CONSTRUCTION SPECIFICATION

PENRITH LAKES DEVELOPMENT CORPORATION

6 January 2014

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1. GENERAL SPECIFICATION

1.1 GENERAL SPECIFICATION

This Construction Specification is generally in accordance with the New South Wales Department of Housing Specification – Revised Edition 1989. It is recommended for use by all organisations involved in urban development in NSW.

It is noted there are some minor amendments to the standard Construction Specification which are relevant and specific to The Penrith Lakes Site.

All works shall be done in a sound, efficient and workmanlike manner and in accordance with sound engineering practice and principles.

All works are to be completed in accordance with the drawings and specifications and with the engineering purpose and intent of the drawings and specifications.

All works carried out and all services provided on the Penrith Lakes Site must be carried out and provided in a way that complies with health, safety and environmental obligations imposed by statute as well as by the Principal under its Occupational Health, Safety and Environmental Management Systems (OHS&E). For the purpose of the Principal's OHS&E the Contractor and every employee must be inducted to the Penrith Lakes Site and must comply with requirements of the Principal's OHS&E specification for the prescribed level of contract while on the Penrith Lakes Site.

The Penrith Lakes Site is subject to a Drug and Alcohol Policy that allows for random testing on the Penrith Lakes Site. No-one is to enter or be on the Penrith Lakes Site with greater than 0.02% blood alcohol content or the trace of any illegal drugs in their body. If it appears that the Contractor or any employee while on the Penrith Lakes Site are impaired by the effects of alcohol or drugs, then the person who appears to be so impaired may be tested.

The speed limit on the Penrith Lakes Site is 20km/h unless sign posted otherwise.

1.2 SAFETY

Design and construction of the works must be consistent with the Principal's OHS&E and comply with all relevant legislation and regulations.

Execution of the works must comply with all statutory requirements in the State of New South Wales including the Work Health & Safety Act and where relevant and nominated by the Principal addition of the Mine Health & Safety Act.

The Contractor must provide an OHS&E management system that complies with current legislation, regulations and Principal's OHS&E requirements at all times.

Work shall not commence on site until the Principal has audited and approved the Contractor's OHS&E management system.

The Contractor's OHS&E must include but is not necessarily limited to;

- Safety Management Plan
- Safe Work Method Statements & Risk Assessments
- Induction Protocols, PPE, Drug & Alcohol Policy
- Vehicle and Equipment Inspections
- Pre-Start Inspections & Toolbox meetings

1.3 NOTICES TO BE IN WRITING

All notices, applications and requests to be given to the Contractor under the Contract shall be given in writing, and the Contractor shall not be entitled to rely upon any verbal notice, application or request, notwithstanding any arrangement to the contrary at any time.

1.4 SITE NOTICE BOARDS

If the Contractor wishes to erect any notice board on or adjacent to the site then the Contractor must first provide the Principal details as to the size, format and general appearance of the proposed notice boards and must obtain approval of the Principal before erecting the notice board.

It is the Contractor's responsibility to provide and comply with the necessary cautionary and warning signs relevant to current regulations and good industry practice in the building and construction industry.

1.5 APPROVALS & CONSENTS

The Contractor must request and obtain a copy of all the relevant approvals and consents from the Principal prior to the commencement of any works on the site.

All works must be carried out in accordance with the conditions of consent.

The Contractor must plan and carry out the works so as to meet all conditions of the development and construction approvals.

The Contractor must plan and carry out the works so as to minimise erosion, sedimentation and contamination of the site and the surrounding lands and watercourses in accordance with consents and the Principal's OHS&E.

The Contractor must design and construct the works to meet the noise and dust limitations set out in the conditions of approvals and consents.

1.6 ACCESS TO THE SITE

The Contractor will be responsible for constructing and maintaining all weather access to the works area including the supply, laying and removal of temporary roads and lay down areas.

The Contractor must park private vehicles in designated Contractor parking areas and the Contractor must provide transport for employees to and from the works to parking areas.

The Contractor is to restrict access to the works to the inducted employees, subcontractors and suppliers for delivery of goods and services.

The Contractor and its employees, subcontractors and suppliers are restricted to the works areas, lay down storage areas and the nominated private roads to and from the work site.

When requested to do so or where required by local and state regulation the Contractor must provide barricades and fencing to protect the relevant work areas.

The Principal and representatives of the Principal may access the works during working hours by informing the Contractor and signing the Contractor's visitor register before and after accessing the work site.

1.7 WORK BY SERVICE SUPPLY AUTHORITIES AND/OR OTHER CONTRACTORS

It should be anticipated by the Contractor that the construction of mains and/or services by Public Utility Service Authorities and/or work by other Contractors may proceed during the currency of the contract.

The Contractor shall permit and maintain access by traffic to such construction and/or work and shall not obstruct the execution of work by the various Service Supply Authorities and/or other Contractors. The Contractor shall not be entitled to any extra payment on the part of the Principal by reason of interference, delay or damage to his works by these Authorities and/or other Contractors and he shall make his own arrangements with the relevant Authority and/or other Contractor where he considers compensation is due to him.

Contractors shall be mutually responsible for complete co-operation in order to ensure the satisfactory completion of the whole of the works.

Should any dispute arise the Superintendent shall adjudicate and his decision shall be final.

1.8 PRESERVATION OF PROPERTY & SERVICES

1.8.1 Care of Existing Works

Prior to the commencement of the works the Contractor shall ascertain from the appropriate utility service supply and/or Local Government Authorities, the position and depth of all public utility or other services which may be interfered with during the excavation and/or construction of the works.

The Contractor shall take every precaution, which is necessary, to secure from damage all existing gas and water mains, gas and water service pipes, stormwater drainage lines, sewers, electrical conduits, telephone installations, other existing works, or services in the area of the work, or which are adjacent to the works and shall maintain the same, until the backfilling of excavations and the general progress of the works render such further precaution unnecessary.

1.8.2 Preservation of Property

The Contractor must be responsible for the preservation of all public and private property affected by execution of the works.

Special attention must be given to the protection of natural heritage and natural vegetation and other landscaping features surrounding and adjacent to the works.

The Contractor is to provide cautionary signage and barrier protection where nearby archaeological and flora and fauna areas could be affected by the works.

All areas of grass and vegetation beyond the limits of the works which are damaged by execution of the works must be restored and replanted to their original condition by using

approved methods and materials.

1.9 SITE FACILITIES

1.9.1 First Aid Equipment

A first aid kit shall be provided and maintained by the Contractor on the site of the work during the whole of the period when workmen are on the site. A plan showing the location of the first aid facilities must be prepared and exhibited on site. The first aid kits shall be kept clean, fully stocked and provided in a location readily accessible from the place of work.

The Contractor must provide and nominate an employee with current first aid qualifications.

1.9.2 Shelter and Change Accommodation

A shelter and change shed for workmen suitably floored and weatherproof, of sufficient size to allow one square metre of accommodation per person and fitted with seats, and fly proof food cupboard, shall be provided by the Contractor. No materials other than tools of trade shall be stored in this shed. The shed shall be kept clean at all times.

1.9.3 Sanitary Convenience

Toilet sheds shall be provided, constructed and maintained in accordance with the following provisions:

a) Number to be provided: One closet shall be provided on every work site where not more than twenty persons are employed at the one time, and one additional closet for each additional twenty persons or part of twenty persons so employed.

b) Location: Such closet accommodation shall be situated so as to be readily accessible from the place where men are working, but shall be far enough removed to avoid nuisance.

c) Construction: All closets shall be soundly constructed and roofed with weatherproof material. The floor of each closet shall be well drained and constructed of approved material, which shall be impervious to water. Every closet shall be well ventilated. Each closet shall have a hinged door capable of being fastened both on the inside and on the outside.

d) Cleanliness: Closets shall be maintained in a clean condition and regularly serviced.

1.9.4 Water Supply

A suitable potable water tank or tanker shall be provided by the Contractor and kept supplied with sufficient quantities of clean, cold potable water at all times by the Contractor.

Adequate provision shall be made by the Contractor for the supply of boiling water for meals and washing of utensils.

1.9.5 Washing Facilities

a) Number: One wash basin shall be provided for each ten persons.

b) Location: Washing facilities shall be situated conveniently close to the change shed.

c) Drainage: Drainage shall be provided for the suitable disposal of waste water.

d) Duckboards: Duckboards shall be provided underfoot where necessary or desirable.

e) Cleanliness: Washing facilities shall be kept in a clean condition at all times.

1.9.6 Work of a Minor Nature

Where the work is of a minor nature and the provisions of these Sub Clauses are considered to be unnecessary, the Contractor may apply to the Superintendent in writing for permission not to comply with any or all of the provisions of the aforementioned sub-clauses and the decision of the Superintendent thereon shall be final.

1.10 NATURE OF GROUND

Where trial shafts, trenches, or borings have been made, and for the guidance of tenderers are shown on the Drawings, tenderers are advised that the Principal assumes no responsibility whatsoever regarding the information so supplied and tenderers must satisfy themselves in all particulars as to the nature of the ground and the requirements of the work.

1.11 ALIGNMENT. SETTING OUT AND CARE OF SURVEY MARKS

The Superintendent shall supply the information necessary to enable the Contractor to set out the Works.

The centrelines of all roads together with drainage easements where appropriate will be marked and recovered, by pegs or other marks as shown on the Drawings. The Superintendent will arrange the survey information necessary for the Contractor to peg sewer mains or common drainage lines.

The Contractor shall construct the roads and/or stormwater drainage lines within road reservations in strict conformity with the surveyed centreline, except where otherwise shown on the Drawings or instructed in writing by the Superintendent. Before any such survey marks are disturbed by construction works, the Contractor shall notify the Superintendent of his intention to offset such marks. The marks shall be offset to a position clear of the construction and the Contractor shall record the offset, both in distance and level and notify the Superintendent.

The Contractor shall at his own expense set out the Works correctly in accordance with the Contract and shall provide all instruments and materials necessary for that purpose.

If at any time during the progress of the work, any error is discovered in the position, level, dimensions or alignment of any part thereof, the Contractor shall immediately on his discovery of the error notify the Superintendent and shall, unless the Superintendent otherwise directs, rectify the error in accordance with the General Conditions of Contract.

The Contractor shall preserve and maintain in their true position all State Survey Marks (SSM) and Permanent Marks (PM) whether or not the marks are to be used for the purpose of setting out, checking or measuring the work under the Contract.

Should any SSM or PM be disturbed or obliterated, the Contractor shall immediately notify the Superintendent and shall unless the Superintendent otherwise determines, arrange for a Registered Surveyor to rectify such disturbance or obliteration, unless the disturbance or obliteration has been caused by the Principal, his employees or agents, the cost of rectification shall be borne by the Contractor.

1.12 GUIDE, FENDER AND/OR INDICATOR POST

Guides, fender and/or indicator posts shall be placed in positions as shown on the Drawings and shall be in accordance with the details shown on Standard Drawing RM18 or as directed by the Superintendent. Timber posts shall be approved hardwood free from imperfections.

The earth backfilled around posts shall be well rammed in layers of not more than 150mm for the full depth. Guide posts shall have one red reflector attached to each face facing traffic. The reflectors shall consist of 100mm x 50mm strips of red retro-reflective material, each firmly affixed to aluminium backing of similar size. White reflectors consisting of 100mm x 25mm strips of retro-reflective material attached to aluminium backing of similar size shall be attached to the reverse face of the posts when directed by the Superintendent.

1.13 STREET NAME SIGNS

Street name signs shall either be erected in positions shown on the Drawings or as directed by the Superintendent and shall be in accordance with the detail shown on the drawings or to the requirements of the Local Government Authority. The Superintendent will direct the Contractor in writing as to which standard is to be adopted.

1.14 SERVICE CONDUITS

All conduit trenches shall be at a grade of not less than one percent in the direction nominated by the Superintendent.

Conduits under roads shall be laid prior to the construction of the initial course of the pavement unless otherwise approved by the Superintendent.

Backfill material under road pavements shall comply with the requirements of pipe bedding in Clause 6.6 of the Construction Specification for Stormwater Drainage. Backfilling and compaction shall generally comply with the requirements of Clause 6.15 of the Construction Specification.

1.14.1 Electricity Conduits

Electricity service conduits shall be excavated for, supplied unless otherwise specified, bedded, laid, jointed and backfilled in locations directed by the Superintendent and shall be to the requirements of the appropriate County Council.

The ends of the conduits shall be plugged or suitably sealed to preclude entry of soil and shall be connected with approved fittings.

The Contractor shall arrange for all conduits to be inspected and approved by the appropriate County Council.

Crossings may comprise single, multiple or multiple layer conduits as directed by the Superintendent and payment will be made at the appropriate rate tendered.

Kerb faces shall be permanently marked at conduit crossings directly above the conduit to the requirements of the appropriate authority and by a peg at the end of a conduit run where kerbing has not been constructed. Marking shall be to the requirements of the appropriate County Council.

1.14.2 Street Lighting

Street lighting shall be provided on all new urban residential subdivisions in accordance with Australian Standard AS1158 part 3. The design parameters governing the supply of luminaries, shall limit adverse effects (see section 2 of AS1158.3).

Generally, Collector and Local roads will require lighting categories P4 & P5 employing Type 4 luminaires. Suitable arrangements for the provision of street lights shall be made with the electricity authority prior to the issue of the Subdivision Certificate. In cases where Council determines that street lighting is paramount to community safety, Council will not issue any Subdivision Certificate prior to that lighting being constructed and operational. Street light pole location is shown on standard drawing SD001

Specific situations where street lighting is required, but not limited to, are:-

(a) Major Intersections.

(b) Pathways and underpasses.

(c) Public carparks.

(d) Taxi ranks.

(e) Bus stops.

(f) Stairways.

1.14.3 Water Service Conduits

Where directed by the Superintendent, the Contractor shall supply, excavate for, lay, joint and backfill water service conduits in carriageways and pathways in accordance with the Water Board, Hunter District Water Board or Local Council regulations as applicable.

The conduits shall be laid with a minimum cover of 450mm and shall extend to a point 300mm behind the kerb faces or concrete edges.

The location of the conduits shall be marked by cutting the letter "W" 75mm in height in the concrete kerb face or concrete edge at each end of the conduit unless otherwise directed by the Superintendent.

The installation shall be carried out by a licensee of the Water Board, Hunter District Water Board or local Council. Prior to commencement of the work the Contractor shall obtain a plumbing permit.

1.14.4 Telecom Conduits

The Contractor shall liaise direct with the local construction office of Telecom Australia to ensure that the necessary road crossings are installed by Telecom prior to placing kerb and gutter. Kerb faces shall be permanently marked at crossings directly above. the conduit to the requirements of Telecom Australia.

1.14.5 Gas Conduits

When directed by the Superintendent, the Contractor shall excavate for, bed, lay, joint and backfill gas conduits in locations nominated by the local Gas Company. The location of the conduit shall be marked *by* cutting the letter "G" 75mm in height in the concrete kerb face at each end of the conduit. Such work shall be regarded as an extra to the contract and payment will be arranged under the provisions of the General Conditions of Contract.

1.15 PROVISION FOR TRAFFIC

In public roads the Contractor shall make full provision for the safe continuous movement of vehicles with a minimum of disruption to traffic flow, and shall erect temporary signs and controls conforming to M.R. Form No. 121. "Specification for Control of Traffic at Road and Bridgeworks" or the equivalent standards.

The Contractor shall provide sufficient fencing, barriers and lighting of all works comprised in the Contract and such temporary roadways, footways, barriers and fences as necessary for the accommodation and protection of pedestrians, vehicles, and animals. The cost of the work under the provisions of this Clause shall be included in the Contract Sum.

The Contractor shall comply with all directions from the Superintendent regarding provision for traffic otherwise alternative arrangements may be made by the Superintendent and charged to the Contractor.

1.16 CARE OF SURVEY MARKS

The Principal shall provide the Contractor details of the necessary survey marks for setting out the works.

In addition to the survey marks necessary for setting out the works as defined in the General Conditions of Contract, the Principal may have other survey marks for its own purposes.

The Contractor shall preserve and maintain in their true position all such survey marks. Should any survey marks be disturbed or obliterated, the Contractor shall immediately notify the Superintendent. The cost to the Principal for the replacement of these marks shall be borne by the Contractor.

1.17 REINSTATEMENT

Prior to the issue of a Certificate of Practical Completion, all surplus material and rubbish shall be removed and the whole of the site left clean and neat in appearance. Any road pavement, footpath or kerb and gutter disturbed or destroyed during construction shall be reinstated to a condition at least equal to that existing before commencement of operations.

Similarly, the whole work shall be left in a neat and tidy condition at the end of the Defects Liability Period.

1.18 CLEANING AND REINSTATEMENT OF EXTERNAL AREAS

The Contractor shall ensure that deleterious material deposited as a result of the works is removed from external roads. Any damage to external areas of the site as a result of the works shall be reinstated by the Contractor as directed by the Superintendent. Any clearing or reinstatement by the Contractor shall be carried out at no cost to the Principal.

1.19 RAW WATER & DUST CONTROL

The Principal will make available a raw water supply at existing dams and connections on the Penrith Lakes Site for construction purposes and dust suppression.

The Contractor must install all pumps, pipework and outlet connections as required to suit water offtake requirements.

The Contractor shall take all reasonable steps to limit the creation of any dust nuisance which might arise during the execution of the works. In this regard the Contractor shall regularly water all haul roads, access tracks and construction areas.

The Superintendent may direct that work cease until such time as any particular dust nuisance has been controlled to his satisfaction. All costs associated with control of dust shall be included in the Contract Sum.

The Principal is unable to supply potable water to the works site. The Contractor will be required to make its own arrangements for potable water supply from the local water utility.

1.20 ELECTRICAL POWER

The Principal is unable to supply electrical power to the works site. The Contractor will be required to make its own arrangements for suitably silenced and portable electricity generators or by connection to nearby utility supply mains.

1.21 FIRE TRAILS

Fire trails shall be constructed to the details shown on the Drawings and/or Standard Drawing RM26 and in accordance with the relevant specifications. The Contractor shall obtain the approval of the Superintendent prior to commencing the construction of fire trails. Passing bays shall be provided generally at intervals of 200 metres but not exceeding 400m. The Superintendent shall indicate the location of the passing bays

Pavement material for fire trails shall generally consist of approved crushed sandstone obtained from on-site excavations or imported local screened -40mm ridge gravels unless otherwise directed by the Superintendent.

1.22 CERTIFICATE FROM REGISTERED SURVEYOR

Prior to Practical Completion the Contractor must provide the Superintendent work as executed drawings and a survey certificate endorsed by a Registered Surveyor showing that the work has been constructed in accordance with the lines, levels and other survey information as provided on the drawings and within the tolerances specified.

The Contractor shall have no right to additional monetary compensation for providing such certification.

1.23 STANDARDS

All works and services must meet the minimum requirements of the appropriate Australian Standards and are in addition to any other Standard nominated by the Principal.

Where an Australian Standard does not exist, the requirements of the appropriate ISO International Standard shall apply.

1.24 QUALITY MANAGEMENT & WORK AS EXECUTED

The Contractor must control the quality of the execution of the works and must establish a Quality Management System relevant to the Contract and generally in accordance with the requirements and intentions of ISO 9001 or approved equivalent.

All the requirements of this Construction Specification must be applied in conjunction with the approved quality standards.

The Quality Management Plan, execution plans and inspection plans must be lodged with the Principal for approval in advance of commencement of works in accordance with the table of key dates.

The Contractor must prepare work as executed plans on completion of the works. The work as executed drawings and all quality control documentation must form part of the Contractor's documentation to be supplied to the Principal.

1.25 MINIMUM INSPECTION REQUIREMENTS

The Superintendent will require the following critical stage inspections during the works. They are to be incorporated into the Contractor's Inspection and Test Plans (ITP's) in the Quality Management System specified in Clause 1.24.

(a) ENVIRONMENTAL - Erosion controls and vegetation clearing

(b) STORMWATER PIPELINES - prior to backfill of pipes to inspect size, class, bedding, haunching, alignment, joints, and plugs

(c) INTER ALLOTMENT DRAINAGE - prior to backfill of subsoil drains - prior to backfill including backfill material

(d) SUBGRADE (Natural or Select) – materials, proof-roll, string-line (for Work-As-Executed levels provided by a registered surveyor) and density (for compaction and moisture)

(e) SUB-BASE – materials, proof-roll under K&G, string-line (for Work-As-Executed levels provided by a registered surveyor), pavement proof roll and density (for compaction and moisture)

(f) BASECOURSE – materials, proof-roll, string-line (for Work-As-Executed levels provided by a registered surveyor), density (compaction and moisture) and Benkleman Beam, prior to final wearing course

(g) BITUMEN SEAL -primer seal, pre-coated aggregates and prior to final wearing course

(h) CONCRETE - paths and pits and other structures prior to pour and after finish/render

(i) FINAL - drainage structures and general "finish" of works

2. SITE CLEARING AND/OR GRUBBING

2.1 DESCRIPTION

This Construction Specification provides for the clearing and/or grubbing and removal of prescribed materials from the full area of the site specified or shown on the Drawings.

2.2 NOTICE

The Contractor shall give the Superintendent seven (7) days clear notice of his intention to commence clearing operations, and no work shall be commenced within that period unless approval to do so has been granted by the Superintendent.

2.3 CLEARING AND GRUBBING

For the full area of the site specified or shown on the Drawings the prescribed materials, being fences, concrete and/or brick foundations and/or floors, structures of all descriptions, trees, shrubs, scrub, stumps, logs, boulders and roots - except those fences, structures, trees, shrubs and/or items which the Superintendent may direct to be retained shall be cleared and/or wholly grubbed, and together with all lying and fallen timber, rubbish and debris of every description, shall be disposed of in accordance with the provisions of Clause 2.6.

2.4 TREES TO BE RETAINED

No growing trees and/or shrubs shall be destroyed or damaged by the Contractor other than those specified or directed to be removed. The Superintendent will mark or otherwise indicate to the Contractor those trees and/or shrubs which are to be removed and the Contractor shall take particular care during the operations of clearing not to remove and/or damage any other trees and/or shrubs.

2.5 CARE OF TREES THAT ARE TO BE RETAINED

Trees and/or shrubs to be retained are to be adequately protected at all times and particular care shall be taken to avoid any damage to the roots, trunks and branches.

If necessary for this purpose, equipment shall be kept clear of trees and/or shrubs and hand methods of excavation shall be adopted to avoid damage.

All costs necessary to adequately protect trees and/or shrubs over the period of the contract shall be included in the Contract Sum unless otherwise specified.

2.5.1 Breathing Layers

Where directed, trees in more than 0.3 metres of fill shall be provided with a breathing layer in accordance with Standard Drawing RM24. The cost of providing breathing layers to trees will be paid for as a variation to the contract.

2.5.2 Roots

Before any excavation is carried out over the roots of trees and/or shrubs to be retained, the Contractor shall obtain a direction from the Superintendent as to whether the levels in the vicinity of the tree can be adjusted to protect the roots.

When any excavation is required in the vicinity of trees to be retained, hand excavation first shall be made to locate any roots. Roots which are then seen to be affected by the line of the proposed work shall be cleanly severed clear of the work before machine excavation commences.

2.5.3 Trunks

If considered necessary the Superintendent may direct the Contractor to protect certain of the trees to be retained. This protection shall be given by lashing pine or other suitable off-cuts upright around the trunks leaving gaps of no more than 150mm. The off-cuts shall be 1.5 metres high and shall extend down to ground level so as to protect the boles. The flat side of the off-cuts shall face outwards and if necessary shall be painted white. The cost of providing this protection will be paid for as a variation to the contract.

2.5.4 Damage to Trunks

Where the trunks of trees are damaged by plant and/or equipment, the Superintendent may direct the Contractor to effectively cover the damaged portion of the trunk with approved tree paint. The Contractor, at his own cost, shall carry out this work in a satisfactory manner within forty-eight hours of being so directed by the Superintendent.

2.5.5 Branches

Where branches of trees to be retained protrude into the working area arrangements shall be made on approval by the Superintendent for their removal by the Contractor.

If in the opinion of the Superintendent any tree or shrub to be preserved contains branches which are dangerous, such branches shall be removed and disposed of in accordance with the provisions of Clause 2.6.

2.5.6 Severely Damaged Trees

If in the opinion of the Superintendent any trees are so damaged as to be unlikely to survive, or are removed contrary to or without the approval of the Superintendent, the Contractor for each-and every tree so damaged or removed, shall be liable to pay to the Principal up to the sum of two thousand dollars ($2,000) for liquidated damages, and the sum or sums payable as such damages may be deducted from any sum or sums due to the Contractor under the contract. The Superintendent shall determine the amount of damages which will be based on the cost of any landscape works or such replanting deemed necessary.

2.6 REMOVAL OF TREES LEFT IN FILLED AREAS

The Superintendent reserves the right to direct the Contractor to clear, grub and remove any tree and/or shrub left living and standing in any area filled in the site preparation works if the Superintendent is of the opinion that such tree and/or shrub is dying.

If the Contractor is directed to remove any tree and/or shrub left standing, which the Superintendent is of the opinion is dying he shall proceed to clear, grub and remove such tree in accordance with the provisions of this Construction Specification.

The Contractor shall be entitled to payment for such additional clearing work as is directed to be done as an extra to the contract amount.

No extra payment will be made to the Contractor for the clearing grubbing and removal of trees damaged during the progress of the contract which the Superintendent may direct to be cleared, grubbed and removed. This work shall be done by the Contractor at his own expense.

2.7 DISPOSAL OF MATERIAL

All material cleared and/or grubbed in accordance with the Construction Specification shall become the property of the Contractor who shall tub and grind where appropriate or otherwise remove cleared and grubbed material from site.

Unless approved by the Principal in writing before commencement of the works the Contractor must not light fires nor burn any of the material that has been cleared and grubbed. Burning in the open is not permitted and all material that cannot be re-used in the works shall be removed from the site.

Where permission is granted to the Contractor for burning then;

a) the Contractor must adhere to the provisions of the Clean Air Act as amended and all local regulations.

b) should the clearing and/or grubbing be done at a season when burning is not permitted, the Contractor shall stack all material which is to be burnt outside the area covered by the works; and

c) the Contractor shall delay burning until fire restrictions have been lifted. If unburnt, the material shall be removed from the site prior to the completion date of the contract.

2.8 FIRES

The lighting of fires on the site for the purpose of this contract is not permitted unless approved in advance by the Principal in writing.

Fires must not be lit during any period gazetted for the particular area under the provisions of the Careless, Use of Fires Act, 1912, as amended by the Bush Fires Act, 1947, nor at any other time unless the Contractor obtains an appropriate permit from the local authority.

The Contractor shall give the occupiers of adjoining properties at least forty-eight (48) hours' notice of his intentions to burn, and shall abide by the provisions of any Act, Ordinance or By-Law or Permit relating to the lighting of fires.

The Contractor shall be responsible for all damage to fences, grass cultivation, buildings, or other property occasioned by fires lighter for any purpose in connection with this contract.

2.9 RESTORATION OF SITE

All holes or depressions caused by the clearing and/or grubbing work shall be backfilled with

approved material and the area compacted in accordance with the provisions of Clause 3.7 of the Construction Specification for Site Preparation Works or Clause 5.10 of the Construction Specification for Formation whichever is appropriate. Prior to being back-filled the holes or depressions shall be inspected by the Superintendent, who will indicate whether backfilling may proceed.

The Contractor shall leave the whole of the site in a clean and tidy state, and shall restore the natural surface to a condition similar to that existing prior to the commencement of his operations.

2.10 PRIVATE PROPERTY

Every precaution shall be taken to prevent timber or other materials falling on and/or being deposited on private property and the Contractor shall remove, at his cost, any timber or other materials so fallen and/or deposited.

2.11 DAMAGE

All damage of every kind, including damage to fencing, caused by the execution of the work shall be made good by the Contractor, at his expense, and to the satisfaction of the Superintendent.

3. SITE PREPARATION WORKS

3.1 DESCRIPTION

This Construction Specification applies to all areas within the limits of the contract indicated on the Drawings and provides for the site preparation of building allotments and/or reserves, inclusive of site regrading.

3.2 CLEARING AND GRUBBING

The area of the site to be prepared shall be first cleared and grubbed in accordance with Section 2 of the Construction Specification for Site Clearing and/or Grubbing.

3.3 STRIPPING OF TOPSOIL

Topsoil shall be stripped from those areas to be affected by earthworks for site drainage and site preparation works to the specified depth, or where no depth is specified to a minimum depth of 100mm. The topsoil shall be stockpiled in approved locations outside areas such as drainage depressions, for later re-spreading, in stockpiles no higher than two (2) metres, and in accordance with the provisions of Clause 3.9. Grass shall be stripped off together with the topsoil. Care shall be taken to avoid contamination by any other material.

3.4 REMOVAL OF UNSUITABLE MATERIALS

Following the stripping of topsoil as specified in Clause 3.3 and before excavation, filling or other works are commenced in any area, all exposed silt and other deleterious material which in the opinion of the Superintendent is unsuitable for the placing of filling shall be removed and disposed as directed by the Superintendent. Minor pockets of unsound material such as those caused by tree stumps etc. shall be removed and all costs associated with the removal and replacement shall be deemed to be included in the Contract Sum.

If in the opinion of the Superintendent unsound or unsuitable material is encountered at the

specified excavation level or embankment base in other than minor pockets additional excavation and its replacement with compacted approved material may be ordered in writing by the Superintendent. All unsound or unsuitable material excavated in accordance with the provisions of this paragraph shall be disposed of by the Contractor where directed or removed from the site. This work shall be additional work with payment being made as a variation to the contract.

3.5 COMPACTION PRIOR TO THE PLACING OF FILLING

On areas to be site regraded by filling, and after removal of the materials as described in Clauses 3.3 and 3.4 and before any filling material is placed, the stripped surface shall be ripped, conditioned and re-compacted for a depth of 150mm to a density not less than 95% of its standard maximum dry density as specified in Clause 3.7.

3.6 SITE REGRADING

Site regarding work shall be carried out as shown on the Drawings by cut and/or fill operations and/or by utilisation of surplus approved spoil material available from road formation and drainage works under the Contract. Where insufficient material is available from these sources for filling purposes, imported material as specified in Clause 4.6 shall be used to complete the site regrading work.

The areas specified to be regraded shall be finished to the levels, with allowance for topsoil replacement, and/or grades shown on the Drawings without abrupt changes of slope and/or depressions, which may hold surface waters. The regraded surface, after the specified compaction shall present a good true surface, free from rocks, clods and rubbish of all description.

All areas not subject to construction works shall be retained free from disturbance or damage during the currency of the Contract. Should these areas become disturbed or damaged they shall be reinstated by the Contractor at no cost to the Principal.

3.7 PLACING AND COMPACTION OF FILLING

Placing of filling on the prepared areas shall not commence until the authority to so do has been obtained from the Superintendent.

The Superintendent may arrange for levels to be taken on the prepared surface prior to the placing of filling.

Prior to placement of filling the Contractor must rip, condition with water and re-compact the prepared surface to the dry density of fill as set out in this Clause below.

Filling shall be carried up in horizontal layers, extending the full width of the area being filled, not more than 250mm thick, loose measurement.

The dry density of fill determined in accordance with AS 1289.E3.1 shall satisfy the following requirements:

a) Sands: Density index more than 651 according to AS 1289.E6.1 where compaction test is in accordance with AS 1289 E5.1.

b) Material other than sand: Dry density ratio according to AS 1289.E4.1 of more than 95% where the compaction test is in accordance with AS 1289.E1.1 (standard).

The Superintendent may direct that certain areas of fill be certified by a N.A.T.A. registered Geotechnical Laboratory and the testing of such areas shall be carried out in accordance with the provisions of Clause 4.8 of the Construction Specification for Excavation. The Contractor shall have no right to monetary compensation or to any claim for damages arising from delay on the part of the testing authority.

The moisture content of each layer shall be maintained at near the optimum during compaction. Where it is necessary to increase the moisture content, each layer or part thereof shall be watered by means of an approved sprayer delivering a uniform distribution of water over the area to be wetted. Adequate watering equipment shall be made available during all compaction operations.

Where material is too wet to allow proper compaction, the working of such material shall be deferred until the required optimum moisture content has been attained.

3.7.1 Compacted Filling Standard (Lot Filling)

Lot-fill shall be performed to Level 1 requirements in accordance with AS 3798 under the supervision of a suitably qualified National Geotechnical Testing Authority. The NATA authority must provide an inspection and testing service, including decisions on the location and timing of sampling and testing operations, to enable it to provide an opinion that the works comply with the requirements of the specification and drawings. The NATA authority may also be required to provide a report on the locations and results of all work that it has carried out.

3.7.2 Site Classification (Geotechnical)

Each new lot shall be classified for building purposes as determined by AS 2870.

3.8 SUBSIDIARY SITE WORKS

When directed by the Superintendent, the contractor shall make available earthmoving plant or equipment for use in allotment preparation, and/or other works, and shall utilise such plant or equipment to carry out the works to the requirements of the Superintendent. Payment for works so executed will be made at the tendered rates for plant or labour.

All additional work shall be performed only upon receipt of written instructions from and under the supervision of the Superintendent.

3.9 REPLACEMENT OF TOPSOIL

The Contractor shall not commence placing the topsoil on the prepared areas until the authority to so do has been obtained from the Superintendent.

After the Superintendent has authorised the placing of topsoil, the Contractor shall spread the stockpiled and/or imported topsoil to the specified depth, or where no depth is specified to a depth determined by the Superintendent.

After spreading the topsoil, it shall then be compacted with a light roller and trimmed so that the finished surface of the topsoil conforms to the design levels and grades unless otherwise specified or directed.

Topsoiled areas, when finished, shall present smooth surfaces free of stones and lumps of soil and blend into adjoining undisturbed ground.

4. EXCAVATION

4.1 GENERAL EXCAVATION

Wherever appearing in the Construction Specification "excavation" shall mean excavation in all classes of materials and shall include the removal of loose earth, sand, clay, all vegetation, shale, igneous, metamorphic and sedimentary rock, ironstone, concrete, masonry, pipes, conduits, made ground and any other obstruction, material, matter or substance.

The Contractor shall excavate to the depths and dimensions shown or implied on the Drawings, or to such greater depths and dimensions, in unsuitable materials in accordance with Clause 3.4, as will ensure sound, permanent foundations. All excavation shall be passed by the Superintendent before any materials or structures are placed thereon.

No additional excavation will be paid for unless ordered in writing under the provisions of the General Conditions of Contract. Any additional excavation made without such authority beyond the limits prescribed in the contract shall be made good by the Contractor with granular or other approved filling placed in layers not exceeding 250mm thickness in loose measurement and compacted in accordance with the provisions of Clause 3.7 of the Construction Specification for Site Preparation Works or Clause 5.10 of the Construction Specification for Formation whichever is appropriate.

Excavated material (if deemed suitable by the Superintendent) shall be used in the formation of embankments and for site filling and the cost of all operations, including loading, hauling, spreading and compacting, shall be included in the contract excavation rates.

No excavation shall be commenced on any portion of the contract until, in the opinion of the Superintendent, the necessary plant is on the site to ensure the uninterrupted progress and continuance of the cut to fill operation.

In carrying out excavation work, the Contractor shall take all reasonable precautions against mishap or accident, whether arising from insufficient strength of timberings, bad workmanship, breakage of machinery or plant, inefficient caulking or packing of open joints

or spaces, flood, or any other cause whatsoever, and he shall be held solely responsible for all damage, injury, or loss that may occur to buildings, structures, bridges, railways, roadways, streets and other surfaces above and adjacent to the excavations, to all persons whether employed by the Contractor, by the Principal or otherwise, and to his own and other works, and the cost of all such damage, injury and loss and any compensation shall be met by the Contractor.

The value of such damage, compensation, injury and/or loss may be deducted from any moneys or security held by the Principal on account of the contract and which may become due to the Contractor.

The surfaces of any exposed rock shall be dressed to finished lines with ripping, picks or scabbling tools so as to remove all loose rock, leaving the surface sound and regular. Excavation shall be taken out as neatly as possible to the dimensions shown and any over excavation shall be made good unless otherwise specified or directed.

4.2 SURPLUS SPOIL

The Contractor shall notify the Superintendent if there is surplus spoil to that necessary to execute those works shown on the Drawings or otherwise specified. On no account shall the Contractor arrange to dispose of surplus spoil or permit others to remove surplus spoil without the express permission in writing of the Superintendent.

Unless otherwise specified the Superintendent may indicate a location or locations where the Contractor shall deliver and dispose of surplus spoil and the Contractor shall load, cart, spread and compact at the location or locations indicated.

If the location or locations be situated within the site or at a distance outside the site of one kilometre or less, no additional payment will be made for this work. For locations situated outside the site at distances exceeding one kilometre, payment will be made at a rate determined by agreement between the Contractor and the Superintendent in accordance with the General Conditions of Contract.

The Superintendent will determine the distances involved and also the volume of the spoil carted for the purposes of any additional payment under this clause. The Superintendent's decision shall be final.

4.3 BACKFILL AT STRUCTURES

Unless shown on the Drawings or otherwise specified, all filling for a distance of two (2) metres back from abutments and wings of bridges or culverts shall consist of approved granular material.

4.4 COMPACTION BY HAND

Where compaction by rolling is impracticable the material shall be compacted by thorough watering and ramming in layers not more than 150mm in thickness, the rammers to weigh not less than 20 kilograms and to have not more than 150 grams per square centimetre of contact area.

4.5 SHAPING OF EARTHWORK

Embankments and excavations shall be evenly graded in accordance with the Drawings, with surfaces and side slopes neatly and evenly graded and trimmed.

4.6 IMPORTED SELECTED FILLING

The Contractor shall provide and import on to the site all filling required for the execution of this contract in excess of the amount available from the excavations and shall make his own arrangements for obtaining suitable filling from sources outside the limits of the Contract. All

filling so provided and imported on to the site shall be Virgin Excavated Natural Material (VENM) as defined in in Schedule 1 of the Protection of the Environment Operations Act and in the EPA's Waste Classification Guidelines or equivalent.

All imported material must be approved by the Superintendent and shall be free from sticks, brickbats, rubbish, rocks, roots, noxious weeds, silt, humus and lumps of clay, or other unsuitable materials.

The Contractor shall give the Superintendent seven (7) days clear notice of his intention to import filling and shall indicate in such advice the source of the material proposed to be used.

The cost of all operations, including the spreading and compacting on site, shall be included in the relevant contract rate.

All filling delivered which is considered by the Superintendent to be unsatisfactory shall be immediately removed from the site by the Contractor at his expense.

Unless authorised in writing by the Superintendent, no unspecified excavation shall be carried out within the site for the purpose of obtaining material for filling operations.

4.7 EXPLOSIVES

Subject to the observance of the provisions of this Construction Specification and any Act of Parliament, Ordinance or Regulation, excavation may be carried out by the use of explosives, subject to the approval of the Superintendent who shall have the right to limit the use of explosives and the sizes of charges used. The Contractor shall provide himself with the necessary licence from the appropriate authority.

The Contractor shall be liable for any accident, damage or injury to any person or property resulting from the use of explosives. Where necessary he shall display warning signs and flags and shall in all cases cause a warning to be sounded prior to firing.

4.8 TESTING

Testing to ascertain whether the contract works comply with the Drawings and Construction Specifications shall be carried out by the Superintendent or by a testing authority approved by him and the costs of such tests shall be borne by the Principal.

The costs of repeat tests carried out in accordance with the provisions of the General Conditions of Contract shall be borne by the Contractor and shall include the costs of arranging and supervising such repeat tests.

The aforementioned testing does not relieve the Contractor of the responsibility of ensuring that the requirements of the Contract are adhered to and in this regard the Contractor shall carry out any necessary control testing at no cost to the Principal.

5. FORMATION

5.1 DESCRIPTION

This Construction Specification provides for the formation by cut and/or fill of the earthworks for the construction of roads, pathways, miscellaneous works and concrete structures.

5.2 REMOVAL AND REPLACEMENT OF TOPSOIL

Topsoil shall be stripped from within the formation areas of roads, accessways, parking areas, pathways, miscellaneous pavements and other works inclusive of batters and shall be placed in stockpiles outside of locations such as drainage depressions and in locations approved by the Superintendent for the later top dressing of formed footpaths, berms, batters and site regrading areas.

The thickness of the topsoil stripping shall be as specified on the Drawings or as called for in the Bill of Quantities but where not specified the thickness of topsoil stripping shall be not less than 100mm.

The Contractor shall maintain all topsoil stockpiles in a neat and tidy condition and not higher than two (2) metres above ground level during the execution of formation earthworks and until replacement of topsoil is carried out.

In the event of a surplus of topsoil remaining in stockpiles after the completion of all specified topsoil replacement the contractor shall inform the Superintendent of the existence of surplus material and shall execute any additional work as and when directed by the Superintendent.

Replacement of topsoil shall be in accordance with the provisions of Clause 3.9 of the Construction Specification for Site Preparation Works.

5.3 REMOVAL OF UNSUITABLE MATERIALS

Following the removal of topsoil as specified in Clause 5.2 and before the specified filling or

other works are commenced in any area, the Contractor shall remove all unsuitable material in accordance with the provisions of Clause 3.4 of the Construction Specification.

5.4 PREPARATION PRIOR TO FILLING

On areas which require filling and after removal of the materials described in Clauses 5.2 and 5.3 above and before any filling material is placed, the cleared and stripped surface shall be thoroughly compacted to meet the requirements as specified under Clause 5.10 for "Compaction of Earthworks and Subgrades".

5.5 EXCAVATION

Excavation for the formation shall be carried out in accordance with the provisions of Section 4 "Excavation" of the Construction Specification.

Subject to the observance of the provisions of Clause 4.8 the excavation for the formation may be carried out by the use of explosives.

The surfaces of any exposed rock shall be excavated to at least 150mm below the designed subgrade and the material (or approved substitute material) replaced and compacted to the designed subgrade level to the requirements of Clause 5.10.

5.6 SURPLUS SPOIL

Surplus spoil shall be disposed of as specified in Clause 4.2 of the Construction Specification.

5.7 IMPORTED FILLING

All imported filling provided shall be in accordance with the provisions of Clause 4.6 of the Construction Specification.

5.8 EMBANKMENTS

Placing of filling on the prepared areas shall not commence until the approval to do so has been obtained from the Superintendent.

Embankments shall be constructed from approved sound excavated material and shall be placed in horizontal layers extending across the full width of the embankment of not greater than 250mm in thickness, loose measurement, and each layer shall be compacted in accordance with the provisions of Clause 5.10.

Where the cross slope of the natural surface is steeper than 1:3, that is one vertical in three horizontal, the base of the entire embankment shall be suitably stepped, scarified or roughened to the satisfaction of the Superintendent before the construction of the embankment is commenced. Natural ground adjoining an existing embankment together with the existing batter shall receive similar treatment before the embankment is widened.

5.9 BOXING

The formation of roads, accessways, parking areas, pathways and miscellaneous pavements shall be boxed out for the construction of the pavement as shown on the Drawings.

Where not otherwise detailed on the Drawings the boxing shall extend between the alignment of the backs of kerbs and vehicular crossings, edges of shoulders or edges of concrete pavements.

Boxing in excavations shall be formed by removal of material from the solid. Boxing in embankments may be formed by building up and compacting by rolling the footway or shoulder area and then trimming the inside edges vertically to correct line.

The Contractor shall make temporary provision for drainage and diversion of stormwater

where water may tend to accumulate. Care shall be taken to guard against scour or any part of the construction, and should any scour occur it shall be made good at the Contractor's expense. All temporary provisions for drainage unless otherwise directed to be retained for use as catch or shoulder drains, shall be restored to the satisfaction of the Superintendent before pavement materials are placed.

5.10 TRIMMING AND COMPACTION OF EARTHWORKS AND SUBGRADES

The earthworks and subgrades shall be thoroughly compacted by rolling near optimum moisture content to achieve the specified compaction density. All soft or unstable patches that may develop during compaction operations shall be removed, filled with approved sound material and blended into the surrounding material, moistened and rolled until thoroughly compacted.

Compaction shall continue until a dry density has been achieved of not less than 98% of the standard maximum dry density when tested in accordance with the current Australian Standard AS1289 Tests E.1.1 or E.1.2.

The Contractor may be called upon by the Superintendent to make available a three (3) wheeled self-propelled roller and carry out proof loading by rolling those sections of subgrade directed to be by proof loaded. Unless otherwise acceptable to the Superintendent the roller shall have rear rollers of at least 1200mm in diameter and an intensity of loading of at least 7000 kg per metre width of roller. The Contractor shall not be entitled to claim or to receive any additional payment for conducting proof loading by rolling.

After compaction, the subgrade profile shall be prepared parallel to the finished surface at the specified depth below the detailed cross sectional and grade lines and over the required widths. The subgrade profile may be tested at the discretion of the Superintendent by means of a template to check its accuracy. Any irregularities found shall be adjusted by the Contractor by the addition or the removal of material followed by further trimming and rolling to achieve the specified profile shape and compaction.

5.11 BATTERS

Unless otherwise specified or directed by the Superintendent the sides of cuttings and embankments, shall be trimmed to a slope of two horizontal to one vertical.

5.12 ENTRANCE TO SIDE ROADS AND ADJACENT PROPERTY

Should any alteration to levels be made opposite entrances to side roads or opposite vehicular entrances to adjacent property, adjustment to restore access shall be carried out by the Contractor as part of the works.

5.13 UTILITY CONDUITS AND SERVICE PIPES

Where specified, utility conduits and service pipes shall be installed in accordance with Clause 1.14 of the Construction Specification.

Any damage to subgrades or earthworks during installation shall be repaired by the Contractor at his expense prior to pavement construction.

5.14 INSPECTION BY SUPERINTENDENT ON COMPLETION OF FORMATION

The Contractor shall not commence the construction of the pavement on the formation until prior authority to so do has been obtained from the Superintendent. Where pavement has been constructed or commenced in contravention of this Clause, the Contractor, when ordered by the Superintendent shall remove the pavement so commenced or constructed, wholly at his expense.

6. STORMWATER DRAINAGE

6.1 DESCRIPTION

This Construction Specification provides for the excavation and backfilling of trenches and the supply, bedding, laying and jointing of reinforced concrete, fibre cement, vitrified clay and uPVC pipe drainage lines, and the construction of precast reinforced concrete box culverts.

Where indicated on the Drawings the Contractor shall construct culverts and pipelines complete with connections to the required headwalls and/or pits.

6.2 DRAINAGE LINE LOCATION

The location of each drainage line shall be determined from the details in the drawings, standard drainage structure drawings, longitudinal profiles of drainage lines and ancillary special drawings. The pegging of survey marks showing the location of drainage easements shall be arranged by the Superintendent at no cost to the Contractor.

Drainage lines shall be constructed so that their centreline coincides with the centreline of the respective internal wall of the drainage structure or as detailed on the Drawings.

Drainage lines within proposed drainage easements shall be centrally located and no segment of a pipe, culvert or drainage structure shall be constructed outside the easement boundaries without the prior approval in writing of the Superintendent.

Should trees exist along the proposed drainage line, or so close to the trench that damage to trees would be unavoidable, the Contractor shall seek direction from the Superintendent before excavation commences.

6.3 MATERIALS

The Contractor shall indicate the source of supply of pipes and box culverts and shall signify in advance when each consignment will be ready for dispatch so that if so desired, arrangements may be made for inspection and testing at the place of manufacture. If so directed, the Contractor shall provide facilities for testing at the place of manufacture, or alternatively, the Superintendent may require the testing of the pipes and box culverts at the point of delivery or on the work.

The Superintendent shall inspect pipes and box culverts upon delivery to the site and rejection of damaged pipes and box culverts shall be at the sole discretion of the Superintendent.

Pipes and box culverts are not to be placed in position in the work until passed for this purpose by the Superintendent either with, or without testing, at his discretion. The fact that pipes are passed by the Superintendent shall in no way limit their rejection subsequently by the Superintendent in the event of it being found that they do not conform to the Construction Specification.

6.3.1 Reinforced Concrete Pipes

Unless a particular class or type be specified, the pipes shall be precast reinforced concrete Class "X", and shall be of the rubber ring joint type unless otherwise specified or shown otherwise on the Drawings.

Pipes and specials such as bends and off-takes shall conform to AS 1342-1973 (Amended 1976) Precast Concrete Drainage Pipes for classes HS", "X", "Y" and "Z" respectively as amended, and the Superintendent reserves the right at any time to call for any or all of the specified tests, (viz. Load, Hydrostatic, or Absorption), to be carried out on each size and consignment of pipes prior to the pipes being used in the work.

Any pipe or pipes may be selected for test and if any pipes do not comply with the test requirements these shall be replaced with satisfactory pipes by the Contractor at his expense.

6.3.2 Fibre Reinforced Cement Pipes

The use of fibre reinforced cement stormwater pipes as a substitute for reinforced concrete pipes may be approved by the Superintendent subject to the Contractor lodging a written application giving at least two (2) weeks' notice requesting the substitution of any pipes. The requests shall also state the sizes, classes and locations of the proposed substitutions in the drainage system.

6.3.3 Vitrified Clay Pipes

Unless otherwise specified, all pipes may be of stormwater grade spigot and socket vitrified clay but shall be subject to the approval of the Superintendent who may reject any or all of the materials if such are considered unsatisfactory. The Contractor may elect to use pipes of higher quality/strength than that specified, but shall not be entitled to any extra payment for use of such pipes.

All fittings shall be first quality conforming to the requirements of AS 1741-1975 Vitrified Clay Pipes, with spigot and socket joints. All vitrified clay pipes and fittings shall be jointed using rubber rings in accordance with clause 6.9.

6.3.4 uPVC Pipes

The use of uPVC pipe Class SH of diameters 100mm to 300mm inclusive shall be permitted in lieu of other pipes of similar size. Pipes and fittings shall conform to the requirements of AS 1260- 1974 Unplasticised PVC (uPVC) Pipes and Fittings for Sewerage Applications.

Stored pipes shall always be protected from direct sunlight by stacking in the shade or under

cover.

6.3.5 Precast Reinforced Concrete Box Culverts

Precast Box Culverts shall conform to the requirements, including load tests and water absorption tests of M.R. Form No. 138A-I975 Specification for Supply and Delivery of Precast Reinforced Concrete Box Culvert Sections. The Superintendent reserves the right at any time to arrange for testing in accordance with this Form.

6.3.6 Mortar

Unless otherwise shown on Drawings or specified, all mortar used shall be composed of one part of cement to three parts of sand. The sand shall be clean and free from any organic or foreign matter and, if necessary, it shall be washed to conform with these requirements. Up to ten percent of lime shall be added if required by the Superintendent.

The sand and cement shall be batched by volume, thoroughly mixed, first in a dry state and afterwards with clean fresh water until well incorporated. The mortar shall be mixed on approved clean sawn timber platforms close to where it is required. Only fresh mortar shall be used and once it has become hard or partially set shall be at once removed from the works.

Where pipe joints to be made may be affected by water during construction, jointing material shall comprise one part cement and one part of approved clay in lieu of cement mortar.

6.4 EXCAVATION

Wherever appearing in the Construction Specification "excavation" shall mean excavation in all classes of material. Excavation shall be carried out in accordance with the provisions of Clause 4.1 of the Construction Specification.

The Contractor shall excavate drainage line trenches to the lines and levels shown on the Drawings, with allowance for bedding in accordance with Clause 6.6.

Should the Contractor excavate trenches to depths greater than that necessary, the excess excavation shall be backfilled to the correct level with properly compacted approved bedding material. This work shall be carried out at the Contractor's expense.

Trenches shall be excavated to a sufficient width so that a minimum space of 100mm is created between the side of the trench and the outside of the pipe barrel. Where necessary to allow the proper handling, jointing and placing of all types of pipes specified, additional excavation shall be carried out at no additional cost to the Principal.

Unless otherwise specified or directed by the Superintendent, trench excavation for bedding on rock shall be a minimum of 200mm below the underside of the pipe barrel. For bedding on earth foundation the trench shall be excavated over its full width to a level at least 75mm below the underside of the pipe barrel before bedding material is placed. All loose material shall be removed from the bottoms of trenches prior to the placing of approved granular bedding material.

Subject to the observance of the provisions of Clause 4.7 of the Construction Specification, excavation may be carried out by the use of explosives.

Subject to any Act of Parliament, Ordinance or Regulation, the Contractor shall satisfy himself as to the necessity of timbering any excavation and shall accept the sole responsibility as to its being required and to its use in the works. The whole cost of supplying, fixing and withdrawing timbering and any timber that the Contractor may deem necessary to leave in the work shall be included in the relevant tendered excavation rate.

The execution of any additional excavation by benching or battering to offset the necessity of timbering may be approved by the Superintendent on the written request of the

Contractor, subject to the Contractor supplying, placing and compacting all additional specified backfill material required to make good the soil excavation in accordance with this Construction Specification, all at no additional cost to the Principal.

Where pipes are required to be placed in filled ground, or in any case where the top of the pipe would be less than 400mm below the natural surface, filling shall first be placed and thoroughly compacted in accordance with the provisions of Clause 3.7 of the Construction Specification for Site Preparation Works or Clause 5.10 of the Construction Specification for Formation to at least 400mm above the top of the proposed pipeline. The trench shall then be excavated in the normal manner to the required levels, and after laying and jointing of pipes, the line shall be backfilled in accordance with the requirements of Clause 6.15 of this Construction Specification.

The Contractor shall take all precautions against accident, damage to the Contract or other works and properties and injury or loss arising from any cause whatsoever to persons employed by the Contractor, by the Principal or otherwise. The cost to the Principal of any such damage, injury or loss may be deducted from any monies due to the Contractor on account of this Contract.

6.5 ALLOWANCES IN EXCAVATION OUANTITIES

In the calculation of quantities and in construction the Contractor is to allow the following for drainage excavations:

Width:

a) single cell pipelines - 200mm plus external pipe diameter.

b) multiple cell pipelines - 200mm plus external pipe diameters.

Excavation Level:

a) 75mm below underside of pipe barrel in other than rock.

b) 200mm below underside of pipe barrel in shale or rock.

The surface level adjacent to the trench sides shall be:

a) finished footway level less 75mm for pipes in excavated footway areas.

b) excavated subgrade level for pipes under paved areas.

c) natural surface level for pipes in open areas.

d) natural surface level less stripped topsoil for pipes under embankment formation but fully contained in trenches below natural surface.

e) finished embankment surface level for pipes partly or fully contained in embankment formation.

Where amendments in drainage line construction are ordered in writing by the Superintendent, variations in trench excavation shall be calculated from the dimensions of the trench widths and depths detailed in preceding sub-clauses and adjustments of the Contract Sum shall be made at the appropriate rates in the Priced Bill of Quantities in accordance with the terms of the General Conditions of Contract.

6.6 PIPE BEDDING

The material used for bedding of pipes shall be approved granular material having high permeability, high stability when saturated and free of organic material.

Samples of the types of materials intended to be used shall be submitted to, and approved by, the Superintendent prior to their use.

No bedding material shall be placed until the excavation has been inspected and passed by the Superintendent. After acceptance by the Superintendent, bedding material shall be placed and compacted to the correct level for pipe laying.

6.7 PIPE LAYING

Pipes shall be laid with lifting holes, if provided, to the top or in accordance with the manufacturers requirements and shall have their full length in contact with the prepared bedding as specified, the pipes being placed to form drainage lines true to line, level and grade as shown on the Drawings and/or as otherwise detailed.

Pipe ends shall be tightly butted against each other and shall be jointed as specified in Clause 6.9 Method of Jointing.

Where two or more lines of pipe are to be laid in parallel the space between the outside of each pipe barrel shall be 300mm.

Any pipe which is not laid on true alignment or to design level and/or grade or which shows any settlement after laying or which is damaged during subsequent backfilling or compaction operations, shall be taken up by the Contractor, replaced with a new pipe, if damaged, and the drainage line completed to the satisfaction of the Superintendent, all at the expense of the Contractor.

Where a pipeline of 1050 mm or larger in diameter is laid in a trench beneath an area to be paved and where the depth of backfill cover between the obvert of pipes and the subgrade level above is less than 0.5m, all pipes shall be temporarily strutted internally in the vertical axis at each pipe joint. Struts shall be of timber or other materials of dimensions approved by the Superintendent and shall bear against sills and caps tightly wedged against the pipes. Strutting shall be removed following completion of the construction of road, accessway or pathway pavement sub-base.

Where a drainage line is to be constructed on a curve, arc or an angled bend, standard and/or curved pipes, angle bends and specials shall be supplied in accordance with the provision of sub-clause 6.3.1 of this Construction Specification and laid to the details shown on the Drawings and in accordance with the provisions of this Construction Specification and the Special Conditions of Contract.

6.8 SUBSOIL PIPES IN STORMWATER DRAINAGE TRENCHES

Subsoil drainage pipes shall be provided adjacent to every inlet stormwater pipe at each pit for a distance upstream of three (3) metres. The subsoil pipe shall be fitted with a filter sock and shall comply with the requirements of Clause 6.17. The filter sock shall be appropriately tied at the upstream end of the subsoil pipe to preclude the entry of filter material. The subsoil pipeline shall be laid at the same grade as the stormwater pipeline.

Where shown on the Drawings or directed by the Superintendent, subsoil pipes shall be laid for the full length along stormwater drainage lines between kerb inlet pits. The subsoil pipe shall be laid on the kerb side of the stormwater drainage trench unless otherwise directed. The subsoil pipe shall be fitted with a filter sock and shall comply with the requirements of Clause 6.17. The pipe shall extend to the upstream pit and shall be connected through the pit wall at a level above the obvert of the outlet pipe.

6.9 METHOD OF JOINTING

All pipes shall be jointed in accordance with the manufacturer’s requirements. Pipes with interlocking or flush type ends shall be jointed using cement mortar as specified. Each pipe joint shall be thoroughly wetted then filled with mortar working on the inside or outside of the pipes according to pipe size, the mortar being struck off to give a neat smooth finish uniform with the adjacent pipe surface. All excess mortar shall be removed from the inside

of pipes.

Where spigot and socket pipes are laid, jointing shall be carried out using cement mortar as specified or an approved bituminous filler or rubber rings to the manufacturer's specification.

Pipes with butt ends shall be jointed either by a bandage joint or precast collar joint. A bandage joint shall be constructed in accordance with the details on Standard Drawing RM13 using cement mortar as specified. Where precast collars are used jointing shall be carried out using cement mortar or an approved bituminous filler.

Cement mortar filled joints shall be protected from rapid drying out by damping down for twenty four hours or covering with an approved curing material.

Where cement mortar filled joints have loosened or have deteriorated during the period of the Contract, all loose material shall be removed from the joints and the joints refilled in accordance with the requirements of this Construction Specification and to the satisfaction of the Superintendent.

When using rubber ring jointed pipe care is to be taken to ensure that the joint is free from dirt or other obstructions and that the rubber ring is placed evenly in the joint.

For fibre cement pipes laid on curves, the pipe to be laid shall bi jointed while directly in line with the previous pipe and the deflection made after jointing.

Where possible the mortar joint immediately adjacent to a pit and/or headwall shall not be made until after the pit or headwall 11 constructed.

All holes provided in concrete pipes for lifting or handling purposes shall be plugged by precast concrete plugs set in mortar before the backfilling of the trenches is commenced.

6.10 CONCRETE ENCASING

Concrete encasement, where shown on drawings, or where directed by the Superintendent, shall have a minimum thickness of 150mm above and below the pipe, and shall extend the full width of the trench. Ductile iron pipes may be substituted for encased concrete pipes, if approved by the Superintendent.

6.11 CONCRETE BULKHEADS

Where shown on the Drawings or directed by the Superintendent, concrete bulkheads shall be constructed. The axis of the bulkhead shall be vertical with a minimum top width of 150mm. Timber or steel formwork is to be used to form the bulkhead.

Unless otherwise directed by the Superintendent, the top of bulkheads shall extend to within 300mm of finished surface level or to the subgrade level where the pipeline is under a road pavement. On each side of the pipe at the level of the trench invert 100mm dia pipes shall pass through the bulkhead. Such pipes shall be filled with fibreglass wool or other approved filter material.

6.12 DIRECT CONNECTIONS

Where direct pipe connections are shown on the Drawings, both pipes shall be carefully cut or manufactured so that a neat junction is obtained. The inside joints shall be neatly and tightly finished off with cement mortar so that the internal shapes of the pipes are maintained. Bandage joints shall be placed on the outside of the connection so that all exposed external joints are lapped at lease 100mm by the bandage.

Junctions with a branch pipe of 225 mm diameter and over shall be supported on concrete as shown on Standard Drawing RM14.

6.13

6.14 PRECAST CONCRETE BOX CULVERTS

Crown units shall be positioned true to line, level and grade as shown on the Drawings, and the sections closely butted together. The sides and top of the crown units for the full length of the butt joint shall be covered with a 300mm wide strip of polypropylene fabric bonded to the crown units with coal tar epoxy or similar so as not to allow backfill material into the butt joint.

The crown unit legs shall be set on a nominal 5mm thickness of 3 to 1 wet cement mortar.

In all cases care shall be taken to ensure that the interior of the crown units have a neat, smooth and uniform surface at the joints. The trenches at the sides of Precast Crown Units shall be carefully packed and compacted with sand or metal dust in uniform layers to the top of the precast section.

6.15 INSPECTION PRIOR TO BACKFILLING

All drainage lines shall be inspected and approved by the Superintendent after laying and jointing and prior to the placing of any backfilling.

6.16 BACKFILLING

Unless otherwise specified or directed, pipe trenches shall be backfilled and 'compacted with granular material conforming to the requirements of Clause 6.6 to a point not less than half the internal diameter of the pipe below the pipe obvert. Selected backfilling above this height shall be placed and compacted by mechanical means in layers not exceeding 300mm compacted thickness to a dry density equal to at least that of the surrounding undisturbed material.

Where drainage lines of any description are laid wholly or in part under road carriageways or kerb and gutter, the trench shall be backfilled with granular material conforming to the requirements of Clause 6.6 in layers not exceeding 300mm compacted thickness up to the subgrade level of the pavement.

The layers shall be saturated with clean water where required by the Superintendent and compacted by a vibrating plate or vibrating roller.

Upon completion of pipelaying, jointing and backfilling of the drainage line, the whole of the drainage line including junction pits, inlet pits, etc., shall be cleaned and maintained in that state for the duration of the contract.

The cost of all work so necessary shall be included in the Contract Sum.

6.17 INTERALLOTMENT DRAINAGE

Where indicated on the Drawings or directed by the Superintendent, the Contractor shall construct interallotment drainage lines complete with fittings, pits and connections to stormwater pits and/or pipes.

Materials shall comply with the requirements of Clause 6.3 and pipe joints shall be of the spigot and socket type unless otherwise specified, jointing being carried out in accordance with Clause 6.9.

Unless otherwise specified the pipes shall be laid with their centreline 500mm from and parallel to the lot boundaries at a minimum grade of 1 percent and having a minimum cover of 300mm. Pits shall be constructed at changes of grade, pipe size or direction.

Pipes shall be laid on a minimum of 50mm of approved sand bedding.

Connections to stormwater drainage lines for pipes up to 150mm diameter shall be in accordance with the detail shown on Standard Drawing RM8. For larger pipes, connections

shall be in accordance with the details shown on Standard Drawing RM14.

Slope junctions shall be provided at the low point of the drainage line within each allotment where no pit is provided. The end of the slope junction pipe shall be fitted with a plug or cap clearly marked "stormwater only."

All lines shall be inspected and approved by the Superintendent after laying and jointing and prior to backfilling. Selected material from the trench excavation shall be used for backfilling unless directed otherwise by the Superintendent. Trench backfill shall be compacted to the satisfaction of the Superintendent and the trench area shall be finally trimmed to restore the surface to final levels.

The location of slope junctions shall be marked with marker pegs of 50mm x 25mm hardwood, painted white, 0.6m long, protruding 300mm out of the ground.

6.18 SUB-SOIL DRAINS

Sub-soil drainage shall be constructed where shown on the Drawings or in the positions nominated by the Superintendent.

6.18.1 1.17.1. Materials

a) Pipes:

   i) Perforated corrugated or smooth wall uPVC pipe, Class 400, conforming to AS2439 Part 1 - 1981 Perforated Drainage Pipes and Associated Fittings;

   ii) Slotted fibre-reinforced cement subsoil drain pipe.

b) Filter socks: shall be stretch or non-stretch of approved manufacture.

c) Filter fabric: shall be woven or nonwoven of approved manufacture and shall satisfy the requirements of the A.R.R.B. Publication titled Sub-Surface Drainage Progress Report September 1979, Section 6 - Guidelines for the Use of Engineering Fabrics for Subsoil Drainage.

d) Filter material: shall be approved coarse washed sand.

The Superintendent may allow the use of a nominal size aggregate (10mm maximum) in lieu of coarse sand as the filter material.

6.18.2 Trench Excavation

Trenches shall be excavated to a width of 300mm and a depth of 600mm measured from the design level of the subgrade, or to a depth such that the pipe can be laid below any service conduit.

In areas outside of road reservations the depth shall be 600mm below natural surface.

6.18.3 Bedding. Laying and Backfillinq

Pipes shall be bedded on 50mm thickness of the specified filter material and shall be graded as shown on the Drawings or at a desirable grade of not less than one percent (absolute minimum 0.5 percent) and shall be connected to stormwater drainage pits.

After laying the pipes the trench shall be back filled with the specified filter material in layers not exceeding 300mm compacted thickness and shall be compacted as specified in Clause 6.15.

7. MINOR CONCRETE STRUCTURES AND PAVEMENTS

7.1 DESCRIPTION

This Construction Specification provides for the forming, reinforcing, mixing and placing of concrete used in the construction of pavements, drainage structures, kerbing and guttering, other kerbs or edge strips, miscellaneous or special structures.

7.2 CONCRETE MATERIALS AND SLUMP

Ready mixed concrete shall be used for the works unless supply is not readily available to the site of the works.

Ready mixed concrete shall be obtained from a source acceptable to the Superintendent and shall consist of a mixture of cement, fine and course aggregates and water complying in all respects with the requirements of the current Australian Standard Specification for Ready Mixed Concrete AS 1379.

The nominal maximum size of aggregate in the ready mixed concrete shall be twenty (20) mm and the slump of the concrete at the time and place of delivery, when tested shall be as specified below.

Any batch of concrete or part thereof delivered to the site of the work and having a slump when tested in excess of that specified shall not be used in the work unless approved by the Superintendent.

All concrete rejected by the Superintendent shall be immediately removed from the site at the Contractor's expense.

Concrete Slump	
Item of Work	Slump (mm)
Machine moulded kerbing and guttering or similar work	20 maximum
Concrete accessway	75 maximum
All other items	75 +/- 15

Where supply of ready mixed concrete is not readily available the Contractor shall lodge a written application with the Superintendent:

a) indicating the reasons precluding the supply of ready mixed concrete;

b) requesting approval of the Superintendent to mixing on site of concrete or part thereof;

c) and clearly detailing the proposed mixture of aggregate materials, cement and water.

The Superintendent may approve of the use of on-site mixed concrete subject to any additional conditions specified by the Superintendent. All costs associated with the use of on-site mixed concrete in lieu of ready mixed concrete shall be borne by the Contractor. The slump and strength of concrete mixed on site shall be in conformity with the relevant requirements of this Construction Specification.

7.3 CONCRETE TESTING AND STRENGTH

Cylindrical test specimens 300mm long by 150mm in diameter prepared by the Superintendent from concrete taken at the time and place of delivery into the forms and taken in accordance with the current Australian Standard AS 1379, shall develop a minimum crushing strength as scheduled below when tested in accordance with the current Australian Standard AS 1012 :-

Concrete Testing & Strength			
	Item of Work	Minimum Crushing Strength (MPa)	
		at 7 days	at 28 days
a)	Concrete accessway pavement and integral kerb (Drawing RM1 and RM20)	18	25
b)	Concrete footway crossings (Drawing RM21 and RM22)	18	25
c)	Concrete dish crossing and apron (Drawing RM1)	18	25
d)	Concrete drainage pits, headwalls, convertors, channel linings, and special structures as detailed on the Drawings	15	20
e)	Concrete pathways and integral kerb (Drawing RM1)	11	15
f)	Concrete kerbing and guttering and miscellaneous kerbing and edge strip (Drawing RM1)	11	15
g)	Concrete street footpaving	11	15

The strength of the concrete shall be determined from the average twenty eight day strength of not less than two test specimens moulded from each specified mix of ready mixed concrete actually placed in the work, selected to represent the whole of the concrete placed during the day of moulding. In general one pair of test specimens shall be moulded from each twenty cubic metres of concrete or part thereof.

Additional specimens may be taken at the discretion of the Superintendent for testing at seven or twenty-eight days. In order that subsequent working operations may proceed, work represented by specimens may be accepted in the event that the seven day test is satisfactory.

Where kerbing and guttering and similar work is constructed using a self-propelled moulding machine, the Superintendent, in lieu of moulding cylindrical test specimens may elect to extract cores from the finished in-situ work for testing purposes in accordance with the relevant section of the current Australian Standard AS 1012.

If cylindrical specimens fail to achieve the specified twenty eight day strength, the Superintendent may arrange for cores to be extracted from the constructed work. In the event of the average strength of such cores, when tested, complying with the specified requirements, the work represented by the specimen cores may be accepted and the cost of extracting and testing of the cores shall be borne by the Principal. In the event of core testing failing to satisfy the strength requirements, the cost of extracting and testing may be deducted from any payment due or that may become due to the Contractor.

Work represented by specimens or cores that fail to satisfy specified strength requirements may be accepted subject to a deduction by way of contract variation of 2% of the scheduled price of the item of work for each 1% or fraction thereof by which the crushing strength is below that specified up to a maximum deficiency in strength of 10%.

If the deficiency in strength exceeds 10% no payment for the work shall be due to the Contractor and the Superintendent may exercise the remedies available to him under the General Conditions of Contract.

7.4 REINFORCEMENT

Reinforcing bars shall be of mild steel conforming to the current Australian Standard AS 1302. Hard-drawn steel reinforcing wire and hard-drawn steel wire reinforcing fabric shall conform to the current Australian Standards AS 1303 and AS 1304 respectively.

All steel reinforcement shall be free from miliscale, grease, tar, paint, oil, mud, mortar or other foreign substance and shall be true to size. If in the opinion of the Superintendent the steel is coated with more than a thin film of rust it may be rejected for use in the work and shall be immediately removed from the site by the Contractor at his expense.

When required by the Superintendent, the Contractor shall provide at no charge, samples of the reinforcement cut to a suitable length or section for testing purposes.

All reinforcement shall be accurately spaced in situ to the spacing and positions shown on the Drawings with bends and hooks located at the points shown.

Reinforcement shall be secured in position being tied a sufficient number of times with suitable wire at laps and crossings to prohibit displacement during the pouring and working of the concrete.

Reinforcement in concrete slabs and similar work shall be supported on chairs of approved manufacture, height and spacing. The use of pieces of concrete, stone, brick, timber or other unsuitable material for the support of reinforcement shall not be permitted.

7.5 FORMWORK

Formwork shall be so designed and assembled that it can be removed without damaging the concrete. Materials used in the formwork shall be of approved timber free from loose knots and other defects, board or metal plate.

Timber forms for exposed surfaces shall be dressed on at least one (1) surface and shall be either dressed or tongued and grooved at connecting edges. Forms for unexposed surfaces of walls, slabs etc. may be of undressed timber, board or metal plate.

Metal plate forms for exposed surfaces shall be clean, smooth, undented and unmarked and devoid of holes. Where bolt, screw or rivet heads are used for connections such connections shall be countersunk.

Forms shall be assembled true to line, level and grade, held rigidly to maintain position and shape and shall be butted so as to be mortar tight. Forms shall be chamfered or filleted to the details as shown on the Drawings.

Prior to the pouring and placing of concrete the internal surfaces of the forms including chamfers, fillets, removeable ducting and similar shall be uniformly coated with a thin film of oil, soap or other approved formwork compound to avoid adhesion of cement mortar and the staining and discolouration of exposed surfaces of the concrete. Any oil, soap etc. adhering to the reinforcement shall be thoroughly removed or the reinforcement taken from the forms and replaced with the specified quantity of clean, undamaged material all to the satisfaction of the Superintendent.

Any bolts, spacers or similar, supporting or separating forms shall be suitably greased and placed so that they may be later removed without damage to the concrete.

Formwork and forms shall be inspected by the Superintendent immediately prior to the placing of concrete and any bulging, warping or displacement of any kind shall be rectified before pouring commences. If during the placing of any concrete the formwork or forms show any signs of displacement that portion of the concrete shall be removed immediately, the formwork or forms re-secured rigidly to the satisfaction of the Superintendent and the concrete pour completed within the requirements of this Construction Specification.

7.6 CONCRETE PLACING

Subgrade, formwork, forms and reinforcement shall be approved by the Superintendent before concrete is ordered for placing. All sawdust, shavings, pools of water and debris shall be removed from the space to be occupied by the concrete.

Concrete shall be placed in the forms by chute in a uniform continuous flow, the length and inclination of the chute being such as to prevent separation of the concrete ingredients. Concrete shall not be dropped into place from a height greater than one and a half metres. Prior to placing, the full area to be occupied by the concrete shall be thoroughly moistened.

Concrete shall be deposited and spread in horizontal layers and shall be compacted by vibration or other approved means. Care shall be taken to fill every space in the forms, to work course aggregate uniformly throughout the mix and away from form faces and to force concrete under and around the reinforcement without it being displaced.

No concrete shall be placed without the prior approval of the Superintendent whilst the air temperature in the shade is or, in the opinion of the Superintendent, is likely within 24 hours to be below four (4^0)degrees Celsius or above thirty eight degrees Celsius.

Any unplaced concrete which has developed initial set shall not be used in the work.

7.7 CONSTRUCTION JOINTS

Where a construction joint is necessary in a concrete pour it shall be provided in accordance with the details shown on the Drawings, or if not shown the joint shall be formed in a slab with a rigid bulkhead and dowels in a manner approved by the Superintendent or in the case of a vertical section by finishing the concrete to a level plane with a roughened surface.

Prior to the resumption of a concrete pour the surface of the joint shall be cleaned of all laitance, loose and foreign material, care being taken not to disturb reinforcement or to damage adjoining concrete surfaces. The joint shall be thoroughly saturated with water and fresh concrete shall be carefully worked against the surface of the concrete previously placed and around reinforcement at the joint.

7.8 REMOVAL OF FORMS

All forms shall remain in position for a period not less than twenty four hours after concrete has been placed, earlier removal being permitted only on the authorisation in writing of the Superintendent.

Should the air shade temperature fall below ten degrees or rise above twenty seven (27^{o}) degrees Celsius, the minimum period may be extended as the Superintendent directs.

Curing of concrete shall commence immediately forms are removed.

7.9 CONCRETE FINISHING

All concrete surfaces shall be finished true and even, free from air and stone pockets, depressions or projections. All arrises shall be sharp and true and moulding shall be evenly mitred, care being exercised in removing forms to ensure this result. Immediately on removal of formwork all rough surfaces, holes and honeycombed areas shall be repaired by removing loose material and defective work, wetting the affected area, filling depressions with fresh cement-sand mortar having the same proportions of cement and sand as used in the base concrete and brought to an even surface with a wooden or steel trowel as required to produce the specified finished surface.

Wire ties protruding from the concrete after removal of the forms shall be cut back and any chipping of the concrete in executing this requirement shall be repaired with cement-sand mortar as previously specified. Holes left by the removal of bolts, spreaders or the like shall be similarly treated. The Superintendent may require additional treatment in some locations.

When directed by the Superintendent exposed surfaces shall be wetted with clean water and rubbed down with an approved carborundum or sandstone block until all repaired areas, rough surfaces and joint marks of forms are removed leaving the surfaces clean and smooth and uniform in colour and appearance. Finishing work shall be completed within two days following removal of the forms.

7.10 CURING

The completed concrete shall be protected from extremes of temperature for a period of seven days during which time the concrete shall be kept continuously moist and covered with canvas, plastic or hessian sheets, chemical curing compounds, sand at least 50mm thick or other approved means.

New work shall be adequately protected from damage by weather conditions, traffic or other causes and all necessary barriers and signs for the control of vehicular and pedestrian traffic shall be erected and maintained for the specified period of concrete curing.

7.11 FOUNDATIONS

Foundations and subgrades shall be prepared in accordance with Section 5 of the Construction Specification - Formation. The bases shall be dressed to a smooth and regular surface and thoroughly compacted to give a foundation of uniform bearing value throughout.

7.12 KERB AND GUTTER

7.12.1 Base

The sub-grade for kerb and gutter shall be formed at the required depth, in accordance with the Construction Specification for formation. A sub-base of compacted thickness not less than the road pavement sub-base shall be provided on the compacted subgrade. The sub-base used shall comply with the Construction Specification for Flexible Road Pavements. Immediately prior to the placing of the concrete, the surface shall be moistened, checked for uniformity and all irregularities made good. The Contractor shall ensure that sub-base materials under the kerb and gutter are protected from stormwater scour prior to backfilling and/or placing of the pavement materials.

7.12.2 Kerb Moulding Machines

Unless otherwise specified kerb moulding machines are to be used for the construction of kerb and gutter and profiles are to be in accordance with Standard Drawing RM1.

The speed of the kerb moulding machine shall not exceed 2.5 metres per minute unless otherwise approved in writing by the Superintendent.

The contractor may apply in writing for approval to construct kerb and gutter by the use of formwork or to vary the kerb and gutter profile.

7.12.3 Finish

All exposed concrete surfaces shall be finished clean and smooth, and uniform in colour and appearance. All corners, joints and edges shall be left neatly rounded.

7.12.4 Joints

Vertical expansion joints of approved bitumen impregnated jointing material shall be placed at the end of each day's construction, at the junctions with the existing old work and at the commencement of each 1.3 metre kerb transition adjacent to gully pits. Weakened plane joints shall be cut at regular intervals approximately 3.5 metres apart and shall extend into the kerb and gutter faces, a minimum of 75 millimetres. A similar weakened plane joint shall be cut at the centre of double vehicular crossings. Joints shall be located at least 0.5 metres from any drainage holes.

7.12.5 Crossings and Pram Ramps

Vehicular crossings and pram ramps, where required, shall be provided in conjunction and concurrently with the construction of the kerb and gutter and the Contractor shall allow for the cost of providing these in the Contract Sum.

The vehicular crossings shall be constructed in positions as shown on the Drawings and to the details shown on Standard Drawing RM2 or as otherwise specified. Contraction joints shall be provided at each end of each crossing.

7.12.6 Curing

Curing shall be carried out in accordance with clause 6.10 except that when kerb moulding machines are used an approved chemical curing compound shall be applied to all exposed surfaces on the day of moulding.

7.12.7 Tolerances

The finished concrete shall not vary more than 10mm from the specified levels and

alignments or if on a straight grade more than 5mm from a straight edge three (3) metres long but under no circumstances shall the kerb and gutter be allowed to pond water.

Notwithstanding the levels shown on the Drawings for gully pits, kerb returns and low points and Contractor shall ensure that the gutter near or adjacent to the gully pit is properly drained.

7.12.8 Provision for Drainage

Outlets through the kerb shall be provided as specified or directed for each house to drain roof water into the gutter.

One drainage outlet shall be provided one metre from the lower side of each lot or from the upper end of the vehicular entrance where provided.

The Contractor shall fit the outlets into the kerb in a workmanlike manner ensuring that they are firmly secured in the concrete and fall towards the gutter. The surface shall be refinished to match the balance of the work.

Where kerb moulding machines are used, the outlets shall be placed in position immediately after the passing of the kerb moulding machine.

Outlets in roll kerb shall be of approved manufacture and made of extruded aluminium or galvanised steel in accordance with AS 1650-1981, Galvanized Coatings. The shape and size of the outlets, shall conform to that shown on Standard Drawing RM1.

7.12.9 Backfilling

After the concrete has set sufficiently, but not sooner than three days after placing, the area behind the kerb and/or gutter shall be backfilled with sound material approved by the Superintendent. It shall be thoroughly compacted in layers not greater than 150 mm in thickness, without displacement of the adjacent construction and left in a neat and workmanlike manner. Backfilling and/or the placement of pavement material shall only be undertaken with the prior approval of the Superintendent.

7.12.10 Replacement of Incorrect and/or Damaged Construction

The Contractor shall construct all kerb and gutter or similar work in a sound workmanlike manner so that it will resist damage or displacement by weather conditions, road construction, builders, and Service Authorities' plant, or undermining by the scouring away of the sub-base materials.

Where kerb and gutter is damaged or displaced by such agencies after construction due to fault by the Contractor, or is not constructed to specified line and level, it shall be removed and reconstructed by the Contractor at his expense.

7.13 CONCRETE FOOTWAY, PATHWAY & ACCESSWAY PAVEMENTS

7.13.1 Subgrade

The subgrade for concrete pavement shall be formed at the required depth below the base in accordance with the Section 5 of the Construction Specification - Formation.

7.13.2 Sub-base

Approved sub-base material of the type shown on the Drawings shall be spread, levelled and compacted on the prepared sub-grade. The minimum compacted thickness of the sub-base material shall be 50mm 'or as directed by the Superintendent.

The sub-base shall comply with the Section 8 of the Construction Specification.

Immediately prior to placing of the concrete the sub-base shall be lightly watered to the satisfaction of the Superintendent.

7.13.3 Reinforcement

Reinforcement shall be as shown on the Drawings and shall be supported above the subgrade by approved means. All splicing of the reinforcement shall have a minimum overlap of 300mm and be securely tied.

7.13.4 Finish

The concrete shall be struck off with a screed and finished with wooden floats, followed by light brooming at right angles to the alignment of the pavement to give a uniform non-slippery surface. All edges and joints shall be finished off with an approved edging tool forming a minimum 50mm margin in a neat workmanlike manner.

7.13.5 Joints

In pathway and footway paving transverse joints shall be constructed at intervals of one and one half (1.5) metres. Expansion joint shall generally be at intervals of six (6) metres and shall consist of 10mm thick approved jointing material.

7.13.6 Protection

Approved barriers and lights shall be provided and erected by the Contractor to protect sections of new work. Where there is any likelihood of access by the public additional barriers and lights shall be provided and erected at the start and ends of all boxing left overnight.

7.13.7 Clearing Up

All spoil shall be removed concurrently with the work of excavation and backfilling. Trimming of footways shall be completed within seven days of the concrete being placed. An additional day's deferment of backfilling at gateways may be permitted to avoid damage to footpaving by vehicular traffic.

All footways for the full width adjacent to constructed paving shall be trimmed by cutting or filling where required and all areas of loose material lightly compacted to the specified crossfalls and grades as shown on the Standard Drawings.

7.14 DRAINAGE PITS

Drainage pits where practicable shall be benched internally with mass concrete to not less than one third of the outlet pipe diameter, notwithstanding that such benching may not be shown on the relevant Drawings.

Where drainage pits exceed 1.2 metres in depth, galvanised climb irons shall be provided at 450mm centres whether shown on the Drawings or not.

Pit walls shall be formed on both the inside and outside faces.

Pits shall be constructed of sufficient internal dimension to avoid birdsmouthing of pipes.

Subsoil drainage pipes, laid in accordance with Clause 6.8 of the Construction Specification, shall be connected through the upstream pit wall and shall extend through any mass concrete benching so as to provide a free outlet.

7.15 PRECAST CONCRETE SECTIONS

Where indicated on the Drawings or where authorised in writing by the Superintendent, precast concrete components shall be provided to the form and dimensions shown on the Standard Drawings and shall be constructed in the positions specified in all cases.

The Contractor shall indicate the source of supply of the precast sections, and shall provide facilities for testing at the place of manufacture. He shall signify in advance when each consignment of precast sections will be ready for dispatch so that prior arrangements may be made for inspection and testing.

The surfaces of the precast components shall be smooth, in true planes with square ends.

Patching and plastering of sections will not be permitted. They shall be sound and free from cracks, chips, porous spots or other visible defects.

7.16 CAST IRON AND STEEL FITTINGS

Cast iron gratings, frames and other fittings are to be to the requirements of AS 1830-1976 Grey Iron Castings.

Steel gratings, frames and other fittings are to be to the requirements of AS 1204-1980, Structural Steels - Ordinary Weldable Grades. They shall be hot-dipped galvanized in accordance with AS 1650-1981, .Galvanized Coatings.

Fittings shall be to the grade and dimension shown on the Drawings and/or Standard Drawings and shall be firmly and evenly bedded into the concrete structure.

8. FLEXIBLE ROAD PAVEMENTS

8.1 DESCRIPTION

The pavement material shall consist of approved crushed or ripped sandstone, natural gravel, fine crushed rock, or blast furnace slag as shown on the Drawings and/or otherwise specified. The material shall be spread on the subgrade or sub-base in uniform layers to provide the specified pavement thickness. No individual layer shall be more than 150mm or less than 75mm compacted thickness. The base shall be recessed as shown on the Drawings unless otherwise specified.

8.2 CLASS OF ROAD

Unless otherwise specified the following road classification shall apply:

Class of Road	
Class	Carriageway width
A	Greater than 11m up to 13m
B	Greater than 8m up to 11m
C	Greater than 6m up to 8m
D	Up to 6m

8.3 SOURCE OF MATERIAL

No material shall be delivered until the Superintendent has notified approval in writing of the source of supply, and the plant and methods to be used in winning the material and constructing the pavement. Such approval will not relieve the Contractor from his

responsibility for so arranging the winning, placing and compaction that the materials in the pavement conform to this Construction Specification. Any approval given to the source of supply of materials may be withdrawn if a significant number of samples taken from the pavement after compaction fail to comply with this Construction Specification.

8.4 CRUSHED OR RIPPED SANDSTONE

Crushed or ripped sandstone shall be minus 125mm nominal size derived from sound, clean sandstone free from overburden, clay seams, shale and other deleterious material and shall meet the requirements of sub-clause 8.4.1.

8.4.1 Material Requirements

The table below sets out the linear shrinkage limits.

Linear Shrinkage Limits				
Test Method AS1289.C4.1 - 1977				
Class of Road	D	C	B	A
Maximum Linear Shrinkage %	5	5	5	5

The table below sets out the desirable grading limits:

Grading Limits		
	% passing	
Nominal Size	Class C & D Road	Class A & B Road
75mm	80-100	85-100
53mm	75-100	75-100
37.5mm	65-100	65-100
26.5mm	57-100	57-94
19mm	50-97	50-88
9.5mm	37-86	37-76
4.75mm	27-76	27-65
2.36mm	20-65	20-52
1.18mm	15-55	15-42
425um	10-38	10-28
75um	5-22	5-17
2 um	0-10	0-5

8.4.2 Variations

Where the grading and linear shrinkage tests vary outside the above limits and there is evidence that the subject material (or material similar in composition to it) has given satisfactory performance under similar conditions to the flexible pavement construction governed by this Construction Specification, then the following requirements shall be applied.

Variations to Tests				
Class of Road	D	C	B	A
% Passing 425um Maximum Limits	15-55	15-50	15-45	15-45
L.S. % x % Passing 425um Maximum	270	250	180	160
P.I. % x % Passing 75um Maximum	200	200	200	200

8.4.3 Sampling and Testing

The Contractor shall arrange for a sample load of the proposed sandstone, ridge gravel or crushed gravel material from the approved quarry to be delivered and stored on site after approval of the source by the Department. Samples for testing shall be taken from the sample load by the Superintendent to assess the conformity with this Construction Specification.

No other deliveries of pavement materials shall be made without the Superintendent's approval of the sample load meeting the Construction Specification requirements.

No pavement material for pavement construction shall be delivered to the site from a different source to that of the sample load without the written approval of the Superintendent.

8.4.4 Conformity with Sample

All subsequent deliveries of pavement materials shall be subject to comparison by the Superintendent with the sample load on site and the subsequent test results. The Superintendent will arrange for samples to be taken for testing.

Where in the opinion of the Superintendent any materials do not meet the requirements of the Construction Specification then the Contractor shall, on receipt of written instructions from the Superintendent, remove such materials from the site at no cost to the Principal.

8.5 CRUSHED ROCK OR BLAST FURNACE SLAG

Crushed rock, crushed concrete or blast furnace slag shall be unbound granular material and may consist of a blend of two or more materials. When the primary material is deficient in fine particles, material may be added and blended as necessary to meet the requirements of the Construction Specification. Material produced by blending shall be uniform in grading and physical characteristics.

8.5.1 Material Requirements

Material Requirements				
			Requirement	
Test Method	Description	BASE	SUB—BASE	
		DGB20	DGS20	DGS40
			Nominal Size	
		20mm	20mm	40mm
AS1289.C6.1	Course Particle Size Distribution			
	% passing 53.0mm sieve	-	-	100
	% passing 37.5mm sieve	-	-	95-100
	% passing 26.5mm sieve	100	100	70-90
	% passing 19.0mm sieve	95-100	95-100	50-85
	% passing 6.7mm sieve	50-70	45-70	30-55
	% passing 2.36mm sieve	35-55	30-55	25-50
AS1289.C6.2	Fine Particle Size Distribution			
	Ratios (for that portion of the material passing 2.36mm sieve)			
	A - Pass 425 um sieve (%)	35-55	35-55	35-60
	B - Pass 75 um sieve			
	Pass 425 um sieve (%)	35-55	35-55	35-60
	C - Below 13.5 um			
	Pass 75 um sieve (%)	35-60	35-60	35-65
AS1289.C1.2	Liquid Limit (if non-plastic) – Maximum	*20	23	23
AS1289.C2.1	Plastic Limit (if plastic) - Maximum	20	20	23
AS1289.C3.1	** Plasticity Index - Maximum	6	12	15
DMR.T114	Maximum Dry Compressive Strength	At Least	At Least	At Least
	of fraction passing 19mm sieve	1.7MPa	1.0MPa	1.0MPa
DMR.T213	Particle shape by Proportional			
	Caliper - % Misshappen (2:1) Max.	35	35	35
DMR.T215	Minimum Aggregate Wet Strength @	100KN	5011	50KN
DMR.T221	Dusting or falling unsoundness of			
	Slag - Maximum		1 particle in 12	
DMR.T215	Wet/Dry Strength			
	Variation Dry—Wet % @ #	Max	Max	Max
	Dry	35	45	45

NOTES: (Applicable to Table 8.5.1)

(1)* The maximum value of the Liquid Limit may be increased to 23 for non-plastic material, provided that the value determined is not influenced by the presence of adverse constituents.

(2)** After being subjected to pretreatment comprising 5 cycles of compaction (Test Method T102) and/or to artificial weathering (Test Method 1103). The Plasticity Index shall not increase by more than 3 from that of the sample prior to any pretreatment and shall not exceed the values of at Table 8.5.1. For category 2(d) base materials the maximum plasticity index shall be 8.

(3)+ Based on testing of any size fraction of the sample specified by Test Method T215. The material may be crushed to provide sufficient quantities of material for any particular size fraction.

(4)# For category 2(d) Class DGB 20 base materials the wet/dry strength variation shall not exceed 45%.

(5) Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75% of the particular larger than 6.70mm.

8.6 NATURAL GRAVEL

Gravel shall be derived from the natural disintegration of rock, and shall be sufficiently free from vegetable matter and other adverse constituents to meet the requirements of Clause 8.6.1 when compacted in the pavement. Gravels from different deposits may be combined to provide material which will comply with this Construction Specification.

8.6.1 NATURAL GRAVEL MATERIALS

Natural Gravel Materials			
Test Method	Description	BASE	SUB-BASE
DMRT106	Maximum Particle Size	26.5mm	Max 50% compacted layer thickness
DMRT171	Modified Texas Triaxial Classification No.* (When tested at not less than 85% of Optimum Moisture Content and 100% of Maximum Dry Density as determined by Test Method T111)**	2.2	-
DMRT171	Average Compressive Modulus	Min 35 MPa	-
DMRT114	Maximum Dry Compressive Strength	Min 2.8 MPa***	Min 1.0 MPa

.....Continued over page

Natural Gravel Materials .....*continued*				
Test Method	Description		BASE	SUB-BASE
DMRT108	Liquid Limit	(if non-plastic)	Max 20	-
DMR109	Plastic Limit	(if plastic)	Max 20	-
DMRT109	Plastic Index		#	#
DMRT215	Aggregate Wet Strength***		Min 100kN	-
DMRT215	Wet/Dry Strength	Dry - Wet % ++ Dry		
		For materials with less than or equal to 8% passing 2.36mm sieve	Max 30	Max 45
		For materials with more than 8% passing 2.36 sieve	Max 35	Max 60

NOTES: (Applicable to Table 8.6.1)

(1) If the material prepared by Test Method T171 cannot be extruded from the compaction mould and placed in the testing cell then the material shall be individually investigated and assessed by the Superintendent.

(2)** Where materials are sufficiently open graded that the moisture content after testing is less than 85% of Optimum Moisture Content, owing to water bleeding from the sample, the materials are to be moulded at Optimum Moisture Content and Maximum Dry Density (as determined by Test Method T111), and tested immediately. The Texas Classification Number so obtained is to be used for comparison with the Construction Specification requirements.

(3)*** This test is applicable only if the Plasticity Index is three (3) or less.

(4)# After being subjected to pretreatment comprising five (5) cycles of compaction (Test Method T 102) and/or to artificial weathering (Test Method T103). The Plasticity Index (PI) of the submitted sample shall not increase by more than three (3) from the PI of the sample prior to any pretreatment.

(5)++ Based on testing of any size fraction of the sample specified by Test Method T2I5. The material may be crushed to provide sufficient quantities of material for any particular size fraction.

8.6.2 LIME TREATED NATURAL GRAVEL

When suitable natural gravels are not available within a reasonable distance of the site, lime-treated natural gravel or shale may be accepted as an alternative subject to the provision of a sample of the material accompanied by satisfactory test results from a NATA registered laboratory.

Use of such material will be at the sole discretion of the Superintendent.

8.7 DELIVERY

The pavement material shall be transported from the source to the work in vehicles which

are constructed so as to prevent the loss of material. Material shall be supplied with a moisture content (uniformly distributed) between the optimum moisture content and 3% below the optimum moisture content.

8.8 SPREADING

Pavement material shall be spread in uniform layers in accordance with the provisions of Clause 8.1 so that after compaction the total pavement thickness is as specified. Spreading shall be undertaken by a method which will ensure that segregation does not occur. The Contractor shall -submit full details of the proposed method of spreading for the approval of the Superintendent prior to pavement construction.

Subject to the Superintendent's approval two or more natural gravels may be mixed. This may be at the source of supply provided that the Superintendent has given approval to the method of mixing and that the resulting mixture conforms to the Construction Specification. Where natural gravels from different sources are to be combined and the Contractor does not elect to mix them at the source of supply he shall spread the constituent materials on the road in layers of predetermined uniform thickness, and shall thoroughly mix them together on the road by an approved mechanical device to form a course of the Class of material specified in Clause 8.1. In such cases the coarser material shall be spread first. The subgrade or sub—base shall not be disturbed during the mixing process.

Prior to compaction, the moisture content of material, other than lime treated, shall be adjusted to that specified in Clause 8.9. Where necessary, water shall be added by an approved method, and shall be mixed uniformly with the pavement material by an approved mechanical device. If there is existing excess moisture in the material, it shall be dried to the specified moisture content by loosening and aerating.

Where the compacted surface is below the specified level the defective area shall be scarified to the full depth of the layer, new material added as required, and the area recompacted to required levels.

Pavement material shall not be spread upon a water-logged subgrade or sub-base. If at any time the subgrade or sub-base material should become rutted, or mixed with the pavement material, the Contractor shall at his expense remove the material, reshape and compact the subgrade or sub-base material to the requirements of Clause 5.10 in the Construction Specification for Formation, and replace the pavement material with fresh material.

8.9 COMPACTING AND TRIMMING

During compaction operations the moisture content of the material of a layer or course shall be uniformly adjusted throughout so as not to exceed Optimum Moisture Content or be less than Optimum minus 3% or as otherwise approved by the Superintendent. Water may be added in an approved manner to achieve or to maintain the required moisture content.

After the mixture has been brought to the specified moisture content, it shall be compacted immediately with approved equipment. The compaction shall begin at the sides and progress to the centre, parallel with the centre line of the roadway, uniformly lapping each preceding pass and covering the surface completely. On superelevated curves the compaction shall commence at the lower edge and progress towards the upper edge of the pavement.

The surface of any compacted layer of material shall, on completion of compaction and immediately before preparation for the overlaying with the next layer, be of a roughened texture, free from compaction planes (false pavement), ridges, cracks, or loose material. All segregated or otherwise defective areas shall be removed to the full thickness of the layer, re-laid with new material and re-compacted to the satisfaction of the Superintendent.

After the first course has been completed to the specified depth and density, the second course shall be uniformly spread on the prepared surface and similarly treated. The top of

each course shall be graded and trimmed generally to line and level.

Variations in the compacted thickness of each course shall not exceed plus 25 mm and minus 15 mm. The finished surface level shall not deviate from the bottom of a three (3) metre straight edge, laid in any direction, by more than 12 mm in the case of lower courses, and by more than 6 mm in the case of the upper course. The finished surface level of the upper course shall not vary more than 15 mm from the planned grade at any point.

Any irregularities in excess of the tolerances stated above shall be corrected by loosening the surfaces, removing or adding pavement material as required, and compacting the area to a uniform surface conforming to the designed cross section and grade. In no case shall quarry dust or other fine materials be used to build up depressions.

Compaction of pavement material shall continue until there is no visible movement of the pavement under the proof roller as specified in Clause 8.12 or if required by the Superintendent a dry density has been achieved of not less than one hundred percent of the density obtainable in the Australian Standard AS 1289 E1.1 or E1.2 Dry Density/Moisture Content Relation of a Soil using Standard Compaction.

8.10 LIME TREATED MATERIAL - CURING

Any layer of lime treated material, not covered within one (1) hour, either by another layer of such material or by another pavement course shall be cured by one of the following methods:

(i) Covering, until the next pavement layer is laid, with impermeable plastic sheeting, adequately secured. Joints of the covering material shall overlap at least 300 mm so as to prevent the egress of moisture.

(ii) Spraying with either a bituminous material or aluminized curing compound, to provide a continuous membrane.

(iii) Other methods to prevent moisture evaporation, approved by the Superintendent.

The Contractor shall programme the laying of the lime treated sub-base, and the subsequent pavement courses, and take such other steps as may be considered necessary by the Superintendent, to afford protection to the treated materials.

8.11 COMPLETED PAVEMENT SURFACE

The completed pavement shall have a uniform, hard, monolithic surface, which shows no visible movement under the roller and in which the pavement particles are tightly and uniformly embedded in a gritty, cementitious matrix.

Final sweeping of the pavement shall be carried out immediately prior to the application of bituminous surfacing materials, the coarse particles of the surface course shall be bared but not dislodged and shall be free of all slurry and/or dust which, in the opinion of the Superintendent, may interfere with the proper adherence of the bituminous materials to the pavement surface.

Prior to the application of the bituminous wearing course, the Contractor shall maintain the pavement in a smooth sound condition to the satisfaction of the Superintendent.

8.12 PROOF TESTING

When called upon by the Superintendent, the Contractor shall make available a three (3) wheeled self-propelled roller and shall carry out proof loading by rolling that section of pavement directed so to be proof loaded by the Superintendent. The roller shall have rear rollers of at least 1200 mm diameter and an intensity of loading of at least 7000 Kg per metre width of roller, unless otherwise approved by the Superintendent.

8.13 INSPECTION, SAMPLING AND TESTING

Regular inspection, sampling and testing of the pavement may be undertaken by the Superintendent or his representative while construction of the pavement is in progress.

Field density tests to determine the degree of compaction may be carried out by the Superintendent or his representative, using the sand replacement method or its equivalent, or using nuclear devices, or such other method as the Superintendent may approve.

8.13.1 Compaction Standards

Minimum dry density compaction requirements are as follows:

Minimum Compaction Requirements		
Layer	Compaction	Standard
Subgrade	100% standard	AS 1289
Sub-base	95% modified	AS 1289
Basecourse	98% modified	AS 1289

8.13.2 Pavement Testing

All testing shall be undertaken by a NATA registered laboratory and a certificate of compliance shall be issued together with test results. All layers shall be tested to the full depth of the layer.

An in-situ density test by sand replacement, nuclear densometer or other NATA approved means is required at the start and finish of the work (within the first and last 5.0 metres) and thereafter at approximately 50 metre intervals along the road. A minimum of two tests shall be carried out for any road less than 50 metres in length.

Testing within cul-de-sac turning heads shall occur, as directed.

The location of tests within the road cross section shall be randomly selected to ensure that the full width of the road pavement undergoes testing.

Individual pavement layers shall not be covered by succeeding layers until test results have demonstrated that the layer has passed the nominated standard. All test results shall be submitted to the Superintendent prior to granting of "Practical Completion".

Where test results fail to meet nominated standards additional testing shall be carried out to isolate the failed area prior to reworking and retesting showing that nominated standards have been achieved.

Prior to application of the wearing surface, an assessment of the pavement shall be undertaken according to the elastic rebound deflection test, in accordance with Test Method T160, utilising the Benkleman Beam or an equivalent method. The resultant Characteristic Deflection for a section of pavement, calculated as the "mean" plus "standard deviation", shall not exceed the values (for unbound pavements) in the following table. A "reliability" product factor shall apply to standard deviation, of 1.0 for roads up to Local (secondary) status, and 1.65 for Local (primary) status and greater. The coefficient of variation ("standard deviation" divided by "mean") should not exceed 0.3.

Frequency of testing shall be on alternate wheel paths at generally 15 metre (maximim) intervals.

Benkleman Beam Assessment Criteria				
Road Type	Max. Number of Lots	ESA's	Characteristic Deflection	Maximum Deflection
Access Place	10	$1x10^5$	1.20	1.80
Local - Minor	20	$1x10^5$	1.20	1.80
Local - Secondary	50	$2x10^5$	1.15	1.60
Local - Primary	100	$5x10^5$	1.10	1.40
Collector	200	$1x10^6$	1.00	1.25
Distributor - Secondary	400	$2x10^6$	0.90	1.10
Distributor - Primary	800	$5x10^6$	0.77	1.00
Arterial or Sub-Arterial	> 800	$1x10^7$min	0.70	1.00
Rural Residential	per above	per above	per above	per above
Rural - Minor	50	$1x10^5$	1.10	1.60
Industrial - Minor	10	$5x10^6$	0.77	1.00
Industrial	> 10	$1x10^7$min	0.70	1.00

8.14 DEFECTIVE MATERIAL

If at any time during the progress of the work, any pavement material supplied by the Contractor and incorporated in the works is found to be not in accordance with this Construction Specification, the Superintendent will direct the Contractor to remove the unsuitable material and replace it with satisfactory material at the Contractor's expense.

Previous acceptance of the whole or part of the pavement material by the Superintendent shall not restrict his right to direct removal and replacement of material subsequently found to be unsatisfactory. The Contractor shall carry out such remedial work immediately at his expense.

8.15 OPENING PAVEMENT TO TRAFFIC

If required during the progress of the works the Contractor shall freely and without undue obstruction permit traffic to use the constructed pavement prior to the preparation for and the application of bituminous surfacing material.

The Contractor shall provide dust suppression, watering and maintenance to the constructed pavement until the application of bituminous surfacing at the Contractor's expense.

Where such use cannot be provided the Contractor shall construct adequate side-tracks or detours.

8.16 MAINTENANCE DURING CONTRACT

During the contract period and throughout the duration of the contract defects liability period, completed pavements shall be maintained by the Contractor in a clean and sound condition to the satisfaction of the Superintendent.

In the event of any defect appearing in a pavement during the contract period or contract

defects liability period and whether before or after the application of surfacing material, the defect shall be immediately made good by the Contractor at his own expense.

Defect areas are to be scarified as required, defective material removed, fresh pavement material added, and the area re-compacted and trimmed and surfaced to produce a pavement which conforms with the requirements of this Construction Specification and which blends evenly in with adjoining construction, all to the satisfaction of the Superintendent.

8.17 ROYALTIES AND PROPERTY DAMAGE

The Contractor shall make his own arrangements for the payment of any royalties on pavement materials, and shall reinstate at his expense any access roads, tracks, gates, fences, or other property damaged during his operations. Before final payment is made the Contractor shall supply to the Superintendent a written certificate from the land owners concerned, stating that all claims for damages and/or royalty have been paid.

9. PAVING UNITS

9.1 DESCRIPTION

Paving units shall be provided to areas shown on Drawings true to all grades, levels, curves etc. as required, and laid to give a uniform and regular pattern.

9.2 PAVING UNITS

Unless otherwise specified, paving units for road carriageways shall be Shape Type A units complying with MA15 Interim Specification for Interlocking Concrete Paving Units published by the Concrete Masonry Association of Australia and shall have a characteristic compressive strength of 45 MPa when sampled and tested in accordance with MA15 unless otherwise approved by the Superintendent.

9.3 SUBGRADE

The subgrade shall be formed at the required depth, in accordance with the dimensions and design shown on the Drawings and on the Standard Drawings, and in general shall be cut from the solid. However, when over cut it may be built up to the correct level by the addition of material approved by the Superintendent. All subgrades shall be thoroughly compacted to the requirements of Clause 5.10 of the Construction Specification for Formation and finished to a firm, smooth surface of uniform bearing value.

Pavement construction shall not proceed until the subgrade has been inspected and approved by the Superintendent.

9.4 HERBICIDE

Roundup or an approved equivalent herbicide shall be spread at the manufacturer's recommended rate on the compacted subgrade prior to spreading the sub-base course.

9.5 SUB-BASE

The sub-base shall be of crushed or ripped sandstone, natural gravel or crushed rock as detailed on the Drawings. Pavement material shall comply with the requirements of the Construction Specification Section 8 for Flexible Pavements. The sub-base shall be laid to the grade and cross falls required for the finished pavement and if not shown on the Drawings or otherwise specified, shall have a minimum thickness of 150mm after compaction.

The sub-base course shall extend to the rear face of all edge restraints unless otherwise specified and shall be inspected and approved by the Superintendent before commencing the placing of the sand bedding course and the laying of units.

9.6 EDGE RESTRAINTS

Concrete kerb and gutter, kerbs and edge strips shall be constructed to the perimeter of paving units and to the details shown on the Drawings and/or Standard Drawings. They shall be in accordance with the Construction Specification Section 7 for Minor Concrete Structures and Pavements and shall be supported on a compacted base course not less than 75mm thick.

9.7 SURFACE DRAINAGE

After compaction of the paving units, their upper surfaces should finish -sufficiently above the levels of adjacent surface drainage channels, edge strips or drainage inlet pits to ensure positive drainage from the grooves formed between adjacent units. Where this is not detailed on the Drawings the units shall be laid ensuring that the lower edges of chamfers finish not less than 10mm above the lip of edge restraints.

9.8 BEDDING SAND

9.8.1 Material

Bedding sand shall be well graded sand passing a 4.75mm sieve and conform to the following grading limits:

Bedding Sand	
Sieve Size	% Passing
9.52mm	100
4.75mm	95-100
2.36mm	80-100
1.18mm	50-85
600um	25-60
300um	10-30
150um	5-15
75um	0-10

The bedding sand shall be free of deleterious soluble salts or other contaminants likely to cause efflorescence or otherwise lead to reduced skid resistance.

9.8.2 Moisture Content

The sand shall be of uniform moisture content when spread and shall be protected from rain when stockpiled on site prior to spreading.

9.8.3 Spreading

The sand bedding shall be spread and screeded in a loose condition to the nominated design profile and levels plus the necessary surcharge to achieve a uniformly thick layer of 25mm, following final compaction of the pavement.

The spread sand shall be carefully maintained in a loose condition and protected against pre-compaction both prior to and following screeding. Any pre-compacted sand or sand left overnight shall be loosened before further paving units are placed. Sand shall be lightly screeded in a loose condition to the predetermined depth only slightly ahead of the laying of paving units. Under no circumstances shall the sand be screeded in advance of the laying face to an extent to which paving will not be completed on that day.

9.9 PLACEMENT OF PAVING UNITS

Paving units shall be placed on the uncompacted screeded sand bed to the nominated laying pattern, care being taken to maintain the specified bond throughout the job. Paving units shall be placed to achieve gaps nominally 2mm to 4mm wide between adjacent units such that all joints are correctly aligned.

The first row shall abut an edge restraint with a gap of 2mm to 4mm and shall be laid at a suitable angle to the edge restraint to achieve the required visual orientation of paving units in the completed pavement.

In each row all full units shall be laid first. Closure units shall be cut and fitted subsequently. Units may be cut using mechanical or hydraulic guillotine, bolster, or by power sawing.

To infill spaces between 25 and 50mm wide a concrete having a 1:2:4 cement:sand:coarse aggregate mix and having a colour similar to the paving units may be used. The nominal aggregate size should not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar may be used.

Except where it is necessary to correct any minor variations occuring in the laying bond the paving units shall not be hammered into position. Where adjustment of position is necessary care shall be taken to avoid premature compaction of the sand bedding.

Any foot or barrow traffic shall use boards overlaying paving to prevent disturbance of units prior to mechanical compaction. No other construction traffic shall be allowed on the pavement at this stage of construction.

9.9.1 Compaction

After laying the paving units they shall be tamped to achieve compaction of the sand bedding and brought to design levels an profiles by not less than three (3) passes of a suitable plate compactor.

The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having a plate area sufficient to cover a minimum of twelve paving units.

Compaction should not be attempted within one (1) metre of the laying face. Compaction shall continue until a uniform surface has been achieved between adjoining units. Joints shall then be filled and compacted in accordance with sub-clause 9.9.3.

All work to within one (1) metre of the laying face shall be left fully compacted at the completion of each days laying.

9.9.2 Damaged Units

Any units which are structurally damaged during compaction shall be removed and replaced.

9.9.3 Road Carriageways

Paving units shall be laid in a herringbone pattern unless otherwise specified or directed by the Superintendent.

As soon as practical after compaction, and prior to the termination of the work on that day and prior to the acceptance of construction traffic, sand for joint filling shall be spread over the pavement. The sand shall pass a 1.18mm sieve and have approximately 10% of silty material but be free of all soluble salts or contaminants likely to cause efflorescence or staining.

The filling sand should be broomed to fill the joints. At least one pass of the plate vibrator is required to achieve compaction of joint filling sand.

As soon as possible after the filling of joints, construction traffic should be encouraged to use the pavement to assist in the development of 'lock up'. Such traffic should traverse the greatest possible area of the pavement.

The Superintendent may direct that, where a pavement is not to be subject to traffic loads for some time after completion, the Contractor maintain a sand surcharge over the pavement to inhibit moisture ingress.

Excess surface sand shall be removed by brooming at the end of the Defects Liability Period unless otherwise directed by the Superintendent.

9.9.4 Tolerance to Design Profile

The surface shall be accurate to within a tolerance of 6 mm measured from the bottom of a 3m long straight edge on straight grades and 6mm from the required levels on vertical curves. Joint lines in plan shall be accurate to within 20mm measured from a general straight line parallel or at right angles to the general road direction.

10. SUPPLY AND LAYING OF ASPHALTIC CONCRETE

10.1 DESCRIPTION

This Construction Specification provides for the supply and spreading of asphaltic concrete on pavements for the areas, depths and nominal mix sizes indicated on the Drawings.

10.2 MINERAL AGGREGATES

Aggregates shall comply with the requirements of AS 2758 - Part 5 ¬1988.

10.3 MINERAL FILLER

The mineral filler shall comply with AS 2357-1980 Mineral Fillers for Asphalt.

10.4 BINDER

The binder shall be bitumen complying with the requirements of AS 2008 - 1980 Residual Bitumen for Pavements. The class of bitumen shall be specified by the Superintendent.

10.5 PROPORTIONING OF MIXES

10.5.1 Job Mixes

Each mix shall be designed with bitumen content and aggregate grading within the general limits of AS 2734 Table 3.3.

The properties for voids, stability and flow as determined by Marshall Compaction shall comply with AS 2734, Table 3.3.

10.5.2 Departures from Job Mix

The grading of the mix as produced shall not be varied from the grading of the job mix by more than the tolerances set out in the following table.

Grading of the Mix	
Sieve Size	Permissible Variation % by Mass of Total Mix
19.0 mm & Larger	+ or - 10
4.75 mm & Larger	+ or - 7
2.36 mm &.1.18 mm	+ or - 5
600 um & 300 um	+ or - 4
150 um	+ or - 2.5
75 um	+ or - 1.5

10.6 MIXING PROCEDURE

10.6.1 General

Mixing shall be undertaken in an approved batch pugmill, continuous pugmill or drum mixing plant, capable of uniformly mixing coarse and fine aggregate, filler and binder to meet the specified requirements at all times. The plant shall include a rotary drum dryer for the continuous heating and drying of the coarse and fine aggregate. Each size of mineral material comprising the coarse and fine aggregates shall be fed into the dryer by mechanical feeder at a uniform rate. The dryer shall maintain a uniform flow of aggregate at correct temperature sufficient to operate the mixing unit at its rated output. Filler shall be stored and handled in a separate system from that which handles aggregate and be capable of accurately measuring and adding the quantity required.

The bitumen storage and handling shall be arranged so that contamination of the bitumen by flushing liquids or other materials cannot occur.

10.6.2 Batch or Continuous Pugmill Plants

Batch pugmill and continuous pugmill type plants shall include a gradation control unit for screening the hot aggregates into a minimum of four sizes, to be stored in separate bins, generally containing particles 40mm-20mm, 20mm-10mm, lOmm-3mm and minus 3mm. Screening shall be such that there is substantial freedom from segregation in each bin and from carry—over of particles into the wrong bin.

Batch pugmill plants shall measure by mass the requisite batch quantity of material from each hot aggregate bin and filler bin. The accuracy of the measurements shall be within + or-1% of the indicated mass in each case. The required batch quantity of bitumen shall be measured by mass or volume and the accuracy of measurement shall be within + or - 1% of the indicated batch quantity.

In the case of continuous pugmill plants, the flow from each hot aggregate storage bin, the filler bin and the binder supply shall be accurately synchronised.

10.6.3 Drum Mixing Plants

In the case of drum mixing plants, aggregate shall be proportioned and measured by accurately calibrated, variable speed continuous belt feeders from each cold storage bin. Each feeder shall maintain a constant and uniform flow throughout the range of its calibration and shall be equipped with a warning device to indicate any interruption to

material flow. The plant shall have positive interlocking between the flows of aggregates, filler and bitumen. The mixing drum shall be so constructed as to produce complete mixing of aggregates, filler and bitumen and to prevent contact between the burner flame and the bitumen.

10.6.4 Temperatures

Thermometer elements of a suitable type, shall be placed in the flow of material from the dryer and in the binder, storage tank or supply line. Thermometer registrations shall be readable and accurate within + or - 2%.

Bitumen shall be at a temperature not exceeding 165°C when introduced to the mix.

Aggregates shall be heated to such a temperature that, when filler and binder are added, the temperature of the mixed asphaltic concrete shall not exceed 165°C.

The mix shall leave the pugmill, drum and/or the hot storage bin(s) at a temperature between 140°C and 165°C. In special cases, the Superintendent may permit a lower temperature, but in no circumstances shall the temperature of the mix at the time of laying be less than the minimum value specified in Clause 10.12.3 for the appropriate road surface temperature and layer thickness.

10.6.5 Mixing Time

Mixing time shall be such that all particles of mineral aggregate are uniformly coated with binder.

10.6.6 Storage of Mix

Asphaltic concrete may be stored in an insulated storage bin prior to delivery. The storage bin shall be constructed and operated in a manner that minimises segregation and avoids localised overheating. Asphaltic concrete which has been stored for more than 24 hours or is below the minimum temperature specified in Clause 10.6.4 shall not be used.

10.6.7 Testing and Acceptance of Mix

The Principal reserves the right to test the mix at any time to determine its compliance with the Construction Specification. The Contractor shall be responsible for taking the samples and shall supply all facilities, equipment and labour for that purpose. The samples shall be taken by the Contractor's representative at the point of production, along with control samples. The Superintendent will arrange for the testing of the samples, and the results shall be made available to the Contractor in 7 - 14 days.

The Contractor shall maintain and operate a testing laboratory at or near the mixing plant so as to ensure complete control over the mix produced. Facilities shall be provided to enable the Superintendent to take samples of the mix or raw materials at any time.

Control testing carried out at the Contractor's laboratory under the supervision of the Superintendent shall be considered as acceptance testing.

10.7 TRANSPORT

The asphaltic concrete shall be discharged into trucks, the bodies of which shall be kept thoroughly cleaned and coated with a thin film of a suitable release agent to prevent mix sticking to the body of the truck. Care is to be taken to remove surplus release agent before loading.

During transport the asphaltic concrete shall be covered with a canvas or other suitable cover which is held down securely.

When asphaltic concrete is to be transported over long distances or in cold conditions, the asphaltic concrete shall be covered with a heavy duty canvas or similar waterproof cover which overlaps the sides of the truck body by at least 250mm and is tied down securely. The

Superintendent may direct that the bodies of all trucks be suitably insulated.

Except as agreed otherwise, all trucks shall carry not less than 8 tonnes of asphaltic concrete.

Delivery of the mix shall be at a uniform rate within the capacity of the spreading and compacting equipment. Transport shall be as expeditious as possible to minimise cooling of the asphaltic concrete.

The mass of all truck-loads of mix shall be measured on a weighbridge certified by the Department of Consumer Affairs.

10.8 WORKING HOURS

Unless otherwise approved, the spreading of asphaltic concrete and associated works shall be completed in daylight hours between 7.30am and 4.30pm Mondays to Fridays inclusive, public holidays excluded. As much preliminary notice as practicable shall be given before the commencement of work, at least twenty-four (24) hours is required.

The Superintendent reserves the right to cancel or halt operations in the event of wet weather or other unforeseen circumstances.

10.9 PREPARATION OF PAVEMENT

The pavement shall be dry and shall be thoroughly broomed immediately prior to commencement. Any foreign matter adhering to the pavement and not swept off by the broom shall be removed by other means. The Superintendent may direct that existing bituminous surfaced pavements be hosed or otherwise washed to remove all foreign matter. Where the cause of such foreign matter is considered by the Superintendent to be the result of actions by the Contractor no additional payment will be made for washing pavements. Any areas significantly affected by oil contamination shall be cleaned by an approved method.

Under no circumstances shall swept or waste material be placed on the footpath verge at any time.

Any depressions or uneven areas are to be tack-coated and brought up to the general level of the pavement with asphaltic concrete before the main course is laid. The correction course shall be laid and compacted in accordance with Clause 10.14 to the general level of the existing surface.

10.10 ADDITIONAL PREPARATION OF SANDSTONE PAVEMENTS

Forty eight (48) hours prior to laying asphaltic concrete on sandstone pavements, the whole of the area shall be sprayed with a protection 'binder" consisting of 5%-10% anionic slow setting emulsion conforming to MR Form No. 305 Specification for Bitumen Emulsion (Anionic) and 0.1 percent detergent. The water cart or bitumen spray cart shall be fitted with an adequate pressure spray to ensure complete surface coverage. All pavements after application are to be closed to traffic until asphaltic concrete is completed as directed by the Superintendent.

10.11 TACK COAT

Unless otherwise directed by the Superintendent and with the exception of sandstone pavements which have been sprayed with a protection binder in accordance with Clause 10.10, the whole of the area to be sheeted with asphaltic concrete shall be lightly and evenly coated with rapid setting bitumen emulsion (cationic preferred) which shall meet the requirements of MR Form No. 305 Specification for Supply and Delivery of Bitumen Emulsion. The application rate of residual bitumen shall be 0.15 to 0.30 litres per square

metre. For bitumen emulsion complying with M.R. Form No. 305, the application rate of undiluted bitumen emulsion shall be between 0.25 and 0.50 litres per square metre. If the bitumen emulsion is diluted, the application rate shall be adjusted to obtain the undiluted rate. As an alternative to dilution, the Superintendent may permit the use of an emulsion that has been manufactured with a lower bitumen content than is specified in M.R. Form No. 305, in which case, the residual bitumen applied shall be equivalent to that stated above.

The tack coat shall be allowed to 'break' (water separating from the bitumen) and resist picking up by tyres before the asphaltic concrete is laid. Over application of tack coat, due to existing surface depression, shall be removed or dispersed by brushing.

The bitumen emulsion shall be applied by a mechanical sprayer with spray bar, unless the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, in which case application by hand spraying or brushing may be permitted.

All contact surfaces of gutters or other structures and all joints shall be painted with a thin uniform application of tack coat.

Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat any concrete kerbing adjacent to the pavement. It is recommended either bitumen paper or sand is placed on concrete surfaces prior to spraying of bitumen emulsion. The Contractor shall remove bitumen emulsion from any exposed concrete surface sprayed with bitumen emulsion as directed by the Superintendent.

The Contractor shall be held responsible for any damage to adjacent property, vehicles or persons sprayed with tack coating material. When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the finished surfaces shall be blinded with limestone dust or similar material to protect them from bituminous material carried over on truck tyres.

10.12 SPREADING

10.12.1 Paver

Spreading shall be by an approved self-propelled paving machine, having an effective spreading capacity of not less than 50 tonnes of mix per hour. The paver shall have:

(a) A receiving hopper of sufficient size to enable continuity of paving while delivery trucks are changing and of a design which allows complete emptying of mix along the sides.

(b) A device, such as a slat conveyor, for moving the mix from the hopper, to the pavement in front of the screed unit and with a suitable means of adjusting the flow of the mix.

(c) Individually controlled screw conveyors (preferably automatically controlled) for spreading the asphaltic concrete laterally and evenly in front of the screed, without segregation.

(d) A floating screed unit comprising a screed plate with thickness controls. The screed shall be connected by levelling arms to the traction unit by pin joints at the tow point. The screed shall be capable of paving widths up to 3.7m.

(e) A device mounted on each side of the machine for adjusting the layer depth, preferably between lOmm and 150mm by either varying the angle of inclination of the screen plate in relation to the levelling arms or varying the height of the pin joint of the levelling arms vertically.

(f) A pre-compaction device such as either vertically oscillating tamper blades immediately ahead of the screen plate or a vertical vibration of the screed plate itself. Unless otherwise approved, the device shall extend for the full width being paved.

(g) A device for controlled heating of the screed plate.

(h) A device for adjusting the screed plate to provide a crown or side slope.

(i) A device for adjusting the width of the screed.

(j) A device for steering accurately to a given line.

(k) Rollers mounted to the front of the hopper for pushing the truck while it is unloading into the hopper and desirably a rapid acting device to engage and release trucks.

(l) Automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam (when specified).

(m) Automatic crossfall control (when specified).

10.12.2 Paving Procedures

Before commencing paving operations the work shall be set out with the order of runs, position of joints and levels clearly defined.

The paver shall operate at a uniform speed and its output shall match the rate of delivery of asphaltic concrete such that, as far as practicable, continuous spreading of the mix is achieved.

The paver shall be so operated that material does not accumulate along the sides of the receiving hopper. Any mix in or under the paver which has become cool due to delay in the transport of mix or for any other reason shall be removed.

In the event of faulty operation of the paver causing irregularities in the spread material, work shall be suspended until the fault is rectified. If the irregularities are of a minor nature, and the surface has not cooled below 115^{o}C it will be permissible to spread a thin layer of fresh mix by hand, level it with lutes and roll immediately. Should this treatment fail to produce a surface of acceptable texture and regularity, or if the faults left by the spreader are of appreciable depth, then the defective surface shall be removed and fresh material shall be laid as previously described.

Unless otherwise approved by the Superintendent, asphaltic concrete shall not be spread by hand behind the paver. Workmen shall not stand or walk on hot asphaltic concrete except where necessary for correction of the surface.

The Superintendent may approve spreading asphaltic concrete by hand for the correction of minor irregularities and in areas inaccessible to mechanical pavers. Asphaltic concrete, so placed, shall be spread so as to produce a smooth even surface with uniform density to the correct level.

10.12.3 Laying Temperature

The temperature of asphaltic concrete at the time of laying shall be as in following table:-

Mix Laying Temperature

Road Surface Temperature in Shade ^{O}C	Mix Temperatures ^{O}C			
	Layer Thickness Less than 30mm	Layer Thickness 30mm to 40mm	Layer Thickness 45 mm to 100mm	Layer Thickness Over 100mm
5-10	Not Permitted	150*	145*	130-155
10-15	150*	145*	140*	125-150
15-25	145*	140*	135*	120-145
Over 25	140*	135*	130*	115-140

* Minimum laying temperature

10.12.4 Layer Thickness

The minimum compacted thickness of mix shall be as specified on the Drawings for the works of the contract.

10.13 JOINTS

Work is to be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum and the daily laying pattern shall be subject to approval by the Superintendent before work commences.

The density and surface finish at joints shall be similar to those of the remainder of the layer.

10.13.1 Longitudinal joints

Care shall be taken temperature Care shall be taken to provide positive bond between adjoining runs.

Longitudinal joints shall be continuous and parallel. They shall coincide within 150mm with lines of change of crossfall where such occur. Joints in successive layers shall be offset by at least 150mm. Joints shall be located away from traffic wheel tracks. Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

Hot joints shall be constructed by leaving an uncompacted strip approximately 150mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

In the case of cold longitudinal joints, the edge of the first run shall be butted and slightly elevated while hot using hand lutes. If the edge is left exposed overnight or longer, the Superintendent may direct that the edge be trimmed to a straight vertical face by cutting disc, rotary saw or pneumatic spade and lightly coated with tack coat material by brushing. The adjoining run shall be placed against the prepared edge with an overlap of 25mm to 50mm. The overlap shall be pushed back using lutes, immediately after placing, to form a slight ridge along the joint which the roller shall compress adjacent to the edge of the previously placed run. Any excess, overlapping or segregated material shall be discarded.

The compaction of the mix at a longitudinal joint shall be carried out immediately behind the paver using either a static steel wheeled roller or a vibratory steel wheeled roller operated in a static mode. Compaction shall commence with the roller travelling on the cold lane with a 150 mm overlap on the hot lane for the first forward and reverse pass. The second pass shall be made on the hot lane with 150 mm overlap on the cold lane.

When thin layers are to be compacted, the Superintendent may allow the use of a vibratory steel wheeled roller operated in the vibratory mode. In this instance, the first forward and reverse pass shall be made with the roller travelling on the hot lane and with a 150 mm overlap on the cold lane.

Rolling shall continue until the joint is smooth and dense.

10.13.2 Transverse Joints

When the end of the spread material has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

Transverse joints shall be approximately at right angles to the direction of paving. They shall be staggered by at least one metre between successive layers and between adjacent runs. Runs shall be ended either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, the feathered material shall be cut back to a line where the full thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut.

The end of the previous run shall be lightly tack coated before the paving of the next run proceeds.

At the start of the run, care shall be taken to set the screed level with sufficient allowance for compaction so that just the correct thickness of asphaltic concrete is placed. The screed shall be heated to the mix temperature.

The joint shall be rolled with a steel roller transversely for several passes, with the roller projecting about I50mm further onto the fresh mix in each pass. If a vibratory roller is used, it shall be operated in the static mode. At locations where.it is difficult to roll the joint transversely, the Superintendent may direct that an alternative procedure be used.

Boards shall be used for off pavement movement of the roller to prevent rounding the edge of the mat. The joint shall then be rolled longitudinally.

When the asphaltic concrete layer is required to join and match the level of an existing pavement surface, sufficient of the existing material shall be cut out to achieve the minimum specified layer thickness.

10.14 COMPACTION

10.14.1 Plant and Equipment

Compaction equipment shall be self-propelled and may include any of the following types of equipment and various combinations of these types:

(a) Static steel rollers shall have a mass not less than 8 tonnes and a drum loading not less than 35kN per metre width of drum. Tandem rollers are preferred but three wheeled rollers may be used.

(b) Vibratory rollers shall have a mass not less than 6 tonnes and a drum loading not less than 20kN per metre width of drum. Tandem, articulated rollers with vibration on both drums are preferred. They should be capable of vibration frequencies between 30Hz and 50Hz and amplitudes between 0.4mm and 1.0mm. They shall have provision for the vibration to be cut off when the roller is coming to a halt or changing direction.

(c) Pneumatic rollers shall have a mass of ten tonnes to twenty tonnes ballasted and tyre inflation pressures variable up to 700kPa. Numbers of wheels may vary from seven to eleven. The tyres shall have wide, flat smooth rolling surfaces.

The minimum number of rollers used for compaction of asphaltic concrete laid at various rates shall be as shown in the following table:-

Minimum Number of Rollers

OUTPUT		ALTERNATIVE COMBINATIONS		
Tonnes/Hour	Tonnes/Day	Steel Static	Steel Vibrating	Pneumatic Tyred
Up to 45	Up to 360	1	-	1
		-	1	1
45 to 85	360 to 680	1	-	2
		-	1	1
85 to 120	680 to 960	1	-	3
		2	-	2
		-	2	1

NOTES: (Applicable to Table 10.14.1)

(1) The output ranges are to be used as a guide only.

(2) Extra rollers may be needed in case of breakdown.

(3) At the discretion of the Superintendent, the number of rollers may be decreased for layer thickness in excess of 60mm.

For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to the Superintendent shall be used.

10.14.2 Compaction Procedures

Rollers shall travel at a uniform speed not exceeding 5km/h for steel rollers and 10km/h for vibratory steel and pneumatic tyred rollers. They shall not remain stationary on recently compacted mix.

Lateral changes in the direction of rolling shall be made on previously compacted mix. Sharp turns shall be avoided and any changes from forward to reverse shall be made smoothly. Vibrating rollers shall not be stopped or reversed while in the vibrating mode.

Vibratory steel rollers shall not be permitted to travel when operating in the vibratory mode on cement concrete or previously compacted asphaltic concrete except where specified in Clause 9.13.

Compaction shall be considered in three stages, initial, secondary and final rolling:

(a) Initial rolling

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the initial passes. On deep lift asphaltic concrete, pneumatic tyred rollers may be used. When compacting thin layers, the Superintendent may permit vibratory steel rollers to be operated initially in the vibratory mode.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver, without damaging the mat, with their driving wheels closest to the paver except on very steep grades where the rollers shall operate with their driving wheels on the partially compacted mix. When rolling unsupported edges, rollers shall overhang the edge by not more than 100 mm. When the layer thickness is 100 mm or more, rolling to within 200 mm of an unsupported edge shall be delayed to minimise possible displacement of the asphaltic concrete. When compacting this 200 am wide strip, the first pass shall cover about half the width of the unrolled strip; the second pass shall cover the remainder of the width but shall not overhang the edge by more than 100 mm.

The transverse and longitudinal joints and edges shall be compacted first as specified in Clause 10.13. Rolling shall then proceed longitudinally with the roller moving parallel to the run and reversing along the same track.

The roller shall gradually progress from the lower to the higher edge of the new mat. Each tract shall overlap the preceding one by about 150 mm and shall terminate beyond the end of the preceding track by at least one metre. Other rolling patterns may be adopted with the approval of the Superintendent.

Initial rolling shall be completed before the mix temperature falls below 105^0C.

(b) Secondary Rolling

Secondary rolling shall immediately follow initial rolling. Either vibratory steel rollers, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers shall be between 500kPa and 600kPa. Rolling shall commence at the longitudinal joint side of the run, with the roller reversing along the same track on each pass and shifting across the run in full roller widths to the opposite side.

Secondary rolling shall be completed before the mix temperature falls below 80^0C.

(c) Final Rolling

Final rolling shall be carried out by a pneumatic tyred roller with tyre pressures between 600kPa and 700kPa to eliminate all roller marks and to produce a uniform finish. If any tyre marks exist after final rolling, the Superintendent may direct that they be removed with a steel roller operated in a static mode.

If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling.

Final rolling shall be completed before the mix temperature falls below 60^0C.

10.14.3 Specified Compaction

The minimum Characteristic Value of Relative Compaction of a lot when tested in accordance with M.R. Form No. 612 shall be 95% for a layer of thickness less than 50 mm or 96% for a layer of thickness of 50 mm or greater.

Mix with an actual Characteristic Value of Relative Compaction of less than 90% shall be removed from the site. For mix having an actual Characteristic Value of Relative Compaction below the specified percentage, but above the percentage abovementioned for rejection, consideration will be given to acceptance of the material subject to a deduction in accordance with M.R. Form No. 612.

10.15 FINISHED PAVEMENT PROPERTIES

The finished surfaces shall be smooth, dense and true to shape, shall not vary more than 10mm from the specified plan level at any point and shall not deviate from the bottom of a three metre straight edge laid in any direction by more than 5mm for the asphaltic concrete course as laid. Sufficient measurements of thickness shall be taken before and after compacting to establish the relationship between the thickness of the uncompacted material and the completed work. The thickness shall then be controlled by measurements taken of the uncompacted material immediately behind the paver. When the measurements indicate that an area will not be within the allowable tolerances for the completed work, the uncompacted area shall be corrected while the material is still in a workable condition by adding or loosening and removing material. Otherwise the defective area shall be removed and replaced with fresh material. Irregularities exceeding the tolerances given above in a particular course shall be corrected before a subsequent course is placed.

Notwithstanding the foregoing tolerance the Contractor shall remain responsible for laying the minimum specified layer thickness of asphaltic concrete on all areas of the pavement.

The finished surface shall be lightly sprinkled with limestone dust, or other approved filler, sufficient to ensure the mix will not be tacky under traffic.

10.16 WEIGHBRIDGE DOCKETS

The Contractor shall provide the Superintendent with numbered, dated weighbridge dockets in accordance with the weighing of truck loads specified in Clause 9.7 of this Specification. All dockets shall bear the supplier's letterhead or identifying mark. Each weighbridge docket shall be countersigned by the Superintendent immediately prior to the material being placed in the paver.

10.17 PAYMENT

Unless otherwise specified, payment shall be made on an area and minimum thickness basis, inclusive of tack coat.

10.18 PROVISION FOR TRAFFIC

All necessary signs, barriers, etc., required for the control and protection. of traffic shall be provided by the Contractor in accordance with H.R. Form No.121 Specification for Control of Traffic at Road and Bridge Works. Special care shall be taken to ensure that vehicles and

pedestrians are not sprayed with bitumen emulsion during tack-coating, and that entry to areas treated with tack coat or hot asphaltic concrete is prevented.

10.19 CLEANING OF GUTTERS AND GULLY PITS

All gutters and gully pits located within the boundaries of the work shall be cleaned and kept clean during the period of contract, of all silt, debris, rubbish and surplus aggregate arising out of the execution of the works of the contract.

10.20 MAINTENANCE

The pavement shall be maintained after completion for the specified period and should any failure of the asphaltic concrete wearing course occur during this period, the area affected shall be removed and be replaced with similar material to that used on the work. Gutters and gully pits shall be cleaned of all asphaltic concrete debris immediately after completion of the asphaltic concrete works and at the conclusion of the Defects Liability Period.

11. SPRAYED BITUMINOUS SURFACING

11.1 DESCRIPTION

This Construction Specification provides for the spraying of hot bitumen and the application of a suitable precoated aggregate to an existing sealed surface or an unsealed prepared surface.

It shall be in one or two applications as specified elsewhere and/or as directed on the Drawings.

The work shall include the following:

(a) Supply of all materials, including aggregate.

(b) Sweeping of pavement.

(c) Heating, cutting back binder in the field and applying binder for seal coats.

(d) Heating and applying cutback binder prepared at the refinery or other supply source.

(e) Pre—coating of aggregate for seal coats.

(f) Application of aggregate for seal coats.

(g) Rolling and incorporation of aggregate for seal coats.

(h) Maintenance of work after completion.

In multiple application treatment, each application of binder shall be covered with aggregate and rolled as specified, before the subsequent application of binder.

No sealing work shall be carried out while the pavement temperature is less than ten degrees (10^0C) in the shade, or during periods of wet weather, unless authorised by the Superintendent.

11.2 SUPPLY OF MATERIALS

The Contractor shall be responsible for supply of all of the various materials including aggregate necessary for the performance of the work in accordance with this Construction Specification.

11.3 MEASUREMENT OF MATERIALS

Unless otherwise stated all rates and quantities under this Construction Specification relating to binder and cutter oil shall refer to measurement by volume at fifteen degrees (15^0C).

11.4 QUALITY OF MATERIALS

11.4.1 Binder

Bitumen shall conform to the AS 2008-1980 Residual Bitumen for Pavements.

11.4.2 Cutter Oil

Cutter Oil shall conform to the Department of Main Roads N.S.W. Specification for Oils for Reducing the Viscosity of Bitumen (M.R. Form No. 349).

11.4.3 Refinery Cutback Bitumen

Refinery cutback bitumen shall conform to AS 2157-1980 Cutback Bitumen.

11.4.4 Precoating Materials

Precoating materials shall conform to the Department of Main Roads Specification for the Supply and Delivery of Cover Aggregate for Sprayed Bituminous Surfacing. (M.R. Form No.351). These may be oil based materials with additives, bitumen based materials with additives or water based materials with additives.

11.4.5 Aggregate

Aggregate shall conform to the Department of Main Roads N.S.W. Specification for the Supply and Delivery of Cover Aggregate for Sprayed Bituminous Surfacing (M.R. Form No. 351).

Unless specifically nominated otherwise elsewhere in this Construction Specification and/or as directed on the Drawings, nominal size(s) of the aggregate shall be 14mm for the first seal coat of a two (2) coat application, and 10mm for a single (1) coat application or for the second seal coat of a two coat application.

11.5 SAMPLING OF MATERIALS

The Contractor may be required to supply at any time without charge, adequate samples of any or all materials used or to be used in the work.

The samples shall be taken by the Contractor's representative in the presence. of the Superintendent when and where directed by the Superintendent. The time of sampling may be either prior to despatch of the material from source of supply or subsequent to its arrival at the job or both. The Contractor shall supply all facilities, equipment and labour for obtaining the samples.

The methods of sampling and testing shall be those described under the relevant materials Construction Specification contained in Clause 11.4 where applicable. If any sample fails to conform to the specific requirements, the whole of the material represented by such sample may be subject to rejection or other action as described in Clause 11.17.

11.6 PLANT

The Contractor shall provide all the plant and equipment necessary for carrying out the work in accordance with this Construction Specification.

All plant and equipment used on the work shall be kept in good operating condition. The Contractor shall remove from the work any plant or equipment considered by the Superintendent to be unsuitable for carrying out the work in accordance with this Construction Specification.

11.7 PREPARATION OF PAVEMENT

The surface of the pavement shall be swept free of loose stones, dust, dirt and foreign matter so as to uncover but not dislodge the stones of the pavement immediately before applying the first coat. Sweeping shall extend 250mm clear of the pavement.

A mechanically operated rotary broom may be used for the sweeping provided it does not disturb the surface stones but if a satisfactory clean surface is not obtained thereby, additional sweeping shall be done by hand using stiff bass or similar approved brooms. Adherent patches of foreign material shall be removed from the surface of the road by the use of a steel scraper or other approved method.

Where the existing pavement is recessed below the gutter lip, additional sweeping shall be done by hand adjacent to the lip to remove all loose material.

No spraying shall be undertaken until the pavement has been prepared to the satisfaction of the Superintendent.

11.8 CONTROL OF WORK

The Superintendent may direct the width, length, alignment and section of road to be sprayed at any time.

Provided the width of treatment does not exceed 7.4 metres, the Superintendent may direct whether spraying is to be carried out to the full width of the treatment or in part widths. Where part width spraying is carried out the work shall be arranged to provide for a reasonably continuous flow of at least one lane of traffic.

The sprayer shall be so guided that the edge of the spray conforms at all times to the required line. Any strips of pavement not adequately covered by binder required shall be sprayed later by the hand attachment.

The Superintendent may order work to cease temporarily on account of adverse weather, unsatisfactory condition of pavement or aggregate, or any circumstances which he considers may affect the work adversely.

The Superintendent may order variations in the proportion of cutter oil in the binder at any stage of the work.

The Bitumen Sprayer and all other equipment used on the work shall be kept in good operating condition and shall be operated by persons skilled and experienced in their respective duties. The Contractor shall remove from the work any workman or equipment considered by the Superintendent to be unsuitable for carrying out the work in accordance with this Construction Specification.

The Contractor shall take all necessary precautions to prevent binder, aggregate or other materials used on the work, from entering or adhering to kerb and gutter, gully pits, hydrant or valve boxes, manhole covers, bridge or culvert decks, and similar road fixtures. Immediately after aggregate has been spread over the binder, the Contractor shall take steps to clean off any material and leave such gratings, manholes, etc., in a satisfactory condition.

11.9 OPERATION OF SPRAYER

Unless otherwise authorised by the Superintendent and except as stated hereunder in this Clause, the application of binder shall be made by means of the mechanical sprayer specified in Clause 11.6 Plant.

Where the use of the mechanical sprayer is not practicable for the spray application to small areas, the spraying of such areas as the Superintendent may approve may be done by means of the hand spray equipment attached to the sprayer.

The spray nozzles shall be of the make and type endorsed on M.R. No. 274, Sprayer Certificate. Any nozzles which may be damaged or become unduly worn or defective, shall be replaced by satisfactory nozzles of similar type. A sufficient number of nozzles for this purpose shall be available at all times.

The Contractor shall measure and mark on the ground the length of the surface to be sprayed by each run of the sprayer. He shall indicate by marks on the road at intervals of not more than seven metres, the line to be followed by the sprayer for the spray to conform to the alignment ordered. The existing gutter lip may be used as the line to be followed where appropriate.

Where part-width spraying is ordered, the application on each width shall be so arranged as to provide for a lap of 50mm at the longitudinal joint with the adjacent spray if special type end nozzles referred to in H.R. Form No. 272, Performance Requirements for Mechanical Sprayers of Bituminous Material, are used. If intermediate nozzles are used as end nozzles, the overlap of spray between adjacent runs shall be 300mm.

The spraying of binder for each 'run' of the sprayer shall commence on a protective strip of heavy paper weighing not less than 120g/sq.m laid across and held securely to the surface beforehand. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application is attained at the commencement of spraying. Unless the Superintendent directs otherwise, the spraying for each run shall terminate on a protective strip of paper laid across and held securely to the surface beforehand. The width of paper at the commencement and/or termination of each run shall not be less than that endorsed on the Sprayer Certificate, or such additional width as the Superintendent may direct.

Binder shall be applied at the rate specified or ordered, and shall be within the tolerances stated in M.R. Form No. 272, or stated in other performance requirements acceptable to the Superintendent. The spraying table referred to in that form shall be available on the work at all times and shall be used to determine the appropriate road speed and settings of sprayer controls prior to the commencement of each sprayer run.

Provision shall be made for ten percent or such other percentage as may be determined by the Superintendent of the rated capacity of the sprayer tank to be retained in the tank at the completion of each run, so as to avoid air entrainment within the delivery system of the sprayer, and provide for minor excess in the rate of spray.

After each sprayer run, the quantity of material sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the specified or ordered rate of application is maintained in subsequent runs.

Spraying shall cease immediately if any defect develops in the spraying equipment, and it shall not recommence until the fault has been rectified.

The Superintendent may require such tests as he considers necessary to check the performance of the sprayer and its equipment. As and when directed by the Superintendent, the Contractor, at his own cost, shall make the sprayer and its equipment available for field testing, and shall supply any assistance required for the purpose. Any sprayer which does not operate satisfactorily, or conform to the requirements of the Construction Specification in all respects, may be rejected by the Superintendent for further use on the work.

11.10 HEATING OF BINDER

Binder shall be heated to a temperature necessary to carry out the operations of cutting (if required) and spraying. The temperature of the binder at the time of spraying, shall be within the limits given in the table below:

Heating and Spraying temperatures			
Type of Material	Grade	Dynamic Viscosity Range in Pa's at 60^0C	Range of Temperatures for Heating and Spraying ^0C
Cutback Bitumen	AMC 4	2.0 - 4.0	110 - 135
	AMC 5	5.5 - 11.0	120 - 150
	AMC 6	13.0 - 26.0	135 - 160
	AMC 7	43.0 - 86.0	150 - 175
Bitumen Class	Class 170	140 - 200	160 - 190

Binders shall be heated in equipment which will permit uniform heating without damage to the content. The heating equipment and methods of operation shall be as approved by the Superintendent.

Quantities of binder in excess of requirements shall not be heated, and such materials shall not be held at temperatures within the spraying range for periods in excess of ten hours.

All binders shall be sprayed as soon as possible after heating.

When binders are delivered from a refinery or a major supply depot to the site of the work in large closed containers, insulated to minimise loss of heat in transit, the contents at the time of despatch may be at a temperature not more than 150C in excess of the upper limit given in the table.

Bituminous materials which have cooled, and are not sufficiently fluid, shall be heated at a slow rate until the whole mass becomes fluid. The temperature of the material just above the heating tubes shall be checked at regular intervals to ensure that there is no local overheating. Burners shall not be used unless the level of the material in the heating tank is at least 250mm above the tops of the heating tubes.

If for any reason binder cannot be sprayed on the same day that it is mixed with cutting oil, then it shall only be used subsequently if in the opinion of the Superintendent, it has not been damaged by prolonged or excessive heating.

Any binder which in the Superintendent's opinion, has been damaged by overheating, shall be rejected and shall be replaced at the Contractor's expense.

Temperatures shall be checked regularly by means of a suitable thermometer with the readings within fi or - 2.5% of the correct temperature.

Two or more suitable fully-charged pressurised dry chemical fire extinguishers, shall be provided, and shall be placed conveniently to the heaters at all times while heating is in progress. Suitable loose sandy material shall also be provided at the heaters for use in the event of fire.

11.11 CUTTING BACK BITUMEN BINDER

The percentage of cutter oil to be used in the binder at any time during the course of the work shall be subject to the approval of the Superintendent and shall generally be determined from the road temperatures and the Cutback Chart MR Form 466. The percentage of cutter oil shall be increased above the amount determined from the Cutback

Chart when sealing sandstone pavements. The increased amount shall be determined by the Superintendent and generally shall be in the range 5 to 10 percent.

11.12 MEASURING ROAD TEMPERATURES

Unless the Superintendent gives directions to the contrary, the Contractor shall measure and record road temperatures at regular intervals during the course of the work. For this purpose a spirit or mercury-glass thermometer or other suitable thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. The bulb of the thermometer shall be covered with a small heap of dust or grit taken from the road shoulder.

If the pavement is partly in sun and partly in shade, the temperature for both conditions shall be taken and recorded.

As a short period of time will elapse between taking road temperatures and spraying the cutback bitumen, it is necessary to make an estimate of the change in temperature during that period. The estimated temperature at time of spraying is then used for selecting the amount of cutter oil from the cutback chart.

The Contractor shall arrange for the binder in each sprayer load to be cutback as directed by the Superintendent, and each sprayer load shall be accompanied by a certificate showing the volume of bitumen and cutter oil material respectively used.

Except as may be authorised otherwise by the Superintendent, the cutter oil, without being previously heated, shall be pumped into the sprayer followed by the hot bitumen. The full sprayer load of binder shall be circulated for at least 15 minutes, or any greater time necessary to ensure that the mixture is homogeneous.

Precautions are to be taken to reduce the possibility of foaming during the mixing of cutter oil and bitumen.

When mixing cutter oil and bitumen in the sprayer, an empty drum or other container should be placed beneath the overflow pipe to catch any material discharged through foaming. Anti-foam preparations are not to be used except with the approval of the Superintendent.

If a part sprayer load of field cutback bitumen is unused on the date of mixing and needs to be returned to the heater- tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter oil shall be added to the returned material unless the tank is fitted with an effective mechanical mixing system.

When the returned material is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned material.

11.13 APPLICATION OF BINDER

The binder shall consist of bitumen or cutback bitumen prepared in a bitumen refinery or other source of supply as scheduled in Section 11.10 or cutback bitumen prepared in the field in accordance with Clause 11.12.

The net cold rate of application of the binder unless otherwise specified, and/or specifically nominated on the Drawings shall be:

(a) Single coat seal or reseal	1.2 litres / sq.m
(b) Two coat seal	
i. 1st application	1.3 litres / sq.m
ii. 2nd application	1.1 litres / sq.m

The Superintendent shall have the right to order variations in the specified rate(s) of application at any stage of the work.

When refinery cutback bitumen is used as the binder, the ordered rate for residual bitumen shall be increased, to allow for cutter oil in the mixture, in accordance with the table below:

Application of Binder				
Grade of Refinery Cutback	Approximate Amount of Cutter Oil	Increase in Ordered Rate (%)	*Permissible Range of Road Temp (^{0}C) Aggregate Precoated	
			No Moisture on Aggregate	Moisture on Aggregate
AMC 4	16	19	-	10 - 15
AMC 5	11	12	12 - 17	12 - 28
AMC 6	7	8	22 - 27	22 - 38
AMC 7	3	3	32 - 37	32 - 48

Allowance shall be made for expansion of the residual binder when heated to spraying temperature, and when cutter oil is included, the rate of application shall be adjusted to allow for the quantity of cutter oil. This necessary adjustment shall be subject to the approval of the Superintendent.

When refinery cutback bitumen is in use, and actual road temperatures are outside the permissible range given in the above table (except when sealing sandstone pavements), the Contractor shall defer spraying until the road temperature comes within that range. Alternatively, in the case when the road temperature is too low, the Contractor may add extra cutter oil to the binder as directed by the Superintendent. Any additional cutter oil shall be mixed uniformly with the binder.

The binder shall be applied to the prepared road surface in the manner specified in Clause 11.9 at a rate of application within a tolerance of + or - 5% of that specified or ordered by the Superintendent.

If binder is applied at a rate outside this tolerance, the section of work concerned may be rejected by the Superintendent in which case no payment shall be made. Alternatively, the work may be accepted at a reduced price.

The temperature of the binder at the time of spraying shall be within the range specified in Clause 11.10.

The binder shall not be heated in the field in excess of the maximum temperature specified in Clause 11.10 and shall be sprayed as soon as possible after heating.

At the time of spraying, the road surface shall be clean and free from loose material and where binder is to be applied to a primed or sealed pavement, the surface shall be dry. Where binder is to be applied to a pavement not previously primed or sealed, the surface shall be slightly damp, unless a direction to the contrary is given by the Superintendent.

Unless otherwise authorised by the Superintendent, spraying shall not be done unless the road temperature has been at or above ten (10^0) degrees Celsius for at least one hour prior to the commencement of spraying operations. Road temperatures shall be measured as set out in Clause 11.11. Spraying shall not proceed if rain appears imminent, or during high winds or dust storms, except as may be authorised by the Superintendent.

The area to be sprayed with binder at any time shall be limited to that which can be covered with aggregate at the specified rate within twenty (20) minutes of the time of spraying.

11.14 PRECOATING OF AGGREGATE

All cover aggregate shall be coated with an approved agent and at an application rate nominated by the Superintendent, generally in the range of 6 to 15 litres/cu.m.

Precoating material shall be thinly and evenly applied by means of a fine pressure spray to a moving stream of aggregate, or by mixing with the aggregate in an approved mixing plant, so that all particles are fully coated, but do not contain excess material. The coating shall be such that no material will drip from a particle of aggregate suspended between the fingers.

The method of precoating and the apparatus to be used shall be as approved by the Superintendent.

When precoated material is being applied, the aggregate may be dry or damp, but shall not contain sufficient moisture to cause uneven distribution of the precoating material on the aggregate particles.

Precoating of damp aggregate shall not be carried out when rain is imminent, unless the Superintendent has authorised the mixing of an adhesion agent in the precoating material or the aggregate is adequately covered to prevent the precoating material from being washed from the aggregate.

Aggregate which contains moisture at the time of precoating shall not be used in the work until the moisture has evaporated and the precoating material has adhered effectively to the aggregate.

Precoated aggregate shall be used within ten days of precoating and not earlier than two days of such treatment, unless a direction to the contrary is given by the Superintendent.

In areas subject to dusty conditions, precoated aggregate shall not be stockpiled for any period longer than is necessary for moisture to dry out unless stockpiles are covered. If dust has blown into stockpiles of precoated aggregate and there is a visible coating of dust on the particles, the Superintendent may direct that portions of the stockpiles be precoated again.

11.15 APPLICATION, DISTRIBUTION AND INCORPORATION OF AGGREGATE

After spraying the binder, aggregate as specified shall be spread uniformly over the sprayed surface by an approved mechanical spreader.

The rate of application of the aggregate, unless otherwise specified and/or specifically nominated on the Drawings, shall be:

(a) Single coat seal or reseal 1 cu.m per 120 sq.m (10mm normal size)

(b) Two coat seal

i. 1st application 1 cu.m per 90 sq.m (14mm normal size)

ii. 2nd application 1 cu.m per 120 sq.m (10mm normal size)

The Superintendent shall have the right to order variations in the specified rate(s) of application at any stage of the work. In all cases the following procedure shall be adopted.

Sufficient loaded trucks shall be at the site to provide the full aggregate cover required for the quantity of binder to be sprayed at that time. Aggregate at site shall be sufficient to re-run or hand cover bare or insufficiently covered places left after the first spreading.

The application of aggregate shall commence immediately after the spraying of the binder and shall be completed within twenty minutes of spraying. If any delay occurs in the application of the aggregate, spraying shall be immediately suspended. Bare or insufficiently covered places shall be re-run with the mechanical spreader or covered by hand as the Superintendent may direct. Aggregate in excess of the rate of application specified or ordered shall be scattered and evenly distributed on the road or otherwise removed and stockpiled in an approved manner.

The aggregate shall be so placed that the particles are bedded against one another to form a dense mosaic of single particle thickness without loose particles resting on the mosaic. In order to meet this requirement, it may be necessary to apply the aggregate initially at a rate slightly less than the optimum and finish with a further light application to make good any minor, deficiencies in the aggregate cover. The Superintendent will order any minor changes in the spreading rate to achieve the results required.

In two (2) coat work, before the second course of binder is applied, the first course of aggregate shall be incorporated thoroughly into the binder by rolling, and if there are any surplus loose particles on any portions of the sealed area, such portions shall be swept lightly, so as to remove the loose particles, but not disturb the aggregate bedded in the binder.

This work shall proceed as soon as the first course of aggregate is firmly held by the binder. After the second application of binder and aggregate, rolling and any necessary drag brooming shall proceed as specified.

After the aggregate has been applied to the satisfaction of the Superintendent, it shall be rolled with pneumatic tyred rollers of the type listed in Clause 11.6 Plant.

Rolling of each section of the work shall commence immediately after the application of the aggregate thereto and shall continue until the aggregate is firmly embedded in the binder to the satisfaction of the Superintendent. Where required by the Superintendent to ensure an even distribution of aggregate, the surface shall be traversed with a light drag broom after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the binder, the Superintendent may direct that the drag brooming be deferred or eliminated and that light hand brooming be substituted. The drag broom shall be in accordance with Clause 11.6. Rolling shall be continued as directed by the Superintendent up to a maximum period of 24 hours after the aggregate is applied.

When the aggregate contains moisture, and weather conditions are suitable for drying, the Superintendent may direct that rolling of the spread aggregate be deferred for a short time to permit the moisture to evaporate. If the aggregate does not become dry shortly after it is spread, and the Superintendent considers that the adhesion of the binder to the aggregate is unsatisfactory, he may direct that the work cease until the conditions improve sufficiently.

11.16 TRAFFIC

Traffic shall not be allowed on the new work until approved by the Superintendent. If the Superintendent directs that the full width of pavement shall not be sprayed in one operation, traffic shall not be permitted on the adjacent strip of roadway while binder is actually being sprayed. All claims arising from the marking of vehicles by binder shall be the responsibility of the contractor.

Any precautions required to ensure the safety of traffic during the progress of the work shall be carried out without extra cost in accordance with M.R. Form No. 121 Control of Traffic at Road and Bridge Works.

Approved advisory signs indicating that the sealing work is in progress shall be erected at intervals of not more than 300 metres and in locations as directed by the Superintendent.

11.17 DEFECTIVE WORK OR MATERIALS

The Contractor shall remove from the work and shall bear the cost of replacing any binder which has been overheated, or has deteriorated, or become contaminated in any way, prior to its application to the road.

The Contractor shall make good at his expense any work, which, in the opinion of the Superintendent, is not in accordance with this Construction Specification, whether caused by bad workmanship, or defective materials supplied by the Contractor, or by materials made

defective by his operations. Alternatively, the defective work may be accepted at a reduced price.

11.18 WASTE MATERIALS

Waste aggregate, bitumen, empty containers or other materials remaining after completion of the work shall be disposed of by the Contractor at his expense to the satisfaction of the Superintendent and the work shall be left in a neat and tidy condition.

11.19 MAINTENANCE

Excess Surplus aggregate shall be removed from the pavement unless otherwise directed by the Superintendent.

Should any defect occur in the surface during the contract or defects liability periods, the area affected shall be thoroughly cleaned and treated with binder and aggregate as herein specified.

12. EROSION AND SEDIMENT CONTROL

12.1 DESCRIPTION

This Construction Specification provides for erosion and sediment control measures to be undertaken during construction.

The Contractor shall provide and maintain controls where shown on the Drawings or where directed by the Superintendent. Such controls shall be in accordance with this Construction Specification.

12.2 GENERAL

Perimeter control measures shall be placed prior to or in conjunction with the first phase of earthworks. Construction shall be phased if directed by the Superintendent so that land disturbance is confined to areas of workable size. This will limit the duration for which disturbed areas are exposed to erosion. Stabilization measures shall be applied on the first disturbed section before the next section is opened up.

Topsoil stockpiles shall be located outside hazard areas such as drainage depressions in accordance with Clause 3.3 of the Construction Specification for Site Preparation Works and/or Clause 5.2 of the Construction Specification for Formation.

Where site regrading or filling is being undertaken, the provisions of Clause 3.6 of the Construction Specification for Site Preparation Works relating to redirecting surface water away from the face of batters shall be complied with.

All areas not subject to construction works shall be retained free from disturbance or damage during the currency of the Contract. Should these areas become disturbed or damaged they shall be reinstated by the Contractor at no cost to the Principal.

12.3 SEDIMENT AND EROSION CONTROL DEVICES

Where shown on the Drawings or otherwise specified, sediment and erosion control devices shall be constructed and maintained. Unless the device is a permanent structure, it shall be removed when the areas above it have been stabilised. The control devices shall be constructed in the locations shown on the Drawings unless an alternative location is directed by the Superintendent.

12.3.1 Temporary Construction Exit

The temporary construction exit is provided to shake off site material from exiting vehicles and shall consist of a pad of coarse crushed rock, crushed slag or gravel (25mm to 75mm range) having a minimum depth of 200mm, a minimum length of 15m and a width as nominated on the Drawings.

12.3.2 Diversion Channels/Banks

Diversion channels are earth channels with a minor ridge on their-lower side constructed across the slope. The channel shall have side slopes not steeper than 1 in 3.

Where flows are too large to be contained by a simple channel, a diversion bank shall be constructed below the channel. The bank shall have a compacted height of at least 500mm with batter slopes no greater than 1 in 2 and a top width of 600mm. The channel behind the bank shall fall to the outlet point.

Diversions shall be stabilised by the method nominated on the Drawings or otherwise specified and shall be located where directed by the Superintendent so that runoff will discharge onto stable disposal areas without causing erosion.

12.3.3 Level Spreader

Level spreaders shall be used as outlets for diversion channels or at other areas of concentrated flow of runoff where conversion to sheet flow onto stable areas is required. The level spreader shall be excavated at zero (0%) grade, the length shall be as shown on the Drawings or otherwise specified. The approach grade of the diversion channel shall not exceed one (1%) per cent for at least six (6) metres before it enters the spreader. The Contractor shall pay particular attention to the sill to ensure that it remains stable and a vigorous vegetative cover is maintained below it. The channel behind the sill shall be de-silted when directed by the Superintendent.

12.3.4 Straw Bale Barrier

Straw bale barriers shall consist of wire bound bales laid lengthwise in an excavated trench nominally 100mm deep. Each bale shall be securely anchored by two stakes or star pickets driven through its centre into the ground such that the top of the stake or star picket is level with the top of the bale. The barrier shall be constructed on that part of the perimeter of the site or at other locations within the site as shown on the Drawings or where directed by the Superintendent.

12.3.5 Gravel Outlet

The gravel outlet, which is an auxiliary structure shall be installed in conjunction with and as part of a diversion bank or other structure designed to temporarily pond sediment-laden surface runoff.

The outlet shall be constructed in accordance with the details shown on Standard Drawing RM23. Aggregate shall be in the 50 to 75mm size range. The crest of the outlet shall be a minimum of 150mm lower than the top of the associated earth bank and may be either level or slightly concave. The gravel outlet shall otherwise have a similar cross-section to that of the adjacent earth bank. The length shall be as shown on the Drawings or otherwise specified.

12.3.6 Sediment Traps

Temporary de-silting structures shall be constructed at inlets to stormwater systems to trap sediment in runoff. They shall consist of the following types:

(a) Surface Inlet

The surface inlet pit shall be completed to throat level and then topped off with one or more courses of standard masonry construction blocks, nominal 150mm thickness, laid on side in accordance with the detail shown on Standard Drawing RM23. Aggregate in the 50 to 75mm size range shall be banked around the outside of the blocks.

(b) Kerb Inlet

Kerb inlet traps shall be provided to pits in areas of high erosion susceptability and shall be constructed by modifying the kerb inlet to allow sediment filtration. A roll of wire netting of a nominal 150mm diameter filled with aggregate in the 50 to 75mm size range shall be placed across the throat in accordance with the detail shown on Standard Drawing RM23. The netting shall be lapped approximately 150mm and wired together. At both ends a concrete spacer block laid on side shall be placed normal to the kerb.

(C) Culverts

Existing road embankments with culverts beneath shall be converted to temporary sediment traps by building around the entrance to the culvert a box of unmortared standard masonry construction blocks nominal 150mm thickness, placed on side in accordance with the detail shown on Standard Drawing RM23. A filter of gravel or coarse aggregate (50 to 75mm size range) shall be placed against the modified inlet. The filter material shall batter at 3 to 1 from the top of the blockwork. The width and height of the blockwork shall be as specified.

12.3.7 Filter Dams

Filter dams built of pervious materials such as straw bales, washed aggregate or gravel, gabions, or sandbags filled with aggregate or gravel shall be placed across minor drainage channels while ground cover is being established, to steady flow velocity and to trap sediment. In grassed channels they shall be embedded at least 100mm in the soil to prevent water tunnelling beneath them.

Straw bales shall be securely anchored by driving two stakes or star pickets through the centre of each bale into the ground such that the top of the stake or star picket is level with the top of the bale.

The Contractor shall check the dam after each storm for structural damage or clogging by silt and other debris and make prompt repairs or replacements to the satisfaction of the Superintendent.

12.3.8 Sediment Basins

Sediment basins, where specified, shall be constructed to the details shown on the Drawings and in accordance with the Construction Specification for Site Preparation Works. The basin shall be constructed as the first phase of the earthworks operation.

12.4 MAINTENANCE

All sediment and erosion control devices shall be maintained in a satisfactory working order throughout the Contract and Defects Liability Period or until such earlier time as the area above has been stabilised and the Superintendent directs that the device be removed.

The Contractor shall inspect the devices after each storm for structural damage or clogging by silt and other debris and make prompt repairs or replacement.

All sediment deposited within ponded areas shall be periodically removed to a disposal area as directed by the Superintendent.

Gravel or other filter materials shall be cleaned and restacked or replaced when directed by the Superintendent to maintain effective performance.

In the case of the temporary construction exit, the contractor shall undertake weekly surface cleaning by drag broom or equivalent, to remove all build-up of foreign material to the satisfaction of the Superintendent.

To control bank growth and to maintain healthy ground cover in channels and on banks, mowing shall be undertaken as directed by the Superintendent. All costs associated with this Clause shall be included in the rate tendered for the respective control devices.

12.5 STABILISATION OF DISTURBED AREAS

Stabilisation of disturbed areas shall be in accordance with the Construction Specification for Grassing and/or Construction Specification for Landscape Works.

Where practical the following principles shall be applied for the control of erosion and sedimentation:

(a) Stabilisation of denuded areas shall commence within thirty (30) days of the areas being disturbed.

(b) Stabilisation of the area over all stormwater drainage lines and sewer mains not within road reservations shall commence within fifteen (15) days of backfilling.

(c) All temporary earth diversion channels/banks and sediment basin embankments shall be seeded within fifteen (15) days of completion of their earthworks.

(d) Stabilisation of all cut and fill slopes shall be commenced within fifteen (15) days of completion of formation.

(e) All stabilisation measures shall be undertaken prior to issue of the Certificate of Practical Completion.

13. GRASSING

13.1 DESCRIPTION

This Construction Specification provides for the preparation, fertilising, sowing, turfing, watering, mowing and generally caring for grasses on defined areas so as to provide a dense uniformly distributed cover of the various varieties of grasses specified.

13.2 PREPARATION

Areas to be grassed shall be ripped along the contour to a depth of 200mm prior to topsoiling to provide a key for the topsoil and improve infiltration of water, unless otherwise directed by the Superintendent. Following ripping, the areas shall be topsoiled in accordance with the provisions of the Construction Specification for Site Preparation Works.

If considered necessary by the Superintendent the area to be grassed shall be rotary hoed along the contour to a depth not exceeding that of the topsoil and generally to a depth of 100mm.

On steep slopes and on other areas of high erosion hazard a rough surface shall be developed. A fine tilth shall be acceptable only on areas of low slope.

Light grading to effect the required surface profile may also be necessary and shall be carried out by the Contractor if so directed by the Superintendent.

The Superintendent may direct that the topsoil of areas to be grassed by turfing be compacted with a light roller.

All weeds and the roots of all noxious weeds shall be thoroughly cleared from the site. Trees existing on the site shall not be disturbed other than by being trimmed as directed.

13.3 GRASSING BY SEEDING

13.3.1 Grass Seed

The seed used shall be of the best quality available, shall have good germination characteristics and be true to variety. The seed shall be obtained from reputable seed merchants and the Contractor shall produce satisfactory evidence that he has complied with these requirements. Until used, any seed in the possession of the Contractor shall be stored off the ground in a cool, dry place and shall not be stored any longer than possible before being used.

13.3.2 Seed mixture for reserves, footways, median strips and embankments

The following mixtures of seed shall be used for reserves, footways, median strips and embankments:

a) Spring/Summer Mix

Lolium perenne (Perennial Rye)	60kg/ha*
Cyclodon dactylon (Couch) Irrigation Hulled	30kg/ha
Axonotus affanus (Carpet Grass)	30kg/ha*
Trifolium (O'Connells Sub Clover)	3kg/ha
Festuca Rubra (Fine Fescue)	27kg/ha

Total	150kg/ha

*For drought conditions substitute Tall Fescue (15kg/ha) for Perennial Rye (7.5kg/ha) and Carpet Grass (7.5kg/ha).

b) Autumn/Winter Mix

Lolium perenne (Perennial Rye)	90kg/ha
Festuca rubra (Fine Fescue)	30kg/ha
Agrostis tenius (Bent)	7.5kg/ha
Festuca arundinacea (Demeter Fescue)	22.5kg/ha

Total	150kg/ha

13.3.3 Seed mixture for earth drainage channels

The following mixtures of seed shall be used on inverts and batters of drainage channels and inlet and outlet drains:

a) Spring/Summer Mix

Lolium perenne (Perennial Rye)	60kg/ha
Festuca arundinacea (Demeter Fescue)	45kg/ha
Cyclodon dactylon (Couch) Irrigation Hulled	15kg/ha
Axonotus affanus (Carpet Grass)	15kg/ha
Trifolium Repens (White Clover)	3kg/ha
Trifolium (O'Connells Sub Clover)	4.5kg/ha
Echinochloa frumentacea (Japanese Millet)	7.5kg/ha

Total	150kg/ha

b) Autumn/Winter Mix

Lolium perenne (Perennial Rye)	90kg/ha
Festuca arundinacea (Demeter Fescue)	30kg/ha
Puccinellia Distans (Saltol)	15kg/ha
Trifolium Repens (White Clover)	3kg/ha
Trifolium (O'Connells Sub Clover)	4.5kg/ha
Secale cereale (Ryecorn)	7.5kg/ha

Total	150kg/ha

13.3.4 Fertilisers

The fertiliser to be used shall be an approved Nitrogen, Phosphoric Acid, Potash compound starter fertiliser.

Unless otherwise specified, fertiliser shall be spread at the rate of 200kg/ha for footways, median strips, embankments and reserves and 250kg/ha for drainage channels.

Where clay panning is evident or where hard packing river loams are used, then the Superintendent may direct that Gypsum be spread at the rate of 200-500kg/ha.

13.3.5 Sowing

When the area to be sown has been brought to a condition suitable for the sowing of grass seed the seeding mixture shall be proportioned in accordance with the requirements of Clause 13.3.2 or 13.3.3 of this Construction Specification.

After proportioning, the various quantities of seeds shall be thoroughly mixed so that each variety will be uniformly distributed throughout the whole.

The seed mixture then shall be uniformly distributed at the prescribed rate of application per hectare and unless otherwise specified, the prescribed quantity per hectare of fertiliser shall be distributed at the same time.

After sowing by hydroseeding or by conventional methods in accordance with Clauses 13.3.6 and 13.3.7 respectively, the whole of the area shall be uniformly watered. The volume of water to be applied at this time shall be equivalent to 10mm of rain unless weather conditions dictate otherwise, in which case the Superintendent shall determine the volume of water to be applied.

The Contractor shall take care to avoid the formation of rills in the surface by a too rapid application of the water.

If the Superintendent is of the opinion that excessive rilling has occurred in the surface, from whatever cause, he shall have the right to direct the Contractor to re-prepare and re-sow the affected area, and if so directed, the Contractor shall re-prepare and re-sow the area at his expense all to the satisfaction of the Superintendent.

Sowing shall be carried out by the method indicated on the Drawings or otherwise specified, in accordance with the provisions of Clause 13.3.6 or Clause 13.3.7.

13.3.6 Hydroseeding

When sowing is to be carried out by hydroseeding, a hydromulching machine approved by the Superintendent shall be used to mix and spray a slurry of seed mixture, fertiliser, mulch and water onto the area to be grassed. Sufficient mulch material shall be contained in the slurry to carry and stick the seed mixture and fertiliser to the prepared surface.

The mulch shall be wood pulp unless otherwise specified or approved by the Superintendent.

13.3.7 Conventional Sowing and Mulching with Bitumen

When sowing is to be carried out by conventional methods the seed and fertiliser may be distributed uniformly by means of a mechanical seed sower to be followed by an application of bitumen emulsion.

No area shall be sown with seed whilst it is in such a softened state due to excessive moisture that it cannot support the weight of the loaded bitumen sprayer.

The seeds shall be covered by 5mm of soil by means of rolling or other methods acceptable to the Superintendent.

As soon as practicable after the application of the water in accordance with Clause 13.3.5, the area shall be sprayed with bitumen emulsion by means of an approved power sprayer fitted with a fixed spray bar set at the maximum width per row.

An approved solution of slow-breaking anionic bitumen emulsion and water mixed in the ratio 1:1 shall be used for this purpose. The application rate shall be 1.0 litre per square metre for general work and four litres per square metre for drainage channels subject to concentrated water flows.

In areas where it is impracticable to utilise the fixed spray bar of the sprayer, the bitumen emulsion may be applied by means of an approved hand spray attached to the power sprayer.

Any areas deformed and/or rutted shall be repaired and re-sown by the Contractor, at his expense, to the satisfaction of the Superintendent.

All concrete structures shall be protected from overspray with emulsion and any surfaces sprayed shall be cleaned to the satisfaction of the Superintendent.

13.4 GRASSING BY TURFING

13.4.1 Fertiliser

When the area has been prepared in accordance with Clause 13.2, the whole area shall be watered and fertilised by the application of an approved nitrogen, phosphoric acid, potash compound fertiliser with an analysis of 10:3.9:6.2 respectively.

The fertiliser shall be applied at the rate of 200kg per hectare spread evenly over the surface, lightly raked and re-watered.

13.4.2 Supply and Planting of Sods.

The sods are to be of kikuyu grass unless otherwise specified. They are to show healthy growth and to be of even thickness when delivered to site. The area from which the supply of grass is to be obtained is to be mowed before the sods are cut.

The placing of the sods shall be commenced immediately the soil has been watered and fertilised.

On completion of the laying of the sods, they are to be compacted by watering and rolling with a 100kg to 150kg roller. Each sod should be butted against the previously laid sod and no gaps shall remain between the sods after laying.

Sites too steep for this compaction treatment shall be covered with a locating mesh of a type approved by the Superintendent. The cost of supplying, fixing and removing this mesh, when required, shall be included in the rate tendered.

Immediately after the sods have been rolled, approved topsoil shall be spread to a depth of 10mm over the whole area and thoroughly watered.

13.5 CARE OF GRASSED AREAS

The Contractor shall regularly care for the sown and turfed areas and shall regularly maintain the moisture content of the ground at a level sufficient to allow, where applicable, proper germination of the seed to take place, to assist the rooting of the runners and generally to encourage the subsequent growth of the grasses.

This regular care by the Contractor shall be continued throughout the currency of the contract plus Defects Liability Period.

Two months after the sowing of the grass seeds and three to four weeks after laying turf, the Contractor shall make an application of Sulphate of Ammonia at the rate of 250kg per hectare which shall be well watered into the soil.

The Superintendent may direct the Contractor to defer this second application of fertiliser to a later date if he is of the opinion that the grass growth would benefit by such deferment. If so directed, the Contractor shall defer the application of the fertiliser until the later date nominated by the Superintendent.

13.6 MOWING

From time to time during the currency of the contract the Contractor shall mow the grassed area with an approved power grass mower. The height of cut shall be nominated by the Superintendent and the Contractor shall obtain the Superintendent's direction in this matter before commencing mowing operations.

If the Superintendent so directs, the Contractor shall mow the grass within forty-eight (48) hours of being so directed.

The Contractor shall not be entitled to receive any extra payment for mowing irrespective of the number of times that he may be required to mow the area.

13.7 ESTABLISHMENT

It is a requirement of the contract that a uniformly distributed dense grass cover of the specified varieties of grass shall be established over the whole of the area specified to be grassed so as to eliminate wind and water erosion of the surface.

The Contractor shall take all steps necessary to establish such a dense grass cover and will not be regarded as having fully discharged obligations under the contract until such time as the required dense grass cover has been established.

13.8 MAINTENANCE

The Contractor shall maintain the grass cover established under the contract until all the other works specified in the contract have been satisfactorily completed and the final certificate under the General Conditions of Contract has been issued.

If necessary, during the period of the contract, the Contractor at his expense, shall take all action necessary to re-establish areas of grass damaged or destroyed by adverse weather conditions, fire, floodwaters, vandalism or any other cause and due allowance for the costs of such necessary action shall be made in the rate tendered.

The Contractor shall have no claim on the Principal for any of the costs incurred in the establishment, re-establishment if necessary, and maintenance of the specified dense grass cover, other than those costs allowed for in the tender.

The Contractor shall make good at his expense any damage that may be caused to any finished surfaces, fences, or paved areas by his plant or trucks used during the progress of the work.

14. LANDSCAPE WORKS

14.1 DESCRIPTION

This Construction Specification provides for the improvement of reserves and other site areas, as detailed on the Drawings, in the form of clearing and ground improvement by rotary hoeing, trimming, topdressing, turfing, seeding and fertilising, together with planting of new trees or shrubs.

Where a Landscaping Plan has been prepared for the Project by a Landscape Consultant, a separate Construction Specification or Special Conditions of Contract may replace this Construction Specification in whole or in part.

14.2 CLEARING

The Contractor, where directed by the Superintendent, shall grub and remove from the site any dead trees, logs and stumps, together with fallen timber of any kind.

Other existing trees within the area specified shall be protected during construction operations by fencing or other method considered suitable by the Superintendent. This protective work shall be carried out prior to the commencement of any grading or earth trimming and shall remain in position until practical completion of the works.

Plant or materials shall not be stored within three metres of any tree indicated for preservation.

When branch cuts are directed, these shall be made close to and parallel to the main trunk and carefully finished to ensure quick callousing. An approved sound dressing shall be applied to all cut surfaces in accordance with the printed recommendations of the Manufacturer.

The Contractor shall remove from each area all weeds and tree roots. He shall also ensure that fallen leaves, branches and wind-blown debris such as papers are collected and removed once a week and that the site is kept in a tidy condition.

14.3 GROUND IMPROVEMENT

The Contractor shall remove from the site all builder's debris, surface stones, heaps of clay and any other material unsuitable for propogation of growth.

14.4 TOPDRESSING OF EXISTING GRASSED AREAS

The Contractor shall allow in his tender for the supply and spreading of all imported topsoil required and shall submit samples to the Superintendent for approval along with the name of the supplier and pit location.

Imported topsoil shall be free from any material toxic to plant growth, stumps, roots, stones, clay lumps or other extraneous material. Imported soils shall be guaranteed to be free from noxious or troublesome weeds such as nut grass, water couch, mullumbimby couch, onion weed or oxalis. Should any such weeds appear in the grassed areas before the end of the Defects Liability Period, the Contractor shall eradicate same at his expense.

Soil required for the final preparation and topdressing of existing grassed areas shall be friable sandy loam, rich in organic matter, non-hard setting, composed of a minimum of 65% sand, a maximum of 20% clay and a maximum of 15% silt with no more than 0.05% salt content, measured on an oven dry basis. The "pH" value should be within the range 5.5 to 6.5.

The Contractor shall spread the approved topsoil to a depth of 50mm loose measurement and rake it uniformly into the grass over those areas specified to be top-dressed.

An approved nitrogen, phosphoric acid, potash compound fertilizer with an analysis. of 10:3.9:6.2 respectively shall be supplied, spread and raked into the topsoil at the rate of 200kg per hectare and well watered.

Two months later the Contractor shall make an application of Sulphate of Ammonia at the rate of 250kg per hectare which shall be watered into the grassed soil surface.

14.5 TREES AND/OR SHRUBS

Where directed by the Superintendent, the Contractor shall supply and plant trees and/or shrubs of the type listed in the Bill of Quantities.

Trees shall have a height of at least 1.2 metres and shrubs 0.5 metres, both measured from ground level.

The Contractor shall excavate a hole 0.4 metre diameter by 0.6 metre deep for each tree or shrub to be planted, and if in the opinion of the Superintendent the excavated material is unsuitable for tree growth, it shall be spread evenly and neatly over the adjoining areas, and any stones larger than 50mm shall be removed from the site.

The hole shall then be filled with approved soil suitable for tree growth and this shall be lightly tamped until 0.3 metres from surface, flooded with water and allowed to settle before planting takes place.

Sixty grams of an approved slow release fertiliser shall be placed in the bottom of the hole immediately prior to planting and covered with a 10mm layer of topsoil.

The trees and/or shrubs shall be thoroughly watered in the containers, which will be subsequently removed, care being taken not to disturb the roots during planting and firming of the backfill, which shall finish as a saucer 50mm deep and 400mm in diameter. Fertiliser of an approved Nitrogen, Phosphoric Acid and Potash Compound type with an analysis of 10:3.9:6.2 respectively shall be lightly raked into the planting area at the rate of 30 grams per plant. The Contractor shall provide and fix one 40mm x 40mm stake 2 metres long driven 600mm into the ground and shall securely tie each plant in a workmanlike manner without damage to the plant.

After planting, each plant shall be immediately watered by the Contractor, who shall ensure that sufficient watering is carried out to keep the soil moist for the period of the contract, including the Defects Liability Period.

For the whole period of the contract, including the Defects Liability Period, the Contractor shall keep the area within 500mm radius of the plant free of all grass and weed growth and shall maintain a fine tilth on the surface. He shall ensure that plants are kept free of insect and fungus attack and at the end of the maintenance period shall give an additional application of fertiliser as above specified at the rate of 60 grams per plant followed by watering. Plants shall have a healthy and vigorous appearance at the time of final completion.

Any plants which die or are vandalised either during the period of the contract or during the Defects Liability Period shall be immediately replaced with plants of the same species in accordance with the requirements of this Construction Specification and due allowance for the cost of such replacement shall be made in the rate tendered.

15. STONE PITCHING AND ROCKWALLS

15.1 STONE PITCHING

Where indicated on the Drawings, embankments shall be protected from erosion or slipping by hand-placed pitching stones.

The stone pitching shall be of sound durable stone, hammer-dressed and of at least one thirtieth (1/30) cubic metre in volume. Alternatively, rectangular blocks of 1:3:6 Concrete one thirtieth (1/30) cubic metre in volume may be used. The stones shall be placed courses with their beds at right angles to the slope, the larger stones being used in the bottom, and the smaller ones at the top, the minimum thickness of wall at right angles to slope being 250mm. The stones shall be laid in close contact so as to create joints, the weight of all stones being carried by the filling and not by adjacent pitching stones. The spaces between the stone shall generally not exceed 10mm in any case. The finished wall shall present an even tight and reasonably smooth surface of the required contour.

The cost of stone pitching shall include any necessary excavation, compaction and backfilling.

15.2 ROCK WALLS

Where indicated on the Drawings or where directed by the Superintendent rock walls shall be constructed in accordance with the detail shown on Standard Drawing RM27.

15.2.1 Materials

Materials used for the construction of the wall shall be large, sound and durable boulders, in general at least 0.5 square metres in area. Prior to placing the material, the Contractor shall identify to the Superintendent a representative sample of the boulders proposed to be used. Approval of the proposed material shall be required prior to its placement.

15.2.2 Foundation Preparation - Rock

Where the wall is to be founded on bedrock the preparation of the foundation shall include the removal of all vegetation, loose rock, soil, clay and friable weathered rock. Any irregularities in the level of the bedrock shall be filled with mass concrete. In particular, the surface shall be shaped so that the foundation in cross-section is level or inclined into the slope. The lowest course of boulders forming the wall may be set into this concrete. Where the rock surface falls away below the toe of the wall, particular care shall be taken to ensure that the wall is founded on intact bedrock and not on a foundation of floaters. Under no circumstances shall a wall be supported on undercut material.

15.2.3 Foundation Preparation - Soil

Where the wall will be founded on soil (maximum height 2.5m), any material containing a high proportion of organic material shall be stripped, the exposed foundation shall be scarified to a minimum depth of 200 mm, brought to near the Standard Optimum Moisture Content (AS1289.E1.1-1977) and compacted to a minimum dry density ratio (AS1289.E4.1-19) of 95% Standard (AS1289.E1.1-1977). All fill should be placed in layers with a maximum loose thickness of 250 mm and compacted in the manner described above. The wall shall be founded in the key excavation specified in Sub-clause 15.2.5.

15.2.4 Foundation Preparation - Inspection

Approval of the foundation by the Superintendent shall be required prior to placement of the wall materials.

15.2.5 Foundation Depth

The wall shall be constructed in such a manner that the toe is in adequate contact with the foundation material. Where the wall is to be founded on bedrock, keying of the wall into rock shall not normally be required, but the prepared surface must be level or inclined into the slope. In no circumstances may a wall be founded on an outward sloping foundation.

Where a wall, more than one metre high, is to be founded on soil, the base of the wail shall be at a level which is a minimum depth of 400mm below the finished surface level at the toe of the wall. The area of the toe shall be graded so that water does not pond at the toe of the wall.

Where a wall, one metre or less in height, is to be founded in soil, the base of the wall may be at the finished surface level at the toe of the wall. The area at the toe shall be graded so that water does not pond at the base of the wall.

15.2.6 Placement of Rock

Rock shall be placed to ensure that individual blocks are interlocking. To achieve this, blocks should be laid roughly coursed and bedded on their broadest bases. All vertical joints between blocks shall be discontinuous. For walls more than 1 m high, the first layer of boulders forming the wall shall be set in a bed of 15MPa concrete, and the joints between these boulders shall be filled with concrete or (3:1) sand:cement mortar so that all voids below the finished-surface level at the toe are filled. Walls one metre high or less may be founded directly on the prepared surface.

15.2.7 Backfill - Materials.

Material used for backfilling behind the wall shall be granular material consisting of sand, clayey sand, ripped sandstone or other approved granular material.

15.2.8 Backfill - Compaction

Compaction of fill placed behind the wall shall be carefully carried out to minimise the induced lateral stress against the wall.

All fill shall be placed in layers with a maximum loose thickness of 250mm and compacted to a dry density ratio (AS 1289 E4.1 - 1982) of not less than 95% Standard Compaction (AS 1289 E1.1 - 1977).

Where pavement construction is to take place using the backfill as subgrade material, compaction shall be carried out in accordance with the requirements of Clause 5.10 of the Construction Specification for Formation.

15.2.9 Appurtenant Structure

Where pipes are to pass through or beneath the rock wall they shall be encased in concrete to ensure that the base of the wall is founded on stable material.

15.2.10 Drainage - Surface Runoff

All surface runoff shall be directed away from the back of the wall so as to prevent infiltration of such surface runoff into the granular backfill. All surface runoff works shall be approved by the Superintendent prior to construction. In the case of walls founded on soil the surface runoff shall be directed so as to prevent erosion and possible undercutting along the toe of the wall.

15.2.11 Drainage - Subsoil Drain

Where the wall foundation consists of soil or where the wall height exceeds three (3) metres a 100mm diameter subsoil drain shall be installed at the rear of the wall foundation.

16. STANDARD DRAWINGS

RM.1 Standard kerbs and gutters

RM.2 Standard vehicular and pram ramp crossings.

RM.3 Components for miscellaneous pits.

RM.4 Precast components for kerb inlet gully pit to R.M.S.

RM.5 Standard kerb inlet gully pit.

RM.6 Standard junction pit.

RM.7 Standard grated gully pit in concrete accessways.

RM.8 Concrete inspection pit & minor drainage details.

RM.9 Standard surface inlet pits.

RM.10 Standard grated kerb inlet pit.

RM.11 Standard surcharge pits.

RM.12 Standard pathway grated pit.

RM.13 Bandage joint details.

RM.14 Standard straight headwall, direct connection & inspection box.

RM.15 Standard concrete headwalls for 300 to 900 dia. pipes.

RM.16 Standard concrete headwalls for 1050, 1200 & 1350 dia. pipes.

RM.17 Standard concrete headwalls for 1500, 1650 &1800 dia. pipes.

RM.18 Standard fender posts and standard sign plates.

RM.19 Accessway speed humps.

RM.20 Reinforced concrete accessway jointing details.

RM.21 Driveway footway crossings.

RM.22 Accessway footway crossings.

RM.23 Erosion control devices.

RM.24 Breathing layer for trees and pathway steps.

RM.25 Details of rock mattresses.

RM.26 Fire trail details.