# Civil Specification

# 1Ha Park

| | |
|---|---|
| **Project Name** | Park Highett |
| **Project Number:** | 22024 |
| **Date:** | 22 June 2023 |
| **Prepared by:** | Dara McGrenaghan |
| **Ref:** | 22024-CI-SP-002 |



MCG Consult Pty Ltd
Level 2, 696 Bourke St, Melbourne
admin@mcgconsult.com.au

MCG CONSULT

| | Date | Comment | Prepared By | Approved By |
|---|---|---|---|---|
| A | 22.06.2023 | Tender | DMcG | DMcG |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Checked, approved by:

Dara McGrenaghan
Director

# Contents

# 1. Introduction

## 1.1 Scope

This Specification covers materials, equipment, methods of construction and workmanship for all Works as herein specified and as shown on the Civil Drawings. It is the intent of this specification to provide basic minimum requirements for the works that will be complimentary to the drawings.

## 1.2 Nature of Ground

The results of an investigation into sub-soil ground conditions are available for the site. These results are provided for the Contractors information only. The Contractor is to make their own assessment of the ground conditions, such as topsoil quality and thickness anticipated material types, unsuitable materials, and ground water levels expected and devise their construction methodology and excavation volumes to suit. Refer to geotechnical report by the geotechnical engineer from Geo Aust Geotechnical Engineers, Report No 6363-6-R.

# 2. Safety

## 2.1 Safety in Design

In accordance with our obligations under Health and Safety Legislation, MCG Consult has undertaken a formal safety in design assessment of the civil design for this project. The purpose of this process is to mitigate or minimise the Health and Safety hazards inherent in this project at the design stage.

We have considered the Health and Safety Hazards specific to this project and site with respect to construction, operation, maintenance and demolition or decommissioning.

The Safey In Design Risk Management Report details a comprehensive list of the hazards that have been considered in this design. Where possible these hazards have been mitigated. Others have been limited to conventional levels that competent persons, experienced in operating in that environment, are routinely able to manage in the course of their work. Others require explicit management requiring specific control measures by particular parties. Finally, there may be some risks that remain unresolved at the completion of the design phase. These later two situations are explicitly highlighted, where they occur, in the Report at the end of this document.

The Safey In Design Risk Management Report follows a systematic risk management process whereby hazards are identified, the risk of harm associated with these hazards is assessed (likelihood and consequence) and a risk rating is derived. This assessment is reviewed at the completion of the design documentation. The risk rating system used is detailed within the report.

The current report is attached as an Appendix. The Contractor shall note and make allowance for risks to be mitigated by the Contractor within their Safety Management Plan and for the management and mitigation of any risks identified. Please note that the provision of the Safey In Design Risk Management Report in no way alleviates the Contractor of any safety requirements specified elsewhere in the specification.

# 3. Earthworks

## 3.1 General

### 3.1.1 Extent of Contract

This specification is for the carrying out of all earthworks indicated on the Civil Drawings. It is the Contractor's responsibility to assess the nature of the soil being cut or filled and to select plant which will achieve the specified results. The Contractor shall also make their own assessment of the quantities of earthworks to be carried out, including the accuracy of existing contours and any effect on the levels of the in-situ material due to the operations selected by the Contractor.

### 3.1.2 Standards

Earthworks shall be completed in accordance with:

- AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments
- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 2870-2011 Residential Slabs and Footings – Construction
- AS 1726-1993 Geotechnical Site Investigations.

### 3.1.3 Setting Out

Prior to any excavation, the general areas of all buildings, services and site works within the contract shall be set out by suitable hurdles, pegs or markers. Levels shall be established and pegged from a common datum.

All setting out shall be carefully checked against the drawings prior to commencement, and any discrepancies clarified before construction commences.

### 3.1.4 Existing Services

The Contractor shall and all personnel on Site shall familiarise themselves, under their direction, with the location of all existing services on and adjacent to the Site and they shall be responsible for the cost of repairing any damage caused to existing services. This repair work shall be carried out by the relevant Authority and shall be arranged by the Contractor.

No guarantee is given that the services shown on the Drawings are in the exact location. The locations of various underground structures, services and other property as shown on the Drawings are approximated locations only. The existing services shown on the Drawings may not be representative of all services within the site of works. It is the Contractor's responsibility to locate all services both in plan and depth to avoid damage and disruption to authority assets. The Principal does not warrant the correctness of such information.

All due care shall be taken to protect existing services, structures and works in and around the site and adjoining streets. The Contractor shall be responsible for any damage, which has been caused by contractual works or operations, to any water, sewerage or gas mains, or any main, cable or pole of the electricity or telecommunication supply.

The Contractor shall, where any damage has occurred to services, notify the Superintendent and also the responsible authority concerned, and make all arrangements for any necessary repairs.

Reinstatement to damaged services and structures shall be performed immediately and without increase to the Contract sum. The Principal shall be indemnified from all claims whatsoever arising from any such damage.

The Contractor shall make provision for the sealing and removal of unused services, for the cutting, sealing and reconnection of any services temporarily requiring attention, and shall ensure that all leaks and defects in any services are stopped and repaired before construction proceeds or recommence, all as approved by the responsible authority.

All fire plugs, valve boxes, manhole covers and other miscellaneous covers are to be set by the Contractor to match the finished surface levels in compliance with typical details. The Contractor shall arrange with the appropriate service authority for the adjustment of all covers, and all associated costs are deemed to be included in the tender price.

### 3.1.5 Disturbance to Private Properties

The Contractor shall not cause any damage to, and shall take reasonable precautions to avoid excessive disturbance to any private property due to dust, vibration, noise, etc., resulting from these works. The Contractor shall not enter onto private property without the written consent of the land owner.

### 3.1.6 Natural or Existing Vegetation

In areas not requiring earthworks, access for machines shall not be permitted. Any unauthorised disturbance shall be remediated to the full satisfaction of the Local Authority or relevant government department and all costs borne by the Contractor.

### 3.1.7 Protection Works

All excavations and embankments shall be graded to shed water at all times.

Temporary earth drains shall be constructed where necessary to prevent water flowing onto the construction works and to take away water from the works. These drains shall discharge into a permanent outfall. Pumps shall be provided where necessary to dewater excavations.

The design of temporary earth drains should minimise water velocities by use of contour drains where possible, wide flat cross sections and hay bale or sand bag weirs to retard flows. Where temporary drains discharge into watercourses or underground drains silt traps are to be provided immediately upstream of the outlet of the temporary drain.

Silt traps are to be cleaned out when they reach 50% of their storage capacity.

All necessary precautions shall be taken to prevent water entering the trench or excavation. Should water enter a trench, it shall be removed by pumping. A sufficient number of pumps in good working order shall at all times be kept on site to remove any water that may accumulate in the excavations. Should any trench or other excavation be filled with water or in other way be damaged or rendered useless for its proper purpose, it will be made good or the excavation extended to solid ground. No additional payment shall be made for extra excavation or backfilling material.

## 3.2 Fill Materials

Unless otherwise specified or directed, the Contractor shall source the materials used for filling. The material shall be free from logs, stumps, vegetation, rubbish and other perishable material.

### 3.2.1 Topsoil

Topsoil placed on formations and disturbed areas shall be capable of supporting healthy, full cover of grass growth, be friable, contain organic material and, shall be free from subsoil, tree roots, clay balls, stones, rocks, rubbish, contaminants, weeds, pathogens and toxic levels of any element with a pH in the range of 5 to 8.

### 3.2.2 Type A Fill

Type A fill material shall comply with the requirements of Table 1 and shall be free of topsoil, deleterious and/or perishable matter. Material classified as silt, either before or after compaction, is not acceptable as Type A fill unless otherwise approved by the Superintendent.

**Table 1 Type A - Material Specification**

| Location and Use of Type A Material | Physical Properties | | | Limits of Grading (% passing by mass) - Post Compaction Sieve Size AS (mm) | | | | Weighted Plasticity Index [3] | PI Range-Post Compaction |
|---|---|---|---|---|---|---|---|---|---|
| | Assigned CBR (min) %[1] | Swell% [1] | Max. Permeability (m/s) [2] | 75.0 | 37.5 | 4.75 | 0.075 | | |
| **Capping Layer** | 6 | ≤ 1.5 | $5 \times 10^{-9}$ | 100 | 80-100 | 40-80 | 0-25 | 1000 | 6-25 |
| **Selected or Structural Fill Material** | 6 | ≤ 1.5 | Not Applicable | 100 | 80-100 | 40-80 | 0-25 | 1000 | 6-25 |

Notes:

- The Assigned CBR and percentage swell values are to be determined in accordance with VicRoads Code of Practice RC 500.20. Sampling for CBR testing shall be undertaken after field compaction.
- The permeability value is to be determined in accordance with VicRoads Code of Practice RC 500.16. The permeability value is to be determined on specimens manufactured from that fraction of material which passes a 19.0mm AS sieve, compacted at optimum moisture content and 98% of maximum dry density as determined by testing using standard compactive effort for CBR and swell.
- The Weighted Plasticity Index (WPI) is defined as the value of the plasticity index (PI) times the % passing the 425 micron sieve. The Contractor must provide the calculations to verify the WPI.
- Oversize Material that does not meet Type A, B or C criteria, but is capable of being compacted in accordance with Table 9.3 “Compaction of Oversize Material".
- Organic material must not be present in structural fill.

### 3.2.3 Type B (Common) Fill

Type B material shall be totally free of organic content, topsoil, deleterious and/or perishable matter such as bricks, concrete, glass, plastic, timber, steel or steel by-products. After compaction Type B material shall have a maximum particle dimension of not more than:

- 150mm within 400 mm of the top of Type B material; and
- 400mm at depths greater than 400 mm below the top of Type B material.

Type B material shall have a minimum Assigned CBR of 8%, and Assigned Percent Swell less than 2.5% which has been determined in accordance with VicRoads Code of Practice RC500.20.

Materials that exhibit swells greater than or equal to 2.5% shall be classified as expansive and shall only be used as Type B material if approved by the Superintendent.

Where the highest quality Type B materials are available they shall be reserved for placement in higher levels of the fills being constructed. Material within the top 400mm of top of Type B material shall have a swell less than 2.5%.

Materials that exhibit swells of 5% or greater are not permitted.

Sampling for CBR testing shall be undertaken after field compaction.

Material classified as expansive or silt, either before or after compaction, shall not be used as Type B material.

### 3.2.4 Type C Fill

Type C material shall be totally free of organic content, topsoil, deleterious and/or perishable matter such as bricks, concrete, glass, plastic, timber, steel or steel by-products and shall be capable of being spread in layers of not more than 500mm and compacted as specified to achieve a stable condition.

### 3.2.5 Recycled Materials

Blends of crushed recycled materials such as crushed concrete, crushed brick, reclaimed asphalt pavement (RAP), slag and crushed glass may be used as Type A, B and C materials in earthworks applications.

Any blend of recycled materials proposed for use on VicRoads contracts shall be registered.

The blend of recycled materials shall only be obtained from a VicRoads accredited source and manufactured in a controlled manner which ensures the blended product has consistent physical properties.

The registered blend of recycled materials shall meet all relevant requirements and properties as listed in this clause.

Low density foreign materials such as plastic, rubber, plaster, clay lumps and other friable material shall not exceed 3% by mass. Wood and other vegetable or decomposable matter shall be limited to a maximum of 0.5% by mass and assessed using test method RC 372.04 'Foreign Materials in Crushed Concrete Products' shown in Section 175.

Crushed glass used in any recycled material blends shall be crushed to a cubic shape and able to pass the 4.75mm AS sieve.

Any blend of recycled materials shall be able to be classified as 'clean fill' in accordance with Environment Protection Authority, Victoria guidelines.

### 3.2.6 Permeable Fill

Permeable fill shall be a mixture of hard, durable, clean sand and gravel or crushed rock, free from clay balls and perishable matter and which complies with the requirements of this specification.

### 3.2.7 Rock Fill

Rock fill is comprised of larger fragments of durable rock containing only a small proportion of fine particles which, when placed and compacted, produces an embankment deriving its stability from the mechanical interlock of the coarser particles and not from the cohesion of finer material. To minimise breakdown during handling and compaction processes, the durability of the larger rock is specified in terms of the Point Load Strength Index (AS 4133.4.1).

Rock fill should not be placed in areas where earth fill has previously been constructed as this could allow rain-water or surface runoff ingress into a potentially moisture sensitive embankment fill layer. Foundations under rock fills should be stripped of topsoil and silt, and shaped to ensure that drainage is maintained and treated to ensure that erosion of the foundation will not occur.

The upper surface of rock fill should first be blinded with smaller particle rock fill prior to the placement of select or general fill materials to provide a more compact and void-free surface. Alternatively a capping layer of specified grading may be used immediately above rock fill embankments.

Rock fill maybe place in embankments in layers and depths as specified in the table below.

**Table 2 Limits for Placement of Rock Fill in Embankments**

| Distance below surface level of select layer | Maximum particle size (mm) | Maximum layer depth (mm) |
|---|---|---|
| 0.4–1.0 m | 75 | 200 |
| 1.0–2.0 m | 150 | 300 |
| >2.0 m | 400 | 600 |

## 3.3 Sampling and Testing

Earthworks shall be progressively tested to demonstrate the specified relative compaction has been achieved.

Field density testing shall be completed and certified by an independent NATA registered laboratory. The laboratory shall calibrate field density testing apparatus against laboratory tests.

**Table 3 Testing Requirements**

| Item | | Test/Record | Frequency |
|---|---|---|---|
| (i) | Topsoil stripping | Contractor's Certificate | 1 per project |
| (ii) | Finished Earthworks levels | Surveyed as-constructed drawing showing finished contours | 1 per project |
| (iii) | Compaction - bulk fill | Compaction Certificate | 1 per Lot, but not less than 1 per 500m2 |
| | Compaction – structural fill | Compaction Certificate | 1 per Lot, but not less than 1 per 200m2 |
| (iv) | Compaction - method specification | Contractor's Certificate confirming roller, passes, water used | For each layer on a grid agreed with Superintendent. |
| NB. Compaction tests should be adequately distributed so as to give a good representation of the whole area, including additional testing within 2 metres of corners and edges of earthworked area. | | | |
| (vi) | Retaining Walls: | | |
| | - Foundation Compaction | Compaction Certificate | Test per 10m length of wall |
| | - Backfill Compaction | Compaction Certificate | Test per layer per 50m2 |
| | - Finished Walls | As-constructed profiles with tolerances and locations | 1 per 20m length of wall |
| | - Stone Blocks | Density Certificate | 3 tests per project |
| | - Mortar | Certificate of sand:cement:lime ratio (6:1:1) | 1 per wall. |
| | - Antigraffiti Coating | Supplier's Application Certificate | 1 per coat. |
| | - Independent Certification | Independent Engineering Certification of Retaining Wall Construction | 1 per project |

## 3.4 Clearing

The clearing shall consist of removal from the area designated in the drawings of all trees, standing or fallen, and other vegetation, boulders and rubbish and shall include the grubbing out of all stumps and tree roots to a depth of 600mm below the natural surface or 400mm below the finished cut surface, whichever is the lower, and disposing of all spoils resulting from the clearing and grubbing. Any holes left after grubbing shall be filled and compacted to the same density as that of the surrounding undisturbed soil.

As little as possible of the surface soil shall be removed during clearing operations.

The Contractor shall take precautions to minimise damage to growing trees and shrubs, fences and other improvements outside the designated areas, and any damage shall be made good.

The spoils of all clearing and grubbing operations shall be removed from the Site. No spoils of clearing and grubbing shall be pushed beyond the limits of the site, or burnt.

Clearing must be approved by the Superintendent prior to further earthworks being commenced.

## 3.5 Mulching

Mulched material shall be generally 75mm maximum length and 15mm maximum diameter and shall be that material passing a 100mm maximum screen.

Chipping of logs between 200mm and 400mm diameter is acceptable (subject to Superintendent approval) however the chipped and mulched material shall be stockpiled in separate heaps.

All mulch and chippings are the property of the Principal and processed mulch/chippings shall not be used for any other purpose, nor removed from the site without specific approval from the Superintendent.

The intent of these works and this specification is to maximise the volume of mulch/chippings for use on stabilising fill batters and the contractor shall undertake all works accordingly.

Due to the risk of self-combustion, stockpiles are to be placed in areas away from bushland and assets, preferably on cleared land. Where this cannot be achieved, sufficient firebreaks should be created such that stockpiles are accessible to water carts from all sides of the stockpile.

Where practical, stockpiles shall be positioned where they will be in passing view of workers to assist in monitoring.

The tops of stockpiles shall be struck flat and are to be thinned out to a height not exceeding 2m.

Water carts are not to be driven over stockpiles as they may cause burnt material to collapse under the weight of the machine.

In the event of a small fire or smoke arising from a stockpile, the heap shall be smothered with sand or water. Where the fire or smoke persists, the stockpile shall be thinned out and sand or water shall be reapplied until under control.

Where a stockpile is in close proximity to water access, a pipe with sprinkler shall be attached to the top of the heap.

## 3.6 Stripping of Topsoil

The existing topsoil shall be stripped from all areas to be earthworked, prior to the commencement of the earthworks, and stockpiled on site at a location agreed with the superintendent.

Topsoil is defined as the layer of surface material containing humus, roots, plants, and organic material exceeding one percent by weight.

Topsoil shall be stockpiled in designated areas. The height of stockpiles shall not exceed 1m and shaped with the top of stockpiles evenly graded and sloped toward the outer extremely of the stockpile to facilitate good drainage.

Topsoil that is in excess to the site requirements for respread shall be disposed off-site at the Contractors cost.

## 3.7 Proof of Compaction

After the site has been stripped and prior to any further earthworks taking place, the site shall be proof compacted using either a:

Static smooth steel wheeled rollers shall have a mass of not less than 12 tonnes and a load intensity under either the front or rear wheels of not less than 6 tonnes per metre width of wheel.

Pneumatic tyred plant shall have a mass of not less than 20 tonne and shall have a ground contact pressure under either the front or rear wheels of not less than 450 KPa per tyre. The area over which this ground contact pressure shall be applied shall not be less than 0.035$m^2$ per tyre.

The following proof compaction procedure shall be utilised:

a. All bulk earthworks areas shall be given a minimum of 4 passes with the roller operating in the low frequency/high amplitude mode. Each pass shall include a minimum overlap of 20%.

b. The site shall then be given an additional minimum of 4 passes with the roller operating in the high frequency/low frequency mode. Each pass shall include a minimum overlap of 20%.

c. All weak areas, that deform excessively under rolling, shall be removed and replaced with compacted clean sand to the requirements of this specification.

d. On completion of vibratory rolling, 2 passes of the site shall be made with the roller operating in the static mode.

The Contractor shall advise the Superintendent when the proof compaction is due to be carried out, giving a minimum of 48 hours' notice.

## 3.8 Cutting to Design Levels

Following the removal of topsoil and proof rolling (if specified), areas shown to be cut shall be cut to achieve the levels shown on the drawings.

Any areas which are over excavated shall be refilled to the design levels shown on the drawings. Any refilling shall be placed as specified in "Filling to Design Levels".

Where no fill is to be applied, cut surfaces shall be finished by further proof rolling (if specified).

The Contractor shall make reasonable efforts to ascertain whether any rock exists within 600mm of the surface by test pitting or other methods.

Where unsuitable material is encountered at the base of excavations the Contractor shall obtain the Superintendent's prior approval before excavating and making good as directed and/or specified.

## 3.9 Rock Excavation

For the purpose of assessing rock the following criteria shall apply:

In bulk excavation - material which cannot be ripped by a crawler tractor dozer unit, having a nominal power rating of 225 kW fitted with a single shank ripper arrangement (Caterpillar D8 or equivalent).

In trench and / or footing excavation - material which cannot be removed by a 20 tonne hydraulic excavator.

Should rock be encountered in the course of the excavation work all means for its removal must be thoroughly tried and exhausted before recourse to blasting and then only with the written approval of the Superintendent.

Where blasting is permitted it shall be carried in accordance with Section 3.2 of this specification.

For the measurement of quantities the basis shall be in accordance with AS 1181.

Over-excavation in rock shall not be measured.

## 3.10 Filling to Design Levels

Filling materials shall be placed in horizontal layers of not more than 200 mm loose thickness and each layer tined and / or watered then compacted as appropriate to the required density before the following layer is placed.

**Type A fill** material shall be used beneath all building structures foundered on ground and compacted to a Maximum Dry Density of 99%. Also Type A fill to be used in the following situations:

a. backfill to walls and other constructed works such as pipes, access chambers etc.

b. refill to over excavated areas

c. refill to over excavated rock areas

d. within 600mm of the finished surface level for any areas of lot fill.

**Type A or B fill** material shall be used for all areas covered by pavements and compacted to a Maximum Dry Density of

a. 98% where placed within 400mm of the finished formation level.

b. 97% where placed more than 400mm below formation level.

For all other areas **Type C fill** material or better may be used and compacted to a Maximum Dry Density of 95%.

The Maximum Dry Density for the fill material shall be that determined using standard compactive effort in accordance with AS 1289.5.1.1.

The Contractor shall assess the fill quantities required within the earthworks area and allow to import any shortfall of fill.

## 3.11 Excess Spoil

Where after the completion of earthworks there is excess spoil it shall be placed on site if shown on the drawings or otherwise removed from the site at the Contractor's expense.

## 3.12 Subgrade Preparation

The sub-grade shall be trimmed to an even surface free from loose material.

Remove roots, boulders and other unsuitable materials such as silt or organic matter as directed by the Superintendent. Grade depressions to drain to the edge of the formation.

Where the subgrade is unable to support construction equipment or it is not possible to compact the overlying pavement because of a high subgrade moisture content the Contractor shall perform one or more of the following at no extra charge and without extension of time for completion:

Allow the subgrade to dry until it will support equipment and allow compaction; and / or

Scarify the subgrade to a depth of at least 200mm, work as necessary to accelerate drying, and re-compact when the moisture content approximates the optimum; and / or

Excavate the wet material and place and compact selected material to the standard specified for filling.

In cut subgrades, if over-excavation, other than excavation to remove unsuitable material, requires a replacement layer less than 100 mm thick, do not backfill, but make good by increasing the thickness of the lowest pavement layer.

## 3.13 Re-Spreading Topsoil

The topsoil shall be free of vegetation pieces larger than 200mm in any one direction. Topsoil shall be spread uniformly to a thickness not less than 50mm and not more than 100mm. Excess topsoil shall be removed from site at the Contractor's expense.

## 3.14 Tolerances

The design surface levels are the levels on the completed earthworks including respread topsoil where applicable. The completed earthworks levels shall be :

- within + 100mm to - 0mm of the design levels where there are no retaining walls; or
- within + 50mm to - 0mm of the design levels where retaining walls exist, are proposed, or will exist in the future.

Where material layer thicknesses are specified they shall be –

- within + 100mm to - 0mm of the design thickness for Type A1 – Structural Fill (Sand), Type A2 – Structural Fill (Gravelly Sand) and any other material described as 'sand' or 'structural fill'; or
- within ± 50mm of the design thickness for all other material types.

## 3.15 Stabilisation

### 3.15.1 Stabilisation by Topsoil and Seeding

Surface stabilisation shall be carried out with a minimum 50mm and maximum 100mm layer of topsoil, and also hydromulch with seed any disturbed areas as specified in the drawings. Where the Contractor has insufficient topsoil to achieve this minimum topsoil thickness the Contractor shall obtain the Superintendent's direction before proceeding further.

## 3.16 Finish

All finished surfaces shall be graded to the finished presentation stage prior to hydromulching, including:

- Rolling the finished earthworks prior to topsoil spreading
- Evenly graded changes between design levels and contours
- All wheel tracks and other disturbances levelled out
- Removal of all debris or rock pieces greater than 100mm in any direction from the surface
- Removal of all spoil heaps
- Rolling or smudge boarding the finished topsoil surface.

# 4. Stormwater Drainage

## 4.1 General

All the Works shall be constructed in accordance with the drawings and this Specification and will be subject to inspections and approval of the relevant Local Authority.

Any instructions from the Authority pertaining to the works shall be issued by that Authority to the Superintendent.

## 4.2 Quality Assurance

### 4.2.1 Testing Frequency

The Contractor shall produce and submit to the Superintendent verified records to confirm that the specification requirements have been achieved as follows:

**Table 3 Stormwater Drainage Testing Schedule**

| Item as Specified | Test/Record | Frequency |
|---|---|---|
| Materials Specification | Supplier's Certificate | 1 per delivery |
| Drain set-out | Contractor's Survey record | 1 per drain line |
| Drain Construction | Survey as-constructed details<br>Invert levels<br>Access chamber locations<br>Access chamber cover levels<br>Bedding details<br>Pit locations<br>Pit type/level<br>Pipe size/type | 1 per drain line |
| Backfill | Contractor's Certificate | 1 per drain line |
| Compaction | Compaction Certificate | 1 per layer per drain line. Test at each layer, near access chambers and along line. |
| CCTV | Report and video footage | 1 per drain line |

The contractor shall note on the record where any item fails to meet the specified requirements, including the planned remedial action to be taken.

## 4.3 Materials

### 4.3.1 Australian Standards

All workmanship and materials used in the Works shall conform to the current Australian Standard where such Standard exists. Where such Standard does not exist, the current Authority's Standard shall apply.

### 4.3.2 Concrete Pipes (RC)

All concrete pipes shall conform to AS 4058 and subsequent Amendments and shall be spigot and socket rubber ring joint type, unless otherwise specified or authorised by the Superintendent. Strength shall be "Class 2" unless otherwise noted on the drawings.

### 4.3.3 PVC Pipes

Rigid PVC drainage pipes and fittings shall be class stormwater HD with solvent cement type joints, manufactured in accordance with AS 1254.

### 4.3.4 Cast Iron Pipes

These pipes and fittings shall be of cast iron with rubber gasket mechanical joints and shall comply with AS1631.

### 4.3.5 Fiber Reinforced Concrete Pipes

These pipes and fittings shall be of "Class 2" or as otherwise shown in the Pipe Schedules or noted on the Drawings, complying with AS 4139; and shall have the following limitations on use:

Site fittings shall be concrete encased where the resin used to manufacture fittings has not been designed for the required stormwater drainage in-service application. Where these pipes are used in areas aggressive to concrete pipes the manufacturer's recommendations should be sought.

Pipes and fittings shall be autoclaved.

The type of pipe and method of jointing to be used shall be spigot and socket type with rubber ring joint. Alternative jointing types may only be used with the approval of the Superintendent.

### 4.3.6 Polyethylene & Polypropylene and Pipes & Fittings

Polypropylene pipe and fittings shall be in accordance with AS/NZS 5065. Pipes for stormwater drainage shall be rubber ring jointed (RRJ). Examples of stormwater drainage pipes include "StormPro" by Vinidex Pty Ltd and "BlackMax" by Iplex Pty Ltd. Equivalent alternatives may be used where approved by the Superintendent.

### 4.3.7 Precast Concrete Box Culverts

Precast culverts shall be of the reinforced concrete lid type, soundly constructed and comply with AS 1597.2.

### 4.3.8 Galvanized Steel and Malleable Cast Iron Pipes

Galvanized steel pipes and malleable cast iron shall comply with AS/NZS 3500.

### 4.3.9 Vitrified Clay or Ceramic Pipes & Fittings

Vitrified clay or ceramic pipes and fittings shall be as specified in BS EN 295-1.

### 4.3.10 Concrete

Concrete shall conform to AS 3600 and shall be supplied by a concrete supplier conforming with AS 1379.

Concrete shall have a characteristic strength of 25 MPa (N25), 60mm slump and maximum aggregate size of 20mm.

Concrete strength shall be tested by means of product assessment methods in accordance with Section 20.4 of AS 3600. The Contractor shall register the project and arrange for results to be sent to the Superintendent.

On site mixing of concrete may be used subject to the Contractor's proposal of mix details being submitted to, and approved by the Superintendent. Site mixed concrete shall be subjected to site testing for slump and strength in accordance with the relevant Australian Standards.

### 4.3.11 Cement

All cement used shall be Portland Cement in accordance with AS 3972 and obtained from an approved manufacturer.

Cement shall be delivered to the site fresh and in sealed bags and there stored in a weatherproof shed until such time that it is to be used. Any bag showing sign of deterioration or setting shall be rejected.

### 4.3.12 Aggregate

Fine aggregate shall be well graded, clean, sharp and free from clay and organic impurities in accordance with AS 1141.

Coarse aggregate shall be crushed granite or diorite clean and free from all impurities and dust in accordance with AS 1141.

The maximum particle size shall not exceed 20mm.

### 4.3.13 Water

Water for use in concrete and mortar shall be of potable quality, free from any impurities harmful to concrete, mortar or steel.

### 4.3.14 Sand

Sand for mortar will be crushed stone or natural sand in accordance with AS 2701.4-2001.

Sand for bedding or backfilling shall be clean sand or fine gravel as defined by AS 1289 grading chart figure C6.1.1. It shall be free from roots, clay or any deleterious matter and shall have a maximum nominal particle size of 4.75mm.

### 4.3.15 Steel

Steel reinforcing fabric and steel reinforcing bars for concrete shall comply with the requirements of AS 1302, AS 1303 and AS 1304 and be free from loose rust or matter likely to impair the bond with concrete.

Structural steel shall comply with the requirements of AS 4100.

### 4.3.16 Bricks

Bricks shall be hard, well burnt, pressed or wire cut clay brick in accordance with AS 1225 and AS 3700 for Class A bricks, having a minimum ultimate strength of 30 MPa and absorbing when saturated, not more than 10% of their own weight of water.

Bricks shall be of uniform shape and size, carefully conveyed and unloaded by hand at the site. No chipped or broken bricks shall be used, and no pieces of brick to be used except where necessary as closures.

Face bricks where applicable shall be carefully picked for uniform colour, sharp arises, etc. The colour shall be selected by the Superintendent.

## 4.4 Setting Out

### 4.4.1 General

The drawings show centre lines, grades, lengths, diameters, invert levels at entry and exit of drains and the location of access chambers.

The distances shown between access chambers are mostly scaled measurements and are for the Contractor's guidance only. In all instances access chambers are to be constructed in the locations shown. Centre lines and invert levels are to be strictly adhered to and no alterations shall be made except on the written authority of the Superintendent.

### 4.4.2 Setting out of Drainage Lines

Centre lines and profile levels for fixing invert levels shall be set out by an Engineering Surveyor, arranged for by the Contractor at their expense.

Profiles shall be set such that there are never less than 3 profiles between access chamber locations or between an access chamber and a headwall or end-wall.

### 4.4.3 Pegging of Access Chambers, Headwalls and Endwalls

Each access chamber is to be pegged and levelled by the Contractor's Engineering Surveyor.

The centre of each access chamber shall be pegged and at least two reference stakes at 5 metres offset on either side of the access chamber centreline shall be provided.

The Contractor's Engineering Surveyor shall provide the Contractor's Foreman with a copy of their survey record for each drain. The record shall indicate all reference pegs, offset pegs, RLs of dumpy pegs, access chamber to access chamber distance, distance to house connections (where applicable) and the height of boning rods. Records shall be retained by the Foreman on Site and shall be available for inspection by the Superintendent.

## 4.5 Excavation

### 4.5.1 General

Clearing, topsoil and stabilisation shall be carried out in accordance with the Earthworks section of this specification.

### 4.5.2 Dewatering

The Contractor shall allow within their Tender the cost of all dewatering and any additional construction costs due to wet ground conditions.

In the event of water being encountered, the Contractor shall make adequate provision to ensure that the excavation is kept free from water during the process of concrete pouring and for a period of at least 24 hours after the concrete pour. No bedding or pipes shall be laid in water and trenches are to be kept free from water until refill is commenced.

### 4.5.3 Trench Excavation

Trenches are to be cut to line and gradient. The line of cut for each side of the trench shall be marked out on the surface before excavation commences.

The trench widths shall be kept to a minimum consistent with the bed width requirements and the requirements of adequate working space and timbering.

Tunnelling shall be only carried out where directed by the Superintendent, and the Contractor shall submit details of method prior to commencement for the approval of the Superintendent.

Should the bed of the trench be over excavated, then the over-excavated volume shall be replaced in accordance with the Earthworks section of this specification.

All trench excavation shall be made in a safe manner, the trenches either being shored or battered back to achieve this. The Contractor shall comply with the Construction Safety section of this specification.

Trenches shall be kept free from water, debris and falling earth.

The final trimming of the bottom 150mm of trench excavation must not be carried out until immediately prior to concreting or placing of pipe bedding. Excavation must be completed for a minimum of 10 metres length ahead of pipe laying.

### 4.5.4 Access Chamber Excavation

Excavation for access chambers must be made to the correct depth and of sufficient dimensions to allow the base and walls to be constructed.

The Contractor shall be responsible for safety at all times.

### 4.5.5 Excavation in Roadways, Footpaths etc.

Excavation is to be kept to a minimum in existing roadways, footpaths, and other paved areas, ensuring that damage to such structures is kept to a minimum. The Local Authority shall be notified, and that Authority's approval received prior to commencing work in roadways and footpaths.

### 4.5.6 Measurement of Excavation

Measurement of excavation for the purpose of costing variations shall be in accordance with the minimum trench dimensions shown on the drawings, and measurement shall comply with AS 1181 "Method of Measurement of Civil Engineering Works."

### 4.5.7 Obstruction to Traffic

Excavation material shall be deposited in an area causing the least interference to vehicular and pedestrian traffic.

At all times when the works are left unattended, all excavation in public areas shall be fenced off with warning signs and lighting and the Contractor shall ensure that they remain in a safe condition.

These safety precautions shall be subject to the approval of the Superintendent.

## 4.6 Drain Construction

### 4.6.1 Pipe Setting

All pipes shall be set in a straight line between access chambers or between access chambers and headwalls. On inspection by the Superintendent, any pipe not placed in a straight line shall be replaced at the cost of the Contractor.

Pipes shall be set in an upstream direction unless otherwise approved by the Superintendent.

### 4.6.2 RC Concrete Pipe Jointing

Spigot and socket pipes shall be jointed with the spigot fully home in the socket and rubber ring joint. Pipes shall be laid such that the sockets face upstream.

### 4.6.3 PVC Pipe Jointing

PVC pipes shall be jointed with the spigot fully home in the socket and the joint solvent cemented. The solvent cement used shall be the product recommended by the pipe manufacturer. The solvent cement shall be applied using a clean brush to both surfaces of the joint after these surfaces have been cleaned.

## 4.7 Pipe Bedding

Pipe bedding shall be constructed as shown on the drawings. Pipes constructed in dry conditions shall be bedded on a shaped trench base. Pipes constructed in wet ground conditions shall be bedded on a crushed rock bedding, all in accordance with the drawings.

Pipe sockets shall not bear on the bedding material either prior to or during jointing and the socket recesses in the trench shall be firmly filled with bedding material prior to backfilling the trench.

## 4.8 Laying

Pipe laying shall proceed in an upstream direction unless otherwise specifically approved.

All pipes shall be laid true to lines, grades, depths, diameters and dimensions shown on drawings complete with all necessary bends, junctions, pipe and pit connections to construct the drain.

Pipes as laid shall be new and unused, free from cracks, chips and distortions. Repaired pipes will not be accepted.

When laying rubber ring jointed pipes the first pipe in every run of drain shall be firmly staked in position before the remainder of the line is laid. At periods of delay in laying the ends of the pipe shall be adequately fixed to prevent joint creep.

Box culverts shall be laid with the lid uppermost unless otherwise specified.

## 4.9 Jointing

All foreign material shall be removed from pipes and fittings before jointing and pipes cleaned again after jointing to remove any surplus jointing material.

### 4.9.1 Rubber Ring Joints

All rubber rings shall comply with AS 1646 and shall be kept dry and dusted with dry cement or other powder.

Before inserting the spigot of a fresh pipe into the socket of that previously laid, both spigot and socket shall be carefully cleaned of all dirt and foreign material. A clean rubber ring shall be used, accurately guided and centred on the socket and forced into place using appropriate lever tools where necessary, until the pipe is fully home in the socket. The joint shall be checked with a gauge to ensure that the rubber ring has travelled uniformly home. Defective joints shall be immediately remade.

### 4.9.2 Rebated Pipes – Mortar Joints

The jointing cavities of rebated pipes shall be cleaned prior to making the joint and after wetting shall be completely and neatly filled with mortar of 3:1 sand-cement mix. Inverts shall be maintained true.

### 4.9.3 Spigot and Socket Pipes – Mortar Joints

Spigot and socket pipes with mortar joints shall have the spigot driven fully into the socket with inverts maintained true. The inside of the socket shall be wetted and then caulked with freshly mixed mortar of 3:1 sand-cement mix and trowel finished neatly against the outside of the pipe with a 45 degree splay from the edge of the socket.

### 4.9.4 PVC Pipes

PVC pipes and fittings shall be jointed using a solvent cement or rubber ring joints. Care shall be taken to keep joints and pipes clean internally as work progresses.

### 4.9.5 Box Culverts

Culvert sections shall be laid as close together as possible with joints firmly caulked with mortar of 3:1 sand-cement mix.

## 4.10 Connections

### 4.10.1 Connection of Downpipes

Each downpipe shall be brought out from the building at a suitable angle and level which will bring its entry to the underground drain at the finished level of the surrounding area.

Connection shall be made by entering the downpipe into the socket of an underground 90 degrees bend, or a straight pipe vertically upstream of the bend, and neatly sealing the joint with an appropriate jointing material.

The top of the entry socket shall be set dead level and 50 mm above the finished surface level.

The connection of the downpipe shall be completed from the 90 degree bend through the necessary straight pipes at right angles to the building to connect through a 45 degree bend to an oblique junction in the main stormwater drain, or through the wall of a pit, as indicated on drawings.

### 4.10.2 Connection to Existing Pits

Where it is necessary to connect pipes to existing pits care shall be taken to only demolish that part of the pit wall as is necessary to insert the new pipe and secure it at its correct level.

The new pipe shall then be jointed to the pit with mortar, of 3:1 sand-cement mix, for the full thickness of the pit wall. The pipe entry and mortar shall be finished off neatly and flush with the internal face of the pit wall.

### 4.10.3 Connection to Existing Drains

Where it is necessary to connect 100 mm diameter pipes to existing stormwater drains of up to 225 mm diameter the connection shall be made through an oblique junction. An appropriate length of the existing drain shall be removed and replaced by an oblique junction together with the necessary straight pipes to reform the drain.

The reconstructed section of drain shall conform in material, size, level and grade with the existing pipe and shall be made good to the satisfaction of the Superintendent.

Where it is necessary to connect 100 or 150 mm diameter pipes to existing stormwater drains of 300 diameter and larger care shall be taken to only break out that part of the existing pipe wall as is necessary to insert the new pipe at the required level. The invert of pipes entering existing drains by this method must be at least 75 mm above that of the existing drain. Entry shall be at 45 degrees to the existing drain and facing downstream with the end of the entry pipe shaped to conform with the entry angle. The end of this pipe shall be inserted into the prepared hole in the drain wall to a position flush with the inner wall.

The new pipe shall then be jointed to the existing drain with mortar, of 3:1 sand-cement mix, or other appropriate jointing material, for the full thickness of the drain wall and finished off neatly externally with a 45 degree splay between pipes.

## 4.11 Drainage Pits

Drainage pits shall be constructed of concrete and to the type, dimensions and details indicated on the drawings.

Excavations for pits shall be trimmed neatly to size so as to give the exact thickness of walls as required. Forms for pits shall be constructed in a workmanlike manner to exact dimensions and shall be suitably lined so that a smooth finish is obtained without the use of rendering.

Concrete shall be at minimum 28 day strength, F'c of 32 MPa and when placed shall be well rammed to ensure thorough consolidation.

Drainage pits shall be bedded on compacted sand or FCR compacted in accordance with details shown on the drawings.

Drainage pits shall be constructed on a precast or cast insitu concrete base.

The pit shall be constructed cast insitu or prefabricated to details shown on the drawings. Prefabricated pits used will be subject to approval by the Superintendent and shall be comply with all relevant Australian Standards the Australian Road Bridge Code Design and other relevant local authority standards.

## 4.12 Pit Covers

Pit covers shall be either cast iron, precast concrete covers or gratings and shall be constructed and fixed to pits in accordance with details as shown on drawings.

The covers to all side entry pits shall be of an approved type and constructed to the details as shown on drawings.

Where indicated on project drawings stormwater pits shall be fitted with covers constructed of cast iron and consisting of a cast iron surround frame fitted with a cast iron cover of cross webbed cellular construction filled with concrete. Covers shall be gas-tight and shall have lifting holes formed in the cast iron near the edge of the cover suitable for the use of standard lifting keys. Plastic plugs shall be provided in all lifting holes.

Pit covers shall comply with AS 3996.

The final line and grade of all pit covers shall match the finished line and grade of the adjoining floor, pavement, kerb and / or channel or garden area as appropriate and to the approval of the Superintendent.

## 4.13 Grates

Grates shall comply with AS1428:1:2009. Grates shall also comply with the following:

- Circular openings shall be not greater than 13mm in diameter.
- Slotted opening shall be not greater than 13mm wide and be oriented so that the long dimension is transverse to the dominant direction of travel.

Note: Where slotted openings are less than 8mm, the length of the slots may continue across the width of paths of travel.

## 4.14 Step Irons

Where access chamber or entry pits exceed 1.0 metres in depth, measured from top of cover to invert level of the base, step irons shall be provided at 300mm centres for the full depth of the access chamber as detailed on the drawings and in accordance with AS 1657-1992.

## 4.15 Headwalls and Endwalls

These are to be constructed using either concrete with 25 MPa 28 day cylinder test compressive strength or mortared stonework as detailed on the drawings.

For mortared stonework the size and quality of the stone shall be as specified for Stone Pitching.

## 4.16 Rock Pitching

Rocks shall generally weigh in excess of 10 Kg each and the greatest dimension of any stone shall not exceed 1.5 times its least dimension.

Rocks shall be hard, sound and durable, shall be set on a sand bed in a close fitting pattern and watered and rammed into position.

Where specified as mortared stone pitching, the joints between rocks shall be raked clean for their full depth and grouted with a 3 parts sand to 1 part Portland Cement mortar.

## 4.17 Pipe Supports

Where shown on the drawings underground stormwater drainage pipes installed under the suspended ground slabs are to be tied into the structural slab with stainless steel hangers and clips to ensure the pipe is supported in the event of bedding or backfill movement.

Clip details are to be certified by an independent Structural Engineer engaged by the Contractor prior to manufacture or installation and for underground stormwater pipes , the minimum requirements are:

- Clips shall be manufactured from Grade 316L Stainless Steel.
- Clips shall be installed at 600mm minimum centres for uPVC stormwater pipes shown on drawing.
- For clips with hangers up to 1400mm in length, minimum strap size shall be 25mm by 4mm with an 8mm stainless steel nut and bolt complete with washers.
- For clips with hangers over 1400mm in length, the minimum strap size shall be 25mm by 6mm with a 10mm stainless steel nut and bolt complete with washers.
- Each hanging strap shall be tied to the top reinforcing bars. The method of connection to the structural reinforcement bars must be approved by the project's Structural Engineer.
- The parts of the clips embedded into the concrete shall be epoxy coated to isolate the hanger from the structural reinforcement.
- Each hanging strap must be folded at right angles in the slab for a minimum distance of 100mm.

The Contractor must submit certification by an independent Structural Engineer prior to manufacture or installation of any clips for approval.

Once backfill has been completed, the Contractor must certify that none of the clips have moved and provide sufficient signage, barriers, barricades and lighting etc to ensure that traffic over the trench is prohibited.

Each clip strap must be custom cut to ensure the top fold of the clips are at the same level.

## 4.18 Backfilling of Pipe Trenches

### 4.18.1 Plain Pipes

Type A fill or FCR shall be used for backfilling to a height of 300mm above the top of pipes and shall be compacted by means of an approved mechanical or a pneumatic tamper to not less than a density ratio of 95% as obtained in AS 1289.5.4.1 (modified compactive effort).

Care shall be taken so as not to disturb the pipe. Backfilling of the remainder of the trench shall be in accordance with the Earthworks section of this specification.

### 4.18.2 Perforated Pipes

Selected 10mm filter aggregate shall be used for bedding and backfilling to the pipe and shall be not less than 150mm thickness below and above the pipe and for the full width of the trench which shall be not less than 150mm either side of the pipe. The remainder of the trench shall be backfilled in accordance with the Earthworks section of this specification.

## 4.19 Testing of Trench Backfill Density

The trench backfill density shall be tested in accordance with the Earthworks and Quality Assurance – Drainage sections of this specification.

## 4.20 As-Constructed Survey and Documentation

### 4.20.1 Survey

Using the Contractor's quality assurance measure up (see Quality Assurance - Drainage), the "as constructed" survey shall be carried out and the results recorded by the Contractor's Licensed Surveyor.

The survey shall include all invert levels at access chambers, entry pits, headwalls and endwalls, centre to centre distance of pits, distances from centre of pits to headwalls or endwalls, size of pipes, types of pipes and bedding, location of pits in relation to adjacent boundaries, reduced levels of access chamber and entry pit covers.

### 4.20.2 Drawings

"As Constructed" drawings, conforming to the Local Authority's standards, shall be produced by the Contractor.

These drawings, when completed, will be submitted by the Superintendent to the Local Authority for their approval.

## 4.21 Tolerance and Acceptance

### 4.21.1 Tolerances

The horizontal deviation of any piped or box culverted drain shall not exceed 25mm from the true alignment. There shall be no obvious sharp changes of direction.

The maximum deviation from grade shall not exceed + or - 10mm for grades flatter than 1 in 500 and + or - 20mm for grades steeper than 1 in 500.

The grade of any piped, box culverted or open drain shall not exceed + or - 5% for grades flatter than 1 in 500 and + or - 10% for grades steeper than 1 in 500.

Invert levels at structures shall not exceed + or - 10mm from the design invert.

### 4.21.2 Acceptance

Acceptance of the works will follow the satisfactory completion of the works, authority inspection and acceptance of as-constructed documentation.

## 4.22 Cleaning Up

Any damage done by the Contractor or their employees to buildings, fences, services, etc. shall be immediately made good to the approval of the Superintendent.

During the period of the Contract, the Contractor shall clean up the construction site and remove all surplus construction material and debris from the site. At the completion of the Contract the Site shall be clean and tidy, all excavations filled flush with the natural ground level, and all excess material removed.

The Contractor shall immediately reinstate any subsidence over trenches occurring at any time during the maintenance period.

## 4.23 Stormwater Pump Sets

### 4.23.1 Stormwater Wet Well

Stormwater pump wet well shall be provided to the detail as shown on the project drawings.

The hydraulic Contractor shall provide all internal fittings, ladders, chains, vents, Gatic type covers, pumps etc., as detailed on the drawings.

### 4.23.2 Submersible Stormwater Pump Sets

Submersible stormwater pump sets shall be as nominated on the Drawings and installed in accordance with the Manufacturers requirements. Equivalent pump sets may be used with the approval of the Superintendent.

Pumps to have hot dipped galvanised guide rails and lifting chains and water proof electrical leads. Chains, guide rails and leads to be of sufficient length to allow removal of the pump/s without the need to enter the pump sump.

Pump system shall operate with water level regulators operating with pump control panel. Control Panel to be located within the Facilities Manager's room or as approved by the Superintendent.

Pump operation shall incorporate the following:

a. Low level.

b. Pump stop.

c. Lead pump start.

d. Lag pump start.

e. High level.

Pump sequence shall alternate lead pump after each operation (duplex controls).

Pump controls shall be fitted with manual override pump start / stop.

Provide two sets of points free contacts within control panel.

Provide electrical conduit for pump and level control in accordance with the Manufacturers recommendations.

Control panel shall be vandal-proof and weather-proof. The Control Panel shall be fitted with a visual and audible alarm system to alert the responsible person/s of pump failure and high water level.

Pump line shall be a minimum of Class 12 uPVC or polyethylene pipe and be provided with a gate valve and non-return valve.

Any alternative pump system must be approved by the Superintendent by submitting full technical data and pump curves for approval.

# 4.24 Sub-Soil Drains

## 4.24.1 Scope

Specified in this section of the Specification is the supply of materials and construction of sub-soil drains.

Materials

Material shall be as indicated on the project drawings and / or shall conform to the following:-

a. uPVC slotted spigot and socket sub-soil drainage pipes.

b. Fibre reinforced cement slotted spigot and socket sub-soil drainage pipes.

c. Perforated corrugated polyethylene continuous tubes.

## 4.24.2 Trench Excavation

Excavations for sub-soil drains shall conform generally to the requirements specified for excavation for services subject to the following specific requirements and modifications:

a. Trench depth and width shall be as shown on the Drawings.

b. Trench bases shall be uniformly graded to an even fall as necessary to suit whichever of the following is applicable:

c. Parallel with pavement or kerb and channel formation grade.

d. Parallel with overall grade of stepped footings.

e. Not less than 1 250.

If it is not possible to conform to any of the above requirements, the Contractor shall notify the Superintendent and await direction before continuing with the affected part of the work.

## 4.24.3 Outlets

Underground outlets shall be installed through walls of pits at suitable levels, provided that inverts are not below the level of the top of the outfall drain.

If a surface outlet other than through a wall is required, the transition length from full depth to zero depth shall be as short as possible.

## 4.24.4 Bedding

The bottom of the trench shall be well compacted and evenly graded with a reasonably smooth surface at the required gradient. If rock excavation was necessary and if the bottom of the trench is uneven, all low and rough areas shall be filled and solid rock outcrops covered with bedding material to a compacted thickness of not less than 20 mm.

## 4.24.5 Pipe Laying

The pipes shall be laid true to line and gradient on the graded compacted bedding.

Pipes shall be jointed to fit tightly by pushing the spigots firmly into the sockets. For pipes without sockets, special end jointing fittings shall be used.

Fittings shall be compatible with pipe material.

### 4.24.6 Backfilling

After installation of sub-soil drains 20 mm nominal one size screenings or equivalent washed gravel free from fines and other unsuitable materials shall be used to fill the trenches to the required levels.

Particular care shall be taken in placement of the screenings to ensure that the pipes and jointing materials are not displaced or damaged.

The screenings shall be carefully packed around the pipes and, after the pipes have been covered, shall be evenly spread in layers of not more than 300 mm loose thickness and each layer well compacted before placement of following layers.

Where the sub-soil drain is below concrete floor slabs, concrete paved areas, or sealed road pavements, the backfilling material shall extend up to the underside of the slab or pavement.

Where the sub-soil drain is below garden beds or grassed areas, the backfill material shall extend up to within 225 mm of finished surface level and shall be covered with fine fibreglass or plastic flyscreening or other approved material in strips equal to the width of trench. The top of the trench shall be filled with re-used turf sods, top soil or good quality garden soil. The surface of the soil shall be finished to the required levels.

# 5. Roadworks

## 5.1 General

All these works must be constructed in accordance with the drawings and this specification and will be subject to inspection and approval of the relevant Local Authority.

Any instructions from the Local Authority pertaining to the Works must be issued by that Authority to the Superintendent.

## 5.2 Standards

The following standards are referred to or are relevant to this section:

AS 1141 Methods of sampling and testing aggregates.

AS 1160-1996 Bituminous emulsions for the construction and maintenance of pavements.

AS 1289 Methods of testing soils for engineering purposes.

AS 2008-1997 Residual bitumen for pavements.

AS 2150-2005 Hot mix asphalt - A guide to good practice.

AS 2157-1997 Cutback Bitumen.

Vic Roads Standard Specifications for Roadworks and Bridgeworks.

## 5.3 Quality Assurance - Roadworks

The Contractor shall produce and submit weekly to the Superintendent verified records to confirm that the specification requirements have been achieved as follows:

**Table 4 Roadwork Quality Requirements**

| Item as Specified | | Test/Record | Frequency |
|---|---|---|---|
| **1.** | **Subgrade** | | |
| | - Removal of unsuitable material | Marked-up plan | Each occurrence |
| | - Finished level, alignment, width | Marked-up road plan | 20m intervals |
| | - Compaction | Compaction Certificate | 1 test per 1000m2 of road |
| **2.** | **Sub-base** | | |
| | - Finished level, depth of layer, alignment, width | Marked-up road plan | 20m intervals |
| | - Compaction | Compaction Certificate | 1 test per 1000m2 of road |
| | - Material Specification | Supplier's Certificate | 1 test per project |

| | | | |
|---|---|---|---|
| **3.** | **Basecourse** | | |
| | - Finished level, depth of layer, alignment, width | Marked-up road plan | 20m intervals |
| | - Compaction | Compaction Certificate | 1 test per 1000m2 of road |
| | - Material Specification | Supplier's Certificate | 1 test per project |
| **4.** | **Sprayed Primes and Seals** | | |
| | - Material Specification | Supplier's Certificate | 1 per coat |
| | - Actual bitumen application (temperature, rate area sprayed) | Bitumen spray record | Each day |
| | - Cover application rate | Application record | Each day |
| **5.** | **AC Seal** | | |
| | - AC Mix Specification | Supplier's Certificate | 1 for each day |
| | - Compaction | Confirm rolling procedure | 1 for each day |
| | - Depth of layer, finished levels | Marked-up roads plan | 20m intervals |
| | - Check for ponding | Contractor's Certificate | 1 for each day |
| **6.** | **Clay Brick Paving** | | |
| | - Material Specification | Supplier's Certificate | 1 per project |
| | - Bedding sand | Grading curve | 1 per project |
| | - Joint filling sand | Grading curve | 1 per project |
| | - Check for ponding | Contractor's Certificate | 1 per project |
| | - Accelerated loading | Contractor's Certificate | 1 per project |
| **7.** | **Kerbing** | | |
| | - Concrete Specification | Supplier's Certificate | 1 per deliver |
| | - Width between kerb, contraction joints, expansion joints. | Marked-up road plans | Width at 20m intervals, all joints. |
| | - Curing | Contractor's Certificate | 1 for each day commenced and completed. |
| **8.** | **Street Signs** | | |
| | Posts and footings | Contractor's Certificate | Each footing to be noted. |

All Compaction Tests shall be adequately distributed so as to give a good representation of the whole area.

The Contractor shall note on the record where any item fails to meet the specified requirement and the planned remedial action to be taken.

## 5.4 Tolerances

The following construction tolerances shall be achieved by the Contractor.

| Item as Specified | Test/Record | Frequency |
|---|---|---|
| 1. | Road centreline alignment | + or - 100mm of centreline of road reserve |
| 2. | Finished subgrade level | + 5mm or - 30mm ( +0mm ) |
| 3. | Sub-base width | + 300mm and - 0mm |
| 4. | Finished sub-base level | + 10mm or - 20mm |
| 5. | Basecourse width | + 300mm and - 0mm |
| 6. | Basecourse thickness | - 0mm |
| 7. | Finished basecourse level | + 10mm or - 10mm |
| 8. | Basecourse surface shape: | |
| | (a) Crossfall | + or - 0.5% of design |
| | (b) Surface | + or - 15mm when tested with a 3m straight edge, laid in any direction. |
| | (c) Longitudinal grades | The gutter grade shall be + or - 20% of the design grade. |
| 9. | Width of prime for AC | + 150mm or - 0mm |
| 10. | Width of primer seal | + 150mm or - 0mm |
| 11. | Thickness of AC | + 5mm or - 0mm |
| 12. | Finished AC or brick paving level | + 10mm or - 10mm |
| 13. | Kerbing: | |
| | - Surface | + or - 5mm when tested with a 3m straight edge |
| | - Level | + or - 5mm |
| | - Line | + or - 10mm |

## 5.5 Quality Assurance Auditing

In order to audit the Contractor's testing programme, routine testing of materials and workmanship over and above the quality assurance schedule may be called for from time to time by the Superintendent at each stage of the roadworks. No work shall be commenced on the next stage until the existing work has been tested and approved by the Superintendent.

It shall be the Contractor's responsibility to advise the Superintendent when each stage of the work is ready for testing. All tests shall be arranged for by the Contractor at locations directed by the Superintendent with an independent testing authority registered with the National Association of Testing Authorities Australia for the tests required.

The Contractor shall give the Superintendent four (4) days notice of when the work will be ready for compaction tests. The Superintendent shall direct the location and type of testing required. The results of all tests shall be issued to the Superintendent by the Testing Authority.

All tests shall be paid by the Contractor directly to the Testing Authority concerned.

The Contractor may claim the cost of all tests requested by the Superintendent over and above the quality assurance schedule and the results of which indicate that the work or material is in accordance with the Contract.

Where tests indicate that the work or material is not in accordance with the Contract, the cost shall be borne by the Contractor.

## 5.6 Materials

### 5.6.1 Australian Standard

All workmanship and materials used in the Works shall conform to the current Australian Standard where such Standard exists. Where such Standard does not exist the current Authority's Standard shall apply.

### 5.6.2 Crushed Rock (Rock Base)

Crushed rock is composed of rock fragments produced by the crushing, scalping and screening of igneous, metamorphic or sedimentary source rock, with or without additives, produced in a controlled manner to close tolerances for grading and plasticity. Source rock shall be in accordance with VicRoads Standard Specification Section 801.

Crushed rock to be used in pavement build-ups shall be as shown on the drawings. For the purpose of this specification crushed rock is to be supplied in various classes broadly defined as follows:

- **Class 1** is a premium cohesive pavement base material for unbound pavements where a very high standard of surface preparation for a sprayed sealed or thin asphalt surfacing is required. It has a minimum Plasticity Index requirement and may have additional requirement for maximum permeability when used for heavy duty unbound pavements.
- **Class 2** is a high quality pavement base material for unbound flexible pavements in locations where a very high standard of surface preparation may not be required. Class 2 crushed rock does not have a minimum Plasticity Index or a maximum permeability requirement.
- **Class 3** is a high quality upper subbase material for heavy duty unbound flexible pavements. It may have a minimum permeability requirement to provide positive drainage to the sub-surface drains. Where specified, Class 3 may be used as base for lightly trafficked pavements provided the material produces sufficient cohesive fines during compaction.
- **Class 4** is a lower subbase material for heavy duty pavements or a subbase material for most other types of pavements. It may have a maximum permeability requirement.

All crushed rock shall conform to the current Vic Roads Standard Specifications for Roadworks and Bridgeworks Section 812 "Crushed Rock for Base and Subbase Pavement".

Where a class of crushed rock is specified, that class shall be regarded as the minimum standard of material, which is acceptable. Class 1 or Class 2 material as specified shall be used for base courses and Class 3 for sub-base courses unless otherwise noted.

A sample shall be taken and tested by the Testing Authority for grading, liquid limit, plastic limit, plasticity index, linear shrinkage, dry compressive strength and maximum dry density of the material. If the material varies in quality or is obtained from various quarries,

each variation in quality, or, material from each quarry used shall have this test performed by the Testing Authority and a record shall be maintained by the Contractor as to where the various materials have been placed.

Notwithstanding this specification, any sample which, in the opinion of the Superintendent, is composed of unsuitable material, or is composed of material which would break down with aging or weathering to such an extent that it would then fall outside the limits of this specification, shall be rejected.

### 5.6.3 Bitumen

The bitumen used is to be a straight run slightly blown bitumen distilled from an asphaltic base petroleum. The grade is to be Class 170 (140-200 pascal second viscosity at 60 degree Celsius). The bitumen is to conform to AS 2008 and the current Austroads Guide to Pavement Technology Part 3. The minimum density at 25 degrees Celsius shall be 1.0 Kg per litre.

### 5.6.4 Cutting Oil

The cutting oil to be used shall be medium curing (kerosene or similar approved product) conforming to the following requirements:-

**Table 5 Cutting Oi Specification**

| Property | Requirement |
|---|---|
| Initial boiling point | 132-160°c |
| Final boiling point | 265°c Max |
| Temperature at 50% recovery | 220°c Max |
| Flash point (open) | 35°c Min |
| Density at 25°c | 0.78-0.82kg/L |
| Percentage aromatics | 15% Min (volume) |
| Miscibility with equal parts of Class 170 bitumen | Complete, no precipitation |
| Viscosity at 40°c | 1.0 - 1.4mm sq/s |
| Water content | 0.05% Max |

### 5.6.5 Fluxing Oil

The fluxing oil shall be slow curing petroleum product distillate fuel oil conforming to the following requirements:-

**Table 6 Flux Oil Specification**

| Property | Requirement |
|---|---|
| | |
| Initial boiling point | 170-195°c |
| Final boiling point | 360-400°c |
| Temperature at 50% recovery | 250-2900c |
| Flash point | 65°c |

| | |
|---|---|
| Miscibility with equal parts of Class 170 bitumen | Complete, no precipitation |
| Viscosity at 40°c | 2.0–4.0mm sq/s |
| Water content | 0.05% Max |

### 5.6.6 Bitumen Emulsion

Bitumen emulsion shall conform as regards physical qualities, sample and testing with the AS 1160, with the following amendments :-

a) Water Content - the emulsion shall not contain more than 40% by weight of water.

b) Specific Gravity - the specific gravity at 16 degrees Celsius shall not be less than 1.00.

c) Bitumen used is to be class 170.

Alternative specification can be submitted by the Contractor provided that:

d) Bitumen content - the residual bitumen content of the emulsion must be stated.

e) Additives - the addition of up to 2% by volume of additives may be required by the Superintendent.

f) Patents - the emulsion to be used shall be manufactured under an approved patent.

Contractor must set out facilities and have spray tankers available for spraying emulsion direct onto the road.

### 5.6.7 Primer

Primer shall be medium curing cutback bitumen complying with the requirements of AS 2157, Grade AMC O, or an equivalent approved proprietary grade of special cutback bitumen.

### 5.6.8 Primer Binder

Primer binder shall be bitumen emulsion of grade ARS or CRS manufactured from Class 170 bitumen and complying with the requirements of AS 1160, or an equivalent approved proprietary grade of special cutback bitumen, or field produced cutback bitumen produced by blending Class 170 bitumen and cutter.

### 5.6.9 Aggregate

The aggregate used for surfacing roads shall consist of crushed basalt stone which shall consist of clean, tough, durable fragments free from an excess of thin or elongated pieces, free from soft or disintegrated pieces, stone coated with dirt, or other deleterious matter, in compliance with AS 2758.2.

The Bulk Specific Gravity of the particles of diorite shall not be less than 2.90 (2.60 for granite).

Should it be found on testing that material delivered to stockpile does not conform to these specifications, such material shall be removed from the site and replaced with suitable aggregate.

Flakiness index of granite shall not exceed 30.

The Los Angeles abrasion loss shall not be greater than 30%.

The limits on percentage of aggregate passing AS Sieves, by mass of sample shall be as follows:

**Table 7 Aggregate Grading**

| Nominal Grading of AS sieve | 5mm | 7mm | 10mm | 14mm |
|---|---|---|---|---|
| 19.0mm | - | - | - | 100% |
| 13.2mm | - | - | 100% | 95-100% |
| 9.50mm | - | 100% | 90-100% | 30-50% |
| 6.70mm | - | 80-90% | 0-35% | 0 |
| 4.75mm | 100% | 0-35% | 0-2% | - |
| 2.36mm | - | 0-3% | 0-2% | - |
| 1.18mm | 30-80% | 0-2% | 0-1% | - |
| 600 micron | 0-20% | - | - | - |

The Superintendent will, as necessary, vary the grading shown above to suit aggregate material selected.

### 5.6.10 Asphaltic Concrete

The requirements for the manufacture of asphalt relating to quality of aggregate and bituminous material, mix design criteria, mixing plant and manufacturing procedure shall be as specified in the current Vic Roads Specification Section 407 - "Hot Mix Asphalt".

### 5.6.11 Concrete

Concrete shall conform to AS 3600 and shall be supplied by a concrete supplier conforming with AS 1379.

Cement shall be Portland type (A) supplied from the same approved kiln throughout the project. All cement used shall be fresh and shall be stored clear of the ground under adequate cover.

Concrete shall have a 28 day characteristic strength of 32MPa (N32), 60mm slump and maximum aggregate size of 20mm or as shown on the drawings.

Concrete strength shall be tested by means of product assessment methods in accordance with Section 20.4 of AS 3600. The Contractor shall register the project and arrange for results to be sent to the Superintendent.

On site mixing of concrete may be used subject to the Contractor's proposal of mix details being submitted to and approved by the Superintendent. Site mixed concrete shall be subjected to site testing for slump and strength in accordance with the relevant Australian Standards.

The Contractor shall be responsible for sampling and testing of concrete at their own expense and shall supply all labour, materials and equipment.

Sampling and testing shall be performed strictly in accordance with AS 3600.

Sampling and site treatment and testing shall be carried out by a NATA laboratory independent of the concrete supplier.

### 5.6.12 Water

Water used for concrete or compaction of pavement materials shall be of potable quality, free from any impurities harmful to concrete or the pavement material being compacted and where public supply is used the Contractor shall obtain the supply Authority's approval to the use of the water for the Contract.

### 5.6.13 Sand

Sand for mortar will be crushed stone or natural sand in accordance with AS A123.

Sand for bedding or backfilling, when required, shall be clean sand or fine gravel as defined by AS 1289 grading chart figure C6.1.1. It shall be free from roots, clay or any deleterious matter and shall have a maximum nominal particle size of 4.75mm.

## 5.7 Plant

### 5.7.1 Bitumen Sprayers

Bitumen sprayers shall be of 2,700 litres minimum capacity and shall comply with the requirements for bitumen sprayers set out in the Austroads Guide to Pavement Technology Part 8. The sprayer shall have been tested for uniformity of transverse distribution and calibrated for overall rates of application. The tests shall be performed within three months prior to use of the sprayer in the works up to spray rates at least 15% higher than specified herein. The certificates and charts applying to such tests shall be made available to the Superintendent. The Superintendent may require the sprayer to be made available free of charge for inspection and testing prior to or during the execution of the works.

### 5.7.2 Rollers

Steel wheeled power rollers shall be three wheel tandem rollers of between 6 and 15 tonnes gross weight and the load per metre of any wheel shall not exceed 5 tonnes.

Pneumatic tyred power rollers shall be of the self-propelled type weighing not less than 15 tonnes gross weight and having "square section" tyres at a pressure of not less than 700 KPa.

### 5.7.3 Brooms

A rotary road broom of approximately 2 metres width is required and the broom must be capable of being turned up to 45 degrees either way.

The rotary drawn broom must be capable of being used as a drag broom or a drag broom must be provided.

### 5.7.4 Graders

Blade graders shall weigh not less than 5 tonnes and shall have a wheel base of not less than 4.5 metres and a blade not less than 3 metres long. The cutting edge shall be checked for straightness against a straight edge.

### 5.7.5 Water Tankers

Water tankers shall have boom sprays and a quick acting valve (plug cock or similar).

## 5.8 Road Reserve Preparation

### 5.8.1 Clearing

The road alignment shall be cleared for the width of the road reserve and shall extend 20m beyond the start and end of the road to be constructed except cul-de-sac and 20m along each cross street measured from the centreline of the road being cleared.

Clearing shall be carried out in accordance with the "Clearing" clause in the Earthworks section.

## 5.9 Subgrade

### 5.9.1 General

The entire width of the road reserve shall be cut or filled as necessary to conform with the levels given on the drawings.

After excavation or filling, compacting, trimming and boxing out, the finished surface of the road sub-grade shall conform to the lines, grades, shape and dimensions shown on the drawings.

Any surplus material shall be spread on road margins to approved levels or dumped at approved sites within one kilometre from the original site and spread and trimmed. Additional filling, where a deficiency occurs, shall be carted to the site.

The subgrade shall consist of a uniform type material. Where the in-situ material varies then the Superintendent shall direct any over excavation and replacement with approved material, either from site or off site to achieve a stable subgrade. The Contractor shall remain responsible to reasonably assess the site conditions and shall allow for the costs of any additional work in their lump sum tender.

### 5.9.2 Compaction

Sub-grade shall be compacted to not less than 95% of the maximum dry density to a minimum depth below the surface of 300mm. Sub-grade to be formed to grade, crossfall etc. to ensure that an even thickness of pavement can be finally achieved.

No further stage of construction to be commenced until the completed sub-grade has been inspected and approved by the Superintendent and the Local Authority.

## 5.10 Sub-Base and Basecourse

### 5.10.1 Spreading and Compaction

After the sub-grade has been compacted to approval, the crushed rock shall be spread in even layers of 150 mm maximum loose thickness.

The material shall be spread to produce the required consolidated thickness by means of approved mechanical spreader. The material shall be maintained at about optimum moisture content, with additional water being added if required during compaction.

Materials shall be spread without segregation of large and small particles, between approved edge boards or kerbs.

The crushed rock shall not be spread upon waterlogged sub-grade. If the sub-grade becomes churned up or waterlogged, the soft spot or intermixed area shall be dug out and replaced with approved material compacted as specified.

Spreading, scraping and consolidation of the various layers of the pavement shall proceed with each layer having a construction tolerance of ±5 mm. The final layer shall have a construction tolerance of ±5 mm.

Rolling shall be performed in such a manner as to eliminate bumps and irregularities with the finished surface true to the required grades and cross-section.

Compaction should be achieved using a progressively heavier roller. The finished surface of the crushed rock shall show no movement under the six (6) tonne smooth steel wheeled roller. The minimum compaction achieved shall be 100% of the Standard Maximum Dry Density in the base course, and 98% of the Standard Maximum Dry Density in the sub-base course. The thicknesses specified are the minimum required.

### 5.10.2 Surface Shape

During final shaping and compacting, the shape shall be checked frequently and corrected as necessary by grading under the direction of an experienced foreman. The crossfall, super-elevation and smoothness of grade shall be checked with a straight edge and built-in level. The finished level shall allow for the thickness of the seal coats.

The Contractor shall provide a 3m straight edge and spirit level required for checking purposes and shall make these, together with the necessary labour, available to the Superintendent when required.

The longitudinal profile at the kerb lines of the completed road shall conform to the design levels within the tolerance given in the sub-clause "Tolerances".

Where the shape of the compacted road or the thickness of the base courses do not comply with the requirements of this specification, the Contractor shall correct the same, at their cost, by scarifying, adding or removing materials as required, recompacting and trimming as necessary to comply with the requirements of this specification.

### 5.10.3 Testing

After the base has been prepared and compacted, no priming shall be commenced until the Superintendent and the Local Authority are satisfied that the specified shape, compaction and course thickness of the base has been achieved.

## 5.11 Prime for Asphaltic Concrete Surfacing

### 5.11.1 General

Priming shall be carried out under favourable weather conditions and the prepared base course shall be sufficiently dry to permit adherence to and penetration of the base course by the bitumen.

Before priming, the pavement shall be broomed free of all loose material and dust, and any defects are to be made good. Should conditions require it, the surface shall be lightly watered immediately prior to the application of the primer.

Primer binder shall be bitumen emulsion of grade ARS or CRS manufactured from Class 170 bitumen and complying with the requirements of AS 1160, or an equivalent approved proprietary grade of special cutback bitumen, or field produced cutback bitumen produced by blending Class 170 bitumen and cutter.

The application rate of primer, either cutback or emulsion, shall be 1.00 litre (total mixture) per square metre. The cutback primer shall be applied at a temperature of 60 degrees Celsius.

Emulsion primer may be heated to a maximum temperature of 50 degrees Celsius if conditions warrant it.

The application rate shall be taken as the quantity measured at 15 degrees Celsius for all primers.

### 5.11.2 Blinding

Blinding for Cutback Prime - sand or 1.5mm aggregate.

This shall be applied after penetration of the primer but while sufficient bitumen is on the surface to allow adhesion. The blinding material shall be applied at a sufficient rate to prevent lifting of the primed surface by vehicles.

Blinding for Emulsion Prime - 3mm aggregate.

The 3mm aggregate shall be evenly applied immediately after spraying at the rate of 80 square metres of primed surface per one cubic metre of metal. The surface is to be rolled until screenings are firmly embedded in the primer.

## 5.12 Spayed Seals

### 5.12.1 Primer Seal

Primer sealing shall be carried out under favourable weather conditions and the prepared base course shall be sufficiently dry to permit adherence to and penetration of the base course by the bitumen.

Before primer sealing, the pavement shall be broomed free of all loose material and dust and any defects are to be made good. Should conditions require it, the surface shall be lightly watered immediately prior to the application of the primer.

No primer sealing shall be applied whilst the pavement surface temperature is less than 20°c or during wet, windy or rainy conditions, or when adverse weather conditions may prevail at any time during the work.

The Superintendent and Local Authority will approve the use of either a cut-back bitumen prime, or a bitumen emulsion prime, to suit weather conditions.

The application rate will be selected by the Superintendent, and will be in the range 1.0 to 1.5 litres per square metre total mixture.

The proportion of cutter oil in cut-back bitumen and application rate shall be dependent on the condition of the base surface and traffic density.

The primed surface shall be covered with 5mm diorite screenings at the rate of 80 square metres coverage to one cubic metre of screenings and rolled with a 6 - 8 tonne roller until screenings are firmly embedded in the primer.

### 5.12.2 Hot Bitumen Seal

When the primed road has been left open to traffic it shall be prepared for bitumen including pot-hole repair to the approval of the Superintendent and the Local Authority. Surfacing is to be carried out to the width shown on the drawings.

The mixture shall consist of 98% residual bitumen, fluxed with 2% distillate.

The application rate shall be 1.45 litres residual bitumen per square metre, (ie 1.48 litres per square metre total mixture), measured at 15 degrees Celsius. The mixture shall be sprayed at not less than 170 degrees Celsius and not more than 175 degrees Celsius. The application rate of the total mixture at 170 degrees Celsius is 1.6 litres per square metre.

The Superintendent will vary the above rates to suit conditions and materials as necessary.

The sprayed area shall be covered with 14mm diorite screenings at a rate of 55 square metres coverage per one cubic metre of aggregate and roll with a 6 - 8 tonne roller not less than six passes and broom to give an even layer of aggregate.

The road must be dry when sprayed and the air temperature must not be less than 15 degrees Celsius for at least 3 hours immediately prior to spraying and there must be no likelihood of rain for 24 hours after spraying. Special care must be taken to screen the bitumen before it has cooled, and to commence rolling immediately after the aggregate has been spread. Longitudinal joints must be made carefully by overlapping of bitumen film and transverse joints by the use of building paper to cover the last metre of a finished strip so that spraying commences on the paper.

Building paper shall have a strength equivalent to or greater than Sisalcraft 310 bitumen laminated paper.

The mixture shall be sprayed as soon as possible after heating and any quantity heated to a temperature within 10 degrees Celsius of the maximum temperature specified shall be sprayed that same day.

The design levels given on the drawings indicate the levels of the finished road surface.

Kerbs and drainage structures and all other works likely to be stained by bitumen shall be adequately protected. Any staining shall be made good.

Hot Bitumen Seal - Second Coat After a minimum period of 36 hours, the second seal coat shall be applied as follows:

- Any damaged areas including potholes, stripping or mechanical damage shall be repaired individually.
- The road surface shall be broom finished and all sand, dust and loose material shall be removed.

The second binder application shall be 1.25 litres residual bitumen per square metre (1.28 litres per square metre total mixture) at 15 degrees Celsius. The total mixture shall be sprayed at 170 - 175 degrees Celsius and the application rate of the total mixture at 170 degrees Celsius shall be 1.38 litres per square metre.

The Superintendent will vary the above rates to suit conditions and materials as necessary.

Aggregate screenings of 10mm nominal size shall be applied at a rate of 125 square metres per cubic metre.

Generally, all details shall be as for the first hot bitumen seal.

## 5.13 Asphaltic Concrete Surfacing

### 5.13.1 Preparation of Surface

The existing primer seal surface shall be inspected and the required correction of defects agreed with the Superintendent.

Excess binder shall be removed from any faulty areas, pot-holes or depressions filled with suitable material, and any deviations to the pavement shape corrected prior to the application of the tack coat.

### 5.13.2 Tack Coat

When ready for the final seal, the previously primer sealed surface shall be broomed free of all loose material and a tack coat shall be applied to provide a "key" for asphaltic concrete.

The tack coat shall consist of a diluted rapid-setting Anionic bitumen emulsion as specified. Application shall take place not less than 30 minutes nor more than 2 hours before placing asphaltic concrete.

The tack coat application rate shall achieve a residual bitumen of 0.1 to 0.2 litres per square metre. The actual rate of application will be selected by the Superintendent to suit the class of material.

Any pools of tack coat which may have formed in surface depressions shall be brushed out.

### 5.13.3 Asphaltic Concrete

The temperature of the pavement to be surfaced should be at least 10 degrees C and no rain shall fall during the placing of the mix and the surface shall be dry.

Asphaltic concrete shall be placed at a rate such that it will give a compacted thickness as shown on the drawings.

The asphaltic concrete mix shall be placed at a minimum temperature of 140 degrees Celsius immediately on delivery to the spreader and in the presence of experienced personnel. The temperature of the asphaltic concrete at the time of initial rolling must not fall below 120 degrees Celsius. Spreading of material below this temperature will not be permitted.

The asphaltic concrete shall be placed in one layer by an approved self-propelled machine spreader, conforming to AS 2150, Section 12.

Compaction shall be accordance with AS 2150 Section 13 except as follows:

Compact initially by rolling with at least two coverages of the smooth, steel drum tandem roller as specified under the clause on "Plant". Immediately following the initial rolling and while the asphaltic concrete is still hot, roll with not less than twelve coverages of the self-propelled pneumatic-tyred roller, of mass not exceeding 12 tonnes, as specified under the Clause on "Plant". Roll finally with a maximum of two coverages of the smooth, steel drum roller while the asphaltic concrete is sufficiently warm to produce a smooth, dense surface.

If the asphaltic concrete begins to shove or crack, in no circumstances continue with rolling until the cause has been determined and corrective measures taken. Keep drums and wheels of rollers wet with water and clean during all rolling operations.

Form any joints necessary and ensure that the finished profile is smooth and even over the joints without ridges or depressions. Joints shall be waterproof. Joints shall be in accordance with AS 2150 Section 12.6.

The density of the compacted concrete shall be not less than 97% of the Marshall maximum density.

### 5.13.4 Testing

Samples of the compacted asphaltic concrete shall be taken by the Testing Authority when requested by the Superintendent and the field density determined. The samples will be taken for the full depth of the layer and may be either approximately square or diameter cores.

All density holes shall be repaired by the Contractor.

## 5.14 Concrete Vehicular Pavements

### 5.14.1 Scope

Specified in this section of the Specification is the construction of concrete pavements subject to vehicular loading other than footpaths and minor paving works.

### 5.14.2 Standards

| | |
|---|---|
| AS 1012 | Methods of Testing Concrete. |
| AS/NZS 4671:2001 | Steel reinforcing materials. |
| AS 1379-2007 | Specification and supply of concrete. |
| AS 3600-2009 | Concrete structures. |

ASTM D1752 – 04a (2008) - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

### 5.14.3 Concrete

Concrete and reinforcement shall comply with the requirements of Section 5.5.11 of this Specification.

### 5.14.4 Joint Sealer

Joint sealers shall be manufactured from either neoprene or silicone type seal (or approved equivalent). The joint filler is to be flexible and waterproof. The sealer type shall be consistent with the expected joint movement. The Contractor is to provide details of proposed sealant for review and approval.

### 5.14.5 Colouring

Where coloured concrete is required, mineral oxide pigments shall be added to the mix to achieve the selected colour provided that the volume of pigments used must not exceed 8% of the volume of cement used in the mix. Colour samples for selection shall be prepared in advance. The finished pavement colour, after curing and drying, shall match closely with the selected colour sample.

All pigments shall be resistant to the effects of lime, alkali, and ultra violet light.

### 5.14.6 Bedding

Class 1 or Class 2 fine crushed rock, free from soil, rubbish and organic matter, shall be spread evenly to a minimum compacted thickness of 50 mm, with surface trimmed to required levels or grades. Refer to drawings for total thickness required.

### 5.14.7 Formwork

All formwork shall be accurately constructed to the required lines and strong enough to remain in position without displacement during placement, compaction and support of concrete, and shall extend to the full depth of the concrete.

Before placing of concrete the forming surfaces shall be cleaned and coated with oil or other approved bond breaking coating.

### 5.14.8 Placing of Concrete

All concrete shall be placed in day light and under the direction of the Builder, except where otherwise authorised in writing.

Prior to placing concrete, all formwork, equipment to handle concrete, excavated areas, reinforcement and existing adjacent concrete are to be clean of all foreign matter and water.

Immediately before placing any concrete, the crushed rock bed shall be uniformly wetted with a hose having a spraying nozzle so that it will not absorb moisture from the concrete when placed. There shall be no pools of water on the base.

Whenever the placing of concrete is delayed until the concrete has taken its initial set, the point of stopping shall be deemed a construction joint and shall be made only where approved by the Builder.

Before placing new concrete on or against concrete which has set the forms shall be re tightened and the surface of the set concrete shall be roughened as required by the Builder, thoroughly cleaned of foreign matter, laitance and loose or porous material and saturated with water. The surface shall then be covered with a thin coating of stiff neat cement to ensure a proper bond and concreting shall then proceed immediately.

### 5.14.9 Compaction

The entire volume of the pavement shall be thoroughly compacted using vibrators to ensure each load of concrete is vibrated into the face of the previously placed concrete and into edges, joints and around dowel bars and the like.

### 5.14.10 Jointing

Jointing in concrete pavement is necessary to allow for contraction, expansion and construction sequency in concrete. It is important that the jointing layout be such that controlled cracking is achieved.

Refer to jointing plan layout. Contractor to submit a “pour sequence diagram” to confirm location and timing of various pours, consistent with the jointing details. Time between adjacent pours shall be as long as possible with a minimum being 3 days.

### 5.14.11 Contraction Joints (Saw Cut Joints)

### 5.14.12 General

Contraction joints shall be provided at locations specified on the Civil Drawings.

Sawn joints must be constructed after the concrete has hardened sufficiently that it will not be damaged by the sawing but prior to shrinkage cracking occurring. The timing of the saw cuts is critical and generally will be between 6–24 hours after placing. If the cut is made too early the edges of groove will ravel; if too late, the slab will randomly crack, defeating the object of the joint. The advice of specialist saw-cutting contractors should be obtained for each project as the timing for saw cutting is affected by concrete mix design, ambient temperatures, and concrete placing temperature.

### 5.14.13 Light Duty Pavements

The joints shall be constructed by an initial saw cut (3 mm by D/3 deep) followed by a secondary cut 12mm wide and 15 to 25mm deep depending on the detail specified on the drawings. The 12mm wide saw cut is to be filled with approved polyethylene foam backing rod and flexible waterproof filler.

In light duty pavement steel reinforcement mesh should be placed centrally and the saw cut should finish short of the mesh.

### 5.14.14 Heavy Duty Pavements

The joints shall be constructed by an initial saw cut (3 mm by D/3 deep) followed by a secondary cut 12mm wide and 15 to 25mm deep depending on the detail specified on the drawings. The 12mm wide saw cut is to be filled with approved polyethylene foam backing rod and flexible waterproof filler.

Top reinforcement should be terminated at least 50 mm, preferably 75 mm, from the joint location.

Provide deformed dowels 16 mm diameter, 600mm long at 300mm centres or as specified on the Civil Drawings. Grease the other half of dowel (or an approved equivalent system) and provide a compressible end cap for expansion space.

### 5.14.15 Expansion/Isolation Joints

Expansion/Isolation Joints provide for both expansion and contraction at the joint. Expansion / isolation joints shall be formed through the full thickness of concrete and shall be installed wherever concrete paving abuts a building, structure, pit, manhole and the like.

Provide deformed dowels 16 mm diameter, 600mm long at 300mm centres or as specified on the Civil Drawings. Grease the other half of dowel (or an approved equivalent system) and provide a compressible end cap for expansion space. Ensure joint is created between pours (full depth, minimum 10mm) with compressible ("Abelflex" or approved equivalent) material and bracing rod and seal with flexible waterproof joint filler. Reinforcement mesh is not to continue through joint.

The joint edges shall be neatly finished with a jointing trowel.

### 5.14.16 Construction Joints

Construction joints shall place at locations specified on the Civil Drawings or at locations at the end of a day's pouring or the location of delay in concrete delivery where the previous delivery has taken an initial set. Construction Joints allow for some shrinkage at the joint.

Joints shall be dowelled with 600mm long, 16mm diameter plain bars (or approved equivalent system) at 300mm centres or as shown on the Civil Drawings. Grease one end of dowel (or an approved equivalent system). Apply bituminous paint to end of first pour prior to second pour. Mesh not to continue through joint. Provide saw cut joint and seal with flexible waterproof filler.

### 5.14.17 Finishing

Unless specified otherwise on the Drawings, concrete pavements should be finished with a steel trowel to a smooth surface at the correct levels, grades and shapes. After trowelling, the surfaces of pavements subject to pedestrian traffic shall be broomed to form a non-skid surface with the pattern of the lines running in one direction only.

All joints and edges and any ruled pattern indicated by the drawings, shall be finished with a jointing trowel and any steps suitably marked with a lining tool.

### 5.14.18 Curing and Protection of Concrete

Approved covering shall be provided to protect the concrete surfaces against rain, hail, dust or any other cause that may damage the concrete during the carrying out of the work.

The formwork may be stripped after 24 hours, but sufficient timbering must be provided to protect all exposed edges for at least four (4) days or longer, where in the opinion of the Builder, damage is likely to occur.

Concrete shall be protected from premature drying at least seven (7) days after initial set has taken place. All covering material shall be kept continuously wet so that the concrete surface is always moist. The thickness of the covering material such as sand, shall not be less than 50 mm.

### 5.14.19 Backfilling

After removal of forms, the adjacent ground shall be filled with suitable material appropriate to the requirements of the Contract and the location of the work and graded to an even surface.

## 5.15 Extruded Concrete Kerbing

### 5.15.1 General

Kerbs to roads shall be constructed of extruded concrete kerbing. Kerbing to smaller radii than can be placed with the extrusion machine used shall be cast insitu to the same cross section as that of the extruded kerbing, except that the cast insitu kerb shall be 100mm deeper than the extruded kerbing and shall be embedded firmly in the road surface to the extra depth. The outward appearance of the extruded and cast insitu kerbing shall be identical.

### 5.15.2 Kerb Construction

All kerbing shall be constructed from 25 MPa 28 day cylinder test compressive strength concrete manufactured in accordance with AS 3600 for 10mm aggregate with a 50mm slump.

The final shape and dimensions of the extruded kerb shall be as detailed on the drawings. The top surface of the kerb shall always be parallel to the ruling grade of the pavement, with gentle transitions at changes in grade.

The kerb shall be placed in straight lines and in circular curves as shown on the drawings. The width of the road shall be the distance between the kerbs along straight sections of the road measured at right angles to the kerbs from toe to toe and shall be as detailed on the drawings. The kerbs shall be equidistant from the road centre line. At road junctions and intersections, the radius or kerbing shall be measured from the road side toe of the kerb.

The kerb shall be placed using an appropriate extrusion machine, approved by the Superintendent and the Local Authority and the work shall be carried out by an experienced and competent crew. The first 150mm of any new pour shall be cut away and removed. The gap between the old and new work shall be filled by hand placing, rodding and shaping of the concrete until a satisfactory shape and finish has been obtained. Extruded kerb shall be joined to existing kerbing by using the same method.

### 5.15.3 Contraction Joints

Contraction joints shall be constructed at 2.0m intervals, at sides of entry pits and at tangent point of sweeps by complete separation of adjoining sections of the kerb immediately after extrusion.

Joints shall be 3mm wide, clean cut and made vertically through the concrete at right-angles to the direction of the work.

Where kerbing is laid by machine, joints shall be formed in a manner which does not cause damage to the adjoining concrete during cutting and to a depth which will prevent cracking elsewhere. In general, it can be expected that the cut should extend to at least one-quarter of the depth of the section.

Where kerbing is cast against fixed forms, contraction joints shall be formed by means of a 3mm thick steel plate cut to profile which shall be withdrawn before final finishing.

The extruded kerb shall be finished by means of a kerb shaped screed.

The finishing shall follow immediately after the cutting of contraction joints. The finishing shall bridge over the contraction joints to form a continuous cover.

Each contraction joint position shall be clearly marked by a cut in the finished surface on the entire exposed face of the kerb before the concrete has set.

### 5.15.4 Expansion Joints

Not less than 24 hours after placing of the kerb expansion joints shall be constructed at every third contraction joint. The expansion joints shall be formed by the sawing of a 10mm gap that completely severs the adjoining sections of the kerb. The gap shall be filled with approved joint filler after the Superintendent and the Local Authority have inspected and approved the cut joints.

### 5.15.5 Curing

Within two hours of surface finishing, all exposed faces of the completed kerb shall be protected against loss of moisture for a period of not less than 96 hours after placing by shrouding with plastic sheeting or by spraying with a curing compound complying with AS 3799.

### 5.15.6 Protection

Kerbs shall be protected from bitumen overspray at all times by adequately covering the kerbs with polythene sheeting or similar approved material.

Any kerbing marked by bitumen spray shall be made good by the Contractor at their own expense.

### 5.15.7 Backfilling

The backfilling to kerbing shall be placed as shown on the drawings after the curing and acceptance of the kerbing. The backfill material to be a similar material to the locally occurring topsoil, free from debris and compacted adequately to accommodate the driving of rubber tyred domestic vehicles.

### 5.15.8 Cleaning Up

The Contractor shall remove any excess mortar or concrete spillages from the road surface prior to completing the pavement construction.

During completion of the pavement, the Contractor shall take every care to avoid damage and bitumen spillage onto the kerbs. Where damage or spillage has occurred, the Contractor shall make good this damage and remove bitumen spillages at their own expense.

## 5.16 Brick Pavement

Brick pavements shall be constructed to the lines and levels shown on the approved drawings.

### 5.16.1 Sub-base

The sub-base shall be constructed in accordance with the specification and to the thickness shown on the approved drawings.

### 5.16.2 Edge Restraint

Extruded concrete edge restraint beam shall be constructed along all edges of the interlocking pavement in accordance with the specification and drawings.

### 5.16.3 Bedding Sand

The bedding material shall be a well graded concreting sand conforming with the following grading.

**Table 8 Bedding Sand Grading**

| Sieve Size (AS Sieve) | Percent by Weight Passing |
|---|---|
| 2.36mm | 100% |
| 1.18mm | 75-95% |
| 600 microns | 50-80% |
| 300 microns | 20-45% |
| 150 microns | 0-15% |
| 75 microns | 0-5% |

Bricklayers' sand and single sized dune sands are not suitable. The sand shall be non-plastic and free from deleterious organic material.

Stockpiled sand shall be protected from excessive changes in moisture content. At the time of placing, the sand shall have a uniform moisture content.

Sand shall be spread loosely to a uniform depth and screeded to the nominated design profile with sufficient surcharge to allow for compaction to a thickness of 30mm (+ or - 5mm).

Bedding sand shall be screeded slightly ahead of laying of interlocking pavers and maintained in a loose condition and protected from pre-compaction including pedestrian traffic or heavy rain. Any pre-compacted sand or screeded sand left overnight shall be removed and replaced with fresh loose sand.

## 5.16.4 Laying Patterns

Laying patterns shall be as specified on the Drawings.

## 5.16.5 Laying of Pavers

Paving units shall be placed with 2-3mm gaps between adjacent units, maintaining correct joint alignment but without pre-compaction of the sand bedding layer. It is important that the joint width between paving units be maintained.

All full units shall be laid first. Any gaps at the pavement edge adjacent to the kerbing shall be neatly filled by cutting units to size. Small gaps less than 25% of the unit size should be avoided by using insertions of one half or three quarter paving units.

## 5.16.6 Compaction of Pavers and Joint Filling

After laying, the paving units shall be immediately compacted and brought to level by not less than three passes of a vibrating plate compactor. The plate shall have sufficient area to simultaneously cover 12 units and a suitable medium such as plywood (minimum thickness 12mm) shall be placed between the vibrating plate and the pavement.

Compaction shall proceed as closely as possible in conjunction with joint filling following the laying of pavers and prior to the acceptance of any traffic. Compaction should not be attempted, however, within 1m of the laying face. Compaction shall continue until lipping has been eliminated between adjoining units. All work to within 1m of the laying face must be left fully compacted at the completion of each days laying. Any pavers not complying with the acceptance criteria hereinafter described or damaged during compaction shall be immediately removed and replaced.

As soon as possible after compaction, sand for joint filling shall be broomed over the pavement and into the joints. Excess sand shall be removed as soon as joints are filled.

The sand used for joint filling shall conform with the following grading envelope and be free of all soluble salts or contaminants likely to cause efflorescence of staining.

**Table 9 Jointing Sand Grading**

| Sieve Size (AS Sieve) | Percent by Weight Passing |
|---|---|
| 2.36mm | 100% |
| 1.18mm | 75-95% |
| 600 microns | 50-80% |
| 300 microns | 20-45% |
| 150 microns | 5-15% |
| 75 microns | 0-5% |

For 300mm from the gutter line the joint filling shall consist of a 4:1 mix of joint filling sand and cement.

## 5.16.7 Protection of Works and Opening to Traffic

Prior to acceptance for opening to traffic, all surfaces and pavement structures shall be true to levels, grades, thicknesses, and cross-sections shown on the drawings. All brick pavements shall be finished to lines and levels nominated to ensure positive drainage to all drainage channels and outlets.

## 5.16.8 Accelerated Loading

Following completion of the brick paving as previously detailed, the Contractor shall provide additional compaction of the brick paving by means of between 5 to 10 passes of a pneumatic multi-tyred roller having a gross weight of not less than 10 tonnes. The roller shall traverse the entire brick pavement to ensure all paving units have been compacted and bedded in to achieve maximum lock-up.

## 5.16.9 Acceptance Criteria for Paving

**a. Initial Acceptance**

The finished pavement shall conform to the construction tolerances and be free draining at all times. The applicable finished surface tolerance is a maximum deviation from the bottom of a 3m straight edge shall be 10mm. The level of adjacent pavers shall not differ by greater than 2mm.

The blocks shall be true to shape and not cracked. A maximum of 1% of spalled units will be accepted.

The colour of the pavement will be uniform, however any slight differences due to different batches shall be transverse to the road centreline. The surface texture shall be uniform throughout.

The completed running surface shall be satisfactory for the anticipated traffic with special emphasis on vehicle vibration and drumming and emitted noise. All excess sand shall be removed. Suction or high-pressure water equipment shall not be used.

**b. Performance in Maintenance Period**

The stability of the pavement shall be such that creep movements by the blocks do not create joints greater than 5mm in width nor affect the location or stability of the kerbing or adjacent bituminised pavements. The sand filler should be stable and such as not to be eroded under normal conditions. Rotation of blocks shall be minimal with no other detrimental effects permitted.

Edge cracking of the blocks shall not exceed 1% provided they do not have an adverse effect on the stability of the pavement.

Individual blocks should not show any sign of deterioration, nor should there be signs of wear in the vehicle paths.

Skid Resistance/Surface Polishing: The surface polishing should be minimal; however, it is imperative that the skid resistance of the surface be compatible with the adjoining bitumen roads. The minimum acceptable pendulum value is 45 (BPN)

# 6. Pedestrian Paths

## 6.1 General

All these Works shall be constructed in accordance with the drawings and this specification and will be subject to inspection and the approval of the relevant Local Authority.

Any instructions from the Local Authority pertaining to the Works shall be issued by that Authority to the Superintendent.

The extent of footpaths and footways to be constructed is as shown on the drawings.

Pedestrian paths may not be constructed until after all drainage, sewerage, major verge clearing and kerbing have been completed.

## 6.2 Clearing

The footpath alignment shall be cleared for the width of the footway reserve. Only trees specifically nominated by the Principal or the Superintendent shall be retained.

Clearing shall be carried out in accordance with the "Clearing" clause in the Earthworks section.

## 6.3 Sub-Grade

The entire width of the footpath reserve shall be cut or filled as necessary.

After excavation or filling, compacting, trimming and boxing out, the finished surface of the footpath sub-grade shall conform to the shape and dimensions shown in the drawings.

Sub-grade is to be compacted to not less than 95% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1) to a minimum depth below the surface of 300mm.

All filling shall be placed in generally horizontal layers not exceeding 250mm and compacted prior to the placing of further material.

A sand bed of clean sand free from roots, clay or any deleterious matter shall be placed to a minimum compacted thickness of 50mm and to the designed footpath width. The bedding shall be compacted to not less than 90% of the maximum dry density obtained in the modified maximum dry density compaction tests (AS 1289.5.2.1).

## 6.4 Cast Insitu Concrete Pedestrian Paths

### 6.4.1 Construction

The path shall be placed on the prepared sand bed which shall be screeded to profile and crossfall to provide the finished slab thickness.

Where the path is constructed in the road reserve, the longitudinal profile of the path shall be the same as the longitudinal profile of the adjacent kerbing. Elsewhere, the path longitudinal profile will be such as to achieve a uniform grading and generally conform to the surrounding finished ground or as shown on the drawings.

No concrete shall be poured until the sand bedding has been approved by the Superintendent.

Rails or guideposts shall be erected to suit the construction programme.

### 6.4.2 Concrete

The concrete used in this construction shall conform to AS 3600 and be provided by an approved pre-mixed concrete supplier, conforming with AS 1379. Each batch provided shall be supported with evidence of strength slump, aggregate size, etc.

Concrete shall be of 25 MPa 28 day cylinder test compressive strength.

The maximum aggregate size shall be 20mm.

The slump shall not exceed 65mm or be less than 25mm.

The concrete, when placed, must be well tamped to remove all voids and to work fines to the surface for trowelling.

### 6.4.3 Contraction Joints

Contraction joints in footpaths and cycleways shall be constructed at 2.0 metre centres for footpaths, footways and cycleways.

Joints shall be neatly as defined on the drawings as either:

- formed by making a cut 3mm wide for at least one-quarter of the depth of the paving. Arises shall be tooled to a suitable radius saw cuts, or
- formwed with a jointing tool and smooth trowel finished for 80mm either side of the joint.

Joints shall be aligned with joints in the kerbing where the path is against the kerbing.

### 6.4.4 Expansion Joints

At max of 12 metre intervals expansion joints shall be constructed 12mm wide for the full depth of the slab. They shall also be provided wherever the paving abuts fixed structures, such as buildings, manholes, etc. An 35mm x 12mm bitumen impregnated canite of an approved joint sealer shall be inserted in the joint and finished flush with the surface of the path. The expansion joints shall be marked out with an edging tool to match the appearance of the contraction joints.

### 6.4.5 Finish

A brushed finish shall be provided to the surface of the slab with joints and edges polished smooth for 80mm width with jointing and edging tools.

The alignment of the edge of the path is to be straight and true to line. Deviations from alignment or from specified width will not be accepted. The path shall be parallel with the kerbing in vertical and horizontal alignment.

The finished path shall be protected from damage by passers-by and with polythene film for 24 hours after completion if rainfall during this period is apparent.

### 6.4.6 Curing

The entire footpath shall be protected against loss of moisture for a period of not less than 72 hours after placing by shrouding with polythene sheeting or by spraying with a curing compound complying with AS 3799.

### 6.4.7 Protection

Barricade, warning signs and lights shall be erected to prevent damage of the footpath from vehicles and pedestrians for not less than 24 hours after completion.

### 6.4.8 Clean Up and Backfilling

All cement droppings, slurry, etc. and surplus materials to be removed from site.

All formwork, pegs, stakes, etc. shall be removed after the curing of the path has been completed.

After removal of the formwork, and acceptance of the path by the Superintendent and the Local Authority, the path shall be backfilled with a clean sand. Backfilling shall be compacted to not less than 90% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993) and shaped level with the top of path.

## 6.5 Concrete Slab Paving

### 6.5.1 Slabs

Slabs shall be 600mm x 600mm x 50mm thick precast slabs or as specified on the Drawings. The tolerance on the slab dimensions is +10mm - 0mm.

The concrete used shall conform to AS 3600 with a maximum strength of 20 MPa 28 days cylinder test and a maximum aggregate size of 12mm.

Slabs shall be formed in a steel mould, placed on a vibrating table after pouring and steam cured for a period of not less than 6 hours.

The top surface of the slab shall be flat with no discolouration, honeycombing, grout loss or cracking. The slabs shall be sound and free from voids.

Slab shall be transported and stacked in such a way as to prevent any damage to the slabs.

### 6.5.2 Sand Bedding

A sand bed of clean sand free from roots, clay or any deleterious matter shall be placed to a minimum compacted thickness of 50mm and of designed footway width. The bedding shall be compacted to not less than 90% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993).

### 6.5.3 Mortar Bedding

Where specified on the Drawings, paving slabs shall be fully bedded in a sand/cement mortar mix of a minimum thickness of 25 mm and a maximum thickness of 40 mm.

The mortar bed mix shall consist of, in measures by volume:

- 1 part Brick Sand
- 2 parts Fine washed sand
- 1 part Portland Type A cement

Mixing shall be performed in cement mixer, free of fresh or loose mortar residues, by adding the aggregates to the liquid (which shall initially be proportioned as one part by volume) whilst mixing continuously to ensure a homogeneous consistency free of lumps.

All components shall be measured by means of calibrated containers.

Water may be added in the specified proportions to impart to the mix a consistency such that it may be loosely hand shaped into a "cricket ball" which shall remain whole when released whilst leaving hand slightly moist (not wet).

The amount of mix shall not exceed the quantity required to lay bluestone within 45 to 60 minutes, depending on climatic conditions.

### 6.5.4 Construction

- After screeding, levelling and consolidating the sand or mortar bed, slabs shall be laid with joints staggered.

- Where the path is constructed in the road reserve, the longitudinal profile of the path shall be the same as the longitudinal profile of the adjacent kerbing. Elsewhere the path longitudinal profile will be such as to achieve a uniform grading and generally conform to the surrounding finished ground.
- Joints shall be filled with a clean sand and the path swept clean.
- Where a standard slab section is not available, that is at public utility access chambers, etc. the resulting space in the path shall be made up with a 4:2:1 concrete mix with a steel trowelled top and neatly lined to conform to the general path pattern.

### 6.5.5 Cleaning Up and Backfilling

All surplus materials, cement droppings, slurry, etc, shall be removed from site.

After acceptance of the path by the Superintendent and the Local Authority, the path shall be backfilled with a clean sand. Backfilling shall be compacted to not less than 90% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993) and shaped level with the top of path.

# 7. Concrete (Miscellaneous)

## 7.1 Scope

Specified in this section of the Specification are the materials and manufacturing procedures required for miscellaneous concrete.

## 7.2 Standards

The following standards are referred to or are relevant to this section:

- AS 1012 Methods of testing concrete.
- AS/NZS 4671:2001 Steel reinforcing materials.
- AS 1379-2007 Specification and supply of concrete.
- AS 3600-2009 Concrete structures.

## 7.3 Cement

Portland type (A) supplied from the same approved kiln throughout the project. All cement used shall be fresh and shall be stored clear of the ground under adequate cover.

## 7.4 Fine Aggregate

Clean, hard natural sand or screened gravel:

- Passing a 4.75 mm test sieve - not less than 85% by weight.
- Passing a 0.30 mm test sieve - not less than 10% by weight.

## 7.5 Coarse Aggregate

Clean, hard crushed stone or natural river gravel:

- Passing a 19.0 mm test sieve - not less than 95% by weight.
- Passing a 4.75 mm test sieve - not less than 10% by weight.
- Passing a 2.36 mm test sieve - not less than 5% by weight.

Approval of a nominal size aggregate smaller than 20 mm may be accepted, subject to Superintendent's approval, where placement of concrete may prove difficult.

## 7.6 Water

Clean and fresh and free from acid, alkali or vegetable substance.

## 7.7 Reinforcement

Complying with the appropriate standard. Free of mill scale, loose rust, dirt, paint or oil.

## 7.8 Tie Wire

16 gauge annealed wire unless otherwise indicated.

## 7.9 Samples

The Contractor shall submit samples and / or certification of suitability of all materials they propose to use, upon the Superintendent's request.

## 7.10 Concrete Quality

The Contractor shall be responsible for obtaining concrete of the specified standard from an approved manufacturer and for advising the supplier of the quality required.

## 7.11 Classes of Concrete

**Table 10 Class of Concrete**

| Grade | F'c | Slump Range | Location |
|---|---|---|---|
| Grade 25 | 25 Mpa | 60-75mm | Kerbs, channels, pedestrian paths |
| Grade 32 | 32 MPa | 60-75mm | Pits, vehicular paving |

Note - F'c. 28 days design strength defined in AS 3600.

Concrete shall develop a minimum compressive strength of 15 MPa at 7 days when cured at 23°C ± 2°C.

The consistency of each batch shall be visually checked by the Contractor prior to placing. Slump cones shall be provided and maintained ready for performance of standard slump tests on each batch of concrete and/or as directed by the Superintendent.

## 7.12 Manufacture

Concrete may be either site mixed, or ready mixed at an approved plant. Mix proportions shall be adjusted to ensure sound compaction, maximum density, low drying shrinkage, low bleeding losses and strength as specified.

After mixing, the concrete shall be conveyed to the place of final deposit without delay, and in the case of ready mixed concrete or concrete mixed at a central mixing plant, within 1 ½ hours of the addition of cement to the aggregate. Any concrete that has not been placed within twenty (2) minutes after discharge from the agitator or on-site mixer shall be removed at once from the site of the works. The method of handling shall be such as will prevent the segregation or loss of the ingredients and avoid re-handling. Dropping the concrete a greater height that 1 metre depositing large quantities any point, and moving or working it along the forms will not be permitted. A plastic surface shall be maintained until the completion of the unit.

## 7.13 Site Mixed Concrete

Shall be manufactured using accurate weight batching procedures as specified by AS 3600. The Contractor shall, at their own expense, prepare trial mixes and submit them to a NATA laboratory testing. The results of testing shall be submitted to the Superintendent for approval 14 days prior to production.

## 7.14 Pre-Mixed Concrete

Pre-mixed concrete may be used subject to the stipulation that such concrete is in accordance with the requirements of AS 1379 and such other requirements as are herein specified.

Water shall only be added at the batching site to produce concrete of the required slump at the site.

Facilities shall be provided so that transporters may be checked at any time, and an approved docket system shall be used showing the time at which each batch is prepared.

Approval of dry batch plants will be subject to inspection of the material storage and handling facilities by the Superintendent.

## 7.15 Sampling and Testing

The Contractor shall be responsible for sampling and testing of concrete at their own expense and shall supply all labour, materials and equipment.

Sampling and testing shall be performed strictly in accordance with AS 3600.

Sampling and site treatment and testing shall be carried out by a NATA laboratory independent of the concrete supplier.

## 7.16 Rejection of Concrete

### 7.16.1 Unhardened Concrete

Shall be liable to rejection if the batch under consideration varies materially from previous batches, particularly as regards consistency and/or colour, and if at any time after mixing the concrete in any batch becomes unworkable.

### 7.16.2 Hardened Concrete

The Superintendent may reject any concrete after placement because test results are below those required under the provisions of this Specification, or because of unsatisfactory finish, or because of incorrect positioning, or other failure to conform to the requirements of this Specification. Upon such rejection, the Contractor may seek the approval of the Superintendent to carry out at the Contractor's expense, a load test or other test on the concrete so rejected and/or having core samples taken and tested.

# Appendix A

# Safety In Design Risk Management Report

# Safety In Design
# Risk Management Report

| | |
|---|---|
| **Project Name** | Park Highett – 1Ha Park |
| **Project Number:** | 22024 |
| **Date:** | 22 June 2023 |
| **Prepared by:** | Dara McGrenaghan |
| **Ref:** | 22024-CI-SID-002 |

MCG Consult Pty Ltd
Level 2, 696 Bourke St, Melbourne
admin@mcgconsult.com.au

MCG CONSULT

| | Date | Comment | Prepared By | Approved By |
|---|---|---|---|---|
| A | 22.06.2022 | Final | DMcG | DMcG |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Checked, approved by:

Dara McGrenaghan
Director

# Contents

# Introduction

In accordance with our obligations under Health and Safety Legislation, MCG Consult have undertaken a formal Safety in Design assessment of the Civil Engineering design for the project. The purpose of this process is to mitigate or minimise the Health and Safety hazards inherent in this project at the design stage.

This is the first stage in the integrated risk management process which this legislation mandates. In presenting this assessment, MCG Consult has discharged its obligations under the Act. Responsibility for completing this integrated process now passes to the client to ensure the end user of the asset is informed of any unconventional or unacceptable residual risks associated with the design of the development. If you are unclear as to your responsibilities and liabilities under this Health and Safety Legislation, please contact the undersigned.

As part of our assessment, we have considered the known Health and Safety Risks specific to this project and site with respect to construction, operation, maintenance and demolition or decommissioning.

When undertaking this assessment, we categorised the risks associated with the hazards foreseen by MCG Consult at the time of design into one of the following four categories:

- The risk is addressed and mitigated within the design
- The risk is of a conventional nature that competent persons, experienced in operating in that environment, are routinely able to manage in the course of their work provided they comply with industry practices
- The risk is limited to a moderate level such that any users of the works would have an acceptably low level of risk provided they conduct themselves responsibly and prudently and the operator/owner manages routine risks in accordance with good practice and legislated requirements
- The risk remains unresolved at the completion of design and responsibility for managing the risk passes to other specific parties

While our design is compliant with the relevant Australian Standards and Codes of Practice this does not eliminate health and safety risks to people using these works. In particular the design standards associated with natural events including wind, earthquake, rainfall and runoff are based on the principle that the probability of a design event being exceeded in any one year is suitably low as to be acceptable to the wider community. This does not mean that they can't and won't be exceeded. Rather that they will be exceeded very rarely.

In the context of climatic change and the relatively short historical sample of natural event intensities it is probable that a construction that has a life of 50-60 years will experience natural events that exceed the conditions for which it was explicitly designed. In these circumstances there can be a high or extreme risk to people using these facilities and it is the responsibility of the owners/managers of these facilities to have in place suitable disaster management plans to mitigate the impact of such extreme events.

Similarly, even with a code compliant design, catastrophic failure of infrastructure is possible and may result in injury or death. Such rare events cannot be eliminated by virtue of our design as they are beyond the designer's control.

In all instances, our Safety in Design risk assessment is based on the assumption that Construction work will be carried out by competent and experienced Contractors. Where conventional risks have been identified, they are deemed to be those that competent and experienced contractors would routinely manage. Responsibility for engaging competent and experienced Contractors lies with the developer and should be a critical part of the risk management process undertaken by the developer in selecting all Contractors.

Similarly, our assessment of hazards is based on the assumption that all infrastructure will be maintained in accordance with all manufacturers and legislative requirements. The responsibility for this compliance rests with the owner and/or operator and/or contractor engaged for this purpose. Failure to comply is not a Safety in Design issue covered by our assessment.

Please note that our Safety in Design process assesses risks for only those components and elements included in the original design. People referring to our assessment at later stages of the project's life must determine if additional elements have been added to the development, after the completion of the original design, which may impact on the risk assessment.

The Risk Assessment is a record for all people involved in later lifecycle phases of this project and contains details about risks that MCG Consult are aware of which may present a health and safety risk beyond the completion of the design phase. Please note that the ongoing Health and Safety risk management process that you implement for this project for the whole life of this development remains your responsibility from this point.

# Risk Rating Matrix

| | Consequence | | | | |
|---|---|---|---|---|---|
| Likelihood | Insignificant 1 | Minor 2 | Moderate 3 | Significant 4 | Major 5 |
| Almost Certain A | Moderate | High | Extreme | Extreme | Extreme |
| Likely B | Moderate | High | Extreme | Extreme | Extreme |
| Moderate C | Low | Moderate | High | Extreme | Extreme |
| Unlikely D | Low | Low | Moderate | High | Extreme |
| Rare E | Low | Low | Low | Moderate | High |

# Code Compliance

Safety risks mitigated through compliance with relevant Australian Codes and Standards either in design or as required of the Contractor by virtue of referencing these standards in the project specification.

| Hazard Identified/Relevant Codes | Likelihood | Consequence | Risk Rating | Residual Risk | Responsibility |
|---|---|---|---|---|---|
| **Dust / Erosion** | C | 2 | M | Dust or erosion affecting safety of person as a result of extreme weather event not contemplated in design. | Local Authority or Land Owner |
| Relevant Federal, State and Local Authority Environmental Guidelines | | | | | |
| **Stormwater inundation of buildings or infrastructure** | E | 5 | H | Persons injured as a result of flooding from extreme storm event not contemplated in design. | Local Authority or Asset Owner |
| Australian Rainfall and Runoff / IPWEA / Local Authority Standards | | | | | |
| **Roads unsafe or impassable due to flooding** | D | 4 | H | Persons being trapped or injured by flooding over or within roads from extreme storm event not contemplated in design. | Local Authority or Asset Owner |
| Australian Rainfall and Runoff / IPWEA / Local Authority Standards / relevant State Department of Main Roads | | | | | |
| **Required maintenance works adjacent or beneath underground/overhead power** | D | 4 | H | Electrocution as a result of poor work practises. | Asset Owner |
| Relevant State Power Authority Guidelines / Local Authority Standards | | | | | |
| **Pedestrian, cyclist and/or vehicle accident on a roadway, cycleway or path** | D | 4 | H | Injury to persons due to collision as result of negligence. | Local Authority or Asset Owner |
| AustRoads / relevant State Department of Main Roads / Local Authority Standards / AS 1742: Manual of uniform traffic control devices (Parts 1-14) / AS 1743: Road Signs - Specifications / AS 3845: Road Safety Barrier Systems / AS 1428: Design for Access and Mobility (Parts 1 - 5) / AS 2890: Parking Facilities (Parts 1 - 6) / AS 2353: Pedestrian Push Button Assemblies / AS 5100.1: Bridge Design - Scope and General Principals | | | | | |
| **Road pavement failure** | E | 1 | L | Eventual traffic loading or volumes differ to that agreed and approved as part of design resulting in pavement failures and subsequently persons injured due to traffic accident. | Local Authority or Asset Owner |
| AustRoads / Local Authority Standards / IPWEA / relevant State Department of Main Roads / AS 3727 - Guide to Residential Pavements | | | | | |
| **Earthworks and/or retaining structure failure** | E | 3 | L : | Building, batter or retaining failure due to loading, undermining or use not contemplated in design resulting in injury to persons. | Local Authority or Land Owner |
| AS 3798: Guidelines on earthworks on commercial and residential developments / AS 4678-2002: Earth Retaining Structures / Local Authority Standards | | | | | |
| **Residual Site Contamination** | D | 3 | M | Remnant contaminated soils or groundwater, or the presence of unexploded ordinances not completely identified and addressed. | Local Authority or Land Owner |
| Local Water Authority Standards / WSAA Standards / AS 3500.1 Water Services / AS 3500.2 Sanitary Plumbing and Drainage | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Drowning within stormwater device or infrastructure** | E | 5 | H | Injury to persons due to unauthorised access or as a result of extreme storm event not contemplated in design. | Local Authority or Asset Owner |
| Australian Rainfall and Runoff / IPWEA / Local Authority Standards / relevant State Department of Main Roads | | | | | |
| **Public Open Space Civil Elements and Infrastructure** | E | 4 | M | Injury to persons due to inappropriate and/or unauthorised access or use. | Local Authority or Land Owner |
| Local Authority Standards / IPWEA / Australian Rainfall and Runoff / WSAA Standards /<br>AS 1428: Design for Access and Mobility (Parts 1 - 5) / AS 3798: Guidelines on earthworks on commercial and residential developments / AS 4678-2002: Earth Retaining Structures / AS 2890: Parking Facilities (Parts 1 - 6) / AS 3500.1 Water Services / AS 3500.2 Sanitary Plumbing and Drainage | | | | | |
| **Access to civil stormwater and sewerage chambers and infrastructure** | E | 4 | M | Injury to persons due to unauthorised access or use. | Asset Owner |
| Local Authority Standards / Local Sewer Authority Standards / WSAA Standards / IPWEA / relevant State Department of Main Roads / Australian Rainfall and Runoff /<br>AS 3500.2 Sanitary Plumbing and Drainage / AS 3996: Access Covers and Grates | | | | | |

# Construction and Commissioning

| Hazard Identified | Pre-design Risk Rating | Design Mitigation | Post-design Risk Rating | Residual Risk | Responsibility |
|---|---|---|---|---|---|
| **Hazardous substances specified or produced as part of works coming into contact with persons** | | | | | |
| Hazardous waste is produced as part of the works and requires management. | Maybe Unconventional | Reference to Environmental / Geotechnical Reports within design documentation. | Conventional | Safety of persons affected. | Contractor |
| **Hazardous substances inherent in the site coming into contact with persons** | | | | | |
| No testing has been done. Contractors should take appropriate precautions. | Maybe Unconventional | Notification within design documentation. | Conventional | Safety of persons affected. | Contractor |
| Testing of the site has revealed hazardous substances and requires management. | Maybe Unconventional | Reference to Environmental / Geotechnical Reports within design documentation. | Conventional | Safety of persons affected. | Contractor |
| Asbestos potential in fencing, soils and demolition materials. | Maybe Unconventional | Notification within design documentation. | Conventional | Safety of persons affected. | Contractor |
| Unexploded ordinances may exist on site. | Maybe Unconventional | Reference to Environmental / Geotechnical Reports within design documentation. | Conventional | Safety of persons affected. | Contractor |
| **Excavations work causing injury to persons. Hazards may include one or combination of:** | | | | | |
| Adjacent structures/railway/main road. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Unstable ground conditions. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Excavation below the water table in unstable soils. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Depth of excavation exceeds 5m. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Tunnelling or jacking. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Use of explosives. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| **Risk of injury due to noise or vibration Hazards may include one or combination of:** | | | | | |
| Deep or high energy impact compaction. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Compaction adjacent existing structures and/or brittle services. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| **Risk of injury to person due to electrocution/explosion/fire. Hazards may include one or combination of:** | | | | | |
| Existing services adjacent/through site not located. | Maybe Unconventional | Notification within design documentation. | Unconventional | Injury to persons | Contractor |
| Works adjacent flammable liquids or gases. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |

| | | | | | |
|---|---|---|---|---|---|
| Works adjacent pressurised services. | Maybe Unconventional | Notification within design documentation. | Unconventional | Injury to persons | Contractor |
| Works adjacent or beneath underground/overhead power. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Mulching stockpile self-combusting. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| **Risk of injury due to vehicle impact for works adjacent highly trafficked area** | | | | | |
| Inadequate traffic and pedestrian management controlling existing or construction traffic. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| **Risk of Injury due to modification of existing structures or services** | | | | | |
| No assessment of capacity of existing structures or services to support construction or demolition loads. | Maybe Unconventional | Undertake assessment or place a notification within design documentation. | Unconventional | Injury to persons | Contractor |
| No assessment of capacity of existing structure to resist earthquake loads. | Maybe Unconventional | Undertake assessment or place a notification within design documentation. | Unconventional | Injury to persons | Contractor |
| No existing drawings or information of existing structures or services. | Maybe Unconventional | Notification within design documentation. | Unconventional | Injury to persons | Contractor |
| No detailed investigation of existing structures or services. | Maybe Unconventional | Undertake assessment or place a notification within design documentation. | Unconventional | Injury to persons | Contractor |
| Existing structures or services old or in poor condition. | Maybe Unconventional | Notification within design documentation. | Unconventional | Injury to persons | Contractor |
| Possible retaining wall collapse due to undermining or adjacent works. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| **Risk to safety during lifting and erection of materials** | | | | | |
| Ground conditions are poor to support crane outriggers. | Maybe Unconventional | Design suitable support pavement or place a notification within design documentation. | Conventional | Injury to persons | Contractor |
| Large components with large windage specified. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| **Working in confined spaces** | | | | | |
| Access to deep structures during construction (either proposed or existing). | Maybe Unconventional | Notification within design documentation | Conventional | Injury to persons | Contractor |
| Risk of inappropriate isolation of existing services. | Maybe Unconventional | Notification within design documentation | Conventional | Injury to persons | Contractor |
| Work required in excavations with 3 or more of the following hazards:<br>- Surcharging structure/live services.<br>- High water table.<br>- Contaminated soils.<br>- Excavation over 2m deep.<br>- Soils prone to instability eg saturated ground, peat etc. | Maybe Unconventional | Notification within design documentation | Conventional | Injury to persons | Contractor |
| **Working in Remote Areas** | | | | | |
| Inadequate amenities and access to Emergency Services at site. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |
| Cyclonic or severe weather conditions experienced at the site during work periods. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Contractor |

| | | | | | |
|---|---|---|---|---|---|
| **Earthworks, preload, site influences, topography, location of site** | | | | | |
| Contaminated ground / acid sulphate soils. | Maybe Unconventional | Reference to Environmental / Geotechnical Reports within design documentation. | Conventional | Safety of persons affected | Contractor |
| Unusual Geotechnical Conditions (unstable ground, steep existing batters etc.). | Maybe Unconventional | Reference to Geotechnical Reports within design documentation and inclusion of recommendations in design approach. | Conventional | Safety of persons affected | Contractor |
| Interface with adjoining properties / risk of undermining or overloading existing structures. | Maybe Unconventional | Undertake assessment or place a notification within design documentation. | Conventional | Safety of persons affected | Contractor |

# Use for its intended purpose

| Hazard Identified | Pre-Design Risk Rating | | | Design Mitigation | Post-Design Risk Rating | | | Residual Risk | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| | Likelihood | Consequence | Risk Rating | | Likelihood | Consequence | Risk Rating | | |
| Hazard identified that cannot be mitigated by compliance with relevant industry standards and codes due to project specific constraints. | | | | | | | | | |
| **Vehicle, cyclist and/or pedestrian conflicts** | | | | | | | | | |
| Inadequate pedestrian/vehicle/cyclist separation and delineation provided to each other or another object/formation. | | | | TBC with relevant Authority. | | | | Injury to persons | Local Authority or Asset Owner |
| Pedestrian crossings and infrastructure not to standard. | | | | TBC with relevant Authority. | | | | Injury to persons | Local Authority or Asset Owner |
| Road design doesn't consider expected vehicle size and movements. | | | | TBC with relevant Authority. | | | | Injury to persons | Local Authority or Asset Owner |
| **Risks due to stormwater** | | | | | | | | | |
| ~~Depth and velocities of flows in open drains excessive.~~ | | | | ~~TBC with relevant Authority.~~ | | | | ~~Injury to persons~~ | ~~Local Authority~~ |
| Detention storage areas at unsafe depth, slope and/or have inadequate public protection. | D | 3 | M | TBC with relevant Authority. | D | 2 | M | Injury to persons | Local Authority |
| ~~Permanent water bodies at unsafe depth, slope and/or have inadequate public protection.~~ | | | | ~~TBC with relevant Authority.~~ | | | | ~~Injury to persons~~ | ~~Local Authority~~ |
| ~~Large drainage headwalls are inappropriately protected with covers/grates to restrict entry.~~ | | | | ~~TBC with relevant Authority.~~ | | | | ~~Injury to persons~~ | ~~Local Authority~~ |
| **Earthworks and retaining walls** | | | | | | | | | |
| Inadequate grades and/or access for pedestrians and people with disabilities. | D | 3 | M | TBC with relevant Authority. | D | 2 | L | Injury to persons | Local Authority |

# Maintenance & Servicing

| Hazard Identified | Pre-design Risk Rating | Design Mitigation | Post-design Risk Rating | Residual Risk | Responsibility |
|---|---|---|---|---|---|
| Hazard identified that cannot be mitigated by compliance with relevant industry standards and codes due to project specific constraints. | | | | | |
| **Risk to safety associated with maintaining stormwater system** | | | | | |
| Pit openings or depth provide inadequate space for entry. | Unconventional | TBC with relevant Authority. | Conventional | Injury to persons | Local Authority or Asset Owner |
| Ladders cannot be positioned to allow entry/exit whilst facing oncoming traffic | Maybe Unconventional | TBC with relevant Authority.. | Conventional | Injury to persons | Local Authority or Asset Owner |
| Location of pits mean they are not readily and safely accessible | Maybe Unconventional | TBC with relevant Authority. | Conventional | Injury to persons | Local Authority or Asset Owner |
| ~~GPT's have inadequate accessibility for cleaning equipment~~ | ~~Maybe Unconventional~~ | ~~TBC with relevant Authority.~~ | ~~Conventional~~ | ~~Injury to persons~~ | ~~Local Authority or Asset Owner~~ |
| ~~GPT's cleaning requirements do not suit Local Authority maintenance vehicle limitations~~ | ~~Maybe Unconventional~~ | ~~TBC with relevant Authority.~~ | ~~Conventional~~ | ~~Injury to persons~~ | ~~Local Authority or Asset Owner~~ |
| Adequate clearances to other infrastructure cannot be achieved. | Maybe Unconventional | TBC with relevant Authority. | Conventional | Injury to persons | Local Authority or Asset Owner |
| **Hazardous substances inherent in the site coming into contact with persons** | | | | | |
| Retaining walls impede ease of access to services. | Maybe Unconventional | Notification within design documentation. | Conventional | Injury to persons | Local Authority or Asset Owner |
| Constructed batters are steeper than allowable standard. | Maybe Unconventional | TBC with relevant Authority. | Conventional | Injury to persons | Local Authority or Asset Owner |
| Possible remnant contaminated soils or unexploded ordinances. | Maybe Unconventional | TBC with relevant Authority. | Conventional | Injury to persons | Local Authority or Asset Owner |
| **General** | | | | | |
| Pressurised or flammable services not within standard corridor. | Maybe Unconventional | TBC with relevant Authority | Conventional | Injury to persons | Local Authority or Asset Owner |

MCG
CONSULT

mcgconsult.com.au

ABN: 77653271160