	500
	Unlined (e.g. turf or rock)		1000	1000

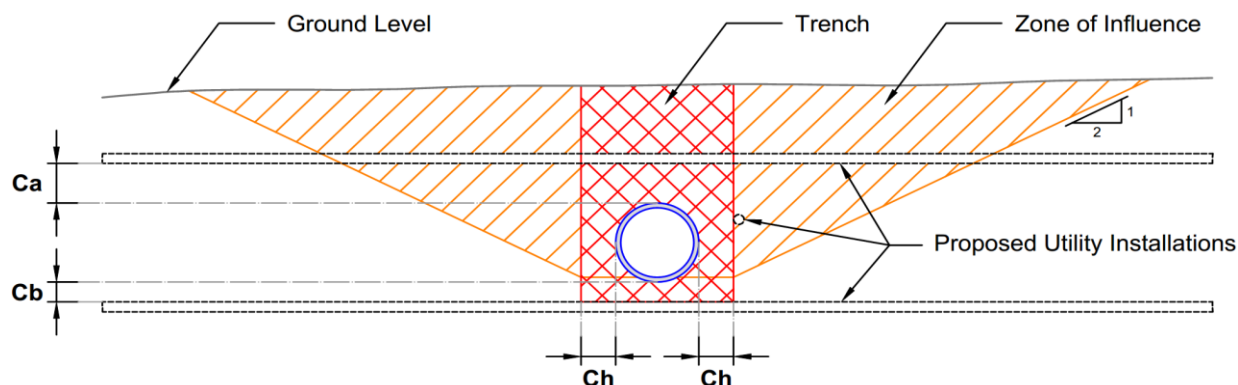
¹ Clearance above stormwater asset² Clearance below stormwater asset³ Horizontal clearance from stormwater asset, where proposed utility installation is running parallel

Ø Internal diameter (mm)

* Measured from the external dimensions of the stormwater drainage assets

Notes:

1. Sewer mains should be installed below stormwater to minimise the possibility of backflow contamination in the event of a main break.
2. Also, where possible, water mains should be installed above stormwater and sewer mains to minimise the possibility of backflow contamination in the event of a main break.
3. For cases where there is no alternative and the main must cross under the sewer, the design shall nominate an appropriate trenchless construction technique or other water main construction and protection treatment, effectively joint-free in the vicinity of the sewer.

Figure 7.4 Typical Stormwater Clearance Requirements

Utility services that are located within 1% AEP flood zones and/or sea level rise affected zones, consideration shall be given to minimise the hazards to community and interruption to service resulting from potential flooding and future sea level rise. Information on 1% AEP flood zones and sea level rise affected zones is available on Central Coast Council's website.

Utility services shall not to be installed on the same vertical alignment as the existing and/or proposed stormwater drainage assets.

The section of the proposed mains, cables and/or conduits passing over the trench of the existing and/or proposed stormwater drainage conduits shall be joint free and self-supporting.

Pits, cabinets, poles, kiosks and/or substations shall not be installed within the trench of the existing and/or proposed stormwater drainage assets.

Pits, cabinets, kiosks and/or substations shall be installed outside the zone of influence of existing and/or proposed stormwater drainage assets, unless underpinning of the proposed structures are undertaken.

Poles shall be installed outside the zone of influence of existing and/or proposed stormwater drainage assets. However, if poles are to be installed within the zone of influence of existing and/or proposed stormwater drainage assets, the poles shall be installed to a depth that is below the zone of influence.

There shall be no installation of utility infrastructure within existing and/or proposed stormwater drainage easements and/or drainage reserves.

Should the clearances required for installing the proposed mains, cables and/or conduits passing over existing stormwater drainage assets cannot be met, the installation shall be below the existing stormwater drainage assets, unless prior approval has been given by Council's Representative.

When the proposed utility mains, cables and/or conduits are concrete encased, the clearance below the stormwater asset may be reduced by the following:

- 100mm for stormwater pipes that are smaller than 1500mm in diameter or box culverts with equivalent cross sectional area.

- 150mm for stormwater pipes that are larger than 1500mm in diameter or box culverts with equivalent cross sectional area.
- 150mm for a lined channel and/or table drain.
- 300mm for a creek, unlined channel and/or table drain.

7.7.3 Depth of Underground Services

Generally, the minimum depth of cover for underground utility services shall be 600mm within footways and 750mm for trench crossings and pits within the carriageway and 900mm for approved longitudinal trenches within the carriageway. For some utilities these depths will increase, see Table 7.3 below. All utility service providers need to be contacted to confirm their individual requirements.

Table 7.3 Nominal Depth of Cover of Utility Service

	Footway (mm)	Carriageway (mm)
Electrical		
LV Cable	600	600
HV Cable to 22kV	600	750
HV Cable 33kV and above	900	900
Gas		
≤ 400kPa		600
≥ 1000kPa	600	900
≥ 3500kPa	1200	1200
Water main		
≥ 750mm diameter	800	800

WARNING: Table 7.3 outlines the depth of underground utilities and indicates only the depths at which the various utility providers are nominally laying services. **It has been prepared for information purposes only.** Existing and future services/utilities may be located at different depths from those indicated. Therefore, Service Providers intending to excavate or bore shall check with the utility providers/authorities concerned before commencing work. They must exercise care in areas where utilities are indicated by the utility providers/authorities and all utilities shall be located by hand excavation/non-destructive method, before any mechanical equipment is used.

7.7.4 Construction of Trenches

All longitudinal trenches, trench crossings and pits within the road reserve shall be constructed in accordance with Council's *Civil Works Specification - Standard Drawings*.

Compaction and compaction testing of backfill and pavement material shall be in accordance with Table 7.4 and Table 7.5 below, which are adapted from AUS-SPEC 1152 (Utilities). Council reserves the right to undertake Quality Control testing, including material compaction and thickness testing.

Table 7.4 Trenches within Footways

Trench Zone	Zone Thickness	Backfill Material	Compaction Requirement	Minimum Testing Requirement
WEARING SURFACE/ COURSE	Grassed:			
		Surface shall be top dressed and turfed with turf rolls and established with appropriate watering		
	Asphalt Pavement:			
	40mm AC	Heavy-duty AC14 or as determined by Council’s Representative		
	Concrete:			
	100mm (path) or 125mm (VAC)	N25 Reinforced Concrete with SL72 mesh		
TRENCH BACKFILL	600mm (min)	Select backfill material (sand as min). Not to use excavated material unless free draining, inorganic, free from stones > 100mm with the fraction passing a 19mm AS sieve with a 4-day soaked CBR ≥ that of the adjacent select material zone to AS 1289.6.1.2	Uniformly compact each 150mm layer over the full area and required depth within the trench to 80% relative density when tested in accordance with AS 1289.5.6.1 (Density Index Method)	1 per 2 layers per 100 linear metres of trench or per 20 road openings for openings of less than 10m² plan area whichever results in the most frequent testing. Testing methods shall be in accordance with AS 1289.5.6.1
BEDDING ZONE	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification

Table 7.5 Trenches within Carriageways

Trench Zone	Zone Thickness	Backfill Materials	Compaction Requirement	Minimum Testing Requirement
WEARING SURFACE (COURSE)	Flexible Pavement:			
	Temporary:			
	50mm	AC (Hotmix only)		
	Permanent:			
	100mm (in 2 layers - 60mm and 40mm)	Heavy-duty AC14 on tack coat or as determined by Council's Representative		
	Rigid Pavement:			
	Temporary:			
	50mm	AC (Hotmix only)		
	Permanent:			
	Match existing thickness (like for like)	Doubly reinforced concrete (N32 min) with SL82 mesh		
BASE COURSE	Temporary: 250mm	Select Pavement Material ARRB SR41 or DGB20 or equivalent	Uniformly compact each 150mm layer over the full area and specified depth within the trench to a relative compaction of 98% when tested in accordance with AS 1289.5.2.1 (Maximum Modified Dry Density) or 102% when tested in accordance with AS 1289.5.1.1 (Maximum Standard Dry Density)	1 per pavement layer, per 100 linear metres of trench or per 20 road openings for openings of less than 10m² plan area whichever results in the most frequent testing. Testing methods are to be in accordance with AS 1289.5.1.1 or AS 1289.5.2.1
	Permanent: 200mm min.			

Trench Zone	Zone Thickness	Backfill Materials	Compaction Requirement	Minimum Testing Requirement
SUBGRADE (TRENCH BACKFILL)	Varies	Select backfill material (sand as minimum). Not to use excavated material unless free draining, inorganic, free from stones > 100mm with the fraction passing a 19mm AS sieve with a 4-day soaked CBR $\geq$ that of the adjacent selected material zone to AS 1289.6.1.2	Uniformly compact each 150mm layer over the full area and required depth within the trench to 80% relative density when tested in accordance with AS 1289.5.6.1 (Density Index Method).	1 per 2 layers per 100 linear metres of trench or per 20 road openings for openings of less than 10m ² plan area whichever results in the most frequent testing. Testing methods are to be in accordance with AS 1289.5.6.1
BEDDING ZONE	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification

AS 1289.5.1.1 - *Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort.*

AS 1289.5.6.1 - *Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material.*

AS 1289.6.1.2 - *Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for an undisturbed specimen.*

7.8 Specification for Road Restoration

All longitudinal trenches, trench crossings and pits located within the road reserve shall be restored in accordance with Council's *Civil Works Specification - Standard Drawings*.

Where paths, road pavements or vehicle access crossings are constructed from other materials such as quarry pavers, pattern pave concrete, bluestones, coloured concrete, or bricks, Council's Representative shall be consulted regarding the restoration of these surfaces.

7.8.1 Quality Restoration Standards for Road Pavements

7.8.1.1 Flexible Pavement

- Extend restoration to a minimum of 200mm outside excavation lines with no depression in the restoration surface. Width of remaining surface adjacent to the

gutter shall be greater than 1.0m. Restoration surface shall match the road cross section.

- All joints shall be crack sealed (to a maximum of 75mm wide) and any longitudinal joints shall not be within wheel paths. There shall be no separation between joints.
- Restored trenches shall be free from broken edges and surface levels along the edges shall be flush with the surrounding pavement.
- Restoration wearing course shall be free of potholes, ravelling, rutting, shoving and any cracks greater than 1mm.
- Restore any pavement markings, signal detectors and sign posts.
- Service manholes shall be flush with surrounding pavement.
- Trench restoration shall include any saw cuts extending past the trench alignment.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.1.2 Rigid Pavement

- For unreinforced plain concrete, reconstruct reinforced full slab.
- Extend the reconstruction of new reinforced slab 500mm outside excavation lines or extend to the nearest joint if the remaining dimension of slab is less than 1.0m. The concrete slab shall be dowelled at 500mm centres with 20mm diameter galvanised bars along longitudinal edges.
- Restoration shall have no depression and finish surface shall match the road cross section and the surrounding surfaces.
- Surface levels along the edges shall be flush with the surrounding surfaces. Restoration surface shall be free of cracking and dusting.
- Restored trenches shall have clean saw cut edges.
- Restore any pavement markings, signal detectors and sign posts.
- Service manholes shall be flush with surrounding surface.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.2 Quality Restoration Standards for Paths

7.8.2.1 Concrete Pavement

- For paths with a width of 1.5m or less, slab replacement shall extend 200mm outside excavation or to expansion joint if within 1.0m and have full depth expansion joint into the existing slab to both sides of trench as required in accordance with Council's *Civil Works Specification - Standard Drawings*.

- For paths with a width of 1.5m or less, longitudinal public utility service installations require full path replacement.
- For paths with a width greater than 1.5m, restoration of concrete surface shall extend 200mm outside the excavation lines and in all directions. All joining faces shall have full depth expansion joints into existing slab to both sides of trench as required in accordance with Council's *Civil Works Specification - Standard Drawings*.
- Restored trenches shall have clean saw cut edges with no chipping. Surface levels along the edges shall be flush with the surrounding surfaces. Restoration surface shall be free of cracking and dusting.
- Control joints shall be placed in accordance with Section 10.2.4 New Reinforced Concrete Paths and Council's *Civil Works Specification - Standard Drawings*.
- Service manholes shall be flush with surrounding surfaces and shall be free from concrete slurry.
- There shall be no water pooling on the restored surfaces.
- Finished surface shall be in accordance with Section 10.2.4 New Reinforced Concrete Paths.
- Surface colour to match existing colour.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.2.2 Asphalt Pavement

- For paths with a width of 1.5m or less, restoration shall extend to the full width.
- For paths with a width greater than 1.5m, restoration shall extend 200mm outside the excavation lines in all directions.
- Asphalt colour coating and pattern shall match the existing pavement.
- Restored trenches shall be free of broken edges and surface levels along the edges shall be flush with the surrounding pavement.
- Restored asphalt pavement shall be free of potholes, ravelling, rutting, shoving and any cracks greater than 1mm. Restoration surface shall have no depression.
- Restore any pavement markings and sign posts.
- There shall be no separation between pavement joints.
- Service manholes shall be flush with surrounding surfaces.
- Trench cross section shall match path cross section.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.2.3 Grassed

- Restoration surface levels shall be flush with the surrounding path surface.
- Restoration surface shall have no depression.
- Surface shall be top dressed, turfed with turf rolls and established with appropriate watering for the entire disturbed area. Turf shall not be placed so that it causes stormwater runoff to concentrate. Turf laid adjacent to concrete works shall be laid flush with the surface of the concrete. Refer to 15.1.10 Turf requirements.

7.8.3 Concrete Vehicle Access Crossings

- Where excavation is between the path and the property boundary, the full strip panel between the property boundary and the back of path of the vehicle access crossing shall be reconstructed.
- Where excavation is within the path section of the vehicle access crossing, the full extent between the front and rear of path shall be reconstructed.
- Where excavation is within the apron of the vehicle access crossing, the full length of slab between the layback and the path shall be reconstructed.
- The restoration surface shall have no depression.
- New concrete slabs shall have control joints and expansion joints as required in accordance with Council's *Civil Works Specification - Standard Drawings*.
- Saw cuts shall be clean and straight along expansion or control joints with no chipping.
- Finished surface shall be broom brushed in accordance with Section 10.2.5.3 Surface Finish of this Specification.
- The profile of layback shall match Council specifications and surface finish shall be smooth steel float finish in accordance with Section 10.2.5.3 Surface Finish of this Specification.
- Any disturbed grassed area shall be restored with turf rolls and re-established.
- Service manholes shall be flush with surrounding surfaces.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.4 Other Assets

For other assets (such as kerbs, gutters, traffic islands and roundabouts) that are not covered in this section, Council's Representative shall be consulted to discuss about the extent of restoration for these assets.

7.9 Additional Requirements

Where longitudinal trench wearing surface joints are located under a wheel path, the entire road lane is required to be resurfaced. Refer to Council's *Civil Works Specification - Standard Drawings*. At intersections and roundabouts complete resurfacing may be required to avoid joints under wheel paths. Inspection of installations by Council's Representative shall be required to determine restoration requirements. Refer to standard drawing for trenching requirements in the vicinity of roundabouts located in Council's *Civil Works Specification - Standard Drawings*.

Pits and trench crossing wearing surfacing joints shall be perpendicular to traffic flow. Refer to Council's *Civil Works Specification - Standard Drawings*.

Maintain connection of house stormwater pipes discharging into carriageway gutters at all times. If damaged, repair or replace to the same diameter and in a sound manner to the satisfaction of Council's Representative. Provide a watertight seal to all joints and connections.

Council's Road Opening Permit application form has been designed to allow applicants applying for a Road Opening permit to also apply for a Road Occupancy Licence (ROL). A Traffic Guidance Scheme (TGS) shall be submitted with a Road Opening Permit application if the proposed works interfere with pedestrian or vehicular traffic. TGSs shall be prepared by a TfNSW accredited Traffic Control person.

Council approval shall be obtained in the case of any modification to the approved Notice of Proposed Works or Road Opening Permit.

All works undertaken shall comply with the standards of the following as a minimum:

- AUS-SPEC 1152 - *Road Opening and Restoration (Utilities)*.
- AUS-SPEC 1151 - *Road Opening and Restoration*.
- NSW Streets Opening Coordination Council's *Guide to Codes and Practices for Streets Opening*.
- Council's *Civil Works Specification*.

Where there is a discrepancy between the referenced standards, this document shall be considered as the minimum standard required. Any work or proposed work that does not comply shall be considered as non-conforming and specific approval shall be sought from Council. All non-conforming applications shall make reference to an industry standard such as AUS-SPEC 1152 or TfNSW *QA Specification M209 Road Openings and Restoration* as a minimum standard. Any proposed trenching works running adjacent to existing kerb and gutter is also considered as non-conforming.

Council may require the Service Provider to indemnify any non-conforming work (or parts of it) to ensure Council is not disadvantaged in allowing for any future road activities.

Full width or complete section replacement of the asset shall be required wherever Council considers that the road opening has compromised the integrity or operation of an existing structure.

Any conflicting utility services and survey marks both existing and proposed shall be identified and located before a Road Opening Permit shall be issued. This is the sole responsibility of the Service Provider.

It is the responsibility of the Service Provider to address all requirements associated with the proposed works such as:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

Considerations shall be made for issues such as:

- Sediment and water runoff control.
- Potential damage to public trees and vegetation.
- Dust and noise control.
- Public safety.

Once a road opening activity is approved by Council, the Service Provider shall be required to obtain relevant approvals from other service owners before work commences. This obligation lies entirely with the Service Provider and any damage to other services will be the sole responsibility of the Service Provider and Council will assume no liability for damage.

Should the Service Provider wish to modify the Standard Drawing(s) or propose an alternative restoration plan, a detailed design and scope of works shall need to be provided to Council's Representative referencing all relevant sections of Council's *Civil Works Specification*. It would be expected that this option would generally only be relevant for significant works involving multiple roads and extensive longitudinal trenches.

All costs associated with the opening, removal, temporary and permanent restorations of road assets will be borne by the Service Provider. Council is the preferred provider of permanent restoration following the completion of restoration works. A schedule of rates for the provision of permanent restoration is available on Council's website or upon request from Council's Representative.

Section 8 - Flexible Pavement Construction

8.1 General

Works in this section of the Specification covers the construction of flexible road pavements comprising layers of pavement material placed above the subgrade or subgrade replacement surface.

Pavements covered by this section of the Specification are to be constructed in accordance with the approved Pavement Design Report prepared by a Geotechnical Engineer and accepted by Council's Representative or resulting from subsequent recommendations by the Service Provider's Consulting Geotechnical Engineer due to further subgrade assessment as required during construction.

Flexible pavements layers covered by this section of the Specification may consist of:

Select layer:	Layer placed immediately above natural or filled subgrade.
Sub-base:	The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required, to prevent intrusion of the subgrade into the base, or to provide a working platform.
Base/Base course:	One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed. It may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
Semi-rigid pavement:	Where the base and/or the sub-base are constructed of bound materials.
Bound material:	A granular or subgrade material to which binders such as lime, cement or bitumen are added to improve structural stiffness.
Modified material:	Granular materials to which small amounts of stabilising agent have been added to improve their performance (e.g. by reducing plasticity) without causing a significant increase in structural stiffness.
Wearing surface:	That part of the pavement specifically designed to resist abrasion from traffic and to minimise the entry of water. This is covered in Section 12 - Bituminous Sealing and Section 13 - Asphalt Surfacing of this Specification.

8.2 Materials

8.2.1 General

Material shall be supplied to comply with the Traffic Category applicable to the pavement. Traffic categories are as defined in Annexure 3051/A of TfNSW *QA Specification 3051 Granular Base and Sub-base Materials for Surfaced Road Pavements or the Categories R1 and R2* in the IPWEA

Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010 (referred to as IPWEA Specification from hereon).

Reclaimed asphalt pavement (RAP) material may be used in asphalt pavement mix design in accordance with the following specifications, subject to the Geotechnical Engineer's/Pavement Designer's approval and if agreed to by Council's Representative:

- TfNSW QA Specification 3152 Aggregates for Asphalt.
- TfNSW QA Specification 3153 Reclaimed Asphalt Pavement Material.
- TfNSW QA Specification R116 Heavy Duty Dense Graded Asphalt.
- TfNSW QA Specification R117 Light Duty Dense Graded Asphalt.

Refer to the relevant asphalt specifications for permissible level of RAP for the applicable product and pavement application requirements.

At least 14 days prior to material placement, copies of recent test results (not more than 3 months old) of the supplied material and certification by a NATA registered geotechnical laboratory of compliance with TfNSW QA Specification 3051 Unbound and Modified Base and Sub-base Materials for Surfaced Road Pavements, or the IPWEA Specification shall be provided to Council's Representative for approval.

No material shall be delivered until Council's Representative has approved the source of the material supply.

Any changes to the approved material and source shall be made in writing to Council's Representative. No delivery of material under the alternative proposal shall take place without the approval of Council's Representative. The cost of testing associated with any alternative proposal shall be borne by the Service Provider.

8.2.2 Select Layer Material

Approved select layer material shall be defined as fill material including sand, soil or broken rock obtained from site excavations or approved borrowed areas remote from site. Such material shall:

- Have a maximum Plasticity Index of 20 in that fraction passing the 0.425mm sieve.
- Be free of material greater than 53mm in size, contain less than 2% organic matter, and be capable of being brought to the required moisture content.
- When tested in accordance with TfNSW Test Method T117 - California Bearing Ratio of Remoulded Specimens of Road Construction Materials following a minimum of 10 days soaking, the fraction passing 19mm AS Sieve shall have a CBR value in excess of 20.
- Select Layer material requirements shall be confirmed and nominated by the project Geotechnical consultant. All select layer material specifications shall be submitted to Council for review forming part of the pavement design and or Geotechnical report for the project.

Approved select layer material obtained shall only be imported from sites having the necessary approvals and waste classification certification for its intended use and comply with Table 8.1 below.

Table 8.1 Select Layer Material Requirements

Test Method	Description	Select Layer Material Requirements ⁴				
		Type CBR15	Type CBR12	Type CBR10	Type CBR8	Type CBR6
AS 1289.3.1.1	Liquid Limit	Max 40	Max 40	Max 40	Max 45	Max 45
AS 1289.3.4.1	Linear Shrinkage	Max 7	Max 8	Max 8	Max 9	Max 10
AS 1289.3.6.1	Passing 0.075mm sieve	Max 45	Max 45	Max 50	-	-
AS 1289.3.6.1	Plasticity Index x% Pass 0.425mm sieve	Max 900	Max 1000	Max 1200	Max 1500	Max 1800
AS 1289.6.1.1	% swell in CBR test ^{1,2}	Max 1.0x	Max 1.3	Max 1.6	Max 2.0	Max 2.0
AS 1289.6.1.1	4-day soaked CBR (95% modified ^{1,2,3} compaction)	Min 15	Min 12	Min 10	Min 8	Min 6

Notes for Table 8.1:

1. Moisture content for CBR tests are to be as follows:

- for materials with a Unified Soil Classification of GW, GP, GC, SW, SP, SC, or CL, 2.0% (+/- 0.5%) dry of the modified optimum moisture content.
- for materials with a Unified Soil Classification of GM or SM, 2.0% (+/- 0.5%) wet of the modified optimum moisture content.
- for materials with dual classifications consisting of soil groups from both those listed above, one test each at 2.0% (+/- 0.5) dry and 2.0% (+/- 0.5%) wet of the modified optimum moisture content.

The lowest CBR value of the two tests shall be taken as being representative of the material tested.

2. The surcharge mass to be applied during soaking and testing of the test specimen shall be 4.5kg, or as determined from Figure 7 of AS 1289.6.1.1 based on a wet density for the overlying materials of 2.0 t/m³.
3. The period of soaking will be 4 days or until swelling movements have ceased, whichever is longer.
4. Select layer material pre-treatment:
 - Select layer material shall be pre-treated prior to testing. Pre-treatment of samples shall be carried out in accordance with the requirements of Table 8.2 and as detailed below.

- Pre-treatment shall comprise cycles of Modified compaction in accordance with Test Method AS 1289.5.2.1 - *Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort* using the size of mould and the associated compactive effort applicable to the size and grading of the sample. The sample shall be conditioned to a moisture content between 90% to 110% of the optimum moisture content for pre-treatment. Fragments larger than 53mm in size shall be initially broken down to a size less than this value. Pre-treatment must be carried out on all materials for use in tests prescribed in Table 8.1. Pre-treatment is in addition to any compaction required for those tests. The pre-treatment, if any, must be shown on all test reports.
5. For fine grained and medium grained soils, as defined in AS 1289.0 - *Methods of testing soils for engineering purposes - Definitions and general requirements*, pre-treatment shall be followed by the following:
- Materials retained on the 19mm sieve shall be replaced by an equal proportion by mass of materials passing the 19mm sieve and retained on the 4.75mm sieve.
 - Percentage by mass of materials retained on the 19mm sieve and the fact that it was replaced shall be included in all test reports.

AS 1289.3.1.1 - *Methods of testing soils for engineering purposes - Soil classification tests - Determination of the liquid limit of a soil - Four point Casagrande method.*

AS 1289.3.4.1 - *Methods of testing soils for engineering purposes - Soil classification tests - Determination of the linear shrinkage of a soil - Standard method.*

AS 1289.3.6.1 - *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.*

AS 1289.6.1.1 - *Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.*

Table 8.2 Sample Origin – Sampling Location – Pre-Treatment

Sample Origin	Sampling Location	Pre-Treatment
Excavated Sedimentary Rock	Compacted in-place materials	1 cycle of modified compaction
	All other locations	3 cycles of modified compaction
All Other Sources	Compacted in-place materials	No pre-treatment required
	All other locations	1 cycle of modified compaction

8.3 Construction

8.3.1 Delivery and Spreading

The pavement base, sub-base and select material shall be constructed in accordance with the approved design. Council's Representative shall approve the selection of materials to meet the required pavement composition. Pavement base, sub-base and select material shall not be placed on the subgrade or underlying layers of pavement until requirements applying to those layers are met and test results confirmed.

Material shall not be placed over a layer, except for moderately to highly expansive clay sub grades, with moisture content exceeding 90% of the laboratory optimum moisture content as determined by AS 1289.5.2.1, or that has become rutted or mixed with foreign matter. Moderately to highly expansive clay sub grades shall be maintained at 90 to 100% of optimum moisture until covered by subsequent layers. If at any time the subgrade material should become rutted, or mixed with the pavement material, the Service Provider shall at his own expense remove the material, reshape and compact the subgrade and/or sub-base material, and replace the pavement material with suitable fresh material.

Base, sub-base and select materials, when delivered, shall have moisture contents within $\pm 2\%$ of the modified optimum moisture content.

The material shall be spread in uniform layers as near as practicable to the required thickness by direct tipping from suitable vehicles or using a mechanical spreader.

Spreading shall be undertaken by a method that will ensure segregation does not occur. The Service Provider shall submit full details of the proposed method of spreading for the approval of Council's Representative at least 2 weeks before pavement construction is commenced.

The sub-base material shall be spread in uniform layers of between 100mm and 200mm to provide the compacted sub-base thickness as specified on the approved drawings. The base material shall be spread in one uniform layer that will provide the compacted thickness as specified in the approved drawings.

Spreading shall be undertaken by a method which will ensure segregation does not occur and movement of material is kept to a minimum. The Service Provider shall submit full details of the proposed method of spreading for approval of Council's Representative at least 14 days before commencement of sub-base operations.

Sub-base material shall not be placed on the roadway more than 24 hours in advance of compaction.

8.3.2 Compaction and Trimming

During compaction the surface shall be kept trimmed and material added where necessary to produce a tight dense surface parallel with the finished wearing surface so that the compacted thickness of each layer is in accordance with Section 8.3.1 above.

Where a course of a particular material is composed of several layers they shall be of approximately equal thickness within these limits. The surface to receive an additional layer, of similar material, shall be lightly scarified prior to placement and compaction of the following layer.

Each single layer shall be compacted so that the relative compaction over its entire area and depth meets the requirements of Section 8.4 Pavement Construction Compliance Criteria.

At the time of compaction of each layer the moisture content of the material shall be adjusted to permit the specified compaction to be attained to a moisture content between 60% and 90% of the optimum moisture content as required in Section 8.4.2 below. Material containing excess moisture shall not be compacted until it has dried out to the specified moisture content. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. No additional payment will be made for wetting or drying the material to be compacted.

Surfaces of base material (i.e. surfaces to receive a bituminous surfacing) shall be constructed slightly higher than the specified levels and cut to profile by power grader or trimming machine towards the end of the compaction process. Rolling shall then continue to produce the specified density and a tight, even surface without loose stones or a slurry of fines.

The top of the base, sub-base or select material layers shall be trimmed and compacted to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the levels shown on the approved drawings or as determined by Council's Representative in accordance with Table 8.4 Pavement Layer Tolerance.

Prior to placement of the next pavement layer where the material has been left for an extended period or has been subject to rain, a visual inspection including proof rolling shall be carried out by the Service Provider in the presence of the Geotechnical Consultant and Council's Representative. Should a dispute arise regarding the adequacy of the material, additional moisture content and compaction testing shall be carried out by the Service Provider to prove compliance.

Placement of successive pavement layers shall closely follow satisfactory testing of the underlying layer. The test results for the underlying layer shall be verified for the Service Provider by the Geotechnical Consultant in writing prior to a continuation of construction of subsequent layers.

Where a layer that has been accepted by Council's Representative and is subsequently contaminated as a result of the Service Provider's activities, Council's Representative may withdraw their acceptance of the layer.

8.3.3 Matching to Existing Pavements

Where the pavement is to be joined to an existing pavement it shall be done in accordance with *Civil Works Specification - Standard Drawings* **and must not compromise ride quality.**

8.4 Pavement Construction Compliance Criteria

8.4.1 Compaction Requirements

Base, sub-base, select layer and subgrade material shall be compacted to the following relative compaction ratios in accordance with TfNSW QA Specification R71 Construction of Unbound and Modified Pavement Course and TfNSW Guide to QA Specification R44 Earthworks, as summarised in Table 8.3 below:

Table 8.3 Minimum Relative Compaction

Design ESAs < 1x10 ⁷	
Layer	Standard Maximum Dry Density
Base course	102%
Sub-base course	100%
Select layer	102%
Subgrade	95%

Design ESAs > 1x10 ⁷	
Layer	Modified Maximum Dry Density
Base course	100%

Proof rolling prior to compaction testing may be required to demonstrate adequate stability of the select layer material when requested by the Consulting Geotechnical Engineer or Council's Representative. Proof rolling is not to be used as a measure that satisfactory compaction has been achieved.

8.4.2 Moisture Content

Base, sub-base and select material shall have moisture contents in the range of 60% - 90% of the laboratory optimum maximum moisture content as determined by AS 1289.5.1.1 - *Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort* or AS 1289.5.2.1 - *Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort* as applicable, when tested for compaction.

8.4.3 Surface Tolerances

On completion of placement, compaction and trimming, base, sub-base and select material courses shall comply with the tolerances itemised in Table 8.4 below. Surface shape shall be such that water cannot accumulate at any point.

Testing of pavement layer tolerances shall be carried out by the Service Provider in the presence of Council's Representative at a time suitable for Council's Representative to attend the site.

Each pavement layer is to be surveyed by the Service Provider for level and thickness conformance. Copies of this survey information shall be provided to Council's Representative upon request.

Table 8.4 Pavement Layer Tolerance

Item	Criteria	Tolerance
Pavement Layers		
Base	Surface Level	± 10mm if adjacent to concrete gutter for asphalt + 10mm to 0mm if adjacent to concrete gutter for flush seals + 10mm to 0mm if no gutter
	Thickness	+ 25mm to 0mm
	Straightness	15mm maximum departure from 3m straight edge placed on the surface both parallel and perpendicular to the pavement centre line
Sub-base	Surface Level	± 10mm
	Thickness	+ 10mm to - 25mm
	Straightness	15mm maximum departure from 3m straight edge placed on the surface both parallel and perpendicular to the pavement centre line
Select material	Thickness	+ 25mm to - 20mm
	Straightness	20mm maximum departure from 3m straight edge placed on the surface both parallel and perpendicular to the pavement centre line
Pavement Width		
Width of pavement	Design centre line to pavement edge	- 0mm to + 300mm from dimensions specified
	Average	Average width from 3 random locations to be not less than the dimension specified

Notes for Table 8.4: Tolerances apply to the top of pavement layer. Pavement layer levels are determined from design surface levels with allowance for design layer thickness or surfacing type as follows:

1. For flush sealed pavements against concrete edge strips, lips of gutters etc the finished base course shall not be below the lip level, etc.

2. For AC surfaced pavement the top of base course surface shall be at a depth equal to the proposed AC thickness below the design pavement surface level.

8.4.4 Benkelman Beam Deflection Testing

Deflection testing using a Benkelman Beam shall be carried out in accordance with TfNSW *Test Method T199 Deflection testing of road formation*, and as required in Section 3.10.1.1 Mandatory Inspections.

Deflection testing shall be undertaken to ensure the constructed pavement thickness is below the maximum acceptable deflection.

Benkelman Beam deflections shall conform to the maximum permissible values in Table 8.5 below.

Council acceptance of pavement thickness designs in no way negates the maximum deflection criteria from being complied with.

Progressive Benkelman Beam deflection testing at the top of subgrade, select and sub-base layers is not required for compliance. However, as a check to ensure proposed pavement thickness above these layers will result in the required maximum acceptable deflections at the pavement surface, this additional testing is recommended. The Service Provider should seek the advice of the Geotechnical Consultant regarding this issue.

Table 8.5 Pavement Surface Maximum Acceptable Deflections

Design Traffic (ESAs)	Unbound Pavement (mm)	Bound Pavement (mm)	Design Traffic (ESAs)	Unbound Pavement (mm)	Bound Pavement (mm)
1 x 10 ⁴	2.10	1.22	7 x 10 ⁵	1.05	0.65
2 x 10 ⁴	1.95	1.18	8 x 10 ⁵	1.00	0.62
3 x 10 ⁴	1.90	1.15	9 x 10 ⁵	0.98	0.58
4 x 10 ⁴	1.82	1.10	1 x 10 ⁶	0.94	0.56
5 x 10 ⁴	1.77	1.08	2 x 10 ⁶	0.935	0.55
6 x 10 ⁴	1.72	1.05	3 x 10 ⁶	0.930	0.51
7 x 10 ⁴	1.67	1.02	4 x 10 ⁶	0.92	0.48
8 x 10 ⁴	1.62	1.01	5 x 10 ⁶	0.91	0.47
9 x 10 ⁴	1.55	1.00	6 x 10 ⁶	0.905	0.46
1 x 10 ⁵	1.50	0.95	7 x 10 ⁶	0.90	0.45
2 x 10 ⁵	1.42	0.85	8 x 10 ⁶	0.89	0.44
3 x 10 ⁵	1.28	0.81	9 x 10 ⁶	0.88	0.43
4 x 10 ⁵	1.20	0.75	1 x 10 ⁷	0.87	0.425

Design Traffic (ESAs)	Unbound Pavement (mm)	Bound Pavement (mm)
5×10^5	1.15	0.72
6×10^5	1.10	0.70

Design Traffic (ESAs)	Unbound Pavement (mm)	Bound Pavement (mm)
2×10^7	0.84	0.395

8.4.5 Surface Deviation and Ride Quality

The pavement wearing course shall have a smooth longitudinal surface profile without obvious irregularities, subject to the satisfaction of Council's Representative - refer to Table 8.6 for Surface Deviation and Ride Quality testing requirements. Any non-conformities shall be rectified by the Service Provider before acceptance of the works by Council's Representative.

8.5 Compliance Testing and Sampling Requirements

8.5.1 General

Testing requirements for flexible pavement works shall be in accordance with this Specification. However, some pavements for major access roads, industrial subdivisions and commercial access roads may be subject to a site-specific specification for testing. Site specific requirements will be contained in the Council accepted pavement design documentation or other approved documentation relating to the particular pavement.

A Consulting Geotechnical Engineer shall be employed by the Service Provider to carry out all testing and inspecting, other than tolerance testing, required to confirm materials and construction compliance for flexible pavements and any other specification required by the Consulting Geotechnical Engineer. The Consulting Geotechnical Engineer shall hold a current NATA Registration for the relevant tests. All test results certificates/reports shall be forwarded to Council's Representative.

For all Flexible Pavement testing the Consulting Geotechnical Engineer shall determine the location where sampling and testing will be taken in accordance with the location and frequency of testing requirements in Table 8.6 - Pavement Construction Test Methods and Frequency of Testing below. This shall be carried out independently of any advice or request by the Service Provider responsible for the works.

8.5.2 Materials

Pavement material test results from a NATA registered organisation confirming that the material to be supplied to the site complies with this Specification shall be provided to Council's Representative prior to the use of the material on site. These test results shall not be more than 3 months old.

Site testing for compliance of materials that have been delivered to site and placed will be limited to the following:

- Particle size distribution, plasticity index, liquid limit and plastic limit for sub-base and base layer materials.
- Plasticity index, liquid limit, plastic limit, linear shrinkage and 4-day soaked CBR for select layer material.

Testing shall be carried out at the frequency shown in Table 8.6 - Pavement Construction Test Methods and Frequency of Testing below. Full testing of material quality requirements may be requested to confirm total compliance in the case that the Consulting Geotechnical Engineer and Council's Representative consider this necessary.

8.5.3 Relative Compaction

All flexible pavement layers shall be tested for relative compaction to the full depth of the layer. Where a pavement layer is made up of multiple courses, each course shall be tested separately.

A minimum of 2 tests per course of compacted pavement material shall be carried out for any road less than 50m in length or section of pavement construction less than 50m in length.

The requirement for relative compaction testing may be relaxed by Council's Representative on small road shoulder type construction for a single residential lot where the width of the new pavement is less than 1m or where new kerb and gutter is founded on an existing compacted pavement of layer of 150mm thickness or more.

8.5.4 Deflection

When requested by Council's Representative tests to determine final surface deflections shall be carried out for all new pavements.

8.5.5 Frequency and Location of Testing

The frequency of testing shall be appropriate to verify conformity and shall not be less than that stated in Table 8.6 below or as described below unless otherwise approved by Council's Representative. If Table 8.6 does not cover a particular situation, the Consulting Geotechnical Engineer in consultation with Council's Representative shall specify the required frequency of testing.

Table 8.6 Pavement Construction Test Methods and Frequency of Testing

Item or Characteristic to be Tested	Test Methods for Compliance	Frequency of Testing (whichever results in the most tests)
Sub-base and base pavement material quality conforming to TfNSW - Pre-Supply Testing	In accordance with tests specified in TfNSW QA 3051 or the IPWEA <i>Specification</i>	Test results that are less than 3 months old from each material supplier for each material to be supplied
Sub-base and base pavement material quality - Initial Testing refer to 8.5.2 above	In accordance with tests specified in TfNSW QA 3051 or the IPWEA <i>Specification</i>	1 per pavement layer for every 200 linear metres of pavement or 1 per layer for each road greater than 50m length

Item or Characteristic to be Tested	Test Methods for Compliance	Frequency of Testing (whichever results in the most tests)
Sub-base and base pavement material quality conforming to TfNSW - Full Testing refer to 8.5.2 above	In accordance with tests specified in TfNSW QA 3051 or the IPWEA <i>Specification</i>	When required by Consulting Geotechnical Engineer or Council's Representative
Select material quality - Pre-Supply Testing	In accordance with tests in Table 8.1	Test results that are less than 3 months old from each material supplier for each material to be supplied
Select material quality - On-Site Testing	In accordance with tests in Table 8.1	1 per every 200 linear metres of pavement or one for each road greater than 50m length
Standard or modified maximum dry density and optimum moisture content for each different pavement material type	AS 1289.5.2.1 AS 1289.5.1.1	1 test for each different material type or as required by the GITA
Relative compaction and moisture content for each course placed within a layer of pavement material	AS 1289.5.4.1 AS 1289.5.3.1 AS 1289.5.8.1 AS 1289.5.7.1	Locations of tests to be determined as described in section 8.5.6 below by 'roll of a dice' method. 2 tests in sections of pavement or roads less than 50m long. 3 tests in sections of pavement or roads between 50m and 85m long. For roads or sections of pavement greater than 85m length generally 1 test in the first 12m by chainage, the next test in next 10m to 60m after the first, then tests at 50m intervals following until a test within the last 60m of the road, then a test with the last 12m. 1 additional test in each turning head or cul-de-sac
Surface deviation (see note 1 below)	Deviation from 3m straight edge laid in any direction by no more than 5mm	1 test per 20m ² minimum
Ride quality	In accordance with tests specified in TfNSW QA R71 and TfNSW <i>Test Methods T182 or T188</i>	Continuous reading per Lot when this test is required by Council's Representative
Deflection	AGPT05-11	Tests in alternative wheel paths at maximum

Item or Characteristic to be Tested	Test Methods for Compliance	Frequency of Testing (whichever results in the most tests)
		20m intervals both sides of the road

Note 1: This test is not required to be carried out by the Consulting Geotechnical Engineer. The Service Provider is to carry out this test in the presence of Council's Representative.

Abbreviations in the Above Table:

Transport for NSW QA Specification 3051 - Granular Base and Sub-base Materials for Surfaced Road Pavements.

Transport for NSW QA Specification R71 - Construction of Unbound and Modified Pavement Course. IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010.

AS 1289.5.1.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort.

AS 1289.5.2.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort.

AS 1289.5.3.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus.

AS 1289.5.4.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio.

AS 1289.5.7.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method).

AS 1289.5.8.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture density gauge - Direct transmission mode.

AGPT05-11 Austroads Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design.

8.5.6 Determination of Relative Compaction Test Locations

The location of relative compaction tests for road pavements shall be determined in accordance with TfNSW QA Specification Q6 as detailed below unless another random selection process has been approved by Council's Representative.

The validity of Lot testing depends on and requires the random selection of test site locations. At the start of the selection process, every point in the Lot must have an equal chance of being selected. Test site selection is to be in accordance with TfNSW QA Specification Q6, Annexure L3, and is to be prepared and calculated carried out by the laboratory. Laboratories must be able to demonstrate their random site selection process conforms to QA Specification Q6, L3.

8.5.7 Non-complying Tests and Retesting Requirements

8.5.7.1 General

A non-compliance report shall be submitted to Council's Representative for any non-complying works that the Service Provider is requesting acceptance of. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

8.5.7.2 Non-complying Tolerances

In the case of non-complying tests for straightness the Service Provider shall immediately rectify the non-compliance and retest the entire area of rework prior to covering up of the subject area.

In the case of non-compliant level tolerances, the Service Provider shall rectify the non-compliance and re-level the entire area of rework prior to covering up. All complying levels shall be confirmed by level checks by the Service Provider on each pavement layer which shall be provided to the Council's Representative.

8.5.7.3 Non-complying Relative Compaction and Moisture Test Results and Retesting Requirements

Where relative compaction and moisture content does not comply based on test results the Service Provider shall rework the layer or course for a length of 25m either side of failed test location for the full width of the pavement.

Retesting of the reworked area shall be carried out in accordance with the requirement for testing a 50m or shorter road as described in this Specification. If the failed test is in a 50m or shorter section of pavement or the road is shorter than 50m then the whole length of the section or road shall be reworked and retested in accordance with this Specification. Locations for retests shall be determined by 'roll-of-the-dice' methods as described in this Specification. Test certificates for retests shall clearly state that they are retest of a particular test and provide details of that particular test.

8.5.7.4 Non-conforming Material

All non-conforming material as determined by testing shall be removed and replaced with conforming material. Additional testing may be carried out by the Service Provider to determine the extent of the non-complying material. The extent of this testing will be at the discretion of the Service Provider. However, until additional test results that may isolate a non-compliant material to a particular area are provided to Council's Representative all material of the type on the site will require removal.

8.5.7.5 Non-conforming Deflection Tests

When a deflection test fails to meet the maximum deflection test criteria, treatment of the failed section shall be deemed as a length of 25m either side of the failed test location. This 50m length of pavement shall be treated, reworked or reconstructed as determined by the Service Provider in consultation with the Consulting Geotechnical Engineer.

Retesting will be required to demonstrate the failed section achieves the maximum deflection criteria.

8.6 Compliance Inspections and Documentation

The Service Provider shall provide copies of the following documents:

- All pavement compaction tests and retests, material tests, Benkelman Beam test certificates and reports as required by this section of the Specification.
- Service Provider's level tolerance survey on top of sub-base and base.

Compliance to this Specification is to be demonstrated during site inspections by the Accredited Certifier or Council's Representative during the construction of flexible pavements.

8.7 Opening of Base, Sub-base and Select Material Layers to Traffic

The flexible pavement shall not be opened to traffic, other than construction traffic, until the specified bituminous surfacing has been completed unless otherwise approved by Council's Representative. If the base layer of pavement is approved to be opened before final surfacing, it shall be surfaced first with a suitable temporary seal or primer seal. Any damage to the seal prior to placement of asphalt will require resealing of the damaged area. Any requirement for resealing will be determined by Council's Representative.

Section 9 - Standard Pavements and Other Pavement Requirements

9.1 General

This section covers the construction requirements for pavements to be constructed in accordance with Council's *Civil Works Specification*.

9.2 Standard Pavement

9.2.1 Flexible Pavement for Road Shoulder, Half Road and Kerb and Gutter

This section applies to pavement design up to 40m in length and 3m in width.

Where no pavement design has been prepared, Council's Representative may give approval for use of the following standard flexible pavement configurations on Access Roads. Refer to Table 6.1 Road Hierarchy and Road Width Schedule in the *Civil Works Specification - Design Guideline* for road classification details. Geotechnical investigation and pavement design shall be carried out to determine the suitability of the following basic flexible pavements.

Flexible pavement materials and construction shall conform to the requirements of Section 8 - Flexible Pavement Construction for material quality and testing unless otherwise approved by Council's Representative.

9.2.1.1 Standard Flexible Pavement - Sand/Silty Sand Subgrade CBR Greater than or Equal to 7.0

- Subgrade greater than or equal to CBR 7.0
- 150mm thick sub-base
- 120mm thick base
- Single coat 10mm seal
- 30mm AC10

9.2.1.2 Standard Flexible Pavement - Sandy Clay/Clayey Sand/Clay Subgrade CBR Greater than or Equal to 3.0

- Subgrade greater than or equal to CBR 3.0
- 300mm thick sub-base
- 120mm thick base
- Single coat 10mm seal
- 30mm AC10

For subgrades with a CBR less than 3.0 a Consulting Geotechnical Engineer shall be engaged to recommend treatment or replacement options to modify the subgrade which result in a subgrade CBR equal to or greater than 3.0.

9.2.2 All Weather Surface

Where the approved drawings or conditions of Development Consent require an All Weather Surface or All Weather Pavement the following minimum construction is required:

- Width of the pavement shall be a clear 4m unless otherwise shown or conditioned.
- Surface crossfall shall be one way and vary between 2% and 6% to suit the topography, 4% is desirable.
- Pavement shall consist of a 200mm minimum thickness of compacted road base material complying with Section 8 - Flexible Pavement Construction. The use of alternative road base materials shall require acceptance by Council's Representative.
- Road base shall be founded on a subgrade meeting the requirements of Section 5 - Site Clearing and Bulk Earthworks. The subgrade shall be proof rolled and inspected by Council's Representative.
- Surface shall be sealed with a minimum single 10mm seal for the full 4m width, or other width as approved or conditioned.
- Table drains, cross drains and piped culverts are to be provided where shown on the approved drawings or where required on site to provide a runoff regime similar to that of the pre-construction site condition.
- All drains, stormwater inlets and outlet areas shall be adequately stabilised and disturbed areas revegetated.

9.2.3 Residential Lot Battle-Axe Handle Driveway Pavements

Where no detail or geotechnical pavement report is provided as a part of the approved documentation, residential lot battle-axe handle driveway pavement subgrade and sub-base construction shall conform to the requirements of 5.5 Road Pavement Subgrades and Section 8 - Flexible Pavement Construction of this Specification.

The minimum requirement for residential lot battle-axe handle driveways shall be:

- Width of the concrete pavement shall be 3m minimum or as shown on the construction certificate drawings.
- Natural or filled subgrade shall be compacted to 100% standard relative compaction and display no soft areas when proof rolled.
- A 75mm minimum thick layer of road base or sub-base quality material compacted to 100% standard relative compaction shall be placed on the subgrade and below the concrete.
- The pavement shall be a 125mm minimum thick N32 normal strength grade concrete reinforced with SL72 mesh placed with 50mm minimum top cover.

- Full depth dowelled expansion joints shall be provided in the concrete pavement at maximum 6 metre centres. Dowels shall be 400mm long R12 at 400mm centres centrally placed in the slab and held in place with a proprietary product such as "Connelly Joint" or equivalent. The top of the key joint shall have a smooth plastic strip or similar flush with the finished surface. One half of the dowel shall be treated with a permanent debonding agent such as bitumen or a proprietary dowel joint product to allow movement. A cap shall be provided to the end of debonded dowels to allow for movement.
- Concrete shall be initially steel float finished and then before initial set broom brushed to a non-slip texture. A nominal 100mm wide steel edging tool shall be used to provide a 10mm radius to smooth the perimeter border and all edges.
- All service conduits where required to service the future rear allotment shall be placed before the concrete access pavement is poured.

In the case that a higher standard of construction is nominated on the drawings then the standard on the drawings shall be adopted.

The vehicle access crossing located within the road reserve or proposed road reserve shall be constructed in accordance with 10.2.5 Vehicle Access Crossings of this Specification and Council's *Civil Works Specification - Standard Drawings*.

9.2.4 Rural Area Vehicle Access Crossings

Rural vehicle access crossings may be constructed in flexible pavement in accordance with 9.2.1 above. The pavement shall extend to the existing road pavement and the seal coat shall overlap the existing road pavement seal. The access shall be adequately drained to prevent stormwater runoff onto the public road.

9.2.5 Compliance Inspections, Testing and Documentation for Standard Pavements

Construction compliance shall be demonstrated during inspections by Council's Representative and the following details provided:

- Relative compaction testing in accordance with Section 5 - Site Clearing and Bulk Earthworks (subgrade).
- Relative compaction testing in accordance with Section 8 - Flexible Pavement Construction (road base and sub-base).
- Material quality tests from the supplier when requested by Council's Representative.
- Pavement layer thickness records demonstrating conformance with the specified thickness of each pavement layer.
- Copies of delivery receipts confirming the material type supplied when requested.
- Results required by concrete batching plants for conformance with Australian Standards.

Council's Representative may request sampling and testing for determination of concrete strength or other nominated properties to confirm the strength grade or properties of the concrete being provided, or where the Service Provider proposes to open the pavement to traffic prior to concrete reaching its full 28-day strength.

9.3 Other Pavements

9.3.1 Rigid Pavements

Designs and construction specifications for rigid pavements not covered by this Specification shall be provided by the Service Provider and approved by Council's Representative.

The construction specification for a rigid pavement shall need to have consideration for the type and location of the rigid pavement. However, the specification shall include (but is not limited to) the following:

- Concrete materials, admixtures, mix requirements and concrete property requirements.
- Jointing requirements including location plan view, time frame for provision of saw cuts and sealant requirements.
- Site testing requirements to confirm compliance of the specified concrete.
- Placing, finishing and curing requirements.
- Construction tolerance.
- Opening to traffic.

9.3.2 Compliance Inspections and Reporting and Testing for Rigid Pavements

Council's Representative will inspect the works at various stages to confirm general compliance with the accepted design and specification. The Service Provider's Consulting Geotechnical Engineer shall carry out inspections at the following stages and certify compliance with the design and specification:

- Subgrade preparation.
- Forming and placement of reinforcing steel (if applicable) and set up for joints in sub-base.
- Finished sub-base.
- Forming and placement of reinforcing steel (if applicable) and set up for joints in base.
- Finished base including sealed joints.
- Completion of all concrete testing confirming concrete property requirements.

Certificates confirming compliance at the above stages shall be submitted to Council's Representative upon completion of the stage. Regardless of a certificate being issued by the Consulting Geotechnical Engineer at any of the above stages Council's Representative may reject the works if non-complying work has been observed.

All cracked or damage concrete shall be removed and replaced to the extent as directed by Council's Representative following consultation with the Service Provider's Consulting Geotechnical Engineer.

When requested results of compliance testing in accordance with AS 1379 - *Specification and supply of concrete* as carried out by the concrete supplier shall be provided to Council's Representative in addition to specified site and project testing contained in the accepted specification.

A Testing Authority shall be employed by the Service Provider to carry out all testing required by the accepted specification and any additional testing requested by Council's Representative. The cost of any additional testing requested shall be met by the Service Provider. The Authority shall hold a current NATA Registration for the relevant tests. A copy of all test results shall be provided to Council's Representative.

9.3.3 Heavily Bound Pavements

Heavily Bound Pavements where nominated for use shall be constructed in accordance with the approved Pavement Design Report and construction specification prepared by the Service Provider's Consulting Geotechnical Engineer which has been approved by Council's Representative.

Specifications for the supply and placement of the heavily bound materials shall be based on TfNSW QA Specification 3051 - *Granular Base and Sub-base Materials for Surfaced Road Pavements* and TfNSW QA Specification R75 *In-situ Pavement Stabilisation Using Slow Setting Binders*. All clarifications for the supply, placement and saw cutting requirements shall be contained in the approved Pavement Design Report.

Compliance testing requirements for the supply and placement of heavily bound base shall be contained in the approved Pavement Design Report or nominated by Council's Representative in the pavement report acceptance.

9.3.4 Full Depth Asphalt Pavements

Full depth asphalt (FDA) pavement construction and materials shall comply with the technical requirements of TfNSW QA Specification R116 - *Heavy Duty Dense Graded Asphalt* and QA Specification R117 - *Light Duty Dense Graded Asphalt*, as applicable. Testing in accordance with R116 and R117 shall be carried out to verify compliance unless otherwise specified in the approved Pavement Design Report. FDA pavements shall be constructed in accordance with the thickness design contained in the approved Pavement Design Report.

9.3.5 Interlocking Segmental Block Pavements

Interlocking segmental block pavements shall be detailed on the approved drawings. Should a design not be available the Service Provider shall arrange a design prepared by a suitably qualified Civil Engineer.

Interlocking segmental block pavements shall be designed and constructed in accordance with Guides published by the Concrete Masonry Association of Australia, Section 7.9 Interlocking Segmental Block Pavement Design from Council's *Civil Works Specification - Design Guideline and Standard Drawings*.

9.3.6 Concrete Thresholds and Access Ways

Raised concrete thresholds, flush concrete threshold and access ways shall be a minimum 170mm thick, reinforced with SL82 mesh and constructed in accordance with the geometry and details shown on the approved drawings.

All concrete used in concrete thresholds or access ways shall be standard strength grade N32 in accordance with AS 1379 - *Specification and supply of concrete*.

All concrete used in thresholds or access ways shall be cured using a compound complying with AS 3799 - *Liquid membrane-forming curing compounds for concrete* which is applied to the surface of the fresh concrete.

Damaged or cracked concrete in all concrete thresholds shall be removed and replaced prior to the final inspection.

The proposed jointing layout and type of jointing shall be constructed in accordance with the approved Construction Drawings unless otherwise instructed by Council's Representative.

9.3.7 Alternative Pavements

Pavements other than those covered by this Specification may be considered. Details of full pavement design by a Consulting Geotechnical Engineer with material specification and proposed compliance testing shall be submitted to Council's Representative for approval at the design approval stage.

Section 10 - Minor Concrete Works

10.1 General

The works covered by this section of the Specification comprise of the construction of various concrete elements which include concrete kerbs, kerb and gutter of various cross sections, mower strips and edging, vehicle access crossings, kerb ramps, dish gutters, dished crossings, concrete paths, small open drains and other minor concrete paving.

Standard Drawings relating to this section of the Specification are contained in Council's *Civil Works Specification - Standard Drawings*. Any variations to the requirements of the Standard Drawings must be accepted by Council's Representative.

The Service Provider proposing to construct the elements of work described in this section of the Specification must conform to all requirements of this Specification including (but not limited to) the following:

- Contacting Council's Representative to arrange a site meeting prior to the commencement of any works at least 5 days prior to the proposed commencement of works.
- Prepare and submit to Council's Representative a Traffic Guidance Scheme, as required by Section 4 - Traffic Management of this Specification.

Failure to comply with these requirements and others contained in this Specification and any additional requirements of Council's Representative will in most cases result in the works being deemed non-compliant. In cases of non-complying work the Service Provider shall be required to remove the non-complying work and reinstate the site to its original condition.

Where the Service Provider is in doubt about the expected finished quality of works they shall seek clarification from the Council's Representative.

10.1.1 Material Requirements

10.1.1.1 Sub-base and Base Course Materials

Where nominated on the Standard Drawings the sub-base and base material shall comply with the requirements of Section 8 - Flexible Pavement Construction.

10.1.1.2 Concrete

Concrete conforming to AS 1379 - *Specification and supply of concrete* shall be supplied to site for the various concrete elements as specified below.

For machine slip-formed or extruded kerb, kerb and gutter, edging, V-drains and dish drains laid on flexible pavement materials, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.

- Minimum effective Portland cement content 280kg/m³.
- Slump to be generally 10mm to 40mm depending on machine requirements.
- Nominal maximum aggregate size shall be 10, 14 or 20mm. If not specified when ordering, typically 20mm would be the default nominal maximum aggregate size.
- Recycled materials may be used in the concrete mix where approved by Council's Representative. Refer to the IPWEA *Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010* for further information.

For formwork formed kerb, kerb and gutter, edging, V-drains and dish drains laid on flexible pavement materials, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 280kg/m³.
- Slump shall generally be 70mm to 80mm or as required by Service Provider to achieved surface finish equivalent to a smooth steel trowel type surface.

For paths (cycleways, footpaths and shared paths), median infill, kerb ramps, edge strips and vehicle access crossings, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25 where the element is reinforced.
- Minimum concrete strength grade of N32 for reinforced industrial vehicle access crossings.
- Minimum effective Portland cement content 280kg/m³.
- Air entrainment shall be between 4.5% and 5.0%.
- Maximum slump 80mm.
- Nominal maximum aggregate size should be 10mm for workability and surface finishing reasons.
- Kerb ramps shall be integrally coloured minimum concrete strength grade of N32 and reinforced in accordance with the *Standard Drawings*.

For open reinforced concrete drains sprayed or hand placed, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 280kg/m³.
- Air entrainment shall be between 4.5% and 5.0%.
- Maximum slump 80mm or as required by Service Provider for spraying.

For footings for small signs, utilities plant, fence post backfill and other minor works, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 270kg/m³.
- Air entrainment shall be between 4.5% and 5.0%.
- Maximum slump 80mm.

For kerb, kerb and gutter, edging and V-drains, hand placed, or slip formed, tied or untied along the edge of rigid pavement concrete base unless otherwise specified in the accepted rigid pavement design, the concrete shall have the following requirements:

- Minimum concrete strength grade of N32.
- Minimum effective Portland cement content 320kg/m³.
- Slump as required by Service Provider to achieve surface finish equivalent to a smooth steel trowel type surface but not greater than 80mm.

10.1.1.3 Reinforcement

Steel reinforcement shall comply with AS/NZS 4671 - *Steel reinforcing materials* as appropriate.

Where specified, galvanising shall comply with AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*.

Reinforcement shall be placed in accordance with the approved drawings or in Council's *Civil Works Specification - Standard Drawings*.

10.1.1.4 Joint Fillers and Sealers

Joint fillers and sealers shall be proprietary products specifically made for the purpose being used. Details of proposed products to be used or already used shall be provided if requested by Council's Representative. Should a product already used be confirmed as not being suitable for the situation it has been used, then the work containing the filler or sealer shall be deemed not to comply and shall be replaced with a suitable product.

10.1.1.5 Curing Compound

Curing Compounds shall comply with AS 3799 - *Liquid membrane-forming curing compounds for concrete*, and must be either:

- Wax emulsion complying with AS 3799 Type 1; **or**
- A hydrocarbon resin compound complying with AS 3799 Type 1-D.

Wax emulsion curing compounds shall not be used on areas subject to pedestrian traffic.

10.1.2 Earthworks and Surface Preparation

Earthworks and preparation of surfaces shall be as specified in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

Where earthworks are required within the road reserve excavated material shall not be deposited on existing grassed areas or pedestrian routes without prior approval from Council's Representative.

Subgrade, sub-base and base material compaction under kerbs, kerb and gutters, V-drains, dish drains or other concrete elements along the edge or within flexible pavement areas shall be in accordance with the requirements of Section 8 - Flexible Pavement Construction of this Specification. A minimum of 150mm thick compacted sub-base quality material shall be placed under all concrete elements in these locations.

Subgrade, sub-base and base material compaction under V-drains, dish drains, paths, cycleways, vehicle access crossings **not** along the edge or within flexible pavement areas shall be compacted to a relative compaction of 100% standard maximum dry density for the full depth of the layer. A minimum 75mm thick compacted layer of road base material shall be placed under all concrete elements unless approved by Council's Representative or otherwise shown in Council's *Civil Works Specification - Standard Drawings*.

10.1.3 Concrete Works – General Requirements

10.1.3.1 Set out and Forming

All concrete elements covered by this section of the Specification shall be set out on site and formed in accordance with the proposed line and level shown on the approved drawings.

Formwork shall comply with AS 3610 - *Formwork for concrete* and be fixed firmly in place. Forms shall extend for the full depth of the concrete and minimise spillage of unformed concrete from below the form. Excessive unformed spillage shall be removed once the concrete has reached initial set.

Where a concrete element has been formed by extrusion or slip form from a purpose made machine all excess concrete spilt beyond the required shape shall be trimmed once the concrete has reached initial set.

10.1.3.2 Removal of Forms

The Service Provider shall maintain all forms in place until the concrete is hardened enough to withstand formwork movement and removal without damage.

The following are the minimum periods, or as extended by the Council's Representative, if air temperature falls below 10°C, which forms shall be kept in place after placement of concrete:

Footpaths, driveways and similar: 2 days

Sides of reinforced concrete walls when height of each day pour is:

Under 600mm	1 day
600mm to 3m	2 days
3m to 6m	3 days
6m to 9m	5 days

Supporting forms under deck slabs of culverts: 10 days

In case of concrete containing special additives, conform to stripping times as specified by the Structural Design, manufacturer's recommendation and if required by the Council Representative.

Forms shall be removed in such a way so that the concrete will not be cracked, chipped or otherwise damaged. Crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms shall not be used.

Hole-formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

10.1.3.3 Repair of Defects

As soon as the forms are removed from mass or reinforced concrete work, the Service Provider shall repair all rough places, holes and porous spots by removing defective work and after wetting, filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete and bring to an even surface with a wooden float. Similarly, the Service Provider shall repair all cavities caused by removal of fitments or tie wires and pack with cement mortar.

The Service Provider shall cut back any tie wires or other fitments extending to outside surfaces after removal of forms, to a depth of at least 40mm with sharp chisels or cutters.

If required, the Service Provider shall coat the surfaces of bolt cavities, tie wire holes, and all defects prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water, generally as required by the manufacturer.

10.1.3.4 Removing Existing Concrete Works

Where existing concrete elements are required to be removed, they shall be saw cut square and vertical at the limit of the required removal. A full depth expansion joint shall be constructed where new concrete meets the existing concrete.

10.1.3.5 Placement of Reinforcement

Reinforcing steel shall be placed on full plastic chairs to achieve a minimum cover of 30mm to the exposed finished surface of the concrete and 40mm to the slab edge or a formed joint. Sufficient chairs shall be placed so the steel maintains cover during placement of the concrete.

Lap splices in reinforcing shall be in accordance with AS 3600 - *Concrete structures*, or as shown on the approved drawings or manufacturer's recommendations.

10.1.3.6 Handling and Placing of Concrete

Concrete shall be placed and finished to:

- Limit segregation or loss of material.
- Limit premature stiffening.
- Result in dense homogeneous hardened concrete which is monolithic between joints and edges.
- Expel entrapped air and result in a dense material around all reinforcement and embedments.
- Result in the specified thickness and surface finish.

Sub-base or base material onto which concrete shall be placed shall be dampened prior to placement of concrete to reduce loss of water from the placed concrete.

Concrete shall not be placed:

- During rain or when rain is predicted.
- When the air temperature in the shade is below 5°C or above 38°C.

In the case that concrete has been placed and the likelihood of rain has become evident since the start of placement the Service Provider shall take measures such as covering the concrete with plastic sheeting to avoid rain damage. Rain damaged concrete shall not be accepted as complying with this Specification.

10.1.3.7 Finishing of Unformed Surfaces

Finishing of unformed surfaces in all cases shall achieve:

- The dimensions and grades shown on the approved drawings and detailed in Council's *Civil Works Specification - Standard Drawings*.
- Minimum cover to reinforcement.
- The specified surface finishes for the element being constructed.
- Minimisation of plastic and drying shrinkage cracking.

10.1.3.8 Concrete Joints

Concrete placement may include the following types of joints:

- Control joints (shrinkage/contraction joints) - formed joint with shear key or weakened plane joint.
- Expansion joints (dowelled).
- Isolation joints.
- Construction joints.
- Tied joints between existing and new concrete elements.

Full depth isolation joints shall be provided when any concrete element abuts another concrete element, for example, a joint between a vehicle access crossing and kerb and gutter, a joint between a dished crossing and a drainage pit, and a joint between a concrete path and utility pit.

All concrete joints shall be constructed and positioned in accordance with Council's *Civil Works Specification - Standard Drawings*. Alternative methods of achieving shrinkage control joints may be proposed by the Service Provider for approval by Council's Representative.

Unplanned cracking in concrete shall not be accepted.

10.1.3.9 Curing

The use of curing compounds shall comply with Section 10.1.1.5 above. Where concrete elements are cured with a commercial curing compound, the concrete shall be cured and applied at the rates recommended by the manufacturer's specifications.

10.1.3.10 Bedding Base / Sub-base Tolerances

Base or sub-base layers alongside or within the flexible pavement areas shall have tolerances in accordance with Section 8.4.3 of this Specification.

Base layers in other locations shall have the following tolerances:

- The level shall not deviate by more than 10mm above or 25mm below the design surface level less the allowance for the proposed concrete thickness.
- The thickness shall not be less than the specified thickness.
- The straightness shall not deviate by more than 10mm from a 3m straight edge.
- Deviations on vertical or horizontal curves shall not exceed 10mm from the true vertical or horizontal alignment.

10.2 Specific Concrete Element Requirements

10.2.1 Kerbs, Kerb and Gutter, Kerb Ramps, Unreinforced Dish Drains and Unreinforced V-drains

10.2.1.1 Set Out and Forming

Kerbs, kerb and gutter, kerb ramps, unreinforced dish drains and V-drains shall be set out to the line and level shown on the approved drawings, or where replacing existing elements to the same line and level as the existing elements, unless otherwise shown on the approved drawings, or otherwise directed by Council's Representative.

Isolated lengths up to 40m on any project may be formed using formwork. For lengths exceeding this length a purpose made slip form or extrusion machine shall be utilised.

The shape of the required element shall be in accordance with Council's *Civil Works Specification - Standard Drawings*.

10.2.1.2 Surface Finish

A finish equivalent to that achieved with a smooth steel trowel shall be achieved.

Kerb ramps shall be initially steel float finished and then before initial set, broom brushed to a slip-resistant texture. This shall be achieved by drawing a moistened nylon broom lightly across the surface at right angles to the pedestrian direction of travel across the entire kerb ramp, including the angled kerb ramp wings. A nominal 100mm wide steel edging tool shall then be used to provide a 10mm radius smooth perimeter border to all edges, including all edges adjacent to expansion joints and isolation joints, but not adjacent to control joints within the kerb ramp.

Additional water shall not be added to the surface of any concrete to achieve the required smooth finish.

Additional water shall not be added to the surface of slip formed or extruded elements for finishing purposes. Extrusion machines may utilise a slurry box to aid in achieving the required finish.

10.2.1.3 Joints

Full depth expansion/isolation joints shall be placed at the following locations:

- Expansion joints at tangent points of curves of less than 25m radius.
- Isolation joints where the concrete element abuts any other concrete elements or structures.

Shrinkage control joints shall be placed at maximum 3m centres. Joints in these elements when tied to a rigid pavement shall be in accordance with the requirements of the rigid pavement design. Joint locations shall match those in the adjoining rigid pavement if no requirements are specified.

10.2.1.4 Stormwater Pipe Outlets in Kerb and Gutter

See Section 6.11 Stormwater Outlets to Kerb and Gutter.

10.2.1.5 Kerb Survey Marks

Existing survey marks shall not be disturbed. Where existing kerb and gutter is to be reconstructed the Service Provider shall be responsible for the replacement of any disturbed marks to the conditions of the Surveyor General's Approval to Remove Survey Marks using a Registered Land Surveyor.

10.2.1.6 Termination of Kerb and Gutter

Where a length of kerb or kerb and gutter is terminated in isolation and without joining a structure, the kerb shall be longitudinally ramped down to the surrounding surface over a length of 700mm minimum (500mm absolute minimum) in accordance with Council's *Civil Works Specification - Standard Drawings*.

10.2.1.7 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 10mm. The finished work shall not deviate from a 3m straight edge by more than 10mm. Deviations on vertical or horizontal curves shall not exceed 10mm from the true vertical or horizontal alignment.

10.2.2 Reinforced Dish Drains, Reinforced V-drains and Edge Restraints

10.2.2.1 Set Out and Forming

Reinforced dish drains, reinforced V-drains and edge restraints shall be set out to the line and level shown on the approved drawings, or where replacing existing elements to the same line and level as the existing unless otherwise shown on the approved drawings, or as otherwise directed by Council's Representative.

All elements shall be formed with formwork and hand placed concrete.

The shape of the required element shall be in accordance with Council's *Civil Works Specification - Standard Drawings*.

10.2.2.2 Surface Finish

A finish equivalent to that achieved with a smooth steel trowel shall be achieved.

Water shall not be added to the surface of the concrete to achieve the required smooth finish. The Service Provider shall ensure that the concrete supplied is suitable to achieve the required finish without the addition of water to the surface.

All exposed corners are to be finished with a 10mm radius.

10.2.2.3 Joints

Full depth expansion/isolation joints shall be placed at the following locations:

- Expansion joints at tangent points of curves of less than 25m radius.
- Isolation joints where the concrete element abuts any other concrete elements or structures at 18m maximum centres.

Shrinkage control joints are required at 3m maximum centres.

Joints in these elements when tied to a rigid pavement shall be in accordance with the requirements of the rigid pavement design. If no requirements are specified joint locations shall match those in the adjoining rigid pavement.

10.2.2.4 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 10mm. The finished work shall not deviate from a 3m straight edge by more than 10mm. Deviations on vertical or horizontal curves shall not exceed 10mm from the true vertical or horizontal alignment.

10.2.3 Unreinforced Concrete paths

All new concrete paths shall be reinforced in accordance with Section 10.2.4 below.

10.2.4 New Reinforced Concrete Paths

All new concrete paths shall be reinforced in accordance with this Specification. All new footpaths shall be a minimum of 1.5m in width unless specified to be another width by the conditions of Development Consent or separate *Roads Act 1993* approval. When it is necessary for the footpath to be adjacent to the back of kerb or the footpath is adjacent to a school boundary, the minimum width shall be 1.77m to ensure a 1.5m minimum path width alongside each layback.

All new shared paths shall adopt the width shown on the approved drawings. If dimensions are not shown, then the shared path shall have a minimum width of 2.5m and be constructed in accordance with Council's *Civil Works Specification - Standard Drawings*.

10.2.4.1 Set Out

Reinforced concrete paths shall be set out to the line and level shown on the approved drawings. Where not shown on the drawings, the edge of paths shall be parallel to the property boundary and 600mm from the property boundary, where the path is located between the road carriageway and the property boundary. The Service Provider shall seek clarification of path locations from Council's Representative in all cases as some variations to the alignment may be necessary for reasons not obvious to the Service Provider.

10.2.4.2 Reinforcement

Reinforced concrete paths shall be 100mm thick and reinforced with SL72 mesh unless otherwise shown on the approved drawings. Steel, polypropylene, nylon or other material fibres may be used as an alternative concrete reinforcement for shrinkage crack control, subject to the approval of Council's Representative.

10.2.4.3 Crossfall

Crossfall on all paths shall be between 1% and 2.5% sloping towards the kerb, where practicable.

10.2.4.4 Surface Finish

Paths shall be initially steel float finished and then before initial set broom brushed to a slip-resistant texture. This shall be achieved by drawing a moistened nylon broom lightly across the surface at right angles to the path direction of travel. A nominal 100mm wide steel edging tool shall be used to provide a 10mm radius to smooth the perimeter border along both longitudinal edges of all paths.

10.2.4.5 Joints

Joints shall be provided in paths in accordance with AS 3727.1 *Pavements: Residential* and as shown in Council's *Civil Works Specification - Standard Drawings* and Section 10.1.3.8 Concrete Joints.

10.2.4.6 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 20mm. The finished work shall not deviate from a 3m straight edge by more than 10mm under a 3m straight edge longitudinally or transversely. Deviations on vertical or horizontal curves shall not exceed 20mm from the true vertical or horizontal alignment.

10.2.5 Vehicle Access Crossings

10.2.5.1 Set Out and Forming

Vehicle access crossings shall be located where shown on the approved drawings or as directed by Council's Representative. Grades and levels of vehicle access crossings shall be constructed as shown in Council's *Civil Works Specification - Standard Drawings*.

The Service Provider must not alter vehicle access grades without approval from Council's Representative.

When a proposed vehicle access crossing requires alteration of an existing concrete path, sufficient length of the concrete path shall be saw cut and removed to allow transition in vertical and horizontal alignment to accommodate the vehicle access crossing profile and maintain the path crossfall as shown in Council's *Civil Works Specification - Standard Drawings*.

10.2.5.2 Gutter Crossing and Layback

Where a new gutter crossing and kerb layback are required the entire existing kerb and gutter shall be removed and reconstructed in accordance with Section 10.2.8 below.

10.2.5.3 Surface Finish

Vehicle access crossings shall be initially steel float finished and then before initial set, broom brushed to a slip-resistant texture. This shall be achieved by drawing a moistened nylon broom lightly across the surface at right angles to the vehicle travel direction over the access crossing. A nominal 100mm wide steel edging tool shall be used to provide a 10mm radius smooth perimeter border to all edges.

Where vehicle access crossings and/or property driveways have excessive longitudinal grades and/or horizontal curves or are unable to be constructed in accordance with the grade requirements in Council's *Civil Works Specification - Standard Drawings*, and a site-specific design has been undertaken due to existing constraints, greater skid-resistance may be achieved by using a steel-tynd comb or similar treatment to groove the concrete surface.

Council only permits the construction of vehicle access crossings within the road reserve in plain concrete, with a surface finish of good durable quality, high strength and slip-resistant with no trip hazards.

Vehicle access crossings constructed during Council's road upgrade projects shall be constructed in plain concrete to Council's *Civil Works Specification - Standard Drawings* at no expense to the property owner.

Council does not permit construction of vehicle access crossings with pavers, tiles, stamped concrete with an uneven surface and exposed aggregate surface finishes in urban residential, rural or industrial areas.

Pavers or other decorative treatments may be used in commercial and Central Business District public spaces, to compliment adjoining paved areas where architectural requirements dictate their use. Pavers used shall meet the requirements of AS/NZS 4455.2 *Masonry units, pavers, flags and segmental retaining wall units - Pavers and flags*. Pavers shall be laid on sand or mortar bedding in accordance with the paver manufacturer's specifications and over a concrete base as shown on the vehicle access crossing details in Council's *Civil Works Specification - Standard Drawings*.

Where specifications contained in a Development Consent or Tender/Contract document are contrary to this section of the Specification, then those specifications shall be applied.

10.2.5.4 Joints

Joints shall be provided in vehicle access crossings in accordance with AS 3727.1 *Pavements: Residential* and as shown in Council's *Civil Works Specification - Standard Drawings*.

Expansion joints shall be placed at maximum 12m centres, at the property boundary and at the joint between the vehicle access and the kerb layback. Isolation joints shall be placed where the vehicle access crossing abuts other concrete elements, structures or utility pits.

10.2.5.5 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 10mm. The finished work shall not deviate from a 3m straight edge by more than 10mm longitudinally or transversely. Deviations on vertical or horizontal curves shall not exceed 20mm from the true vertical or horizontal alignment.

10.2.6 Reinforced Open Concrete Drains – Sprayed or Hand Placed

10.2.6.1 Set Out and Forming

Open concrete drains shall be located where shown on the approved drawings or as directed by Council's Representative. Grades, levels and cross sectional areas of open drains shall be as detailed on the approved drawings.

Open drains shall have a minimum thickness of 100mm unless otherwise shown on the approved drawings.

10.2.6.2 Surface Finish

Open drains which are hand placed and finished shall be steel floated to a smooth finish. A steel edging tool shall be used to provide a 10mm radius to smooth all edge corners.

Sprayed concrete shall have a consistent dense surface finish with no irregularities, bumps or depressions.

10.2.6.3 Joints

Unless otherwise shown on the drawings, expansion joints shall be placed at maximum 4m centres. Isolation joints shall be placed where open channels abut other concrete elements or structures.

Shrinkage control joints are not required unless otherwise shown on the approved drawings.

10.2.6.4 Tolerances

Deviations on vertical or horizontal curves shall not exceed 40mm from the true vertical or horizontal alignment. There shall be no isolated depressions in the surface finish that will pond water. Continual fall in the invert of the channel is required. The cross section of the resultant channel shall not be smaller than that specified on the approved drawings.

10.2.7 Provisions for Existing or Proposed Utilities and Service Mains

Where a proposed vehicle access crossing, path or other concrete element is to be constructed before the planned installation of service mains and utilities, conduits or sections of mains shall be first installed under the concrete element in accordance with requirements of the relevant authorities.

Where a proposed vehicle access crossing or other concrete element is to be constructed over existing service mains or utilities, provision shall be made for access to valves, water service stop cocks or similar. If the depth to existing mains or utility is being reduced the relevant authority shall be contacted by the Service Provider to obtain that Authorities requirement and approval.

Regardless of whether cover is being reduced, increased or remaining the same, where a vehicle access crossing or other concrete element is to be constructed over an asbestos cement water main, the Water Authority shall be contacted prior to any works, to determine the exact location of the main and to determine if that section of main requires replacement.

For further details about road openings and restorations see Section 7 - Utility Services Installation, Road Opening and Utility Restorations.

10.2.8 Construction and Replacement of Kerb and Gutter, Dish Drains and V-drains along the Edge of Existing Pavement Areas

The existing pavement shall be saw cut a minimum 300mm out from and parallel to the new concrete element.

Remove the existing pavement to a depth of 150mm below the base of the proposed concrete element and extend 150mm beyond the footprint of the proposed element.

A 150mm thick layer of sub-base quality material shall be placed and compacted to the requirements of Section 8 - Flexible Pavement Construction of this Specification. A minimum of 2 relative density tests shall be required on the new sub-base unless otherwise advised by Council's Representative.

The new concrete element shall then be constructed in accordance with this Specification.

The area between the saw cut in the pavement and the concrete element shall be filled with compacted deep lift asphaltic concrete in accordance with this Specification.

This section is applicable to vehicle access construction where a new gutter crossing with layback is required.

10.3 Compliance Inspections, Testing and Documentation Requirements

Compliance with this Specification shall be demonstrated during inspections by Council's Representative, testing as required by Section 5 - Site Clearing and Bulk Earthworks and Section 8 - Flexible Pavement Construction of this Specification where applicable, relative compaction testing

on bedding sub-base layers, provision of material quality tests from the supplier when requested and provision of copies of delivery receipts confirming the material type supplied when requested.

Testing of concrete supplied other than that required by concrete batching plants for conformance with Australian Standards, should not be required; however, Council's Representative may request sampling and testing for determination of concrete strength or other nominated properties in the case where there is doubt about the strength grade or properties of the concrete being provided or where the Service Provider proposes to open the concrete element to traffic prior to concrete reaching its full 28-day strength.

Level tolerance and horizontal alignment of elements shall be demonstrated by work-as-executed surveys and drawings prepared by a Registered Land Surveyor. The requirement to provide work-as-executed drawings on small infill or isolated kerb and gutter works or single vehicle access construction may be relaxed by Council's Representative in cases where levels are dictated by existing site features.

10.3.1 Non-complying Work

Where works are observed by Council's Representative to not comply with this Specification the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying works(s) shall be rectified or removed before the works proceed further.

Where test results for relative compaction show non-compliance, the material shall be reworked and re-compacted. Retesting shall be required to demonstrate compliance.

Where material quality test results demonstrate non-compliance with this Specification, that material shall be removed and replaced with complying material.

Section 11 - Major Concrete Works

11.1 General

The works covered by this section of the Specification comprise the construction of major concrete elements, products and structures including:

- Buildings and building elements.
- Bridges.
- Large cast in-situ drainage structures including box culverts, open channels and non-standard pits.
- Retaining walls.

All structures covered by this section of the Specification are required to have had a design and a specification for the construction of the structure prepared by a Certified Practising Civil or Structural Engineer. All concrete structures shall be designed and constructed in accordance with AS 3600 - *Concrete structures*.

The specification for the construction of the structure prepared by the Certified Practising Civil or Structural Engineer will take precedence over any conflicting requirement of this Specification.

11.2 Certification of the Design and Construction

Certification of the design stating compliance with relevant Australian Standards will be required prior to construction. Inspections and certification of the construction confirming compliance with the design specifications shall be required as construction progresses. Certification at the completion of the structure shall be required to confirm that the structure has been constructed in accordance with the design and specification, is structurally adequate and shall meet the serviceability requirements intended by the design.

These certifications shall be provided by a suitably qualified Civil/Structural and Geotechnical Engineer(s). Copies of all certifications shall be provided to Council's Representative (refer to **Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements**).

11.3 Construction and Material Requirements

11.3.1 General

All works shall comply with the requirements of Section 17 - Material and Construction Requirements of AS 3600 - *Concrete structures*. The following additional specific requirements shall apply where not specified in the specification for the construction of the structure as prepared by the Certified Practising Civil or Structural Engineer.

The requirements of AS 3600 shall take precedence over the following requirements. Any conflicts between AS 3600 Section 17 and the specification for the construction of the structure prepared by

a Certified Practising Civil or Structural Engineer shall be brought to the attention of Council's Representative.

11.3.2 Formwork and False Work

11.3.2.1 General Requirements

Formwork and false work shall comply with the relevant requirements of AS 3610 - *Formwork for concrete*.

Certification that formwork and false work are structurally sound and suitable for the purpose they have been constructed shall be required from a Certified Practising Civil/Structural Engineer prior to the placement of any concrete.

Formwork shall be provided to produce hardened concrete to the lines, levels and shapes shown on the approved drawings or as specified by Council's Representative. Formwork shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Subject to approval by the design and Certifying Engineer, false work may be supported on completed sections of the works provided that the construction loads imposed thereon do not result in over-stressing or instability and that due allowance is made for any deflection of the supporting sections.

The Service Provider on the advice of the Certified Practising Civil/Structural Engineer shall undertake structural strengthening or modification of such sections necessary for their use as support structures.

11.3.2.2 Concreting Against Rock and Firm Ground

Concrete may be placed against rock faces, provided that the cover to the reinforcement on the rock face is increased by a minimum of 25mm. Before any concrete is placed against a rock face all leakage and percolation of water which could cause damage to the wet concrete shall be effectively sealed. Concrete shall not be poured against horizontal or inclined rubble, fill or earth surfaces in lieu of formwork.

11.3.2.3 Formed Surface Finish

Finishes to formed surfaces shall be produced in accordance with the requirements and recommendations of AS 3610 - *Formwork for concrete* and the specification for the structure. If the surface class is not specified, the class listed in Table 11.1 below shall be used.

Table 11.1 Class of Surface for Formed Work

Surface	Class
Footings and other buried structures, rear surfaces of retaining walls, surfaces to be faced with stone	Class 5
Bridge and other surfaces which shall receive heavy applied finishes	Class 4
Concealed surfaces of walls, beams, slab soffits, stairs, abutments, bridge decks, etc	Class 3
Surfaces to receive a granular or plaster finish, and all exposed surfaces	Class 2
Surfaces not specified	Class 2

11.3.3 Reinforcement

11.3.3.1 General Requirements

Steel reinforcement supplied to the site and incorporated into the works shall conform to AS/NZS 4671 - *Steel reinforcing materials* and AS 3600 - *Concrete structures*.

All steel shall be free from loose or thick rust, loose mill scale, grease, tar, paint, oil, dirt, mortar or other unspecified coating. If the steel has more than a thin film of rust, it may be rejected for use in the works and shall be immediately removed from the site by the Service Provider. Reinforcement shall be stored and supported above ground and protected from contaminants.

Reinforcement shall be readily identifiable as to grade, origin and its final location in the works. The necessary tie wire, support chairs, spacers, supplementary reinforcement and the like shall be supplied for adequate fixing of the reinforcement.

The Service Provider shall provide a certificate of compliance with the relevant standard AS/NZS 4671 - *Steel reinforcing materials*, or alternatively provide test certificates from a NATA registered testing authority. Test certificates shall show results of mechanical tests and chemical analysis.

Where the material cannot be identified with a test certificate, samples shall be taken, and testing arranged by the Service Provider. The samples shall be selected randomly and consist of three specimens each at least 1.2m in length.

The cost of all samples and tests shall be borne by the Service Provider.

11.3.3.2 Splicing

All reinforcement shall be furnished in the lengths detailed on the approved drawings. If splicing is required, it shall be in accordance with the provisions of AS 3600 - *Concrete structures*. All splices shall be at the locations shown in the approved drawings or described in the specification for the structure.

11.3.3.3 Fabric Splices

A lap splice for fabric shall be made so that the 2 outermost transverse wires of 1 sheet of fabric overlap the 2 outermost transverse wires of the sheet being lapped plus 25mm.

11.3.3.4 Weld Splices

Bars may only be welded by an approved electrical method as directed by Council's Representative. No welding will be allowed on cold-worked or hard grade reinforcing bars.

Welding shall conform to the requirements of AS/NZS 1554.3 - *Structural steel welding - Welding of reinforcing steel* and shall be carried out in the presence of Council's Representative.

Unless otherwise approved by Council's Representative, the welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

11.3.3.5 Storage

Reinforcement, unless concreted promptly, shall be stored under a waterproof shelter and supported above the surface of the ground, and shall be protected from injury and from deterioration due to environmental exposure.

11.3.3.6 Bending

Reinforcement shall be carefully formed to the dimensions and shapes shown on the approved drawings. Reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the approved drawings shall not be permitted.

11.3.3.7 Protective Coated Reinforcement

Unless otherwise shown on the approved drawings, if an element is specified to contain protective coated reinforcement, the same coating type shall be provided to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates, ferrules and the like.

Galvanised reinforcement shall comply with AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*, and the following requirements.

Minimum coating mass:

- For wire: Type A.
- For reinforcement: 100 microns of 98% pure zinc metal.
- Preparation: Pickling to AS 1627.5 - *Metal finishing - Preparation and pre-treatment of surfaces - Pickling*.
- Passivation: After galvanising, the galvanised coating shall be passivated by immersion in a bath of 0.2% sodium dichromate solution.

If damage occurs to the coating, either the damaged reinforcement shall be replaced, or repairs may be carried out to AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*.

Starter bars and the like left projecting from cast concrete for future additions, otherwise unprotected and expected to be exposed to the weather for more than 1 month, shall be coated with a cement wash.

11.3.3.8 Placing and Fixing Reinforcement

Reinforcement shall be spaced accurately to the pitches and position as shown on the approved drawing. Reinforcement shall be secured against displacement by tying at all intersections with annealed iron wire ties not smaller than 1.25mm diameter, or by approved clips. The ends of wire ties shall be bent away from nearby faces of forms so that the ties do not project into the concrete cover.

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded and shall comply with AS 3600 - *Concrete structures*.

11.3.3.9 Reinforcement Supports

Reinforcement shall be supported by purpose-made plastic chairs. Steel shall not be supported on metal supports which extend to the surface of the concrete, on wooden supports, or on pieces of coarse aggregate or loose rock.

For exposure classifications more severe than A1, as defined in AS 3600 - *Concrete structures*, reinforcement shall be accurately supported by plastic supports of adequate strength and of a shape appropriate to the location.

Damage to waterproofing membranes or vapour barriers shall be prevented by placing a plastic plate under each support to prevent puncturing when reinforcement is supported over membranes.

Chairs shall be spaced sufficiently close together to ensure that the specified cover is maintained during placement of concrete, and to ensure that crushing of the chairs or penetration into the formwork does not occur. The reinforcement shall not have permanent deflection or displacement of more than 2mm during placing and consolidation of the concrete.

11.3.4 Placing and Compaction of Concrete

11.3.4.1 General Requirements

The Service Provider shall plan and control the placing, compacting, curing and finishing operations to prevent cracking in the various concrete elements.

No concrete shall be placed in the works until the false work, formwork, reinforcement and stressing materials have been inspected, all foreign material has been completely removed from the forms and certification has been given by the Civil/Structural Engineer responsible for inspecting and certifying the formwork and false work.

Formwork shall not be disturbed or adjusted during the concreting operation and shall remain undisturbed up to the minimum removal time specified.

11.3.4.2 Placing

Concrete shall be deposited within the forms as near as possible to its final location.

Excessive use of vibrators and tamping rods to move the concrete along the forms is not permitted.

Movement of concrete to the pour face may be by means of suitable conveyors, clean chutes, troughs or pipes which shall be made of metal, or have metal linings, or by pumping.

Water shall not be used to facilitate the movement.

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 water ponds.

No concrete shall be placed if:

- The temperature of the concrete is less than 10°C or exceeds 35°C.
- The ambient air temperature is likely to be greater than 35°C during placement or within 2 hours subsequent to placement.
- The ambient air temperature measured at the point of placement is likely to exceed 35°C during placing and finishing operations, the Service Provider shall take practical precautions to ensure that the temperature of the concrete does not exceed the permitted maximum so that the concrete can be placed and finished without defects.

Special attention shall be paid to providing early curing for hot weather concreting operations. The Service Provider is to provide a proposal for the protection of concrete in cold or hot weather.

Concreting operations shall be carried out in a continuous manner between approved construction joints or from end to end in the case of precast items. Fresh concrete shall not be placed against concrete which has taken its initial set. If an interruption (around 45 minutes) occurs that causes the initial set at the leading edge of the concrete, a construction joint approved by the Civil/Structural Engineer responsible for the design shall be placed.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2m or be deposited in large quantities at any point and moved or worked along the forms. Buckets shall have the capability of a controlled rate of discharge. If placing operations necessitate a drop of more than 1.6m, the concrete shall be placed using a flexible tube reaching to the base of the formwork.

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.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

The Service Provider shall 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.

Concrete affected by rain before it has set, including during mixing, transport or placing, shall be deemed as non-compliant.

11.3.4.3 Compaction

Concrete shall be compacted immediately after placing by immersion and/or screed vibrators accompanied by hand methods, continuous spading or slicing as appropriate to remove entrapped air and compact the mix. At least 1 reserve vibrator, in working order, shall be provided as standby during concreting operations.

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 with a wooden float. Where shown on the approved drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

11.3.5 Curing and Protection

11.3.5.1 General

All finishing operations shall be completed prior to the application of any curing. The finishing operations shall be such as to provide a dense surface free from visible surface cracking.

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 exposed surfaces shall be cured using a commercial curing compound in accordance with AS 3799 - *Liquid membrane-forming curing compounds for concrete*, for a minimum period as detailed in the specification for the structure. During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism, any traffic and other causes likely to damage the concrete. All costs involved in making good or

replacing any work that has been damaged due to the above-mentioned factors shall be the Service Provider's responsibility.

Wax-based or chlorinated rubber-based curing compounds shall not be used on surfaces forming substrates to concrete toppings, bridge decks, cement-based render and the like.

11.3.5.2 Protection

The Service Provider shall obtain the approval of the Inspecting/Certifying/Design Engineer before loading the concrete structure. The concrete shall be protected from damage due to load overstressing, heavy shocks and excessive vibrations, particularly during the curing period.

Finished concrete surfaces shall be protected from damage from any cause, including mortar splashes and stains, timber stains, rust stains, chemical attack, additives, curing compounds, protective coatings, rain, running water and the like.

11.3.6 Project Assessment of Concrete

The specification for the structure prepared by the Practising Civil or Structural Engineer shall specify the requirements for project assessment including details of how the assessment shall be made if different from AS 3799 - *Liquid membrane-forming curing compounds for concrete*.

In the case that no Project Assessment of the concrete is specified the Service Provider shall confirm with the Certified Practising Civil or Structural Engineer who prepared the specification that no Project Assessment is required.

11.4 Compliance

11.4.1 Compliance Inspections, Testing and Documentation Requirements

Inspections and certification of the construction confirming compliance with the design and specifications will be required as construction progresses and will be required to be carried out by the Certified Practising Civil or Structural Engineer who prepared the design or their appointed representative. Certification will be required at the completion of the structure to confirm that the structure has been constructed in accordance with the design and specification, is structurally adequate and will meet the serviceability requirements intended by the design. Copies of all certificates shall be provided to Council's Representative.

Testing and sampling for major concrete works, including major drainage structures, shall be carried out in accordance with AS 1379 - *Specification and supply of concrete* and AS 1012.1 - *Methods of testing concrete, Method 1: Sampling of concrete*. The results of this concrete testing shall be supplied to Council's Representative.

The results of all project assessment testing shall be supplied to Council's Representative. The results of testing carried out by the Service Provider's concrete supplier confirming compliance with AS 3799 - *Liquid membrane-forming curing compounds for concrete* shall be supplied to Council's Representative.

Certification that the reinforcing steel supplied for the structure complies with AS/NZS 4671 - *Steel reinforcing materials* shall be provided to Council's Representative.

Council's Representative may also carry out inspections of the construction of the structure for compliance with the design, the design specification and this Specification where applicable. Any non-compliance observed shall be brought to the attention of the Service Provider and the Certified Practising Civil or Structural Engineer or their appointed representative responsible for providing construction and completion certification of the structure as required by this section of the Specification.

11.4.2 Non-complying Work

Where works are observed, by the Practising Civil or Structural Engineer or their appointed representative responsible for providing construction and completion certification or Council's Representative, to not comply with the specification for the structure, this Specification or AS 3600 - *Concrete structures*, the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying item(s) shall be rectified before the works proceed further.

Where test results from concrete suppliers and/or the project assessment show a non-compliance, remedial action shall be taken by the Service Provider following the advice of the Certified Practising Civil or Structural Engineer responsible for the design.

Where other material quality test results demonstrate a non-compliance with the specification for the structure, this Specification or AS 3600 - *Concrete structures*, remedial action shall be taken by the Service Provider following the advice of the Certified Practising Civil or Structural Engineer responsible for the design.

Failure by the Service Provider to rectify any non-complying work to the satisfaction of the Practising Civil or Structural Engineer or their appointed representative responsible for providing construction and completion certification and Council's Representative shall result in the works not being issued with a Compliance Certificate.

11.5 Concrete Bridge Design, Construction, Inspection and Handover

11.5.1 General

11.5.1.1 Scope

This Section sets out the requirements for the design, construction, inspection and handover of bridge structures within the Central Coast local government area.

Works include (but are not limited to) the following:

- Bridge substructures and superstructures.
- Deck systems, barriers and drainage.
- Bearings and expansion joints.
- Associated approach works (where specified).

The latest edition of TfNSW's Country Bridge Solutions Design Guide and Construction Guide for modular bridge design and construction should be used for guidance on procuring or carrying out timber bridge replacement designs on regional and local roads.

11.5.1.2 Objectives

The objective of this Section is to ensure that bridge structures:

- Are safe and fit for purpose.
- Achieve a minimum design life of 100 years.
- Are durable in coastal and estuarine environments.
- Are maintainable with minimal whole-of-life cost.

11.5.1.3 Reference Documents

Bridge works shall comply with the latest editions of the following:

- AS 5100 and AS/NZS 5100 - *Bridge Design* (all relevant parts, including but not limited to the following):
 - Part 1: Scope and General Principles.
 - Part 2: Design Loads.
 - Part 3: Foundations and Soil-Supporting Structures.
 - Part 4: Bearings and Deck Joints.
 - Part 5: Concrete.
 - Part 6: Steel and Composite Construction (AS/NZS 5100).
 - Part 7: Bridge Assessment.
 - Part 8: Rehabilitation and Strengthening of Existing Bridges.
 - Part 9: Timber (for timber bridge designs).
- AS/NZS 1170 - *Structural Design Actions*.
- AS 3600 - *Concrete Structures*.
- AS 4100 - *Steel Structures*.
- AS 2159 - *Piling Design and Installation*.

And:

- TfNSW G-Series and B-Series Specifications and Bridge Technical Directions.
- TfNSW Country Bridge Solutions - Design Guide.
- Austroads *Guide to Bridge Technology series (Bridge Design, Management, Construction and Maintenance)* as follows:
 - Part 1: Introduction and Bridge Performance.
 - Part 2: Materials.
 - Part 3: Typical Superstructures, Substructures and Components.

- Part 4: Design Procurement and Concept Design.
- Part 5: Structural Drafting.
- Part 6: Bridge Construction.
- Part 7: Maintenance and Management of Existing Bridges.
- Part 8: Hydraulic Design of Waterway Structures.

11.5.1.4 Precedence

Where inconsistencies occur, the following order of precedence shall apply:

1. Contract documents.
2. Central Coast Council requirements.
3. TfNSW Specifications.
4. Australian Standards.

11.5.2 Design Requirements

11.5.2.1 General

Bridge design shall:

- Comply with AS 5100 - *Bridge Design*.
- Incorporate principles from Austroads *Guide to Bridge Technology*.
- Consider coastal, marine and tidal exposure conditions.
- Address ultimate and serviceability limit states.
- Incorporate durability, constructability and maintenance requirements.

11.5.2.2 Design Life

Unless otherwise specified:

- Minimum design life: 100 years.

11.5.2.3 Design Submission

Submit the following:

- Design report and calculations.
- Issued for Construction (IFC) drawings.
- Durability design report.
- Hydraulic and flood assessment (where applicable).
- Independent design verification (if required).

11.5.3 Hold Points and Witness Points

Work shall not proceed beyond the specified hold points and witness points and any other specific key inspection points required by the Design Engineer, without approval from the Principal.

Hold points and witness points shall be based on TfNSW B-Series Specifications and determined during the design stage and agreed to by Central Coast Council.

11.5.4 Construction Requirements

11.5.4.1 Inspection and Test Plans

The Design Engineer shall prepare Inspection and Test Plans (ITPs) covering all bridge works.

11.5.4.2 Survey Control

Provide survey verification of the following:

- Alignment.
- Levels.
- Setout.

11.5.5 Practical Completion Inspection

Prior to Practical Completion, undertake a comprehensive inspection including the following:

- Structural components.
- Deck and drainage.
- Bearings and joints.
- Barriers and safety systems.
- Protective coatings.

All defects shall be rectified prior to submission.

11.5.6 Load Rating and Certification

Provide the following:

- Load rating in accordance with AS 5100 - *Bridge Design*.
- Certification by a CPEng.
- Load limit recommendations (if applicable).

11.5.7 Asset Handover

Submit a complete Bridge Asset Handover Package including the following:

11.5.7.1 As-Built Documentation

- Drawings (PDF and CAD).
- Design reports.

11.5.7.2 Asset Data

- Inventory data.
- GIS location.
- Asset identification.

11.5.7.3 Operation and Maintenance Manuals

- Inspection schedules.
- Maintenance procedures.
- Access requirements.

11.5.7.4 Inspection Records

- Construction records.
- Final condition report.
- Photographic records.

11.5.7.5 Warranties

- Materials and system warranties.

11.5.8 Defects Liability

During the Defects Liability Period:

- Rectify defects at no cost to the Principal.
- Undertake a 12-month inspection.
- Repair any deterioration.

11.5.9 Design and Supply or Design and Construct Options**11.5.9.1 General**

Where a Design and Supply or Design and Construct arrangement applies, the Contractor shall be responsible for the following:

- Structural design.
- Documentation.
- Fabrication and supply.
- Certification.

11.5.9.2 Design Responsibility

The Contractor shall:

- Engage a Chartered Professional Engineer (CPEng).
- Undertake all necessary design work.
- Co-ordinate structural, geotechnical, and hydraulic inputs.

11.5.9.3 Design Submission and Approval

Submit the following:

- Basis of Design Report.
- Design calculations and drawings.
- Verification documentation.

11.5.9.4 Fabrication and Supply

Provide the following:

- Material certificates.
- Shop drawings.
- Factory inspection records.

All components shall comply with approved design documentation.

11.5.9.5 Interface Requirements

Ensure compatibility between the following:

- Supplied bridge elements.
- Substructures and foundations.
- Roadworks and approaches.

11.5.9.6 Certification and Warranties

Provide the following:

- Design certification.
- Structural adequacy certification.
- Product warranties.

11.5.9.7 Additional Handover Requirements

Provide the following:

- Design models and calculations.
- Fabrication records.
- Proprietary system manuals.

11.5.10 Departures from Standards

Departures shall:

- Be documented and justified.
- Include supporting engineering assessment.
- Be approved prior to implementation.

Section 12 - Bituminous Sealing

12.1 General

This Section specifies the following:

- Type of bituminous seal required in specific situations.
- Requirements for supplying and constructing primers, primer sealing and sealing where required in accordance with this Specification.

12.1.1 General Requirements

All hot bitumen primers, primer seals and seals shall be supplied and sprayed in accordance with applicable TfNSW *QA Specifications - Pavement (Bituminous) R101-R123* and associated Guidelines and Austroads *Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals*.

All bitumen emulsion primer seals or seals shall be provided in accordance the applicable TfNSW *QA Specifications - Pavement (Bituminous) R101-R123* and associated Guidelines and the recommendations of the bitumen emulsion manufacturer and/or supplier.

Unless otherwise shown in the Council-accepted pavement design, bituminous seals will be required as defined below:

- 10mm seal is required on the surface of base course pavement layers, under all asphalt surfacing layers.
- 7mm and 14mm 2-coat or seal on roads classed by Council as rural roads.
- 10mm single coat seal is required on all road shoulders nominated to be sealed and on All Weather Surfaces.

Other sealing types may be required where shown on the Council accepted pavement design.

Generally, Class 170 (to AS 2008 *Bitumen for pavements*) hot bitumen is to be used as the binder for sprayed sealing works with the addition of cutting oil as required depending on site conditions.

Cutback hot bitumen class shall be within the appropriate class for the primer (AMC00 to AMC1), primer binder (AMC2 to AMC4) or seal (AMC5 to AMC7) in accordance with AS 2157 - *Cutback bitumen*.

Cationic rapid setting bitumen emulsion may be used as the primer seal binder for minor works only and shall be subject to approval by Council's Representative.

Sealing shall only be carried out following suitable preparation of the road base surface which is to be sealed. The surface to be sealed must comply with the requirements of Section 8 - Flexible Pavement Construction of this Specification and shall be:

- Homogeneous in nature without segregation of similar size particles.
- Uniform in texture to achieve a uniform bond.

- Hard and dense to resist embedment of sealing stone.
- Capable of being broomed without laminating or tearing of the surface.
- Free from loose material or foreign matter.

All surfaces to be sealed shall be inspected by Council's Representative prior to commencement of sealing operations.

The type of binder used in sealing shall be selected by the Service Provider with due consideration to required curing times before placement of traffic on the seal or placement of asphalt surfacing over the seal or primer seals.

Completed and cured seals must be observed to be consistently and securely adhered to the underlying pavement layer. Seals that strip or detach from the underlying material in mat-like fashion under traffic or with minimal force applied will be rejected.

12.1.2 Bitumen Emulsion Seals

Cationic rapid setting (CRS) bitumen emulsion may be used as the binder for minor works only and shall be subject to approval by Council's Representative. Bituminous emulsions shall comply with AS 1160 - *Bituminous emulsions for the construction and maintenance of pavements*. CRS bitumen seals shall be constructed in accordance with the latest Austroads Guidelines at a rate of approximately 1.3 to 1.5L/m². The 10mm aggregate shall be applied at a rate of approximately 120 to 140m²/m³, for minor works only with prior approval from Council's Representative.

12.2 Compliance

12.2.1 Compliance Inspections, Testing and Documentation Requirements

The following inspections will be required to be carried out by Council's Representative:

- Prior to surface preparation by the sealing Service Provider.
- Following surface preparation by the sealing Service Provider.
- Prior to spraying of binder.
- During spraying of binder and placement of aggregate.
- Following completion of the seal.

The Service Provider shall provide a copy of their quality plan, test certificates, design calculations (if applicable) and records relating to sealing works if requested by Council's Representative.

12.2.2 Non-complying Work

Where works are observed by Council's Representative to not comply with this Specification the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) will be required to be rectified before the works proceed further.

Where material quality test results demonstrate a non-compliance with this Specification that material shall be removed and replaced with complying material.

Where a seal fails to perform as a result of material quality, a poor design, or an error on the part of the Service Provider then the Service Provider shall propose a method of rectification for the acceptance of Council's Representative. Compliance Certificates will not be provided until all rectification works are complete.

Section 13 - Asphalt Surfacing

13.1 General

This section covers the requirements for the following:

- Design of asphalt mixes.
- Requirements of constituent materials in asphalt mixes.
- Preparation for placement of asphalt.
- Placement and compaction of asphalt.
- Compliance inspections, testing and documentation to demonstrate compliance.

The types of asphalt covered by this Specification are:

- Dense Graded Asphalt (or Asphaltic Concrete) (DGA or AC).
- Fine Gap Graded Asphalt (FGGA).

13.1.1 General Requirements

Asphalt surfacing will be required in all new urban residential, industrial and commercial development roads regardless of the pavement being full road, half road or shoulder construction.

Asphalt surfacing will also be required in rural cul-de-sac/turning circles and rural intersections unless otherwise detailed on the approved drawings.

The Service Provider supplying the asphalt shall have established, implemented and maintain a Quality System in accordance with this Specification and the requirements of AS/NZS ISO 9001 - *Quality management systems - Requirements*.

This requirement does not apply to a Service Provider placing a small area of asphalt up to 120m² associated with pavement shoulder or kerb and gutter construction.

13.1.2 Asphalt Surfacing Type and Thickness

Asphalt surfacing shall be supplied and placed using the following types and thickness of asphalt unless otherwise specified in the approved Pavement Design Report.

Urban Residential Developments with design ESA up to 3×10^5 shall have a minimum 30mm thick AC10 on a 10mm seal in accordance with Section 12 - Bituminous Sealing.

Urban Residential Developments with design ESA up to 3×10^5 to 1×10^6 shall have a minimum 40mm thick AC10 on a 10mm seal in accordance with Section 12 - Bituminous Sealing.

Rural Intersections and cul-de-sacs/turning circles shall have a minimum 40mm thick AC10 on a 10mm seal in accordance with Section 12 - Bituminous Sealing.

Industrial/commercial developments shall have an asphalt surfacing thickness in accordance with the approved Pavement Design Report. The thickness will be specified following consideration of the heavy vehicle loadings and likely vehicle turning and braking forces.

Surfacing other than dense graded asphalt shall only be used where specified in the approved Pavement Design Report.

The asphalt surfacing shall not be laid within 7 days of the placing of a seal. This requirement shall only be changed with the approval of Council's Representative following consideration of information presented by the Service Provider justifying an earlier placement of asphalt. In any case the Service Provider shall obtain their own advice as to the appropriate length of time that a seal should be allowed to cure prior to the placement of asphalt over the seal. That advice shall take into consideration the amount of cutter present in the bitumen binder of the seal.

Asphalt that is adversely affected due to being placed over a seal that has not been allowed to fully cure shall be fully removed along with the underlying seal and replaced.

Seals that have been affected by the trafficking of vehicles over the seal shall be resealed to the satisfaction of Council's Representative prior to placement of asphalt.

13.1.3 Asphalt Mix Design

Asphalt mix designs shall be carried out by the Service Provider or their asphalt suppliers in accordance with the specifications nominated in this section. Any documentation relating to mix designs shall be provided upon request to Council's Representative. The mix details shall meet the updated Register of Asphalt Mixes for TfNSW.

13.2 Supply and Placement of Asphalt

13.2.1 Asphalt for Traffic Loading

Asphalt for pavements shall be supplied, placed, finished and tested in accordance with the requirements of TfNSW *QA Specification R116 Heavy Duty Dense Graded Asphalt* and *QA Specification R117 Light Duty Dense Graded Asphalt*, as applicable. The following clarifications in relation to the requirements of *R116* and *R117* shall apply:

13.2.1.1 Generally

- Superintendent or Principal shall mean Council's Representative.
- A Project Quality Plan is not required.
- Documentation required in *Annexure R116/D* and *R117/D* shall be provided when requested by Council's Representative.
- Referenced documentation shall be those that are current at the date of the pre-construction site meeting.
- Hold points shall not be applicable unless requested by Council's Representative.

13.2.1.2 Supply of Asphalt

- If not specified in the approved Pavement Design Report, binder shall be Class 450 bitumen.
- Submission of mix designs to Council's Representative is required 2 weeks prior to the commencement of work.

13.2.1.3 Placing Asphalt

- Course layer thicknesses shall be as nominated in this section of the Specification or as nominated in the approved Pavement Design Report.
- Asphalt incorporating binders compliant with TfNSW 3253 shall not be placed or continued where the temperature of the existing surface, measured at the level to be paved, is below 8°C for asphalt with a nominal size less than 20mm, or below 5°C for asphalt with a nominal size of 20mm or greater, assuming zero wind speed. Where binders compliant with TfNSW 3252 are used, the minimum allowable surface temperatures shall be increased by 5°C. These minimum temperatures shall be further increased by 5°C for each 5km/h increment in wind speed above zero, provided that the minimum temperature does not exceed 30°C.
- Tack coat and/or asphalt shall not be applied where the surface is wet or where wet weather conditions are imminent.
- Tack coat shall be applied uniformly at a residual bitumen application rate between 0.15 and 0.30L/m², ensuring effective bonding to the underlying surface. For joints and chases, the application rate shall be doubled. The proposed tack coat application rate shall be submitted in writing to the Principal prior to application. The tack coat bitumen emulsion shall be CRS/170-60, compliant with AS 1160, unless otherwise approved by the Principal.
- A placement trial will not be required.

13.2.1.4 Finished Pavement Properties

- Compaction control testing on cores is not required unless requested by Council's Representative.
- When compaction testing is requested a Lot shall be the section of pavement nominated for testing. A minimum of three cores will be required in any section of pavement requiring testing for compaction.
- For the purpose of determining course thickness compliance a Lot shall be a section of pavement up to 100m length.
- Cores for determining course thickness compliance shall be taken when requested by Council's Representative. A minimum of three cores will be required in any section of pavement requiring testing for course thickness.
- The surface shape requirements shall apply to all road pavements. Surface shape requirements shall be tested by Council's Representative.

- Determination of ride quality in accordance with TfNSW *QA Specification R116* and *QA Specification R117*, as applicable, *Section 4.5 Ride Quality* will only be required when requested by Council's Representative.

13.2.1.5 Conformity

- Areas that exhibit cracking, ravelling, bony or fatty material, or have been damaged during construction in the opinion of Council's Representative, shall be removed and replaced. The extent of the removal and replacement will be directed by Council's Representative.
- Sampling and testing of the asphalt mix or placed asphalt shall only be required if requested by Council's Representative.
- Results of any tests requested by Council's Representative shall be provided to Council's Representative prior to the pre-final inspection.
- The Service Provider shall rectify any area of non-conforming asphalt works as determined by Council's Representative following consideration of finished pavement properties and test results.
- Any reference to Schedule of Rates and deductions do not form part of this Specification.

13.2.2 Other Requirements for Asphalt Supply and Placement

Where procedures for the supply and placement of asphalt are not covered in TfNSW *QA Specification R116 Heavy Duty Dense Graded Asphalt* and *QA Specification R117 Light Duty Dense Graded Asphalt*, as applicable, the procedures of AS 2150 - *Hot mix asphalt* and Austroads *Guide to Pavement Technology - Part 4B* shall be adopted.

Asphalt placed against the lip of gutter shall not be lower than the lip level or 10mm higher than the lip level. The criteria shall be applied during the pre-final inspections and at the end of the defects liability period. This requirement shall be applied regardless of the requirements of other specifications and standards referred to in this section.

13.3 Compliance

13.3.1 Compliance Inspections, Testing and Documentation Requirements

The following inspections and tests will be required to be carried out by Council's Representative:

- Prior to placement of asphalt - inspection of seal and preparation.
- During placement of asphalt.
- Following completion of asphalt surfacing.
- Surface shape using a 3m straight edge.
- Pre-final inspection.

The Service Provider shall provide a copy of test certificates, design calculations and records relating to asphalt works if requested by Council's Representative.

The Service Provider shall arrange and meet the cost of testing requested by Council's Representative.

13.3.2 Time for Submission of Test results

Test reports for combined particle size distribution, binder content and air voids determined from laboratory-compacted asphalt mixes shall be submitted to the Principal within one working day of asphalt placement. Where requested, test reports for in-situ air voids, course thickness and course shape shall be submitted within a period of three working days to four weeks following asphalt placement. The timing of testing shall be determined at the discretion of the Principal.

Air voids testing requirements and associated reporting shall comply with TfNSW Q5/Q6 Specifications. Notwithstanding this, the determination of testing parameters, including test frequency, lot sizes and related details, shall remain at the discretion of the Principal.

13.3.3 Non-complying Work

Where works are observed by Council's Representative to not comply with the Specification requirements the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) will be required to be rectified before the works proceed further.

Where material quality test results demonstrate a non-compliance with this Specification, that material shall be removed and replaced with complying material.

Where asphalt surfacing fails to perform as a result of material quality, poor design, or an error on the part of the Service Provider, the Service Provider shall propose a method of rectification for the acceptance of Council's Representative. Compliance Certificates will not be provided until all rectification works are complete.

In the case of asphalt being low at the lip of kerb and gutter or flush kerb, the asphalt shall be removed and replaced from the lip alignment to the crown alignment of the road or other alignment as agreed to by Council's Representative. Should removal of the asphalt result in the removal of the primer seal below the asphalt then the primer seal shall be reinstated prior to any asphalt being placed.

Section 14 - Cold Milling of Asphalt and Base Course

14.1 General

This section covers the requirements for the removal of pavement materials from road pavements by cold milling, including the treatment of the milled vertical surfaces and the cleaning up, removal and disposal of the milled materials.

For traffic safety reasons, the Service Provider shall ensure that all milling or profiling work is not carried out any sooner than 48 hours prior to new asphalt being placed on the milled surface.

All traffic control will be undertaken in accordance with Section 4 - Traffic Management of this Specification.

14.2 Detection and Documentation of Hidden Object

The Service Provider shall undertake a comprehensive investigation to determine the location of all hidden objects within the limits of work. This shall include (but is not limited to) the following:

- Make enquiries with the relevant Authorities to confirm the exact locations of all objects within the proposed milling area.
- Survey the area to be milled for hidden objects using a locating device or metal detector. The locations and extent of any objects (metal objects, public utilities, etc) detected must be clearly marked on site. Determine whether the Hidden Object is within the depth to be milled.
- Submit a report, 5 working days before commencing works, with the following information:
 - Survey details of any hidden objects or utilities.
 - Written advice confirming that all authorities' requirements have been satisfied.

Protection of underground utilities shall be in accordance with this Specification Section 7 - Utility Services Installation, Road Opening and Utility Restorations.

14.3 Cold Milling Operation

Set out the cold milling work area as shown on the drawings or as specified by Council's Representative. Mark all milling depths and locations of any hidden objects or utilities on the road surface.

Perform cold milling to the nominated depth(s), width, length, alignment and road sections as per drawings or as directed by Council's Representative.

Demonstrate the use of controls to the satisfaction of the Council's Representative. Control the cold milling machine either by levelling beam or stringline and automatic sensors unless otherwise approved.

There shall be a 5mm maximum difference in levels between adjacent runs, depths and surface levels.

If milling near access chambers or other similar structures, operate the cold milling machine as close as possible to the structure without causing damage to it. Remove the remaining asphalt and base course by hand or other approved method.

14.3.1 Milling to Achieve Specified Depth of Cut

Milling to achieve a specified depth of cut may be directed in one of the following ways:

- Where nil tolerance on depth of cut applies for 'greater than specified' refer to Figure 14.1 below.
- Where above and below depth of cut has been specified refer to Figure 14.2 below.

14.3.2 Milling to Retexture a Surface

Groove depths in the existing surface to be between 5 to 10mm depth. Do not fully remove the existing surface. Groove spacing to be 10mm maximum.

14.3.3 Milling to Optimise Final Ride Quality

When the Service Provider is milling to optimise final ride quality, the outcome shall be achieved by cutting to an average depth predetermined by survey and to tolerance as specified in Table 14.1 below. The nominal cutting width must be 2m.

The milling machine must be equipped and operated using a minimum 6m averaging beam or an equivalent non-contact system. The Service Provider must set the milling operations to a constant speed and the cutting sequence must start from the crown and proceed towards the kerb.

The Service Provider shall verify the shape and profile of the milled surface by the use of a 3m straight edge after each cut. The milled surface must not deviate from any point on the bottom of the straight edge by more than 5mm.

14.3.4 Cold Milling over Concrete Structures

Where cold milling is required over existing concrete structures the Service Providers shall undertake a comprehensive investigation to determine the thickness of the existing asphalt over each Concrete Structure.

Carry out the investigation as follows:

- Determine the proposed pattern of milling works and mark on the pavement the lines of movement of the depth sensing foot on each side of the milling machine.
- Investigate the thickness of asphalt by taking small diameter cores (e.g. 25mm), at 3m intervals (over concrete bridge elements) or 20m intervals (over other concrete structures) along each line of movement of a depth sensing foot, at least 24 hours prior to the commencement of milling.

Submit the findings of the investigation to Council's Representative at least 24 hours before commencement of milling.

The depth of cut shall conform to the requirements of Table 14.1 below.

14.3.5 Temporary Ramps

Where the milled surface is to be temporally opened to traffic the edges of the milled surface shall be tied into the existing road surface.

There are two methods allowed for forming temporary ramps, these are, bevelling and the placement of cold mix asphalt.

When bevelling with the cold milling machine ensuring any lip remaining at the toe or head of the bevel does not exceed 10mm in height. Ensure surface and horizontal tolerance conform to Table 14.2 below.

The use of cold mix asphalt shall conform to the following:

- Apply an emulsion tack coat to the milled surface prior to the placement of cold mix asphalt.
- Maximum thickness and layering of cold mix asphalt shall conform to Table 14.2 below.
- Leave the cold mix asphalt ramp in place no longer than 1 week.
- Maintain the ramp in good condition.
- Compact all cold mix.

14.3.6 Tolerances

Table 14.1 Tolerances for Cold Milling Operations

Nature of Milling Work	Tolerance, Depth of Cut (mm)		Groove Spacing (mm)	Surface Texture Depth (mm)
	Greater than specified	Less than specified		
Cutting to depth $\leq 40\text{mm}$	0	8 max	15 max	2.5 max
Cutting to depth $> 40\text{mm}$ where the floor of the cut is asphalt or bound material	10 max	5 max	15 max	Not specified
Cutting to depth $> 40\text{mm}$ where the floor of the cut is unbound material	15 max	5 max	15 max	Not specified
Cutting to depth within nominal 40mm of the surface of a Concrete Structure and/or waterproofing membrane that is to be retained	0	8 max	10 max	2.5 max
Producing a surface suitable for spray sealing without prior correction	Not specified	Not specified	10 max	1.5 max
Milling to achieve specified level	10 max	0	Not specified	Not specified
Producing a surface to optimise ride quality	5 max	5 max	Not specified	Not specified
On Concrete Bridge Element	0	8 max	10 max	1.5 max

Depth of cut and other associated terminology is shown in Figure 14.1 and Figure 14.2 below.

Figure 14.1 Where Nil tolerance on depth of cut applies for Greater than specified

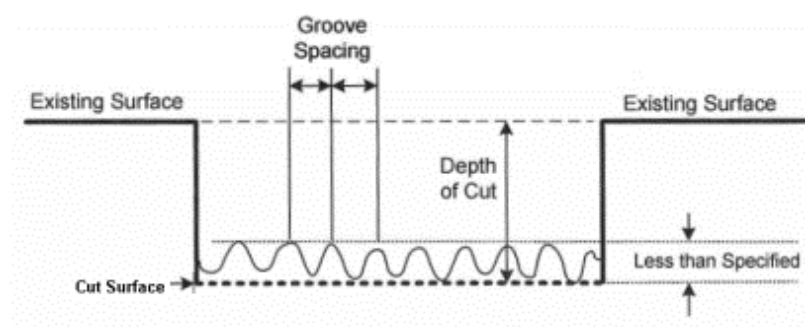
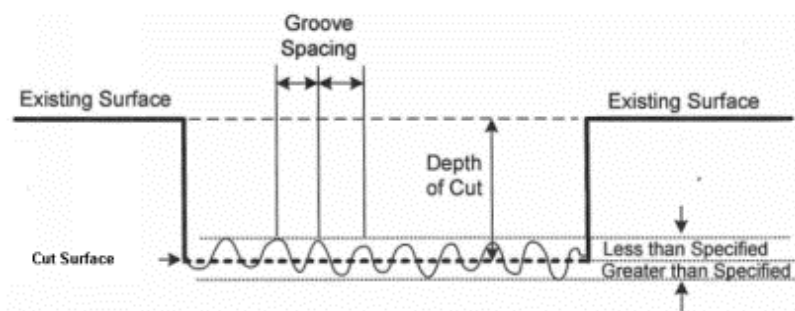


Figure 14.2 Where above and below depth of cut has been specified**Table 14.2 Tolerances for Cold Milling Operations**

Activity	Limits/tolerances
Cuts of cold milling machine	
Difference in levels between adjacent runs, depths and surface levels	< 5mm
Temporary ramps	
Dimensions for transverse joints	Speed limit > 60km/h: minimum taper length of 2.5m per 50mm variation in levels. Speed limit ≤ 60km/h: minimum taper length of 1.5m per 50mm
Dimensions for longitudinal joints	Provide a ramp of minimum 1.0m length for each 50mm variation in levels
Interface with structures	Provide ramps with a minimum taper length of 1.5m for each 50mm depth of cut
Methods of forming ramps	
Bevelling	Ensure any lip remaining at the toe or head of the bevel does not exceed 10mm in height
Cold mix asphalt	Maximum thickness ≤ 40mm. Where site conditions require greater thickness, place the cold mix asphalt and compact in layers between 25 and 30mm thick
Levelling of stockpiles	Height = 2m with uniform shape

14.4 Milled Surface

Following the cold milling operation remove all loose material from the road pavement, gully pits and median areas.

Sweep the pavement and leave the site in a clean and tidy state. Remove all cold milled material from the site and transport to stockpile site(s) or otherwise remove from the site as directed.

Prior to covering the milled surface, arrange to inspect the surface with Council's Representative prior to the removal of milling equipment from site.

14.4.1 Unsuitable Material

The Service Provider shall remove any planes of weakness within the asphalt, cement, concrete and/or pavement materials, or any unsuitable material existing at the base of the cut, which is not removed by the milling operation to the extent directed by the Council's Representative.

14.5 Clean Up and Disposal of Milled Material and Temporary Ramp Material

The Service Provider shall at the completion of cold milling, remove all loose milled material. The material removed will become the property of the Service Provider unless otherwise specified.

If the milled material remains the property of Council, deliver the milled material to the nominated stockpile site(s). Shape the milled material in uniform stockpiles with regular sides and, where appropriate, slope the top to promote water runoff. Clearly identify the milled material by signposting.

If the milled material becomes property of the Service Provider, remove it from the site in accordance with the Waste Management Plan.

The Service Provider shall notify Council's Representative, before the commencement of milling operations, how and where the milled material will be reused, recycled, stockpiled or discarded.

Section 15 - Restoration and Finishing of Surfaces

This section covers the requirements for reinstatement, restoration and finishing of surfaces other than pavement surfaces, concrete path surfaces or other hard surface treatments.

Areas to be landscaped shall be finished in accordance with the approved Landscape Plan.

Areas for Vegetation Management shall be finished in accordance with the approved Vegetation Management Plan.

A vegetative cover shall be established on all areas prior to issue of final acceptance of works, Occupation Certificate and Subdivision Certificate.

Spreading of mulch in isolation over disturbed areas is not accepted to satisfy establishment of a vegetative cover as required and referred under this Specification.

15.1 General Requirements

15.1.1 Removal of Rubbish and Excess Materials

All rubbish, excess construction materials, timber, loose roots and other materials not to be incorporated into the works must be removed from the site progressively and at the completion of site works.

15.1.2 General Surface Grading

Unless otherwise shown on the drawings, all disturbed areas shall be graded to an even surface. The finished surface shall not have ridges and hollows that pond or direct runoff in other than a sheet flow fashion. Ridges shall be trimmed, and depressions filled as necessary to produce a surface which will drain freely and is suitable for the operation of tractor-mounted mowers. Regraded areas are to be shaped and graded at a minimum of 1% to avoid depressions and to generally direct surface flow to the drainage system designed for that catchment.

Concentrations of surface water shall not be diverted towards trees. Filling within natural drainage paths is not to cause permanent or semi-permanent increases in the levels of the water table or standing water surface levels where upstream trees would be adversely affected. The diversion of natural drainage flows away from existing trees shall be avoided. Measures shall be taken to maintain existing surface and subsurface flows about retained vegetation and through the site.

Provisions must be made along the toe of the fill batters or base of retaining walls to permit the free passage of stormwater and subsurface water away from adjoining properties. Reductions in stormwater disbursement from adjoining properties shall not be permitted.

15.1.3 New Surface Treatments

The following requirements apply to all exposed areas not to be treated in accordance with an approved Landscape Plan.

All disturbed areas not to be landscaped in accordance with the approved Landscape Plan or Vegetation Management Plan shall be scarified, topsoiled, grass seeded and established to a vegetative cover.

In addition, all areas used for access tracks and any areas compacted by vehicles, stockpiles or storage of materials shall be ripped to a minimum depth of 300mm regardless of the requirements of 5.1.2 Soil and Water Management, Erosion and Sediment Control. Stones and rocks larger than 50mm shall be removed from the surface after ripping.

Ripping will not be required where rock outcrops are evident.

Proposed lot areas are to be topsoiled, grass seeded and established to a vegetative cover upon completion of grading to final surface levels.

Cut and fill road batters are to be topsoiled, stabilised with jute mat or equivalent and revegetated as shown on works approval drawings unless an alternative treatment is approved.

Temporary fencing of areas once topsoiled and undergoing revegetation shall be installed by the Service Provider. Fencing shall be as required to effectively discourage vehicular or construction plant access.

Further guidance on the suitability of various batter surface stabilisation techniques can be found in the TfNSW publication *Guideline for Batter Surface Stabilisation using vegetation*.

15.1.4 Verges

Verges shall be scarified and topsoiled in accordance with the requirements Section 15.1.9 Topsoil and turf placed in accordance with Section 15.1.10 Turf.

15.1.5 Pavement and Hard Surfaces

All hard surfaces shall be swept clean at the completion of the works. All rubbish, soil and other materials resulting from the sweeping are to be removed from the site.

15.1.6 Restoration of Existing Surface Finishes

Unless otherwise shown on the approved drawings or covered elsewhere in this Specification, all existing surfaces finishes that are disturbed during construction are to be reinstated to the requirements of this Specification. In the case of private property surface restoration shall be as agreed between the property owner and Service Provider.

15.1.7 Surface Defects

Any surface treatment, that in the opinion Council's Representative becomes defective during the defects liability period as a result of normal usage, shall be removed and replaced and be subject to a further defects liability period.

15.1.8 Finishing Adjacent Surfaces

Areas immediately adjacent to all concrete elements shall be topsoiled and turfed as shown in Council's *Civil Works Specification - Standard Drawings* or as required by landscaping or Vegetation Management Plan requirements.

Provide two turf strips (900mm wide minimum) each side flush with constructed paths. The residual footway/verge width each side of constructed paths shall be topsoiled and turfed for subdivision development works and where these areas (back of kerb to property boundary) are otherwise completely disturbed by road and/or path works, as shown in Council's *Civil Works Specification - Standard Drawings*.

Partial path width reconstruction shall not be accepted.

Adjacent surface levels to concrete elements shall be finished so that they do not intercept, pond or concentrate stormwater sheet flows.

15.1.9 Topsoil

All disturbed areas, including fill areas must be scarified to a minimum depth of 75mm and top dressed with topsoil to a minimum depth of 75mm. Once topsoiled, the area is to be revegetated as shown on the approved drawings and as detailed in this Specification.

Topsoil shall comply with AS 4419 - *Soils for landscaping and garden use*. In the case of topsoils stripped from the site some modification to the soil may have to be made by mixing additional materials.

Topsoil sourced from the site shall be used first in preference to importing topsoil. Topsoil sourced from the site is not to contain stumps, roots, clay lumps or rocks greater than 25mm diameter.

Site topsoil shall not be modified where an approved Vegetation Management Plan specifies soils to be used in their natural state or similar.

15.1.10 Turf

Turf or grass sods should consist of dense, well-rooted, vigorous growth turf with 25mm of approved topsoil attached. The sods should be free of noxious weeds, soil pests and diseases. The sods are to be cut by an approved sod cutter in long lengths of uniform width of not less than 300mm and are to be in a sound unbroken condition.

The turf species, regardless of Construction Drawing requirements, shall be Buffalo or Couch. The use of Kikuyu grass is prohibited.

All areas should be scarified and then topsoiled in accordance with Section 15.1.9 above prior to the placement of turf. Laying of turf should be scheduled so that each section is rolled or tramped immediately after it has been laid to obtain a key with the underlying soil. Each row of turf should be butted hard against each other so that there are no gaps and the outside edge should be left staggered to form an uneven edge when strip turving is not proposed.

Turf must be placed so stormwater sheet flow is not concentrated and does not cause erosion. To promote stormwater sheet flow runoff from the adjoining surface, turf must be set down to match the level of the adjoining area, or alternatively, the areas adjacent to the turf shall be graded to match the surface of the new turf.

Turf laid adjacent to concrete works shall be laid flush with the surface of the concrete. Excessive surface level differences between the turf and adjacent concrete will not be accepted. Turf shall be removed, topsoil regraded, and turf re-laid as directed by Council's Representative.

On batters, it is essential that the turf sections be laid along the contour, while in drains, turf sections should be laid across the drain at right angles to the direction of flow. The turf should be anchored with wire netting and pinned with rabbit bows on steep sites or drains to ensure stability in accordance with Council's *Civil Works Specification - Standard Drawings*.

If the soil profile is hard, making penetration of rabbit bows difficult, lengths of reinforcing mesh, cut to size, should be used. It is essential that these bows, or rods, pin the netting hard against the grass sods. It is preferable to shorten the bows, etc to achieve this than to have the bows flatten out where penetration to the depth of the bows cannot be achieved. Removal of netting and bows is required after establishment where later maintenance, such as mowing, will be carried out.

Turf should be watered regularly for at least a week after it has been laid to ensure maximum rate of establishment. Afterwards, watering should be carried out as necessary for the duration of the work and subsequent maintenance period.

Dead and/or damaged turf will not be accepted and is to be replaced immediately.

15.2 Compliance

15.2.1 Compliance Inspections

Compliance with this part of the Specification will be confirmed upon site observation by Council's Representative.

15.2.2 Non-Complying Work

Where surface restoration and finishing of surface works are observed by Council's Representative to not comply with this or any section of the Specification, the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) must be rectified prior to the final inspection.

15.3 Service Provider's Responsibility for Site Security

The Service Provider is responsible for the theft or vandalism of any surface treatment up to the following milestones:

- Final inspection where the surface treatment is located on existing public land, road reserve or other Council maintained land; and/or
- Registration of the linen plan in the case of land being dedicated to Council.

Section 16 - Traffic Signs, Pavement Marking and Road Safety Barriers

16.1 General

This section of the Specification covers the supply and installation of traffic signs, pavement markings and other pavement delineation, permanent traffic and pedestrian control devices and permanent safety barriers. This section of the Specification does not include traffic signals. Traffic signals are subject to TfNSW approvals, specifications and installation compliance.

16.2 Supply and Installation

All traffic signs, pavement markings and permanent traffic and pedestrian control devices shall be supplied and installed in accordance with current requirements of TfNSW QA specifications, TfNSW supplements to Australian Standards, technical guidelines, technical directions and where not covered by TfNSW documents, then in accordance with AS 1742 - *Manual of uniform traffic control devices* suite of standards.

Where signs, pavement markings and permanent traffic and pedestrian control devices shown on the approved drawings conflict with the requirements of TfNSW and/or AS 1742 suite of standards, Council's Representative shall be requested to confirm what measures are required.

Where traffic signs, pavement markings and permanent traffic and pedestrian control devices for a particular situation are required by TfNSW and/or AS 1742 suite of standards and there is no requirement shown on the drawings, then Council's Representative may direct the Service Provider to install appropriate measures.

16.2.1 Street Name Signs

Street name signs shall be supplied and installed in accordance with AS 1742. All road names shall be gazetted or approved by Geographical Names Board as per the *NSW Address Policy*. Confirmation of road names, correct spelling and road type i.e. Street, Avenue, Close, etc shall be obtained by the Service Provider from the approved drawings. Confirmation of wording for other Council signs shall be obtained from Council's Representative. The technical characteristics of signs shall be in accordance with Council's *Civil Works Specification - Standard Drawings* and Council's *Signage Manual*. No advertising of manufacturer's name shall be permitted unless prior written approval is provided by Council's Representative.

16.2.1.1 Lettering

The letter used on the street name signs shall be as detailed in Council's *Civil Works Specification - Standard Drawings*. Use road type abbreviations as shown in table below, where not specified on the approved engineering drawings or Standard Drawings:

Table 16.1 Road Type Abbreviations

Type	Abbreviation	Type	Abbreviation	Type	Abbreviation
Alley	ALY	Crescent	CR	Parade	PDE
Arcade	ARC	Drive	DR	Parkway	PWY
Avenue	AVE	Esplanade	ESP	Place, Plaza	PL
Boulevard	BVD	Expressway	EXP	Promenade	Prom
Brace, Brae	BR	Freeway	FWY	Quay	QY
Chase	CH	Gardens	GDNS	Road	RD
Circle, Circlet	CIR	Glen	GL	Square	SQ
Circuit	CCT	Grove	GR	Street	ST
Close	CL	Highway	HWY	Terrace	TCE
Corner	CNR	Junction	JNC	Walk	WK
Court	CT	Lane	LA	Way	WY

16.2.2 Other Signs

Where shown on the drawings or directed by Council's Representative other signs may be required. Other signs shall be installed in accordance with the relevant Australian Standards and Council's *Signage Manual* and *Municipal Wayfinding Guidelines*. Where details of the type and size of other signs are not specified on the approved drawings the Service Provider shall provide details of the proposed signs to Council's Representative for approval prior to ordering and installation of the signs.

Table 16.2 Colour of Signs

Council will specify the colour of signs required as shown in Council's *Signage Manual*. Commonly used combinations generally include (but are not limited to) the following:

Sign Type	Letter Colour	Background Colour
Suburb name	White	Blue
Direction sign	Black	White
Emergency facilities	White	Red
Tourist information	White	Brown or blue
Community services and facilities	White	Blue
Local information service	White	Green

16.2.3 Installation of Signs

Signs shall be installed in accordance with Council's *Civil Works Specification - Standard Drawings*.

Details of the proposed post holders are to be provided to Council's Representative for acceptance prior to installation.

Signs erected within the verge shall provide 2.2m minimum vertical clearance to the underside of the sign (or the lowest mounted sign in an assembly of signs) in rural areas, or 2.5m minimum vertical clearance within the verge (footway area/nature strip/path) in urban areas, from the finished ground level; and 300mm minimum lateral clearance behind face of kerb, or 600mm minimum behind the edge of bitumen.

16.3 Pavement Markings

All pavement markings on roads, including lines, diagonals, chevrons, symbols and words, shall be installed in accordance with TfNSW *QA Specification R145 Pavement Marking (Performance Based)*, as required, and other applicable TfNSW specifications and publications.

Permanent pavement markings shall be set out by a Surveyor and applied in white reflectorised thermoplastic paint; or white reflectorised waterborne road marking paint on most Council-controlled rural roads or urban roads with a low traffic volume (typical annual daily traffic (ADT) volume ≤ 400), unless otherwise directed by Council's Representative, except for (NS1) parking restriction lines, which shall be yellow - see below and the Pavement Marking Schedule in Council's *Civil Works Specification - Standard Drawings*.

Any decision by Council's Representative to alter the above requirements for white reflectorised thermoplastic paint or white reflectorised waterborne road marking paint will be based on the road surface treatment (new or existing; sprayed bituminous, asphalt or concrete surface), road hierarchy and traffic volume and the condition, material and type of existing pavement markings, where applicable. In the case of Council's pavement marking or road renewal program, budgetary considerations shall also apply in confirming the type of pavement marking to be adopted.

All yellow (NS1) parking restriction pavement marking lines on roads shall be applied in yellow reflectorised thermoplastic paint, unless otherwise directed by Council's Representative.

Retroreflective Raised Pavement Markers (RRPMs) shall be provided with all longitudinal pavement line marking on roads (except alongside yellow (NS1) parking restriction lines) unless otherwise approved by Council's Representative. Pavement markers to be in accordance with AS 1906.3 - *Retroreflective materials and devices for road traffic control purposes - Raised pavement markers (retroreflective and non-retroreflective)* and TfNSW *QA Specification R142 Retroreflective Raised Pavement Markers* and other applicable TfNSW publications.

All pavement markings on shared paths and bicycle paths, including longitudinal and transverse lines and symbols), shall be applied in white reflectorised road marking paint unless otherwise

shown in Council's *Civil Works Specification - Standard Drawings*, or unless otherwise directed by Council's Representative.

The Service Provider shall be responsible for the maintenance and replacement, if necessary, of raised pavement markers and all pavement markings until the expiry date of the defects liability period. Unless pavement markings are being travelled over by the Service Provider's construction vehicles, the Service Provider's liability in this regard does not include damage through normal wear and tear.

All spillages shall be immediately cleaned up by the Service Provider. The Service Provider shall incur the costs of any restoration work required, in the opinion of Council's Representative to restore the surface to its original state.

All temporary and obsolete pavement markings shall be removed by milling (thermoplastic paint) or sand blasting (waterborne paint) the wearing course. Where required by Council's Representative, an appropriately specified single seal shall be applied in accordance with Section 12 - Bituminous Sealing of this Specification.

16.4 Road Safety Barriers

Road Safety Barriers shall be supplied and installed to comply with the requirements of TfNSW *QA Specification R132 Safety Barrier Systems*, TfNSW's Accepted Road Safety Barrier Systems and Devices and AS/NZS 3845 *Road safety barrier systems and devices*. The following clarification shall be applied when using TfNSW *QA Specification R132 Safety Barrier Systems*:

- Superintendent or Principal shall mean Council's Representative.
- Project Quality Plan is not required.
- Documentation required in Annexure *R132/D* shall be provided when requested by Council's Representative.
- Referenced documentation shall be current at the date of the preconstruction site meeting.
- Hold points shall not be applicable unless requested by Council's Representative.
- All materials are to be supplied by the Service Provider.
- Basis of measurement and payment does not form part of this Specification.
- Location of safety barrier shall be as shown on the approved drawings.
- Waste resulting from installation of safety barriers shall be removed from the site by the Service Provider.
- Setting out shall be sufficient to construct the safety barrier to the alignment as designed.
- Traffic control is to be provided in accordance with Section 4 - Traffic Management of this Specification.

Mowing strips, a minimum of 300mm wide (depending on the safety barrier type) and 100mm thick on 100mm compacted gravel with jointing type and locations appropriate for the purpose is required.

Rub rails and plastic post caps shall be provided to the rear and/or top of the safety barrier posts, or the installation of a separate pedestrian barrier fence shall be provided, where there is an adjoining footpath or shared path.

16.5 Compliance

16.5.1 Compliance Inspections and Documentation

Compliance with this section of the Specification will be confirmed upon site observation by Council's Representative.

All traffic signs, pavement markings, permanent traffic control devices and safety barriers installed and/or removed as part of the works shall be shown on the work-as-executed drawings.

Safety barrier installations shall be confirmed in writing by the installation contractor, certifying that their installation conforms to the approved drawings and manufacturer's specifications and requirements.

16.5.2 Non-complying Work

Where traffic signs, pavement markings, permanent traffic control devices and safety barriers are observed by Council's Representative to not comply with this or any section of this Specification, the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying item(s) shall be required to be rectified prior to the final inspection.

Appendix A - Work-as-Executed Data and Drawings and Compliance Documentation Requirements

Work-as-executed (WAE) data, drawings and related compliance documentation shall be provided to Council's Representative for approval prior to handover of works.

For development-related works, Compliance Certificate(s) and Subdivision Certificate(s) for any works shall not be issued without Council's review and acceptance of the WAE drawings and related compliance documentation, showing all information as required by this Specification and the applicable Development Consent.

A.1 Information Required on Work-as-Executed Drawings

Work-as-executed (WAE) data and drawings shall demonstrate that works have been constructed as shown on the approved drawings and in accordance with this Specification, to the approved line, level and specification tolerances.

WAE drawings shall be prepared and certified by a Registered Land Surveyor in the State of New South Wales or a suitably qualified Engineer.

WAE drawings shall have the following notation on each drawing set in red and is to be signed by the certifying Surveyor and/or Engineer:

I certify that:

- 1. This work-as-executed drawing, outlines in red what has been constructed in the field and includes all variations from the original design drawings.*
- 2. All public drainage works constructed within private property, are located centrally within existing or new easements to drain water.*
- 3. All construction of public assets within private land has appropriate easements, right-of-way, or like restriction over the whole of the structure.*

Date:

Printed Name:

Signature:

WAE drawings shall be prepared using the approved Design and Construction Drawings as a base to identify compliance with the approved drawings and to highlight approved changes that may have been required during construction.

All WAE information shall be provided in red and shall consist of either:

- A red tick on approved drawings next to level, note or label where the WAE information is the same as that on the approved drawing.
- New levels, notes or label information in red where WAE information is different from the approved drawings and the original approved information struck through in red.

- New plan and section detail lines and symbols shown in red and original approved plan and section detail lines and symbols crossed out with a series of small crosses in the case of lines or a single cross in the case of a symbol.
- All assets that have been removed, or made redundant, must be labelled accordingly with a red note.

Additional details required to be shown on all WAE drawings include:

- Design drawing title block updated to reflect status as work-as-executed drawings.
- All levels shall be in metres AHD.
- All co-ordinates shall be referenced to MGA.
- Finished levels and horizontal alignment of concrete kerb and gutter, vehicle access crossings and other concrete works.
- All traffic signs, pavement markings, permanent traffic control devices and safety barriers installed or removed as part of the works.

WAE drawings shall be submitted in an electronic and hard copy format to Council's Representative for approval. The electronic file format shall be high resolution Portable Document Format (.pdf) or other Council-approved format, such as AutoCAD (.dwg), with all pages of the drawings contained in a single file.

WAE Quality and Compliance documentation shall also be provided in conjunction with the WAE drawings.

A.2 Roadworks and Pavement As-Constructed Compliance Details

A.2.1 Work-as-Executed Drawings

For development-related works, the Service Provider in collaboration with the Consulting Geotechnical Engineer shall prepare work-as-executed (WAE) documentation, including as-constructed Pavement Testing Report, incorporating the approved Construction Drawings showing (but not limited to) the following:

- Extent of as-constructed pavement.
- Average pavement layer thickness (i.e. as averaged from surveyed conformance levels during construction - refer below).
- Location and test identification number of test results from all relative compaction testing carried out for the works (i.e. as separated by each pavement layer tested during construction).

Finished surface levels of road pavements and elsewhere in the road reserve or proposed road reserve:

- Surveyed as-constructed pavement layer levels shall be presented in tabular format, which references the chainage and provides enough levels to define the surface of each layer. The table shall also provide the average pavement layer thickness for each road based on the difference between each adjoining pavement

layer's conformance levels. The as-constructed levels referred in the table shall be taken at the top of the following pavement layers:

- Subgrade layer.
- Subgrade replacement layer.
- Select material layer.
- Sub-base layer.
- Base course layer.
- Asphalt wearing course layer.

A plan view from the approved drawings shall be used to mark the final pavement layer thickness, as averaged from the surveyed pavement layers conformance levels (i.e. summarising each road's final averaged pavement layer thicknesses), including the following:

- Subgrade replacement layer.
- Select material layer.
- Sub-base layer.
- Base course layer.
- Asphalt wearing course layer.
- Any other pavement layer that may have been incorporated into the works.

A.3 Stormwater Drainage Details

A.3.1 Work-as-Executed Drawings

Work-as-executed (WAE) data and drawings, in addition to those listed in A.1 above, shall include (but is not limited to) the following:

- Finished surface, grate or lid levels to AHD at all pits and other structures.
- Finished surface levels between pits and other structures.
- Location of finished surface levels taken labelled (e.g. top of kerb, centre of headwall, centre of grate, centre of concrete lid).
- Finished invert levels for pits, other structures, pipes, channels and box culverts.
- Changes to the horizontal position of any pits, other structures, pipes, channels and box culverts.
- Confirmation of the installed pipe diameter.
- Pipe material and class of pipe.
- Confirmation of the dimensions of installed box culverts.
- Pipe or box culvert grades.
- Locations of subsurface drainage cleanouts and outlets.
- Details of overland flow path including horizontal alignment and levels to AHD.

- Finished invert levels, top of bank levels, base width, top width, base/wall material for open channels.
- Manufacturer/model number of any proprietary drainage structure.
- Dimensions, structural components and certification for stormwater drainage basin(s), wetland(s), bio-retention/detention, rainwater tank(s) and sediment basin(s). Minimum volume requirements are compliant with the approved plans and/or Water Cycle Management Report(s).

The Service Provider shall submit details regarding ongoing maintenance requirements such as operations and maintenance manual(s) for gross pollutant traps (GPTs) and/or water quality basin structures.

Stormwater pipeline trench backfill compaction compliance documentation and CCTV pipe inspection video file(s) and report(s) shall be submitted in accordance with the requirements under Section 6.8 Trench Backfilling Compliance Testing Specification and Section 6.6.5 Compliance Inspections and Documentation of this Specification, respectively.

A.3.2 Asset Attribute Spreadsheet

Council's Drainage Assets Team will provide the Asset Attribute Spreadsheet Template which is to be populated by the Service Provider with the relevant asset attribute data. The requirements for each drainage asset category are listed below, and this information is required on each individual drainage asset constructed or modified. The data shall include (but is not limited to) the following:

Pits

Pit asset ID number	Grate/Lid RL (m AHD)
X co-ordinate (Easting)	Pit depth (m)
Y co-ordinate (Northing)	Pit width (m)
Installation date	Lintel length (m)
Pit type	Pit inflow type
Pit material	
Lid width (mm)	
Lid length (mm)	

Pipes

Asset ID number	Length (m)
From (upstream) pit number	Diameter (m)
To (downstream) pit number	Grade (%)
Upstream invert level (m AHD)	Class
Downstream invert level (m AHD)	Construction type
Installation date	Joint type
Type	
Material	

Headwalls

Asset ID number	Installation date
Type	Connected conduit size

Material	Number of connected conduits
Width (m)	Apron (Y/N)
Depth (m)	Energy dissipator (Y/N)
X co-ordinate (Easting)	
Y co-ordinate (Northing)	

Box Culverts

Asset ID number	Width (mm)
From (upstream) pit number	Length (m)
To (downstream) pit number	Material
Upstream invert level	Grade
Downstream invert level	Type
Installation date	
Height (mm)	

Stormwater Quality Improvement Devices (SQUIDS)

Asset ID number	Capacity (m ³)
X co-ordinate (Easting)	Lid RL (m AHD)
Y co-ordinate (Northing)	Depth (m)
Installation date	Width (m)
Type	
Model number	
Manufacturer	

The Asset Attribute Spreadsheet Template is also available for downloading from Council's website.

A.4 Earth-Retaining Structures and Embankments

Work-as-executed (WAE) drawings shall include as-constructed locations and details of all earth-retaining structures and embankments where shown on the approved drawings. WAE drawings shall confirm details as shown on the approved drawings, including (but not limited to) the following:

- Component type.
- Component size.
- Buried components (backfill material extent and type, foundation including piers of piles, etc).
- Location of subsurface drainage lines, flushing points and the connection of subsurface pipes to the drainage system.
- MGA co-ordinates at each end of each structure.
- Plan showing:
 - Horizontal alignment at toe of structure(s).
 - Horizontal alignment at top of structure(s).
 - Horizontal alignment and extent of buried components; rock bolts, tie backs, soil reinforcement, etc.

- Longitudinal section(s) of the top and base levels of earth-retaining structures.
- Typical cross section showing:
 - Footings size/extent.
 - Chainages at each end of each site.
 - Zone of influence for loading at back of retaining structure.
 - Zone of influence for excavation at toe of structure.
 - Zone of influence clearance to any nearby underground services.

An as-constructed Certification by a suitably qualified Structural or Civil Engineer and Geotechnical Engineer shall be provided and include (but not limited to) the following:

- Photo mosaics and/or all site photos taken during site inspections of all structural elements, including drainage components associated with the earth-retaining structures and embankments.
- List of dates of all site inspections where carried out by the certifying Structural or Civil Engineer and Geotechnical Engineer.
- List of all referenced Australian Standards, National Codes of Practice, guidelines and specifications, the as-constructed structural elements are certified to, following the elements' construction.
- Full details of the certifying professional(s), including the following:
 - Printed full name and signature.
 - Contact details.
 - National Engineering Register accreditation/registration number.
 - Building Professionals Board Category of accreditation and registration number.
- Copy of the certifying Structural or Civil Engineer and Geotechnical Engineers' professional indemnity insurance and certificate of currency.
- Photo mosaic(s) are required when stabilisation works involve multiple types of work, including rock removal, geotechnical and structural specifications.
- Engineering report on any stabilisation works during construction, including rock removal, temporary support or any additional geotechnical and/or structural specifications applied during the structure's construction.
- Engineering report on any Quality Assurance documentation requested by the approved drawings, such as, Geotechnical and/or Structural aspects confirming that the specifications or an acceptable equivalent have been met.

Any retaining structure with covered, buried or otherwise hidden components shall require a photo mosaic(s) of components before covering, e.g. rock bolts and reinforcing mesh pre-shotcrete, in addition to the above requirements, as part of the WAE documentation.

A.5 Water Supply Infrastructure

- Reticulation mains - all installation details as shown on the Design Drawings.
- Trunk mains - all installation details as shown on the Design Drawings.

A.6 Sewerage Infrastructure

- Gravity sewer - all installation details as shown on the detailed Design Drawings.
- Sewer rising mains - all installation details as shown on the detailed Design Drawings.
- Pump stations - all installation details as shown on the detailed Design Drawings.

Appendix B - CCTV Survey Inspections Technical Specification - Drainage Assets

B.1 General Requirements

This part of the *Construction Specification* defines how Closed-Circuit Television (CCTV) survey inspections of Central Coast Council's drainage assets are to be carried out. CCTV inspections are used to assess current performance and condition of the asset (including any damage that may have occurred during development construction), and to assess the workmanship of any new drainage infrastructure that has been constructed to be handed over to Council's care and control.

The CCTV data is to include the recorded video footage, condition and defect information and the associated pdf report.

B.1.1 Working hours

All services shall be carried out in daylight hours between 7.00am and 5.00pm Monday to Friday. No works are to occur outside of these hours unless prior approval is obtained in writing from Council.

B.1.2 Insurance

The contractor shall provide copies proving the currency of Public Liability Insurance for \$20 million and full Workers Compensation insurance prior to commencement of any services. Insurances must be kept current for the duration of the service.

B.1.3 Work Health and Safety (WHS)

All activities carried out are to comply with Council's WHS policies and procedures. The contractor is to provide all necessary WHS documentation including SWMS to Council for review and approval prior to undertaking any activity.

The contractor must be inducted to site by a Council Representative prior to the commencement of works and shall provide a copy of all completed safety documentation including pre-start checks and site-specific risk assessments to Council.

B.2 CCTV Inspection

B.2.1 Personnel

The Contractor shall ensure that all personnel responsible for operating CCTV cameras, identifying and recording defects and preparing CCTV survey reports are trained and accredited in defect identification including picture interpretation, defect coding and classification as outlined in Part 2 of WSA Code 05 – Conduit Inspection Reporting, or similar certified training.

Personnel should also hold a current White Card – Construction induction certification.

Confined space entry should be avoided wherever practical. If there is no feasible way to complete a survey without entering a confined space, Council's Representative must be notified and provided with all relevant documentation for review in accordance with Section 4.3 of the NSW *Work Health and Safety Regulation 2025*. Confined space entry works shall not proceed until Council's representative has granted permission in writing.

Any personnel undertaking confined space entry works must hold full confined space entry certification in accordance with Section 4.3 of the NSW *Work Health and Safety Regulation 2025*.

Any personnel implementing Traffic Guidance Schemes must be accredited with the Implement Traffic Guidance Scheme certification. Any personnel who have prepared or will modify any Traffic Guidance Scheme must be accredited with the Prepare Work Zone Traffic Management Plans certification.

Personnel must be competent in the use of service locating equipment associated with the CCTV camera including sonde use.

A minimum of two personnel is required for all CCTV inspections.

B.2.2 Planning the Inspection and Council's Assistance

Council will provide the CCTV operator with the following information where available:

- Plans/maps containing the asset location, asset type, asset id numbers and street names. Aerial photography can also be included. This information will be provided through the OneDrive portal.
- An Asset Attribute Data spreadsheet for recording pit, headwall, pipe and culvert condition data.

The contractor is to make all reasonable attempts with two personnel to lift access pits safely to carry out the survey. If there are lids that require mechanical assistance to open; Council staff are to be notified to discuss these requirements. Options may include the utilisation of Council's maintenance staff and plant or external contractor assistance.

B.2.3 CCTV Inspection Equipment

The Contractor's CCTV equipment shall include (but is not limited to) the following:

- Appropriate closed-circuit camera(s) that are tractor mounted with varying sizes of tractors to cater for a large range of conduit sizes.
- Service locating functionality that can be attached to the camera/tractor and associated sonde to allow locating of buried pits, junctions and changes of direction.
- Sufficient traffic control equipment to fully implement any required Traffic Guidance Schemes.

- The CCTV camera shall include pan and tilt capabilities to allow right angle and 360-degree rotational inspections, as well as zoom functionality.
- The camera and illumination system shall provide a clear, accurate and in focus record of the internal condition of the conduit in colour.
- The camera/cable shall provide an accurate running chainage relative to the entry pit/manhole. The camera cable shall be retracted to remove slack and to ensure an accurate chainage reading.
- All equipment must be fully charged and in good working order.

B.2.4 Camera Operation

Direction of CCTV inspection - CCTV surveys shall be completed from maintenance pit to maintenance pit (or headwall) preferably following a downstream direction, however when not feasible, upstream direction shall be acceptable.

A new survey is required for each pipe or culvert reach (from pit to pit).

Prior to commencing the formal survey, a dummy run should first be conducted to confirm network layout and identify any changes such as bends or previously unidentified buried pits.

The CCTV inspection is to commence with a recorded inspection of the entry pit walls and floor, so this information can be utilised to determine a condition rating for the pit. Pit condition and defect information is to be recorded in the Asset Attribute Data spreadsheet (to be provided by Council).

A running chainage is to be embedded in the footage and is to commence from the pipe or culvert connection to the pit and is to be continuously updated and displayed throughout the CCTV inspection.

Pipe defects are to be recorded as outlined in the following section **Observation of Pipe Defects (Structural)**.

Camera position - the camera is to be located centrally within the pipe or culvert wherever possible to prevent the risk of image distortion and lack of illumination.

Camera speed - the camera shall progress through the pipe/culvert at a speed that will allow the viewer to clearly inspect defects, features and general condition.

Data to be displayed on the CCTV footage at the commencement of each pipe/culvert reach survey should be as follows:

- Name of operator.
- Name of company.
- Town or suburb.
- Location/street.
- Pipe or culvert ID number.

- Upstream pit or headwall ID number.
- Downstream pit or headwall ID number.
- Pipe diameter/culvert width and height.
- Material.
- Direction of camera.

During the CCTV inspection, the footage shall always include the following information:

- Street location.
- Start pit/MH ID number and end pit/MH ID number.
- Pipe or culvert ID number.
- Conduit size.
- Direction of inspection.
- Running chainage.
- Date of inspection.
- Longitudinal grade.

B.2.5 Encoding of Observations

Each observation of a feature within a conduit shall be described by one or more main observation codes, accompanied, as appropriate by several data fields of supporting information. The scores for all defects shall be allocated to the service and structural defects and will be applied to the pipe or culvert reach.

The WinCan database file is to include:

- All the location details.
- Characteristics of the reportable features.
- All defects identified during the inspection.
- References to all digital video recordings, photographs and reports.

The contractor shall produce a condition assessment report generated in WinCan based on the information collated in the inspection survey. The grading of structural condition and service shall be based on WSAA's WSA code 05 - Conduit Inspection Reporting.

Operators must assign an overall condition score (1 to 5) for each asset in accordance with IPWEA Practice Note 5, which is to be recorded in the Asset Attribute Data spreadsheet.

B.2.6 Observation of Pipe Defects (Structural)

Pipe/culvert joints: 360-degree panning is required at every pipe or culvert joint. Panning must be conducted at a speed that allows the viewer to adequately assess the joint for defects.

Lifting holes: inspection is required at all lifting holes.

Intruding connections: identifying all connections and coding their structural status is mandatory. The CCTV survey is to give a clear view of each internal junction by looking along the axis of the lateral connection.

All structural defects are to be recorded and coded in accordance with WSAA's WSA Code 05 - Conduit Inspection Reporting.

All utility service intrusions and buried pits are to be recorded, coded and the locations marked on the ground surface by spray paint. Locations of these issues are to be clearly marked up on the plans or maps provided.

The Contractor is to notify Council's Representative immediately if any defective pipes or culverts are identified that score a condition or service rating of 5 and are in danger of imminent collapse or require urgent attention.

B.2.7 Observation of Pipe Blockages (Serviceability)

Intruding connections: identifying all connections and coding the serviceability status is mandatory. The CCTV survey is to give a clear view of each internal junction by looking along the axis of the lateral axis.

Debris or foreign material and tree root intrusion is to be identified and coded in the reports.

The contractor shall notify Council's Representative immediately if there are any significant/critical blockages identified, such as, blockage > 60%.

Where surveys cannot be completed due to blockages, displacements or drop pits, Council's Representative shall be notified and the issues recorded in the footage and on the report.

B.2.8 Deliverables

B.2.8.1 CCTV Inspection Survey Video Footage

The Contractor shall provide:

- A separate mpeg or MP4 file for each pipe or culvert reach.
- The electronic file name for the video file must use the following naming convention: "Conduit ID number"_"From node ID number"_"To node ID number"_"Date (DDMMYYYY)".

Example: a survey of Pipe "DPI-12345" from Pit "DPIT-23456" to Headwall "DHW-34567" on "9 February 2026" would be labelled as follows:

DPI-12345_DPIT-23456_DHW-34567_09022026.mpeg

B.2.8.2 Inspection Reports

Inspection reports shall be provided in electronic pdf format. The inspection reports shall include:

- The location details, characteristics of the reportable features and defects identified during the inspection. The inspection reports shall include all mandatory detail and specifications included in the above sections.
- The electronic file name for the PDF report file must use the following naming convention: "Conduit ID number"_"Street Name"_"Date (DDMMYYYY)".pdf
Example: a survey of Culvert "DCUL-12345" at "King Street" on "7 July 2026" would be labelled as follows:
DCUL-12345_King Street_07072026
- Condition assessment gradings based on the information provided in the inspection report. The grading of structural and service internal condition shall be based on WSAA's WSA Code 05 - Conduit Inspection Reporting.
- A minimum of two photographs shall be taken to illustrate each reportable feature/defect during conduit inspections in accordance with WSAA's WSA Code 05 - Conduit Inspection Reporting. One photograph with a perspective view and one with a close-up view as a minimum, and one photograph when inspection survey is abandoned. In particular:
 - Digital images shall provide a clear and concise picture quality of the reportable features and defects, using adequate lighting, iris and focus to capture images.
 - Images should be adequately referenced to each section report and linked to the WinCan VX version database.

B.2.8.3 Asset Attribute Data

Council will provide an Asset Attribute Data spreadsheet that is to be used to populate asset and condition data. This data is to be entered into the spreadsheet for each asset surveyed. Pit and headwall condition ratings are also to be included when observed at the start and completion of each surveyed pipe or culvert reach. These condition ratings must be assigned in accordance with the IPWEA Practice Note 5 rating scale.

B.2.8.4 Asset Updates from CCTV Surveys - Marked Up Plans

- Drainage maps provided to the contractor will include the relevant asset ID numbers. Where new assets are found during a survey, Council shall provide a list of new asset ID numbers that can be assigned - please contact the Drainage Assets team via ask@centralcoast.nsw.gov.au.
- Work-as-Executed CCTV maps must include annotations for:
 - Endpoint of an abandoned survey.
 - Blockages > 60%.
 - Locations with observed subsidence on the ground surface.
 - Unknown utility penetrations.
 - Buried pits.

- Significant defects which would be considered a high risk.
- Any discrepancies in relation to Council's current asset records, including assets not recorded, are to be marked up on the maps provided with the appropriate level of information to support updating of the asset register.

B.2.8.5 Site Photographs and Surface Marking

All major defects and buried pits must be located on the surface using a sonde, marked with spray paint and photographed. Items to be located, marked and photographed include:

- Endpoint of an abandoned survey.
- Blockages > 60%.
- Locations with observed subsidence on the ground surface.
- Unknown utility penetrations.
- Buried pits.
- Significant defects which would be considered a high risk.

Photographs should be taken from at least 3 angles, with sufficient detail to allow the location to be identified - features such as nearby buildings, fences, or road markings assist in finding the location again at a later date.

Photographs must also be named with a descriptive title, using Asset ID numbers where relevant.

B.2.8.6 Data Transfer Management

All data including maps, video files, PDF reports, the Asset Attribute Data spreadsheet and site photos are to be transferred/shared through OneDrive. OneDrive can be accessed using any smart phone, tablet or computer. Council will provide a link to several shared folders as follows:

- CCTV Maps: this is where Council will upload the relevant maps which outline the assets to be surveyed with the relevant asset IDs shown.
- CCTV Maps - WAE marked up: this is where the contractor is to save all marked up maps indicating any significant issues, discrepancies or new assets.
- CCTV Video Files: all CCTV video files are to be saved into this folder with the appropriate file names and file type as outlined above.
- CCTV Reports and Asset Condition Template: all CCTV reports are to be saved into this folder with the appropriate file name. The Asset Attribute Data spreadsheet is to be updated as outlined above.
- CCTV Site Photos: all site photographs, including surface markups, are to be saved into this folder.

All CCTV surveyed data is to be uploaded into OneDrive on the day of the survey.

Appendix C - Structural Lining of Stormwater Pipelines, End Sealing and Sealing of Junctions Technical Specification

C.1 General Requirements

This Specification has been compiled to outline Council's requirements for structural lining of stormwater pipelines (non-pressure), end sealing and sealing of junctions within the Central Coast Local Government Area.

The inclusion of specifications, standard details, or construction methodologies within this Structural Lining of Stormwater Pipelines, End Sealing and Sealing of Junctions Technical Specification does not constitute approval by Council for the application of those works to defective or existing drainage assets.

Any proposed treatment, rehabilitation, or renewal works intended to address defective drainage assets must be subject to explicit assessment and written approval by Council prior to construction, where the asset is to be handed over to, or accepted into, Council's care and control.

The selection of an appropriate treatment must be based on site-specific conditions, asset condition, hydraulic performance, structural requirements, service life objectives, and whole-of-life considerations.

The presence of a relining specification within this document shall not be interpreted as permission to reline by default, nor as Council endorsement of relining as a universally acceptable solution.

This Specification is applicable to all structural lining systems, including cured-in-place-pipelines (CIPP), spiral-wound and fold-in-form liners. This Specification is not applicable to linings which act solely as a protective coating, or which are installed using spray techniques.

Structural lining is widely accepted as a practical alternative to replacement of pipelines ranging in diameter from 100mm to 1600mm and may be considered where there are concerns over integrity, leaking, root invasion and/or where site conditions would make full replacement difficult, disruptive and expensive.

An initial investigation should be undertaken to determine the suitability of structural lining for specific assets.

Project specific requirements shall be provided by Council's Representative where applicable. Where specifications that are contrary to all or part of this Specification are contained in a Tender/Contract document then those specifications shall be applied.

If this Specification does not cover a requirement for an activity, then the provisions of the current AS/NZS 2566.1 - *Buried flexible pipelines, Part 1: Structural design* shall apply unless otherwise instructed by Council's Representative.

When a specification for an item is not defined by this Specification or applicable Standards then Council's Representative shall determine the appropriate specification to be applied.

This Specification is not for the purposes of providing an interpretation of what the Service Provider is required to comply with regarding various Acts and Regulations. It is expected that the Service Provider is familiar with their obligations to comply with various Acts and Regulations.

C.2 Investigation and Design

C.2.1 Initial Investigation

A thorough investigation of the site should be undertaken including (but not limited to) the following:

- Desktop study and site inspection to determine pipe size, age, material, inlet and outlet locations, asset conditions, site constraints and access points.
- Asset cleaning and CCTV inspection to determine defect types and chainages, overall condition, buried pits, junctions and changes in vertical or horizontal alignment.

Once investigation is complete, the optimal intervention treatment can be determined which may include the selection of an appropriate structural liner.

C.2.2 Selection of Structural Lining Product

The recommendation of a particular structural liner is to be supported by documentation outlining the assessment of remediation options and justification as to why the particular liner was preferred. Council's Drainage Assets Section will need to support the proposed treatment. The product must be proven and comply with applicable Australian/New Zealand Standards. The manufacturer of the product should have in place a quality system that conforms to or is equivalent to AS/NZS ISO 9001 - *Quality management systems - Requirements*, for certification covering design, manufacturing, installation and service.

The Structural Liner shall be constructed of materials which will not be subject to excessive shrinkage, thermal contraction, recovery or reversion affecting the shape or dimensions of the liner following installation. It shall be sufficiently robust not to be damaged by common cleaning equipment. The minimum expected service life is 50 years. For Cured in Place Liners, the minimum thickness shall be 5mm.

Independent test results should be made available which confirm long-term material properties (particularly modulus of elasticity). Long-term material property tests shall be taken from a minimum 2 years post-installation.

C.2.2.1 Products for Stormwater Rehabilitation

Council reserves the right to accept or reject proposed products. Council is open to existing proven products on the market and innovative new products providing they meet the requirements of this Specification and comply with applicable Australian/New Zealand standards.

C.2.2.2 Chemical Resistance

The product is to be such that all materials used are to be chemically resistant to withstand exposure to chemicals typically found in stormwater pipes, external exposure to soil bacteria and any chemical attack which may be due to residues remaining on the conduit wall or materials in the surrounding ground.

Test results should be made available which confirm long-term chemical resistance properties in accordance with Australian/New Zealand Standard Test Methods.

Table B.2.1 Minimum Chemical Resistance Requirements for Structural Liners

Chemical Solution	Concentration %
Tap water (pH 6-9)	100
Nitric acid	5
Phosphoric acid	10
Sulfuric acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

C.2.2.3 Abrasion Resistance

The product is to have abrasion resistance to the migration of silt, sand and debris along the pipe. It is to be sufficiently robust not to be damaged by common cleaning equipment. Test results should be made available which confirm long-term abrasion resistance properties.

C.2.3 Responsibilities and Accreditations

The design and installation of the Structural Liner, End Sealing and Sealing of Junctions generally include the following responsibilities.

C.2.3.1 Works Generally Undertaken by Council

- Initial investigation.
- Survey (if required).
- Hydrological study - in cases where it is suspected that the existing pipe may be under capacity (allow for thickness of liner).
- Civil/Structural design of the following (if required but also may be delivered by the Service Provider):
 - New inlet pits and outlets structures.

- Construction and maintenance access.
- Culvert extensions including connection details.

Council may specifically request all or part of the above works be undertaken by the Service Provider in addition to the below requirements.

C.2.3.2 Works Generally Undertaken by the Service Provider

The Service Provider shall supply full details of design calculations with the tender including (but not limited to) the following:

- Design of the structural liner and liner thickness.
- Third-party verification of the civil/structural design in terms of access etc. for installation of structural liner.
- Selection of the lining method (to be supported by Council).
- Planning of bypass/flow management.
- Dewatering.
- Planning of traffic control.
- Cleaning and preparation including pipe intrusion grinding, patching and sealing.
- Installation and curing of the liner including end sealing, recommissioning of private connections and sealing of junctions.
- Trimming and testing of the liner.

C.2.3.3 Service Provider Accreditation

The Service Provider shall be accredited by the product manufacturer to install the product and have the capability to design the liner and liner thickness using the manufacturer's published lining product properties specific to the works under contract.

C.2.4 Design of the Structural Liner

The structural liner is to have a minimum serviceable life of at least 50 years in accordance with AS/NZS 2566.1. The Service Provider must submit evidence of product testing to demonstrate this requirement.

The lining system shall not reduce the internal diameter of the existing pipe by more than 10% unless otherwise approved by Council's Representative.

After installation of the liner, the flow capacity of the pipe shall not be reduced. The predicted hydraulic performance of the liner shall be demonstrated by the contractor by way of calculation prior to commencement of rehabilitation works.

The supplier/installer shall be responsible for the design of the liner and liner thickness in accordance with AS/NZS 2566.1.

The long-term stiffness (SDL) of the liner used in design shall be specified by the tenderer and be determined as detailed in Section 2.2 of AS/NZS 2566.1.

C.2.4.1 Design Loadings

- Vertical earth pressures shall be calculated in accordance with AS/NZS 2566.1 Clause 4.3 using a soil density of 20kN/m³.
- Live load pressure from vehicle traffic shall be calculated in accordance with AS 2566.1 Clause 4.7 or taken from Figure 4.1 of AS/NZS 2566.1.
- Live loads from aircraft or railways shall be provided by the relevant authority or in the case of construction equipment from the equipment manufacturer.

C.2.4.2 Vertical Deflection

- The predicted long-term deflection shall be less than 6% when calculated in accordance with AS/NZS 2566.1, Section 5.2.
- The following values of soil modulus (E') shall be used in design:
 - E' = 2.0MPa or
 - E' = 5.0MPa if voids in the host pipe wall and gaps in the host pipe wall are filled with cementitious grout.

C.2.4.3 Strength (Long-Term Ring Bending Strain)

- The predicted long-term flexural strain calculated in accordance with Clause 5.3 of AS/NZS 2566.1 shall not exceed the allowable flexural strain of the liner material.

C.2.4.4 Buckling

- The liner shall be designed such that it is able to support the applied design loads without buckling.
- The buckling resistance of the liner shall be calculated from Equation 5.4(5) of AS/NZS 2566.1, using the same value of E' as in B.2.2.2 (above). The factor of safety shall be taken as 2.5.
- The buckling resistance of the liner calculated above must exceed the buckling load calculated from the equation:

$$q = \gamma \left(\frac{D_e}{2} + H \right) + w_g$$

Where: γ = soil density. Where this is taken to be 20kN/m³, it can be considered to include groundwater.

D_e = outside diameter of liner (m)

H = cover over liner (m)

w_g = load from traffic

- Where a lower value of soil density is used, the weight of any groundwater must be added, and so the buckling load on the liner should be calculated from Equation 5.4(1) of AS/NZS 2566.1.

C.2.4.5 Design Calculations

Individual design calculations for each length or section must be provided showing that the liners proposed have enough strength to achieve the design loadings. Each separate design calculation must show the wall thickness or profile of the designated liner.

A copy of the design should be provided to Council's Representative who will be responsible for ensuring that (in consultation with the supplier/installer) the correct design inputs are being used. The critical inputs to be aware of are as follows:

- Minimum factor of safety of 2.5 as per AS/NZS 2566.1.
- Fully deteriorated - all new liners should be totally self-supporting.
- Water table height for groundwater loading.
- Depth to invert.
- Size of host pipe (inside diameter).

C.3 Installation

C.3.1 Preparation

C.3.1.1 Safety

The Service Provider shall be responsible for adequate safety precautions during progress of the works, in accordance with the relevant legislation, regulations, standards and codes of practice. This includes but is not limited to the safety of the public, employees and contractor personnel. The provision and erection of any signs, lights and barricades necessary for pedestrian and traffic safety in public roads or places are also part of the responsibility of the contractor to ensure adequate safety precautions are made on site.

C.3.1.2 Working Hours

Requests for work to be undertaken outside of Council's normal working hours shall be made to Council's Representative for consideration. Appropriate controls will need to be put in place to minimise any impacts should this be approved.

C.3.1.3 Consultation and Liaison with Adjoining Properties

Council will liaise with residents and businesses throughout the course of the work. The contractor is to ensure that any impacts are minimised and complaints are dealt with effectively.

C.3.1.4 Bypass/Flow Management

Stormwater systems may carry flows even in dry weather periods. The Service Provider shall submit a flow management plan to Council's Representative at least 10 working days before the intended

date of work. The flow management plan shall detail the methods proposed for each segment of the installation, including any bypass pumping which may be necessary for the successful installation of the liner.

The flow management plan shall detail measures to return the system to full capacity in the event of a sudden increase in flow, such as may be caused by heavy rainfall.

C.3.1.5 Groundwater Management

Where the proposed method requires the management of groundwater in the process, the Service Provider shall submit a methodology of groundwater management as part of the proposal. Excess groundwater should not be allowed to impact on the quality of the installation.

C.3.1.6 Chemical Management

Where the proposed method requires the use of chemicals in the process, the Service Provider shall submit a methodology of management and disposal as part of the proposal. Excess chemicals are not to be allowed to migrate to other parts of the stormwater network.

C.3.1.7 Traffic and Pedestrian Management

The Service Provider shall provide a Traffic Management Plan (TMP) including Traffic Guidance Schemes (TGS) and Pedestrian Management Plan (PMP) where required for all works that may affect any public place or road where traffic control will be needed regardless of the extent of works being carried out.

Traffic control measures shall be installed and maintained by persons appropriately qualified by TfNSW. Traffic Controllers shall be persons appropriately qualified by TfNSW.

The Service Provider shall always allow for the safe passage of pedestrians along footpaths and footways around the work site. The Service Provider must place and maintain suitable barriers and signs to define and warn pedestrians near the construction area.

C.3.1.8 Vehicle Parking

The work is to be arranged to minimise the impact on vehicle parking in affected streets.

Where vehicle parking bays are required for the conduct of the works, Council will need to be advised at least one week prior to provide notification to the occupants of adjoining properties.

C.3.1.9 Noise Control

All construction equipment is to be fitted with the recommended noise suppressor in accordance with statutory requirements. The Service Provider is to comply with the statutory regulations and take all practical precautions to minimise noise levels.

C.3.1.10 Waste Management

All waste is to be stored on-site in a secure manner until it can be removed off site to an EPA approved facility. Containment or covering of wastes which may be spread by wind or rain is required. Disposal of construction wastes on site is not acceptable.

C.3.1.11 Damage to Property

The Service Provider shall take adequate precautions to prevent deterioration and damage to private property, public roads, public utilities and reserves during construction.

C.3.2 Method of Installation

The installer must allow for the installation of continuous liner sections between pit locations. Joints made between pits will not be accepted unless agreed with Council's Representative during the design of the works.

The manufacturer's installation procedures must be followed for each stage of the installation, and the installer will generally choose the method of installation based on what best suits the specific site. The installer shall supply a written methodology of the installation which demonstrates compliance with the manufacturer's procedures.

C.3.3 Cleaning and Debris Removal

Cleaning of all silt, debris, slimes, encrustations, roots, etc. is required for all stormwater conduits to be rehabilitated, prior to installation of the lining system.

Cleaning is to include the removal and disposal of all foreign matter including tree roots from the pipelines, junctions and pits designated for lining works. Resulting debris from the cleaning operations shall be removed at the downstream end of the section being cleaned. Flushing of any debris downstream of the cleaning area is not permitted.

The Contractor, when using cleaning equipment or undertaking any of the associated cleaning activities, must take all necessary precautions to ensure that these activities do not:

1. Damage or flood public or private property.
2. Damage the stormwater pipe being cleaned or any other associated conduits or structures.
3. Pollute the downstream receiving environment.

C.3.4 Repair and Preparation

The Contractor shall seal all locations with active infiltration where it is deemed necessary for proper installation of the structural liner as per manufacturer's specifications.

All connections that protrude into the section must be cut or ground back prior sufficiently so as not to interfere with the installation or long-term performance of the structural liner. Cut/ground surfaces shall be smooth and even with no jagged edges.

Fill all voids as per the manufacturer's procedures. Void filling shall ensure structural integrity of the system and prevent bridging by the liner. The Contractor shall submit for the review and acceptance of Council's Representative a detailed method statement outlining the procedures and materials to be used in filling the voids.

Proof of the repair and preparation shall be provided in the form of pre-CCTV inspection prior to installation of the liner.

C.3.5 Resin Impregnated Liners (where applicable)

Ultraviolet-cured is the preferred curing method for resin impregnated liners. A minimum of 5% and up to 10% excess resin shall be used to allow for polymerisation shrinkage and the loss of resin.

It is the responsibility of the contractor to ensure the wetted liner is stored and transported in a climate-controlled environment in accordance with the manufacturer's recommendation. Council's Representative may reject the product and cancel the installation if the storage and transportation conditions are compromised.

The contractor shall not install any impregnated liner that has expired, been stored in a warehouse for more than 1 month or has been compromised in any way. If the liner is impregnated in advance of lining, the contractor shall provide a temperature log documenting storage of the liner at the facility prior to installing the liner to demonstrate that the liner has not been compromised and is acceptable.

C.3.6 End Sealing

The liner shall be sealed at both ends and rendered smooth with the existing access chamber surfaces to provide a permanent watertight seal between the outside of the liner and the existing pipe and to prevent water migration behind the liner. The end seal shall have a service life equal to that of the liner, i.e. >50 years.

The composition of the material forming the seal must be compatible with the liner material and the access chamber. Suitable materials are epoxy-based mortars and cementitious grouts. The sealing system shall not rely on the use of polyurethane grout. The contractor shall provide full details of the proposed end sealing methodology with their tender submission.

Liners that have a polyethylene outer sleeve must have the polyethylene coating removed for a minimum of 300mm along the full circumference of the liner at both access chamber ends. Removal of the polyethylene sleeve is necessary to enable sufficient adhesion between the liner, end seal material and inside of the deteriorated pipeline.

C.3.7 Sealing of Junctions

Junctions can either be part of the stormwater network or from private stormwater systems. All live junctions must be reconnected to the lined conduit. Such reconnections should be carried out robotically, without excavation.

Liners which may be subject to shrinkage, i.e. those that have been heated, winched, pulled or inverted in the installation process, must be left to cool and/or relax for a minimum of 6 hours prior to cutting to reconnect laterals. This time period is to allow for relaxation of the liner due to shrinkage, thermal contraction, stress recovery or adjustment in mechanical properties during the installation and curing process.

The cut out in the junction must be flush with the inner surface of the junction line opening. The cutting tool must leave a smooth, bevelled edge free of any protrusions which may inhibit flow or catch solid material.

Each required opening may have an initial rough cut on the day of lining and be completed after the lining has reached its final dimensions allowing enough time for curing, shrinkage etc, as necessary.

To ensure the lining system is fully sealed, all reinstated lateral connections must be sealed. The minimum expected service life of the installed junction seal shall be equivalent to the expected service life of the installed conduit liner, i.e. >50 years.

Sealing of junctions shall be achieved by installing a short-form cured-in-place liner composed of a combination of felt and resin. Permitted resins shall be silicate or epoxy based or other non-shrinkage resins. Polyester and vinyl ester resins shall not be permitted. Seals achieved by injection of grout or similar techniques are not acceptable.

The felt shall be capable of being fully impregnated with resin, which shall be retained within the felt layers under installation pressures and temperatures.

If requested by Council's Representative, the contractor shall provide information on the proposed short form liner such as chemical resistance data and bond tests to demonstrate its suitability in the particular environment.

C.3.7.1 Configuration of Junction Seal

The junction seal shall provide a seal by covering the gap between the host pipe and the lateral line and shall extend 50mm into the lateral line. The seal shall be of "Top Hat" configuration except where the main pipe is smaller than DN 300, in which case a "Tee" configuration shall be used.

In the "Top Hat" configuration the seal is applied around the full circumference of the lateral line but only partially covers the main line. In the "Tee" configuration, the seal is applied around the full circumference of both the main line and the lateral line.

C.3.7.2 Sealing Defective Junctions

If the contractor believes installation is not possible due to defective junctions, then the contractor shall advise Council's Representative immediately. Defective junctions should be rectified prior to installation of the liner.

C.4 Acceptance and Compliance

C.4.1 Liner Acceptance Criteria

Acceptance of the liner will be in accordance with the following conditions:

1. The finished liner thickness is to be >90% of nominal liner thickness.
2. The liner is to be hydraulically smooth.
3. The liner satisfies the structural strength and material requirements.
4. End sealing and sealing of junctions has no cracking and/or delamination.
5. Post-rehabilitation CCTV has been reviewed and approval of the works has taken place by Council's Representative.
6. All Compliance, Inspection and Testing records have been submitted.

Any liner or part thereof deemed non-compliant requires full replacement of the continuous length between pit locations. A plan for replacement must be proposed within 28 days.

Defects which are considered unacceptable include the following:

1. Wrinkling, ridges or bulges.
2. Leakage through the liner.
3. Constrictions and protrusions at end/junction seals.
4. Lack of adhesion and movement at end/junction seals.
5. Cracking and delamination at rendered pits and channels.

C.4.2 Inspection, Monitoring, Testing, Compliance and Defects Liability

C.4.2.1 CCTV Inspection

A closed-circuit television (CCTV) inspection shall be carried out after installation to establish that lining, end sealing and junction sealing has been completed as specified.

CCTV inspections shall be carried out in accordance with **Appendix B - CCTV Survey Inspections Technical Specification - Drainage Assets**.

C.4.2.2 Monitoring of Longitudinal Shortening

For liners subject to shrinkage, i.e. those requiring heat or curing, monitoring of longitudinal shortening shall be carried out and recorded for each lined section.

Linings shall initially be cut off "long" with 100mm protruding into the chamber at each end of the section. Fixed marks shall be placed on both the liner and chamber wall. Three series of measurements shall be taken as follows:

1. At completion of cut-outs, or at 24 hours for linings without cut-outs.
2. Fourteen days.

3. Ninety days.

An acceptable change in length shall be 1mm for every 2m of liner length.

Where change in length is unacceptable, the seal at each lateral connection shall be pressure tested and repaired as necessary, in accordance with Section C.3.7 Sealing of Junctions.

The lining shall be trimmed to final length and resealed to the chamber wall in accordance with Section C.3.6 End Sealing.

C.4.2.3 Lining Material Sampling and Testing

For liners subject to variation in material properties, i.e. those requiring heat or curing, material sampling and testing shall be provided using one of the following methods:

1. A test sample shall be cut from a section of the cured lining at a chamber or termination point that has been held in place by a suitable heat sink, such as sandbags.
2. A test sample shall be fabricated from the actual tube and resin/hardener system used and cured in a clamped mould placed in cure water.

The sample shall be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and tensile testing.

The specimens shall be tested at a NATA-approved facility to confirm the minimum properties specified in the design.

C.4.2.4 Storage and Transport Records

Where applicable, the Service Provider must complete the Storage and Transport records to demonstrating compliance with product manufacturer's procedures.

C.4.2.5 Wet-Out Process Records

Where applicable, the Service Provider must complete the Wet-Out Process records demonstrating compliance with product manufacturer's procedures.

C.4.2.6 Curing Process Records

Where applicable, the Service Provider must complete the Curing Process records demonstrating compliance with product manufacturer's procedures.

C.4.2.7 Non-Complying Work

Council's Representative shall be notified immediately where any works do not comply with this Specification. Alternatively, the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) must be rectified prior to the final inspection.

C.4.2.8 CCTV Post-Defects Liability Period

The defects liability period of 12 months shall commence on the date of Practical Completion. The contractor shall at its own cost and expense make good to the satisfaction of Council's Representative all defects of materials and workmanship that may arise during this period of defects liability.

At the conclusion of this period a further CCTV inspection shall be carried out to establish that the liner and junction seals remain free of the defects listed above.

Defects shall be rectified within 28 days of notification. In default, Council may have the work of rectification carried out at the Service Provider's expense.

Appendix D - Stormwater Infiltration System Technical Specification

D.1 Design Guideline

D.1.1 Suitable Locations

Infiltration systems are most effective when they are located in free-draining, sandy soils and above the seasonal high groundwater level. The seasonal high groundwater table should be $\geq 1.5\text{m}$ from the base of the infiltration system, with a separation of 1.0-1.5m posing higher risk to system performance, and separation of $< 1.0\text{m}$ not suitable.

Areas identified at risk of ground water flooding in the Woy Woy Floodplain Risk Management Study and Plan are not suitable for infiltration systems. Infiltration systems shall not be used in the following areas:

- Mackenzie Avenue
- Connex Road
- Dulkara Road
- Shoalhaven Drive
- Greenhaven Drive
- Neera Road
- Numby Close
- Palmtree Grove

Other areas with known shallow groundwater are unlikely to be suitable for infiltration systems. Based on groundwater level mapping by Larry Cook Consulting for the Woy Woy Integrated Flood Modelling project, areas where groundwater is likely to be $< 2.5\text{m}$ below ground have been marked as potentially unsuitable for infiltration systems and are shown in the map below.

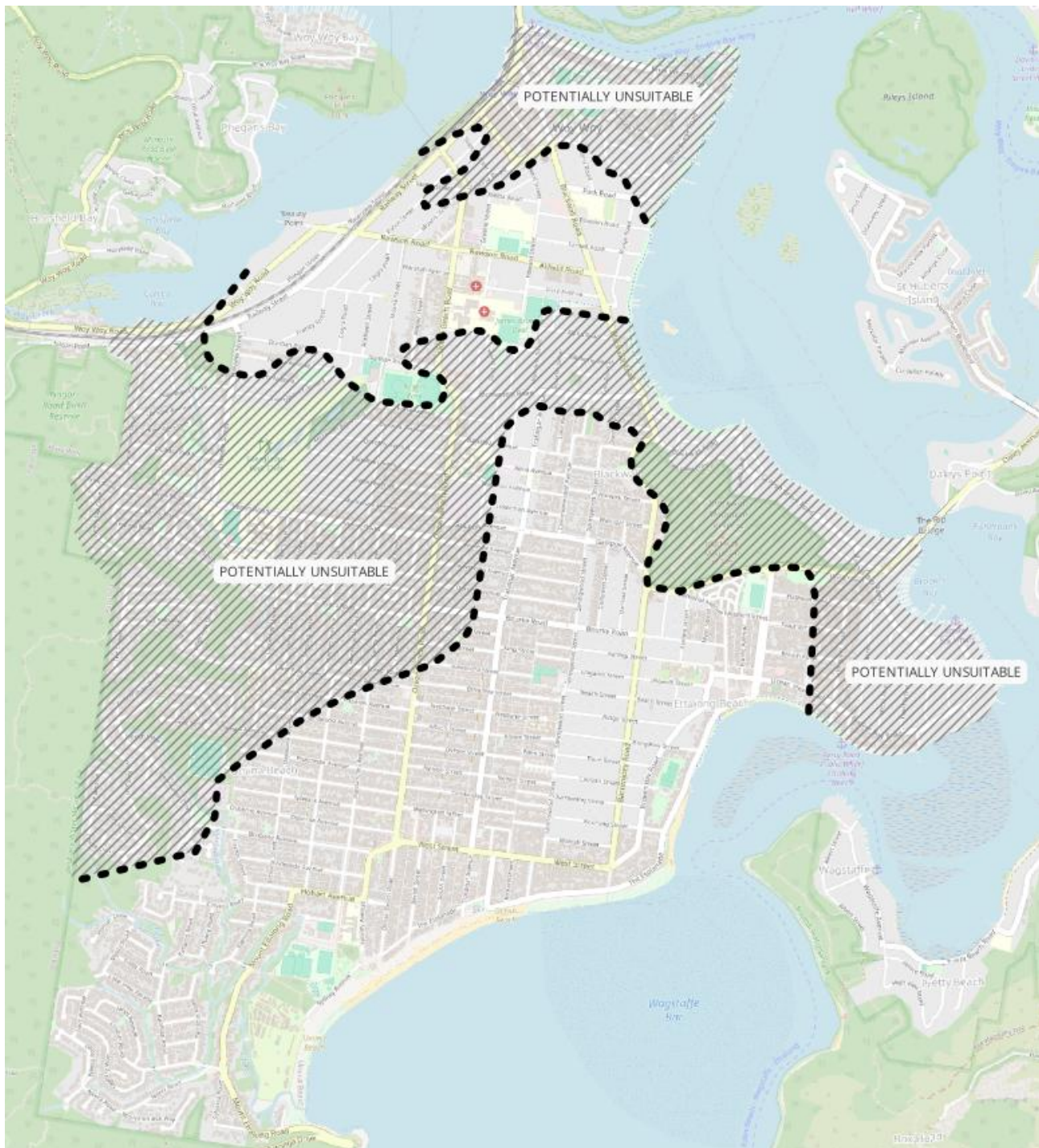


Figure 16.1 Areas potentially unsuitable for infiltration systems derived from groundwater levels in Larry Cook Consulting 2019 and LIDAR topography data from NSW Spatial Services 2020 (base map data from OpenStreetMap)

In all other areas, the soil properties shall be established as specified in the site investigation requirements below. Infiltration systems will only be permitted where it can be demonstrated that:

- The site soils are sand with no loam, silt, clay or organic layers.
- The saturated hydraulic conductivity is at least 360mm/h.
- The seasonal high groundwater level is at least 2.5m, and preferably 3.0m, below the ground level.

D.1.2 Site Investigation

Site conditions shall be established by an experienced geotechnical engineer based on intrusive site investigation.

At a minimum, the site investigations shall include one borehole per 20m length of infiltration system, progressed to a minimum of 4m below ground level or until groundwater is encountered. The site investigation shall establish the following:

- Soil classification of soil layers encountered presented on a borehole log.
- Any indicators of contamination (visible, odours, etc).
- Depth to groundwater.
- Estimated seasonal high groundwater depth, based on observations of soil properties such as colour.
- Saturated hydraulic conductivity, using a constant head test at a depth of 1.5m below ground level or the likely depth of the infiltration system, whichever is greater.

D.1.3 Design Method

Infiltration systems shall be sized for a 10% AEP event using the method in Melbourne Water *WSUD Engineering Procedures: Stormwater* (2005).

For duplex sites where the combined area (property and half road) draining to the infiltration system is no greater than 750m², a maximum pipe size of 600mm diameter can be adopted, subject to calculations being submitted to Council demonstrating that a minimum level of service of 50% AEP will be achieved.

Design rainfall and climate change factors shall be obtained for the project location from the ARR data hub (<https://data.arr-software.org/>). The rainfall depths provided shall be adjusted using the climate change factors for the year 2030 and climate scenario SSP3-7.0.

The critical duration for the design event will be different to that of the pipe drainage design and a full range of storm durations shall be considered in alignment with Melbourne Water *WSUD Engineering Procedures: Stormwater* (2005).

Other design parameters shall comply with the following:

- Where the saturated hydraulic conductivity established from site investigation is greater than 3,600mm/h, the saturated hydraulic conductivity used in the calculations shall be 3,600mm/h (as flow through the perforated pipe may begin to limit system performance above this level)
- The volumetric runoff coefficient C_v shall be 0.75.
- The void ratio of single-sized aggregate backfill shall be 0.30.

Example calculations for two typical installations are provided below.

D.1.3.1 Case Study 1 – half road only

This case study considers a site where the property drainage is managed within the site, and the infiltration system caters for runoff from the half width of road fronting the site.

The design input parameters are:

- Half road width 10m
- Property frontage 15m
- Catchment area 150m²
- Runoff coefficient, $C_v = 0.75$
- Saturated hydraulic conductivity, $K_h = 360\text{mm/h}$ (designers shall use the measured hydraulic conductivity for the project site, subject to the upper limit listed above)
- Soil hydraulic conductivity moderating factor, $U = 0.5$
- Rainfall depths and climate change factors – see table below

Duration	10% AEP rainfall depth, mm	Climate change factor
10	23.6	1.18
15	29.7	
20	34.2	
25	37.9	
30	40.9	
45	47.9	
60	53.2	

Note: In this example durations up to 60 minutes have been used to illustrate the concept within the space available. Actual design calculations should consider all durations up to 72 hours.

Try a 300mm diameter perforated pipe. The dimensions of this option are:

- Length of trench 14m (to allow for junction pit)
- Width of trench 0.74m
- Depth of gravel 0.94m
- Area of trench base available for infiltration 10.4m²
- Perimeter of trench available for infiltration 29.5m
- Void ratio of combined pipe and gravel 0.36
- Available storage volume 3.5m³ (pipe and gravel)

Duration	Rainfall depth adjusted for climate change, mm	Inflow volume, m ³	Outflow volume, m ³	Required storage volume, m ³
10	27.8	3.1	0.7	2.4
15	35.0	4.0	1.1	2.9
20	40.4	4.5	1.5	3.1
25	44.7	5.0	1.8	3.2
30	48.3	5.4	2.2	3.2
45	56.5	6.4	3.3	3.1
60	62.8	7.1	4.4	2.7

As the available storage volume (3.5m³) is greater than the maximum required storage volume in the second table (3.2m³), the selected 300mm perforated pipe is adequate.

D.1.3.2 Case Study 2 – half road and duplex development

This case study considers a site where the property drainage is managed within the site, and the infiltration system caters for runoff from the half width of road fronting the site.

The design input parameters are:

- Property depth and half road width 50m
- Property frontage 15m
- Catchment area 750m²
- Runoff coefficient, $C_v = 0.75$
- Saturated hydraulic conductivity, $K_h = 720\text{mm/h}$ (designers shall use the measured hydraulic conductivity for the project site, subject to the upper limit listed above)
- Soil hydraulic conductivity moderating factor, $U = 0.5$
- Rainfall depths and climate change factors – see table below

Duration	50% AEP rainfall depth, mm	10% AEP rainfall depth, mm	Climate change factor
10	13.8	23.6	1.18
15	17.2	29.7	
20	19.8	34.2	
25	21.9	37.9	
30	23.7	40.9	
45	27.8	47.9	
60	31.0	53.2	
90	35.9	61.2	1.17
120	39.8	67.4	1.16

Note: In this example durations between 10 and 180 minutes have been shown to illustrate the concept within the space available. Actual design calculations should consider all durations up to 72 hours.

As this is a duplex development and the catchment is no greater than 750m², the maximum pipe size is 600mm. Try a 600mm diameter perforated pipe for 10% AEP. The dimensions of this option are:

- Length of trench 14m (to allow for junction pit)
- Width of trench 1.28m
- Depth of gravel 1.28m
- Area of trench base available for infiltration 17.9m²
- Perimeter of trench available for infiltration 30.6m
- Void ratio of combined pipe and gravel 0.40
- Available storage volume 9.3m³ (pipe and gravel)

Duration	Rainfall depth adjusted for climate change, mm (10% AEP)	Inflow volume, m ³	Outflow volume, m ³	Required storage volume, m ³
10	27.9	15.7	2.3	13.4
15	35.0	19.7	3.4	16.3
20	40.4	22.7	4.5	18.2
25	44.7	25.2	5.6	19.5
30	48.3	27.2	6.8	20.4
45	56.5	31.8	10.1	21.7
60	62.8	35.3	13.5	21.8
90	71.6	40.3	20.3	20.0
120	78.2	43.98	27.0	17.0
180	88.5	49.8	40.5	9.2

As the available storage volume (9.3m³) is less than the maximum required storage volume in the second table (21.8m³), the selected 600mm perforated pipe does not provide the desired 10% AEP level of service.

Check that the 600mm pipe meets the minimum 50% AEP level of service:

Duration	Rainfall depth adjusted for climate change, mm (50% AEP)	Inflow volume, m ³	Outflow volume, m ³	Required storage volume, m ³
10	16.3	9.2	2.3	6.9
15	20.3	11.4	3.4	8.0
20	23.4	13.1	4.5	8.6
25	25.8	14.5	5.6	8.9
30	28.0	15.7	6.8	9.0
45	32.8	18.5	10.1	8.3
60	36.6	20.6	13.5	7.1
90	42.0	23.6	20.3	3.4
120	46.2	26.0	27.0	0
180	52.7	29.6	40.5	0

As the available storage volume (9.3m³) is greater than the maximum required storage volume in the second table (9.0m³), the selected 600mm perforated pipe does provide the minimum 50% AEP level of service and can be selected.

D.1.4 System Layout Requirements

Infiltration systems shall not be located on the high side of retaining walls over 1m high or within a horizontal distance from the toe of a retaining wall over 1m high equal to the height of the retaining wall.

Infiltration systems shall not be located within 1m of property boundaries, fences and other structures.

Infiltration systems shall not be located within the tree protection zone of trees, including trees within the boundary of private property.

In most cases, the infiltration system is likely to need to extend for the full site frontage to achieve adequate performance. For sites with high soil permeability and where the performance of the system exceeds 10% AEP, the size of the system could be reduced. The preference is for any reduction in size to be through reduction of the pipe diameter within the range of values shown on the standard drawing, as this will provide additional clearance to the kerb and any utilities in the verge. Where there are other constraints, e.g. a power pole or tree, the length of the system could be reduced.

The kerb inlet pit and junction pit can be located at any appropriate point on the kerblines in front of the property where they will not clash with driveways, power poles, street trees or other obstructions. Where the site drainage is not on the driveway side, the kerb inlet and junction pit can be located at this end of the frontage, with a single length of pipe across the site frontage.

Site drainage shall connect to the junction pit adjacent to the kerb inlet pit where this drains roof water only or water that has been through water quality treatment (e.g. GPT or filter cartridge system) prior to leaving the site. Untreated runoff from driveways, landscaped areas and other ground-level surfaces shall be discharged to the kerb so that it passes through the kerb inlet pit before entering the infiltration system.

Where site drainage is connected directly to an infiltration system pit, the site drainage shall be designed for a tailwater level in the street drainage at top of kerb level.

Where space permits on a site with existing kerb, the minimum offset between the kerb and the infiltration system (dimension 'X') should be increased by 150mm. Where the kerb is being installed as part of the same project as the infiltration system, this offset could be reduced by 150mm.

The clearance between infiltration systems and other utilities shall generally be in accordance with the *Guide to Codes and Practices for Streets Opening* (NSW Streets Opening Coordination Council, 2018). For the infiltration systems, the clearance should be taken to be between the edge of the gravel trench and the nearest face of the other utility. Where there is insufficient space, this clearance could be reduced to 150mm, but the width of the trench shall be maintained in all cases.

D.1.5 Standard Drawings

Refer to Council's *Civil Works Specification - Standard Drawings* for further engineering details on infiltration systems.

D.2 Construction Specification

D.2.1 Excavation

Trench excavation and preparation for infiltration systems shall comply with Council's *Civil Works Specification - Construction Specification*, except for treatment of unsuitable material in the base of the trench.

Unsuitable material, which includes soft soils and isolated organic material, shall be removed from the trench invert and replaced with compacted sand excavated from elsewhere in the trench.

D.2.2 Geotextile

Non-woven geotextile filter/separation layer shall be used in the infiltration system with aggregate filter material and shall meet the requirements for application in trench drains in TfNSW *D&C Specification R63 Geotextiles (Separation and Filtration)*.

Woven geotextile used around the ACO Stormbrixx shall be ProFab Monoweave or approved equivalent.

Geotextile shall be placed to conform loosely to the shape of the trench. The geotextile shall wrap around the ends and top of the trench to fully enclose the gravel in the trench.

Overlap between geotextile segments and where they wrap back on themselves shall be a minimum of 500mm.

D.2.3 Gravel Bedding

Aggregate for bedding around the perforated pipes and storage cells shall be nominal 20mm single-sized aggregate conforming to the following grading:

Sieve Size (mm)	% passing by mass
26.5	100
19	85-100
13.2	-
9.5	0-20
6.7	-
4.75	0-5
2.36	-
0.075	0-2

Gravel bedding shall be compacted to 94% standard dry density in layers of maximum 300mm thickness.

D.2.4 Pits

The pits should comply with Council's *Civil Works Specification - Construction Specification*.

D.2.5 Pipes

The perforated HDPE/PP pipes shall be in accordance with Council's *Civil Works Specification - Construction Specification*, with a minimum ring stiffness class of SN8.

Perforations shall be factory formed in accordance with American Association of State Highway and Transportation Officials (AASHTO) M 252 and M 294 SP Class II.

Joints between pipe segments shall be by a rubber ring spigot-socket joint.

Pipes shall be laid level and, where there are pipes extending either side of the pit, the pipes shall be laid at the same level.

D.2.6 Storage Cells

Storage cells shall be ACO Stormbrixx SD or similar approved modular plastic storage cell. The storage cells shall be capable of withstanding light traffic loads with 500mm cover.

Storage cells shall be installed in accordance with the manufacturer's recommendations, including provision of a vent pipe or shaft and wrapping with geotextile prior to backfilling with gravel.