



# Disaster Recovery Works - Kalbarri Coastal Works Package

**Technical Specification**

Shire of Northampton

08 April 2024

→ **The Power of Commitment**



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# 1. Introduction

STC Seroja, a category 3 cyclone, impacted the coastline of Western Australia in April 2021 which led to the declaration of disaster event AGRN965 in accordance with the Disaster Recovery Funding Arrangements of Western Australia (DRFAWA). This project is to be delivered in accordance with the DRFAWA requirements.

## 1.1 General

This Specification is for the coastal works to be constructed at Chinaman’s Beach, Blue Holes, Jacques Point and Red Bluff Beach Access. This Specification should be read in conjunction with the relevant drawings, regulations, Codes and Standards.

## 1.2 Location of works

Figure 1 outlines the sites which coastal work will be undertaken.



Figure 1 Site location for the coastal Works package

## 1.3 Scope of Work

Refer to GHD’s 12596020-SOW Kalbarri Coastal Works Package, Construction Scope of Work.

Table 1 outlines a summary of the Scope of Work for each site.

Table 1 Scope of Work for each site

Name of site	Scope of works
All sites	<ul style="list-style-type: none"> <li>– Site setup and establishment</li> <li>– Survey and setout</li> <li>– Provision of all Management Plans and supervision to undertake the works</li> <li>– Provision of all HSE and OHS requirements</li> <li>– Obtaining approvals for undertaking works where required</li> <li>– Locating and protecting services prior to commencing work</li> <li>– Testing, Quality Control and Quality Assurance requirements</li> </ul>

Name of site	Scope of works
	<ul style="list-style-type: none"> <li>- As constructed plans on completion of the Works. All waste and debris shall be correctly disposed of at the Kalbarri Landfill facility</li> <li>- Site cleanup and demobilisation</li> </ul>
Chinaman's Beach	<ul style="list-style-type: none"> <li>- Cut back and dispose of the damaged pavement and debris</li> <li>- Stockpiling of rock recovered from the damaged rock wall and placement of the rock in front of the new limestone block wall upon completion</li> <li>- Earthworks and pavement reconstruction for sealed car park</li> <li>- Two coat seal (10/7) with cutback bitumen primer seal</li> <li>- Kerb installation along sealed car park and access road</li> <li>- Installation of sealed car park drainage</li> <li>- Construction of a gravel footpath along the sealed car park and access road</li> <li>- Construction of a reconstituted limestone block retaining wall with a staircase providing beach access and tying into an existing concrete footpath near the ablution facilities</li> <li>- Installation of a handrail on top of the limestone block retaining wall</li> <li>- Installation of a kerb ramp and concrete landing providing access to the disability accessible fishing platform</li> <li>- Installation of tactile ground surface indicators on kerb ramp</li> <li>- Pavement marking and signage for the sealed car park and access road</li> <li>- Reinstatement gravel car park</li> <li>- Installation of timber post and rail fencing with ringlock wire</li> <li>- Installation of a Replas seat near the fishing platform</li> <li>- Reinstatement of beach access west of the lookout (Provisional sum)</li> <li>- Clearing the existing red asphalt footpath from sand and debris as well as repair of the existing fence leading up to the lookout</li> <li>- Construction of two shade structures with concrete slabs located at the following locations: <ul style="list-style-type: none"> <li>• In front of the Chinaman's Beach gravel car park</li> <li>• On the beach near the Sally's Tree car park</li> </ul> </li> <li>- Installation of Replas tables and benches located at the shade structures.</li> </ul>
Blue Holes	<ul style="list-style-type: none"> <li>- Cut back and dispose of the damaged pavement and debris</li> <li>- Earthworks and pavement reconstruction</li> <li>- Two coat seal (10/7) with bitumen cutback primer seal</li> <li>- Kerb installation</li> <li>- Storm water sump/drainage infiltration swale</li> <li>- Construction of a concrete footpath</li> <li>- Installation of tactile ground surface indicators at kerb ramps</li> <li>- Construction of rock revetment at the front of the car park and footpath</li> <li>- Installation of two Replas staircases over the proposed rock revetment</li> <li>- Construction of a reconstituted limestone block retaining wall at the back of the carpark</li> <li>- Pavement marking, including disability parking spaces and bollards</li> <li>- Construction of a shade structure, including earthworks and concrete base slab with two Replas tables and benches</li> <li>- Installation of pine log fence with ring lock wire</li> </ul>
Jacques Point	<ul style="list-style-type: none"> <li>- Earthworks and construction of proposed unsealed car park and footpath adjacent to the existing access road</li> <li>- Construction of rock revetment, tying in with the rocks in front of Mason's shelter and terminating at the emergency vehicle access</li> <li>- Pedestrian access from the proposed car park to the beach via a Replas staircase over the rock revetment with timber post and concrete footings</li> <li>- 30mm red oxide asphalt disability parking space, including line marking and disability access ramp with tactile ground surface indicators</li> <li>- 30mm red oxide asphalt footpath from the disabled parking to the shelter (part of which constitutes a disability access ramp)</li> <li>- Installation of Weldlok handrails adjacent to disability access ramp</li> </ul>

Name of site	Scope of works
	<ul style="list-style-type: none"> <li>- Installation of concrete wheel stops in car park</li> <li>- Installation of pine post and rail fencing between rock revetment and footpath.</li> <li>- Installation of H4 treated timber edge board along edge of pavement</li> <li>- Reinstatement of Mason's shelter (Provisional sum)</li> <li>- Reconstruction of damaged shelter (beach level - location and orientation to be confirmed on site as directed by the superintendent)</li> <li>- Timber stairs and placement of flat rocks to provide access from Mason's shelter onto the emergency vehicle access and down to the beach</li> <li>- Reinstatement of the gravel emergency vehicle access to the beach (gravel resheet)</li> <li>- Reinstatement of pedestrian gravel access from the upper car park down to the beach including repair of existing fencing</li> <li>- Medium grade and tidy up of the gravel access road</li> </ul>
Red Bluff Beach Access	<ul style="list-style-type: none"> <li>- Reinstatement of pedestrian gravel access from the car park and shelter down to the beach</li> <li>- Reinstatement of posts and ring lock fencing</li> </ul>
Works by others	<ul style="list-style-type: none"> <li>- Disability accessible fishing platform at Chinaman's Beach to be constructed by others</li> <li>- Bins will be provided by the Shire.</li> </ul>

## 1.4 Definitions

Table 2 outlines definitions used throughout this document.

*Table 2 Definitions*

Item	Description
Principal	Shire of Northampton.
Contractor	Party awarded the Contract to complete the Works.
Superintendent	The Kalbarri Coastal Remediation Project Superintendent will be overseeing the Works for the Principle.
Works	All construction works required to deliver the project as defined by the Scope of Works, Specifications, drawings, and Contract documents.

## **2. General Requirements**

### **2.1 Australian Standards**

All workmanship and materials used in the Works shall conform to the current edition of the appropriate Australian Standard. Where the regulatory Authority's requirement differs from the Australian Standard, the regulatory Authority's requirement shall prevail.

### **2.2 Precedence and Dimensions of Drawings**

#### **2.2.1 Documentation**

The order of precedence of the contract documents shall be:

1. The Drawings
2. The Technical Specification
3. Conditions of Tendering
4. The General Conditions of Contract and Amendments

#### **2.2.2 Discrepancies**

All discrepancies shall be immediately notified in writing to the Superintendent.

### **2.1 Electronic information**

PDF Drawings takes precedence over the electronic models and survey data issued. The Tenderer / Contractor shall solely be responsible for checking all electronic information provided against the current PDF Drawings and must report any discrepancies in writing to the Superintendent.

### **2.2 Interpretation of Documents**

The tenderer shall make their own interpretation, deductions and conclusions from the information made available and shall accept full responsibility for such interpretations, deductions or conclusions.

The Contractor or any Subcontractor to them shall check all relevant dimensions on site before proceeding with the works. No claim for additional costs arising from failure to obtain measurements and other information on site will be allowed.

### **2.3 Omissions**

The Principal does not represent that information made available shows completely the existing site conditions. The Principal is not responsible for any interpretations, deductions and conclusions made by the Contractor from the information made available and the Contractor shall accept full responsibility for any such interpretations, deductions and conclusions.

As the information supplied to the Contractor could include errors or omissions or could be ambiguous or misleading, the Contractor shall advise the Superintendent of any discrepancies at the earliest possible time.

If the Contractor supplies information to anyone else, including a Contractor or Subcontractor, for any information supplied the Contractor shall indemnify the Principal and Superintendent for any claim by that person arising out of errors or omission or the misleading nature of the advice.

## 2.4 Warranty

The accepted Tender under this Contract is deemed to be a warranty that notwithstanding that any part of the equipment or the materials supplied has been satisfactorily factory tested and/or inspected before installation, if any item or part thereof shall fail to perform its specified function under test or during the Contract defects liability period, then all costs of replacing all faulty equipment or parts thereof shall be borne by this Contractor.

## 2.5 Traffic management

The Contractor shall undertake all necessary traffic management requirements including:

- Submit a TMP in accordance with the Shire of Northampton's traffic management requirements for review and approval prior to mobilisation.
- The intent is that public access to work site will be restricted during the Works, but where this may not be possible, the TMP is to provide a safe working environment for both construction workers and the public. Note that all sites cannot be closed at the same time.
- Provide traffic management as per the approved TMP.

All signs and method of traffic control shall be generally in accordance with AS 1742 and to the approval of the relevant Statutory Authority.

All damage to existing pavements and improvements shall be made good to the standard of the pre-existing conditions. These works shall comply with the Local Authority requirements for works on public lands.

## 2.6 Programme and staging of work

The Contractor shall submit to the Superintendent for approval within one week of acceptance of his tender, a diagrammatic or other approved form of time schedule for the carrying out of the various parts or stages of the works. The programme shall :

- Include consideration of Saturdays, Sundays, Statutory Public Holidays, building industry annual close down holidays and Rostered Days Off shall be clearly shown on the program;
- Clearly identifies each area/location, trade and element of work;
- Indicates closure of sites
- Indicates starting and finishing dates for each activity, milestone events, logic dependencies and critical path activities;
- Highlights in colour the critical path;
- Does not show any activity with a duration more than 10 days unless related to supply and/or prefabrication lead times;
- Does not include any activity describing more than one major element and/or trade and/or area;
- Shows all major critical off-site activities of supply, prefabrication, testing, samples, prototypes, shop drawings, approvals required; and
- Includes the activities of all the Contractor's, subcontractors, suppliers etc.

The Construction Program shall be accompanied by notes which outlines the basis of the program including assumptions made, allowances incorporated, external interfaces and constraints provided for.

## 2.7 Contractor's area

An area will be allocated to the Contractor for his temporary buildings, materials, plant storage and servicing, vehicle parking and the like. The Contractor shall provide improvements such as fencing, access roads, surfacing or other facilities. The area shall be graded and levelled so as to shed water to a proper drainage system.

The Contractor at his own expense shall provide and maintain and at appropriate times dismantle and remove such buildings and facilities as may be required for his own use and that of his sub-contractors.

All such temporary buildings and facilities shall be removed from the site, and the area of such occupation properly reinstated, within 14 days of the date of issue of the Certificate of Practical Completion unless otherwise approved in writing by the Superintendent.

The Contractor at his own expense shall provide and maintain proper sanitary conveniences for the use of the workmen engaged on the works. Such conveniences shall be kept clean, shall comply with Local Government requirements and shall be removed at the completion of the works.

## **2.8 Survey set out**

The works shall be set out by the Contractor and constructed in accordance with the alignments, levels, grades and cross sections as shown on the approved drawings or as directed by the Superintendent in accordance with this specification.

The Contractor shall have on site at all times survey equipment of a standard suitable to accurately confirm detailed set-out and levels, plus personnel skilled in the proper operation of this equipment.

The works shall be set out, using all the necessary survey equipment, from the pegs and benchmarks given and these shall be used constantly during the progress of the works to check the accuracy thereof. Care shall be taken not to disturb any survey peg, survey recovery pegs or survey marks.

Under no circumstances will any interference with any official benchmark be permitted. Before commencing work, all such benchmarks in the area covered by the Contract shall be protected.

Where it is necessary to cover a survey peg, such a peg must have a substantial stake driven beside it and this stake shall extend at least 75mm above the finished surface and be appropriately marked to identify it. Any State Survey mark affected by the works shall be identified and reported.

Set out amendments, if required, shall only be undertaken on site in conjunction with the Superintendent and are subject to Approval.

Approval to proceed shall not constitute acceptance of the accuracy of the work nor relieve the Contractor of their contractual obligations and responsibility for the work.

Payment for survey set out will be assumed to be included in the relevant schedule item for each activity.

## **2.9 Inspections**

The Contractor shall notify the Superintendent and the relevant service Authority inspector not less than 48 hours prior to an inspection being required for those phases of the work specified in the Technical Specifications.

## **2.10 Behaviour of personnel**

The Contractor shall ensure that persons employed in connection with the work under the Contract conform to a code of behaviour and cooperation which shall be above reproach in all dealings or liaison with the public and with property owners or occupiers. Offensive behaviour or language in public by any person employed in connection with work under the Contract shall not be permissible.

## **2.11 Pets prohibited on site**

The Contractor shall ensure that persons employed in connection with the work under the Contract shall not permit pets or animals, which are in the control or ownership of such persons to be on the Site.

## **2.12 Trespass**

### **2.12.1 By contractor**

- a. The Contractor and his employees shall not trespass on any land adjoining the area in temporary possession of the Contractor for purposes of the Contract.

## 2.12.2 By others

- a. The contractor shall ensure that all machinery, excavation works and building works are left and maintained (both during and after working hours) in a safe condition, including but not limited to provision of advisory signing, reflectorised posts, temporary barriers etc.
- b. The contractor shall take care when moving machinery or carrying out the works to ensure trespassers are not subject to unreasonable danger.
- c. In the event that trespassers are noted entering the site, the contractor shall erect appropriate warning signs at identified trespass access locations. The contractor shall warn trespassers by way of secure signage that they should not enter the area as they may be exposing themselves to risk of injury.

## 2.13 Site meetings

Site meetings will occur on a regular basis as advised by the Superintendent. The Contractor, or his representative, and the Superintendent's representative shall attend the meeting.

The Contractor shall, if required, arrange for the attendance of Subcontractors and other staff members as may be required.

The Superintendent, or their representative, will chair the meeting and provide copies of the minutes of the meeting to the Principal and the Contractor.

## 2.14 Protection of existing vegetation

Great importance is placed upon retention of the natural vegetation within the areas not affected by the works. The Contractor shall not disturb any existing vegetation unless specific Directions or Approval to do so has been given. The Contractor shall not under any circumstances clear, stockpile site sand, topsoil or other materials, or travel with plant or vehicles outside of those areas specifically requiring such operations. Any clearing, or damage by other means, extending beyond the prescribed limits, without the authorisation of the Superintendent, shall be assessed accordingly and any such costs shall be borne solely by the Contractor by way of a reduction in the monies payable under this Contract.

## 2.15 Safety

The Contractor is responsible for maintaining a safe site at all times in accordance with WorkSafe requirements.

All site staff shall be deemed to be employed by the Contractor, and the Contractor shall arrange for all staff to meet the site safety requirements.

Possible hazards shall be addressed by the Contractor, and managed to ensure that no significant hazard is overlooked, and that all risks are properly assessed and adequately controlled.

Trenching shall be carried out in accordance with the West Australian Work Health and Safety (WHS) Act 2022. All excavation shall be fenced off with warning signs and lighting if required. The Contractor is responsible for the complete supply and maintenance of all such safety measures and costs for these works shall be deemed to have been included with the Tender.

The Contractor's safety plan shall include the following;

- Have an adequate number of employees trained in first aid to meet potential hazards in the workplace, with an experienced First Aid officer available at all times when work is in progress.
- Have an adequate training program for all employees and subcontractors, which is relevant to work undertaken and includes hazard identification, assessment and reporting.
- Adequate fire prevention equipment, including portable fire extinguishers.
- Good housekeeping onsite, and an accident notification procedure
- Promotion of safety information to all employees.

- Should the Works involve any unusual activities such as trenchless technology, deep excavations, work close to existing structures or large/high pressure services, unusual ground conditions, work at height, etc then the Contractor shall submit a Method Statement to the Superintendent defining the timing, plant, labour, materials and other temporary facilities associated with the works at least 48 hours before commencing such activity.
- The Contractor shall notify the Superintendent of any and all accidents within the meaning of the Workers' Compensation Acts and/or Regulations which may happen to his employees or employees of his Sub-Contractors or nominated Sub-contractors engaged on the Contract work within 24 hours of the occurrence of each such accident.

## **2.16 Work by others and other work at site**

During the currency of the Contract, other work may be preceding at or in the vicinity of the site. The Contractor shall act and cooperate at all times with any other contractors so as to ensure the expeditious completion of the project, and to ensure that no obstruction or interference with other contractor's occurs.

The Contractor shall be responsible for arranging the progress of the work and the attendance at appropriate times of sub-contractors and service authorities (including inspectors).

The Contractor shall be responsible for the making good of damage caused by sub-contractors and service authorities, and for finishing surfaces to match adjacent surfaces.

## **2.17 Damage**

The Contractor shall be responsible for any damage caused to buildings, grounds, fences, persons or services by whatever cause due to the works and shall make these good and bear any compensation. Where services are damaged, the relevant Authority is to be notified immediately, and all charges, fees etc. paid by the Contractor, at his cost.

The Contractor shall make good all damage or present proof of settlement of all claims for damage caused by his works before the issue of the Certificate of Practical Completion for the section of the work in which the damage has occurred.

The Contractor shall present proof of settlement of all claims by Public Authorities for works carried out by the Authorities as a result of works under this Contract before the Final Certificate will be issued.

## **2.18 Existing services**

It shall be the Contractor's responsibility to verify the position of underground and other services before commencing excavation and further, to arrange repair by the responsible servicing authority, at his own cost, all damage caused to these services during the works.

Where existing services must be interrupted to enable carrying out of the works such interruption shall be at a time agreed by the Superintendent. The Contractor shall organise with the responsible servicing Authority so that the interruption shall be for the minimum practical time. All costs shall be considered to be included in the Contractors price to complete the works.

## **2.19 Diverting water and dewatering**

The Contractor shall do all work necessary to drain and/or divert any water interfering with the progress of the works, keep the excavations free from water while the works are in progress and prevent any injury to the works by water due to floods or other causes. The cost of such work shall be deemed as having been included in the Contractor's Tender Price.



## 2.20 Nuisance

The Contractor shall take all necessary precautions to prevent nuisance to adjoining or nearby owners or tenants including but not limited to nuisance by way of dust, smoke, wind-blown sand or debris, noise, vibration and electrical interference.

## 2.21 Rock excavation

No extra payment shall be made for rock excavation unless the Contract Documents specifically provide for such payment.

When necessary for the purpose of payment, the different kinds of material met with in excavation shall be classified under the headings "Other than Rock" or "Rock", and where such words occur in the Contract Documents they shall have the following meanings:

- a. "Other than Rock" shall mean all kinds of materials, which in the opinion of the Superintendent do not require blasting or removal by jackhammer or mechanical rock breaker.
- b. "Rock" shall mean hard rock, which in the opinion of the Superintendent requires blasting and is in fact blasted or removed by jackhammer or mechanical rock breaker.

## 2.22 Restoration

Excavation is to be kept to a minimum in all established areas such as roadways, footpaths and other paved areas. Unless otherwise specified or shown, all damage to existing improvements as a result of construction works, shall be made good by the Contractor, to pre-existing conditions. No existing trees, shrubs, sheds or other permanent structures shall be removed without the prior approval in writing of the Superintendent.

The Contractor shall liaise with the relevant local authority where such works are located on public land. Construction and reinstatement works shall conform to the local authorities' requirements. The cost for reinstatement work shall be deemed to have been included in the tender.

Existing pavements and kerbs shall be saw cut to provide a neat edge for reinstatement works.

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

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

## 2.23 Testing

The Contractor shall be responsible for providing verification that all materials and work comply with the requirements of this specification.

The Contractor shall allow within the Lump Sum Breakdown for all testing as required by the Technical Specification.

Where the tests fail, the work shall be rectified and retested until the work falls within the specified tolerances to the satisfaction of the Superintendent.

The Principal shall pay for additional testing requested by the Superintendent unless such tests fail, in which case, such testing shall be at the Contractors expense. All re-tests shall be at the Contractors expense.

## 2.24 Payments

Progress payments will be assessed for all work installed in accordance with the contract. Full certification of payment will not be made until each section of the work has been tested, approved, backfilled and measured for as-constructed requirements.

## **2.25 Practical completion**

The intended purpose of the Works is to achieve the relevant Authority acceptance and takeover of the Works.

Practical Completion shall therefore be awarded when;

- All Authority inspections have been successfully completed and works have been accepted by the Principal;
- All testing has been successfully completed;
- All as-constructed details and drawings have been accepted by the Principal.

## **2.26 Final certificate**

The Final certificate at the end of the Defects Liability Period shall not be issued until the Council or relevant statutory authority has inspected the works and provided a defects clearance list and accepted takeover of the works.

## 3. Earthworks

### 3.1 General

All works shall be constructed in accordance with the Drawings, the current version of AS 3798 and this Specification. The specific requirements of this section of the Specification describe the formation of earthworks by cutting, filling and/or importing of suitable material.

### 3.2 Hold Points

Table 3 Hold points for earthworks

Specification Section	Detail	Hold Point Timing
3.4	Commencement of clearing to allow for identification of any trees, etc which require protection	7 days prior to commencement
3.5.4	If unsuitable subgrade or hazardous material is found on site, Contractor to notify Superintendent immediately and await direction from Superintendent.	During excavation
3.5	Completion of excavation to ensure that the profile is to the lines and levels specified and all debris is removed. Contractor to await direction from Superintendent for retaining wall transition.	Completion of excavated sections
3.6	Method statement for compaction behind limestone retaining wall.	14 days prior to works commencement
3.8.2	Testing and results of compaction tests for each layer specified within Specification	At completion of compacted layer and prior to placement of next layer

### 3.3 Discrepancies

"Discrepancy" for the purposes of this section means a difference between contract information about the site and conditions encountered on the site, including but not limited to discrepancies concerning:

- The nature or quantity of the material to be excavated or placed;
- Existing site levels; and
- Services or other obstructions beneath the site surface.

If the Contractor considers that he has discovered a discrepancy, he shall notify the Superintendent immediately, and obtain a determination before proceeding with the Works, otherwise no claim for extra cost shall exist.

### 3.4 Clearing and Grubbing

#### 3.4.1 General

Remove any objects and debris from the working area which do not form part of the works. The cost of such removal and of any disruption to the works as a consequence shall be borne by the Contractor.

The Contractor shall give seven day's notice of intention to clear any section of the works so that the Superintendent may determine and demarcate the trees and plants which are to be preserved.

Within the area of works, only clear vegetation where necessary to enable construction.

All suitable spoils from clearing shall be chipped/mulched and stockpiled on site as directed.

## 3.4.2 Disposal of Material

Unless otherwise permitted or directed, all debris resulting from clearing operations together with all lying and fallen timber which is not chipped or mulched shall be removed from the site. All cleared material removed from the site shall, unless required by the Contractor for other purposes, be loaded, hauled and dumped in compliance with statutory requirements.

No burning is permitted.

## 3.5 Excavation

### 3.5.1 General

Excavate to conform to the lines, grades, cross-sections and dimensions shown on the Drawings. The Superintendent may order the removal of any soft spots, debris or organic material exposed when excavated areas have been trimmed to finished formation levels. The Contractor shall remove any unsuitable material exposed when excavated areas have been trimmed to finished formation levels.

Separate the clean sand material from excavations for use as backfill at appropriate locations following placement of new materials.

Over excavation shall be backfilled as specified herein.

### 3.5.2 Stripping and stockpiling of topsoil

Strip topsoil from all areas to be cut or filled. Nominally 150 mm deep.

Unless otherwise directed, the depth of stripping shall be to the bottom of the grass root zone, or to the bottom of any organic layer, whichever is the deeper. Any uncertainty in strip depth shall be brought to the Superintendents attention prior to fill being placed. Avoid contamination by any other material.

### 3.5.3 Disposal of surplus spoil

Surplus spoil is to be stockpiled where specified or disposed off site as directed.

### 3.5.4 Hazardous Material

Give notice immediately if hazardous materials or conditions are encountered during excavation.

Stockpiling of Excavated Material

The Contractor shall identify a stockpile area for placement of excavated material required for backfilling. This stockpile area is to be approved by the Superintendent prior to the commencement of earthworks.

### 3.5.5 Excess Excavation

The Contractor is not entitled to contract variation or extension of time for excavation in excess of that required by the contract, including excavation below required depths, or additional excavation which the Contractor may elect to undertake to permit the use of certain constructional plant, and any consequent additional backfilling or testing.

Where excavation exceeds the required extent, reinstate to the correct depth and required density.

## 3.6 Filling

### 3.6.1 General

Backfilling is required following placement of new materials.

Backfill material shall be sourced from excavated material and shall be free from all organic and other deleterious materials. The Superintendent may direct that stockpiled excavated material is unsuitable as fill and shall be screened to produce clean sand fill.

Place and compact fill to conform to the lines, grades, cross-sections and dimensions shown on the drawings.

Before filling commences, the Contractor shall remove any unsuitable material exposed when topsoil has been stripped.

Contractor to measure by survey in situ the volume of additional material required to replace unsuitable material.

## 3.6.2 Materials

Unless otherwise specified or directed, the fill materials shall be obtained from cutting in situ material and/or importing material from approved sources off-site.

### **Sand**

All fill shall be clean, free draining, medium to coarse sand or equivalent, free from foreign and organic matter. It shall be non-plastic with all material passing the 4.75 mm sieve and not more than 10 % passing the 0.075 mm sieve, with a soaked CBR of 15 % minimum when compacted to 100 % of MMDD at OMC.

### **Clay**

Where in situ clay is used as fill, it shall be taken directly from the excavation to the fill site, placed and compacted at optimum moisture content in maximum 200 mm layers.

## 3.6.3 Compaction equipment

It is the Contractors responsibility to assess the nature of the soil being cut or filled and to select the appropriate method and machinery to be used in order to achieve the specified results.

Light compaction equipment shall be used 1.5 m from back edge of retaining wall.

## 3.6.4 Compaction

Place and compact in uniform layers of appropriate thickness and using compaction equipment capable of achieving the level of compaction specified. Layers should extend for the full width of embankments. Each layer shall be compacted to the appropriate density prescribed in Table 4 and as indicated on Drawings.

During compaction the moisture content of fill should be maintained in the range OMC  $\pm$ 2% by drying, or by the addition of moisture, as appropriate. Water spraying equipment used for this purpose shall be capable of distributing water uniformly in controlled quantities. Mechanical mixing of the fill material can be used to help ensure uniform distribution of moisture before commencement of rolling.

## 3.6.5 Backfilling near structures

The Contractor shall be solely responsible for any damage to existing structures as a result of filling and compacting operations.

## 3.7 Trimming and finishing of surfaces

Prior to Practical Completion, the entire work site is to be trimmed and graded in order to achieve a uniformly neat and tidy Site free of wheel tracks and ruts.

## 3.8 Acceptance

### 3.8.1 General

All tests specified herein shall be undertaken by a laboratory, certified by the National Australian Testing Authority, NATA, and approved by the Superintendent.

The Contractor shall monitor and test all works specified herein to ensure compliance with requirements specified in Clause 3.6.2.

Upon completion of the compaction process of each and any layer, the Contractor shall determine the in-situ moisture content, dry density and layer thickness of the compacted material throughout the full thickness of the layer at random locations in every 500m<sup>2</sup> of surface area. The rate of testing shall be not less than one for each 500m<sup>2</sup> of surface area, with a minimum of three tests where the area of each section is less than 500m<sup>2</sup>.

The in-situ dry density shall be determined in accordance with the requirements of AS 1289 5.3.1 or 5.8.1 as required by the Superintendent except that the nuclear density gauge shall be calibrated in accordance with the Main Roads Western Australia Test Method not AS 1289 5.8.3. The density ratio shall be determined in accordance with AS 1289 5.4.1.

For each uniform section of each layer of the material, which has been placed, and compacted, the Contractor shall determine the dry density ratio of the material at random locations throughout the uniform section.

A uniform section is defined as a section in which all of the material has been placed and compacted within a 48-hour period.

Modified maximum dry density determinations shall be made at a rate of not less than one for each uniform section, in accordance with the requirements of AS 1289 5.2.1 (for cohesive soils) and AS 1289 5.5.1 (for cohesionless soils).

### 3.8.2 Compaction requirements

Compaction requirements for work carried out under this Section of The Specification are itemised in Table 4.

Table 4 Compaction requirements

Item		Minimum Relative Density		
		Cohesive Soils	Cohesionless Soils	
		Minimum Dry Density Ratio (AS 1289.5.2.1)	Minimum Dry Density Ratio AS 1289.5.2.1	Minimum Density Index AS 1289.5.5.1
1	Backfilling of Grub holes and replacement of unsuitable material	Fill with cohesionless soils & compact as per specification.	95% Mod	70%
2	Fill	95% Mod (if $\rho_{0.075} < 10\%$ ) 93% Mod (if $10\% < \rho_{0.075} < 20\%$ ) Not acceptable if $\rho_{0.075} > 20\%$	95% Mod	70%
3	Subgrade (to a depth of 0.3m)	93% Mod	98% Mod	80%

Notes:

- All dry density ratios relate to AS 1289.5.2.1 and AS 1289.5.4.1.
- Density Index as a means for control of achieved relative compaction may be difficult to use and interpret. Local correlations with other methods may exist and can be used where these are well established.

For cohesionless soils a calibration of the Perth Sand Penetrometer (PSP) shall be carried out against the Density Index. Where the Density Index specified in Table 3.1 corresponds to less than 7 blows/300mm of the PSP the compaction required shall be a minimum of 7 blows/300mm. Where the Density Index specified in Table 3.1 corresponds to more than 7 blows/300mm of the PSP the compaction required shall be that which yields the specified Density Index, or the PSP blows that corresponds to this.

Acceptance of each layer is conditional upon the application of uniform and sufficient compactive effort by appropriate equipment over the whole of the layer.

Where fill material is being placed which the Superintendent considers is not suitable for testing by standard laboratory methods, then compaction operations shall be carried out as directed. The Superintendent may specify the type of compaction requirement, layer thickness and the means of adjustment of moisture content. Rollers may be required to operate singly or in combination up to a total of 12 coverages.

### 3.8.3 Tolerances

On completion of cutting, filling and all incidental operations, and before the placement of covering materials, finished surfaces shall conform to the tolerances in level and shape itemised in Table 3.2.

*Table 5 Tolerances*

Item	Description	Tolerance
1.	Clearing and grubbing (width of design earthworks plus 2m)	±0.5m
2.	Earthworks - level	±20mm
3.	Verge level	±15mm
4.	Cut or fill batters	±2°
5.	Topsoiling thickness	±10mm
6.	Subgrade - Width - Level	±100mm -20mm, +0mm

### 3.8.4 Defective work

Where a section of the work is rejected on the basis of inspection of test results, further compactive effort shall be applied to the section or nominated parts of the section until the specified standard is achieved. Scarify the area for the full depth of the layer and add water as necessary. Mix mechanically to ensure uniform distribution of moisture before commencement of rolling.

## 3.9 Removal of existing structures

Removal of existing structures such as pavements and footpaths shall be undertaken as indicated on the Drawings. The disposal of these materials shall be undertaken under the direction of the Superintendent.

## 4. Roadworks

### 4.1 Scope

This section of the specification covers the construction of road pavements & footpaths. Current Council specification shall apply where available. Whenever Council specifications are unavailable or where they do not cover the required scope of works then the following clauses in this section of the specification shall apply.

### 4.2 Standards

All work and associated performance tests shall comply with the requirements of all relevant Australian or Main Roads WA (MRWA) standards.

### 4.3 Quality and Process Control

The Contractor shall continuously monitor the processes used in the supply, filling, mixing, placing, compacting and finishing of construction works and shall continuously monitor the quality of all materials incorporated into the works. As part of the quality and process control, the Contractor shall undertake a program of inspection, testing and supervision with the aim of ensuring that all the materials incorporated in the works conform with the requirements of this specification and the requirements of the Local Authority.

All tests specified herein or required by the Local Authority shall be undertaken by a laboratory, certified by the National Australian Testing Authority (NATA), and results produced within 7 days of the test sample.

Copies of all test results shall be supplied to the Superintendent within 48 hours of receiving the test results unless otherwise required / noted in this specification. All test results shall include at least all the information listed in the following conformity tables (which have been set-up to enable results to be readily recorded for each test sample).

### 4.4 Base and Sub-Base Courses

#### 4.4.1 Materials

**Laterite Gravel** - shall consist of durable laterite pebble quarried from sources approved by the Superintendent, containing no organic matter or other deleterious material, and shall conform to the following requirements:

Table 6 Laterite gravel pavement – conformity table

Particle Size Distribution: (Grading for portion passing a 37.5mm AS sieve)			
	AS Sieve Size (mm)	Required Percentage (%) Passing by mass	Actual Result
1.1	37.500	100	
1.2	19.000	71 - 100	
1.3	9.500	50 - 81	
1.4	4.750	36 - 66	
1.5	2.360	25 - 53	
1.6	1.180	18 - 43	
1.7	0.425	11 - 32	
1.8	0.075	4 - 19	
2.	Portion of the total sample retained on the 37.5mm sieve shall not exceed 10%		
3.	Ratio of portion passing 0.075mm sieve to the portion passing 0.425mm sieve to be in the range of 40-60%		



Particle Size Distribution: (Grading for portion passing a 37.5mm AS sieve)			
4.	Material Constraints: (For portion of sample passing the 0.425mm sieve)		
	Material attribute	Required Measurement	Actual Result
4.1	Liquid Limit	not greater than 25%	
4.2	Plasticity Index	not greater than 6	
4.3	Linear Shrinkage	not greater than 3%	
4.4	Maximum Dry Compressive Strength	not less than 2 MPa	
4.5	California Bearing Ratio (soaked)	Basecourse not less than 80 % when compacted to 98 % MMDD at OMC Subbase not less than 40 % when compacted to 95 % MMDD at OMC	

\*\* Location of where “tested material” was placed must be indicated on a locality plan

**Crushed Limestone Rubble** - shall be obtained from an approved source, and shall be free from sand, organic and other deleterious material and conform to the following table:

Table 7 Crushed Limestone – Conformity Table

1. Particle Size Distribution: (Grading for portion passing a 75mm AS sieve)			
	AS Sieve Size (mm)	Required Percentage (%) Passing by mass	Actual Result
1.1	75.00	100	
1.2	19.00	55 - 85	
1.3	2.360 & less	35 - 65	
2.	% of wear of crushed limestone not to be less than 30% or exceed 55% (calculated by the Los Angeles test)		
3.	Calcium Carbonate Content (CaCO <sub>3</sub> ) shall not be less than 60% or greater than 80%.		
4	California Bearing Ratio (soaked) Subbase not less than 40 % when compacted to 96 % MMDD at OMC		
5.	Maximum Dry Compressive Strength (MDCS) shall be no less that 700 kPa.		

\*\* Location of where “tested material” was placed must be indicated on a locality plan

#### 4.4.2 Sampling and testing sub-base and base course material

At the commencement of production or supply of sub-base and base course material, the Contractor shall take two representative bulk-samples from the first 500t of each material. During placement, the Contractor shall take at least one representative bulk-sample of the material from each successive 1000t of material from each source to be used at the site of the works.

All test results shall be submitted to the Superintendent for approval and shall include at least the information listed in the conformity tables in the preceding paragraphs for the sub-base and base course material.

### 4.4.3 Construction

#### **Delivery and spreading**

Pavement material shall not be placed on the sub-grade or previous layers of pavement until the Local Authority (L.A.) inspector or Superintendent has given their approval. Material shall not be placed over a layer weakened by moisture.

Crushed materials, when delivered, shall have moisture content with  $\pm 2\%$  of the modified optimum moisture content.

Spread material in uniform layers as near as practicable to the required thickness by direct tipping from suitable vehicles. Care shall be taken to avoid segregation of material during tipping and spreading. The tipping of material in heaps and spreading by grader is to be avoided. If material becomes segregated it shall be remixed.

#### **Compaction and finishing**

Layers of pavement material shall be not less than 100mm in compacted thickness. Maximum layer thickness shall be limited to that which will allow compaction to specified densities by the equipment in use. Where a course of a particular material is composed of several layers they shall be of equal thickness within these limits.

Rollers of variable mass shall be ballasted to the greatest mass which can be supported without distress to the pavement or sub-grade. Tyre pressures of pneumatic tyred rollers shall be adjusted to at least 700 kPa.

During compaction, maintain moisture content of pavement materials in the range specified above. Water spraying equipment used for this purpose shall be capable of uniformly distributing water in controlled quantities over uniform lane widths.

Surfaces to be primed shall be constructed slightly higher than the specified levels and cut to profile towards the end of the compaction process. Rolling shall then continue to specified density and to produce a tight, even surface without loose stones or a slurry of fines.

The finished base course shall be in a uniformly bound condition with no evidence of layering, cracking or disintegrating. The finished surface shall be of even texture, tightly bound, free from loose, dusty, stony or slurred areas and suitable to receive a bituminous surfacing.

#### **Matching to Existing Pavements.**

Where the pavement is to be joined to an existing pavement, remove a strip of the existing pavement at least 300mm wide for its full depth and trim the edge to an angle of approximately 45 degrees in steps of maximum height 150mm before placing new pavement material. If the existing pavement is sealed, saw cut the seal, to a neat edge.

### 4.4.4 Testing dry density and layer thickness

Upon completion of the compaction process of each and any layer, the Contractor shall determine the in-situ moisture content, dry density and layer thickness of the compacted material throughout the full thickness of the layer at random locations in every 1500m<sup>2</sup> of surface area. The rate of testing shall be not less than one for each 1500m<sup>2</sup> of surface area, with a minimum of three tests where the area of each section is less than 2000m<sup>2</sup> and a minimum of four tests where the area of the section is greater than 2000m<sup>2</sup>.

When used, nuclear density meter shall be calibrated in accordance with the MRWA Test Method.

### 4.4.5 Acceptance

#### **Compaction requirements**

Sub-base shall be compacted to 95% of modified maximum dry density.

Base course shall be compacted to 98% of modified maximum dry density.

## Tolerances

On completion of placement, compaction and trimming, pavement courses shall comply with the tolerances specified in the table below, except that surface shape shall be such that water cannot accumulate at any point:

Table 8 Tolerances

Component	Tolerances in mm	
Sub-grade	Thickness	Level
	-	+ 0 - 20
Base Course	+ 10	+ 10
	- 0	- 0
Asphalt	+ 5	+ 10
	- 0	- 0

## Sampling and testing

### (a) Procedures

Sampling shall be carried out in locations selected by a qualified independent materials tester or as directed by the Superintendent.

### (b) Materials

The properties required are applicable to the materials in their final condition in the pavement.

### (c) Costs for testing

The Contractor shall allow for and include the costs of all testing.

## 4.5 Primer sealing

### 4.5.1 Authority to commence priming

Primer sealing shall not be undertaken until the Superintendent or the Superintendent's representative has inspected the pavement and approved the works to proceed.

### 4.5.2 Plant

#### Spraying equipment

All spraying equipment shall comply with the requirements of the MRWA "Specification 503 Bituminous Surfacing".

When requested by the Superintendent, the contractor shall provide a current certificate and calibration chart issued by the Main Roads Department before commencing spraying operations.

#### Rollers

The following rollers may be used:

- Three-point self-propelled steel roller of minimum 8 tonnes mass;
- Self-propelled rubber tyred roller minimum 15 tonnes mass,

#### Trucks

Sufficient numbers of single or tandem-axle trucks with tipper bodies should be made available. The trucks should be fitted with approved tailgate mounted metal spreaders. In addition, at least one truck with drop-sided or tray body for the manual application of aggregate should be provided (as required).

## **Brooms**

A mechanical broom capable of removing all dust and debris from the surface of the road (prior to spraying), and a drag-broom, capable of evenly spreading aggregate but not so as to dislodge stones from the mat, should also be provided.

### **4.5.3 Application**

The prepared base course shall be sufficiently dry with no primer sealing to be carried out during inclement weather conditions unless special provisions made to the approval of the Superintendent.

Before primer sealing, the pavement shall be broomed free of all loose material and dust, and any defects made good. Should conditions require, and if approved by the Superintendent, the surface may be lightly watered immediately prior to primer sealing. The primer seal shall be applied to the approved surface course for its full width.

For tendering purposes, the primer seal shall be a cutback primer consisting of 90% residual bitumen and 10% power kerosene at a rate of 1.2 l/m<sup>2</sup>, measured at a temperature of 15°C and applied at a temperature of between 80 and 100°C. The actual application rate shall be determined on site by an experienced and competent operator.

The bitumen shall be modified with 0.40% wet fix or similar approved during wet weather application.

Should weather conditions preclude the use of cutback primer, the Superintendent may approve a 60/40 cationic bitumen emulsion applied at a rate of 1.20 litres per square metre, measured at a temperature of 15°C. Emulsion primer may be heated to a maximum temperature of 50°C if conditions warrant.

### **4.5.4 Blinding**

Unless otherwise approved, the blinding shall be a nominal 7mm aggregate applied immediately after spraying at a rate not less than 1 cubic metre per 150 square metres and sufficient to prevent lifting of the primed surface by vehicles. For the road widening sections the blinding shall be 10mm aggregate applied at 1 cubic metre per 100 square metres.

For emulsion primer the blinding shall be a normal 3-5mm aggregate applied immediately after spraying at a rate not less than 1 cubic metre per 150 square metres and sufficient to prevent lifting of the primed surface by vehicles.

Aggregate shall be crushed from hard, sound, durable rock. The percentage loss as measured by the Los Angeles Abrasion Test shall not exceed 30. All aggregates shall be free of excess dust, and the Superintendent may order the pre-washing of dusty aggregate.

The surface is to be rolled until the aggregate is firmly embedded in the primer.

The surplus aggregate shall be swept up and removed from site not less than seven days after the completion of the rolling or as approved by the Superintendent.

### **4.5.5 Acceptance tolerances**

The width of the prime shall not vary by more than +150mm - 0mm.

Acceptance of sealed surfaces will be subject to the availability of certified records of the works carried out. Actual rate of application of binder shall be in the range of 95% to 110% of the ordered rate. If the application rate is less than 90% or more than 110% the surface shall be resealed (unless otherwise directed).

## **4.6 Two Coat Seal – Prime Coat**

### **4.6.1 General**

The general provisions of Clause 6.5 'Primer Sealing' shall apply with respect to spraying equipment, brooms, workmanship, and aggregate material.

## 4.6.2 Application

The primed base course shall be sufficiently dry with sealing not to be carried out during inclement weather conditions unless special provisions made to the approval of the Superintendent.

Before priming, the pavement shall be broomed free of all loose material and dust, and any defects made good. Should conditions require, and if approved by the Superintendent the surface may be lightly watered immediately prior to priming.

## 4.6.3 Aggregate

Unless otherwise approved, the first coat seal blinding shall be a nominal 14mm pre-coated aggregate, applied immediately after spraying at a rate not less than 1 cubic metre per 90 square metres and sufficient to prevent lifting of the sealed surface by vehicles.

Unless otherwise approved the second coat seal blinding shall be a nominal 10mm pre-coated aggregate applied at a rate not less than 1 cubic metre per 100 square metres and sufficient to prevent lifting of the sealed surface by vehicles.

The surface is to be rolled until the aggregate is firmly embedded in the binder.

All surplus aggregate shall be swept up and removed from site not less than seven days after the completion of the rolling or as approved by the Superintendent.

## 4.7 Specification for Asphalt

### 4.7.1 Scope

This section covers the manufacture, delivery, laying and testing of dense graded asphalt for road pavements.

### 4.7.2 Nominal Size

The nominal size of the asphalt shall conform to the following:

Table 9 Nominal size

Item	Descriptions	Thickness Tolerance
	Local Road (pavement width less than 10m) - AC7, 7mm nominal size with compacted thickness of 25mm	(+ 5mm) (- 0mm)
2	10m wide roads and arterial roads - AC10, 10mm nominal size with compacted thickness of 25mm	(+ 5mm) (- 0mm)
3	Thick lift where specified or shown on the Drawings - AC14, 14mm nominal size with compacted thickness of 50mm	(+ 5mm) (- 0mm)
4	Local Road (low volumes of light vehicles traffic) - 'Gap Graded' 7mm nominal size with compacted thickness of 25mm	(+ 5mm) (- 0mm)

### 4.7.3 Materials

Asphalt shall be a mix of clean, dry graded, coarse and fine aggregates, mineral filler and bitumen in accordance with the current relevant Australian Standard(s) and conforming to the following requirements:

1. The binder shall be residual asphaltic Class 170 bitumen.
2. All aggregate, with the exception of naturally occurring sands, shall be the product of crushing sound stone quarried from approved deposits.

3. The aggregate shall be free from all clay overburden, soft or weathered material, and other foreign matter.
4. The coarse aggregate shall consist of a combination of separate sizes produced from sound crushed and screened stone which shall be uniform in quality throughout. It shall be clean and free from particles which are soft, friable, composed of clay or weathered rock. Its wearing qualities shall be determined by the Los Angeles Abrasion Test and the percentage loss permitted shall not exceed 30. The shape of each size of material to be combined in the coarse aggregate shall be determined by the Flakiness Index which shall not exceed 35. The size distribution within the separate aggregates shall not be such as to cause undue segregation. The grading shall comply with the current relevant Australian Standard and as shown in the following table. Other job mixtures may be proposed, such that the separate sizes of the aggregates will combine with fine aggregates and mineral fillers to form a satisfactory pavement surface.

**Table 10 Aggregate Grading**

AS Sieve Size	AC5 Nom Size 5mm	AC7 Nom Size 7mm	AC10 Nom Size 10mm	AC14 Nom Size 14mm	Gap Graded Asphalt
19mm				100	
13.2mm			100	85-100	
9.5mm		100	90-100	70-85	100
6.7mm	100	80-100	70-90	62-75	93-100
4.75mm	85-100	70-90	58-76	53-70	75-85
2.36mm	55-75	45-60	40-58	35-52	57-67
1.18mm	38-75	35-50	27-44	24-40	44-64
0.60mm	26-43	22-35	17-35	15-30	35-45
0.30mm	15-28	14-25	11-24	10-24	18-24
0.15mm	8-18	8-16	7-16	7-16	6-12
0.075mm	4-11	5-8	4-7	4-7	

5. The fine aggregate shall comprise of a mixture of one or more natural sands and crusher sand. The natural sands shall consist of clean, tough, rough surfaced grains, free from clay, loam, mica, lumps or other foreign matter. Crusher sand shall consist of a uniformly graded product from the crushing of clean sound stone.
6. Mineral filler shall consist of a finely divided mineral material of a type and from a source approved by the Superintendent. It shall be thoroughly dry and free from lumps of any kind.

If filler is required to be added to the mixture in order to make it comply with the specified limits of the paving mixture, it shall consist of Portland cement, ground limestone, stone dust or other approved material. The aggregate for the wearing course shall be subjected to the Sand Equivalent Test by the method specified in A.A.S.H.O. T176 - 56.

If in order to comply with the grading limits of the paving mixture filler other than stone dust has been added, the sand equivalent test shall be carried out on that portion of the aggregate passing a 4.75mm A.S. sieve, excluding such added filler. If the combined aggregate mixture contains the specified amount of material passing a 0.075mm sieve without the addition of Portland Cement, ground limestone or other similar material, or if stone dust has been added to the mixture in order to comply with the specified requirements, the sand equivalent test shall be carried out on the whole of the portion of the combined aggregate passing a 4.75mm sieve. The requirement for the sand equivalent test shall be not less than 50.

The mix should contain 1.5% of total mix by mass of hydrated lime. Hydrated lime shall comply with the requirements of the current relevant Australian Standard. If the case where hydrated lime is difficult to source, an approved adhesion agent can be selected from Table 511.16 within the Specification 511 "Materials For Bituminous Treatments".

7. The paving mixture for the surface course &/or the binder course shall be submitted to the Superintendent for approval at least 7 days before laying.

8. The Superintendent shall have the right, without extra cost, to increase the filler in the job mixture by 1% of the total mix by weight, when necessary to correct the workability of any batch or batches.

The exact amount of bitumen shall be determined for the job mixture with due regard to the nature of the aggregates to be used.

The percentage of bitumen binder to total mix by mass shall meet the following requirements:

**Table 11** Percentage of bitumen binder

Nominal Size mm	Percentage of Bitumen to Total Mix (By Weight)
5	5 to 7
7	5 to 7
10	4.5 to 6.5
14	to 6.5
7 (Gap Graded)	7.95 to 8.5

The mix when compacted in the laboratory in accordance with the Marshall Test using 50 blows of the hammer on each end of the cylinder, shall meet the requirements as stated in the current relevant Australian Standard. For nominal mix size of 14, mix shall be compacted to 75 blows under the Marshall Test.

**Table 12** Marshall testing

Nominal Mix Size (mm)	Minimal Marshall Stability of Compacted Mix (kN)	Marshall Flow Value (mm)
5	5.0	2 to 4
7	5.5	2 to 4
10	6.6	2 to 4
14	6.5	2 to 4
7 (Gap Graded)	5.0	2 to 5

The air voids in the total mix when compacted shall be as follows:

**Table 13** Air voids within total mix

Nominal Mix Size (mm)	Range of Voids Content (%)
5	3 to 7
7	3 to 7
10	3 to 7
14	3 to 7
7 (Gap Graded)	2 to 4

At no stage shall the temperatures of the bitumen in the mixture exceed 165°C and the plant shall be such that the temperature of the mixture may be controlled to within (+) or (-) 5°C.

The temperature of the mixture as delivered to the point of spreading shall be not less than 150°C.

The delivery of asphalt shall be in accordance with the current relevant Australian Standard. The material shall be delivered to the point of spreading in tipping trucks have steel lined bodies and tarpaulins covering the loads.

## 4.7.4 Red asphaltic concrete

The specification for red asphaltic concrete is as follows:

Red asphaltic concrete shall be produced in the same manner as black asphaltic concrete except that sound diorite shall be replaced by sound laterite crushed to a nominal 7mm size and the mix specification shall be as noted below.

Table 14 Mix specifications

Sieve Sizes (mm)	Range passing % 7mm standard
13.20	
9.50	100
6.70	80 - 100
4.75	63 - 83
2.36	43 - 60
1.18	29 - 44
0.600	19 - 32
0.300	12 - 22
0.150	6 - 13
0.075	2 - 6
Red Oxide	1%
Bitumen Content (% range)	5.0 - 7.5
Minimum Marshall Stability (kN)- 50 Blow	5.5
Marshall Flow(mm)	2 - 4
Air Voids(% range)	3 - 7
Bitumen Class	170

## 4.7.5 Sampling and testing asphalt materials

During the course of production and supply of asphalt, the Contractor shall carry out sufficient sampling and testing to satisfy himself that:

- a. The material ingredients satisfy the requirements of this Specification.
- b. The material supplied is in accordance with the mixture design as submitted to, and approved by, the Superintendent.

Additionally, the Contractor shall carry out the following sampling and testing and submit the results to the Superintendent for approval.

At commencement of production or supply of an asphalt mixture design, the Contractor shall take two representative bulk samples from the first 50 tonnes of material delivered to site. As delivery proceeds, the Contractor shall take at least one representative bulk sample from each successive 100 tonnes of material.

The bulk sample shall be taken in accordance with the requirements of the current relevant Australian Standard, or alternatively Main Roads Department Test Methods.

For the material in each bulk sample, the Contractor shall determine the following properties:

- aggregate particle size distribution
- bulk density
- bitumen content
- Marshall stability, flow and air voids



The above properties shall be determined by current relevant Main Roads Department Test Methods or the current relevant Australian Standards.

The results of these tests shall be submitted to the Superintendent within 10 days of date of collection of the samples.

## 4.7.6 Construction plant

Sprayers shall be capable of spraying the tack coat uniformly through jets in a spray bar at the desired rate of application up to a width of 2.5m. The spray bar shall be fitted with end shields.

Pressure type sprayers used for spraying bitumen emulsion shall be capable of operating at a continuous pressure of 175kPa.

Pavers shall be self-propelled and they shall be equipped with hoppers and distributing screws of the counter-rotation type to place the asphalt evenly in front of the screed. Means shall be provided to heat the screed uniformly over its full width. They shall be capable of spreading the asphalt without segregation.

All rollers shall be fitted with approved devices to enable the whole of the surface of the wheels to be kept damp with a minimum amount of water.

The Contractor shall provide self-propelled reversible rollers complying with the following requirements:

- Steel wheeled rollers shall have a mass not less than 9 tonne (non vibratory) and 6 tonne vibratory, and shall have a static load intensity not less than 4.5 tonne per metre width of drive roll.
- Self-propelled, pneumatic tyred, multi-wheeled rollers with a mass of 10t to 20t ballasted shall be equipped with tyres of equal size and diameter, having smooth treads. Tyres on the rear wheel shall be offset relative to the front tyres to give overlapping wheel paths and complete coverage for the effective width of the roller. The tyres shall be capable of being inflated to 700 kPa. The total operating mass and tyre pressures shall be varied as directed by the Superintendent.
- All rollers shall have approved brushes or similar devices so that each roll or tyre is kept clean of foreign material and can be kept uniformly damp.
- For compacting confined areas, the Contractor shall provide a small roller and/or a mechanical impact type or vibrating type hand-operated compactor.

## 4.7.7 Preparation of surface

The existing primed or primer-sealed surface shall be inspected in the attendance of the Superintendent to assess the required correction of any defects (such as filling of potholes and depressions, removal of excess binder, repair of edge breaks or irregularities etc).

The area to be surfaced shall be thoroughly swept with a power broom of all loose or 'foreign' material immediately prior to the application of the tack coat.

## 4.7.8 Tack coat

Tack coat shall be in accordance with MRWA Specification 503 and consist of CRS/60-170 diluted with water at a 50:50 ratio.

Tack coat shall be applied by a sprayer through jets in the spray bar at an application rate of 0.6 litres per square metre.

The tack coat shall cover the pavement with an even thin coat of bitumen to form a key to receive the asphalt.

## 4.7.9 Corrector course

When directed by the Superintendent, prior to surfacing those areas in which there are departures of more than 20mm from a 3m straight edge, a separate regulating course shall be placed for correction of both longitudinal and transverse pavement shape.

Unless directed otherwise, the maximum compacted thickness of any one layer of the corrector course shall not exceed five times the size of the asphalt used.

## 4.7.10 Spreading

Asphalt shall be spread with to the compacted thicknesses as shown on the drawings. The asphalt shall be laid on a foundation which is dry and free from puddles.

No asphalt shall be placed in layers less than 25mm compacted thickness when the ambient temperature is less than 10 degrees Celsius - unless rolling is done immediately after spreading.

Under no circumstances shall asphalt be spread when the ambient temperature is less than 5°C.

The asphalt shall be spread to such line, level and camber shown on the contract drawings.

Base corrector courses shall be completed to a surface parallel to the finished surface of the pavement and at a depth below it equal to the thickness of the subsequent course.

The speed of the paver shall be as uniform as possible and the lowest consistent with the rate of delivery of asphalt. The occasions on which the paver needs to be stopped shall be kept to a minimum.

Asphalt paving operations shall not commence until the Superintendent is satisfied that sufficient asphalt is on site to permit continuous spreading operations.

The asphalt shall be spread without tearing, gouging, or displacement to produce an even surface.

Asphalt shall be spread in such a manner as to minimise the number of joints in a carriageway, and unless otherwise specified, the layout of joints shall conform to the following requirements:

- In any individual layer transverse joints in adjoining paver runs shall be displaced longitudinally by not less than 2m.
- All longitudinal joints shall be offset from layer to layer by not less than 150mm.

The screed of the paver shall overlap the previously spread lane by 25mm to 50mm. At cold joints the overlapped asphalt shall be removed to waste.

Immediately after any layer is spread and before compaction is started, the surface shall be checked, any unevenness adjusted, and all sandy, segregated, hungry, or dusty areas removed and replaced with fresh hot asphalt. Irregularities in alignment and grade along the outside edge shall be corrected by the addition or removal of asphalt before the edge is rolled.

When hand laying of asphalt is approved it shall be distributed into place without segregation in a loose layer of uniform density and to the correct level. It shall be spread without tearing, gouging or displacement to produce a smooth even surface true to line, level and camber. Raking shall be done in a careful and skilful manner. Asphalt shall not be deposited any faster than can be properly handled.

## 4.7.11 Thickness control

The Contractor shall carry out measurements to determine the thickness reduction achieved in the compaction of the asphalt courses. The appropriate allowance for compaction shall be incorporated in the spread depth of asphalt and if necessary adjusted as required to achieve the required compaction thickness within the specified tolerances.

The Contractor shall frequently measure the actual thickness of the spread material prior to compaction and shall compare this thickness with the thickness to be placed at that location. The thickness check shall be carried out for nominal thickness and variable thickness construction at intervals not exceeding 10 metres and the screed adjusted accordingly to give the desired thickness.

## 4.7.12 Joints and junctions

The number and extent of joints in asphalt layers should be kept to a minimum and the paving pattern should be designed accordingly in advance of the work.

All longitudinal and transverse joints shall be carefully made in such a manner as to be waterproof and the finished surfaces at all points shall have the same texture, density and smoothness as elsewhere.

Hot longitudinal joints are preferred.

When constructing hot longitudinal joints, a 150mm wide strip along the outer edge of each lane shall not be rolled until after the adjoining lane has been spread.

The longitudinal joint shall then be made by rolling this 150mm wide strip simultaneously with the adjoining material of the next lane after it has been spread. When no adjoining strip is to be placed during the same day, the last lane shall be rolled evenly across its full width. The roller shall not be allowed to overhang the free edge by more than 50mm.

With cold joints, the edge of the first run shall be formed while hot, by butting using hand lutes, or should be trimmed to a straight edge. Edges shall be lightly tack coated to aid the bending of the runs. The adjoining run is to be placed against the prepared edge with an overlap of between 25 to 50mm. The overlap is to be pushed back, using lutes, immediately following placing form a slight ridge along the joint which is then compressed against the edge of the previously placed run by the breakdown roller.

Junctions between old and new pavements and joints between successive days' work shall be carefully made in such a manner as to ensure a thorough and continuous bond between the old and new surfaces and to provide a smooth riding connection across the junction or joint. The cold edge need not be trimmed to a vertical face, but any loose material along the edge shall be discarded. The edge shall be painted with a bituminous emulsion before placing adjoining asphalt.

All longitudinal joints shall be continuous and parallel to the centre line of the carriageway.

Transverse joints shall be at right angles to the direction of spreading and cut to a straight vertical face for the full depth of the layer. The edge shall then be painted with bituminous emulsion before placing adjoining asphalt.

Where asphalt is required to match an existing surface, road, bridge deck, fixed rail, or other fixture, the Contractor shall place the asphalt in such a manner as to provide a smooth riding surface across the junction.

### 4.7.13 Compaction procedures

After spreading, the asphalt shall be thoroughly and uniformly compacted as soon as it will support the roller without undue displacement.

Initial, secondary and final rolling shall be done in accordance with the current relevant Australian Standard.

Initial rolling shall be performed with a steel wheeled tandem roller operating as close as possible to the paver. Steel rollers either vibrating or non-vibrating shall be used. Initial rolling shall be completed before the mix temperature falls below 105°C.

Secondary rolling shall be performed as soon as possible after initial rolling, and shall be performed with a self-propelled pneumatic tyred roller or vibratory roller of gross mass not exceeding 12 tonne. Secondary rolling shall be completed before the mix temperature falls below 80°C.

Finally, before the mix temperature falls below 60°C, roll with two (2) passes of a self-propelled steel wheeled roller at 6-8 tonnes range to produce a smooth dense surface.

Compaction shall generally commence at the kerbside and work towards the centre of the roadway.

The speed of rollers shall not exceed 5km/h for steel wheeled rollers or 25km/h for self-propelled pneumatic tyred or vibrating rollers, and at all times shall be slow enough to avoid displacement of the asphalt.

Around access chambers and similar structures, and at all places not accessible to the roller, thorough compaction shall be obtained by means of approved tampers.

Each layer shall be compacted to a density not less than 94% of the Marshall density.

## 4.7.14 Testing density and layer thickness

The Contractor, as directed by the Superintendent, shall cut a minimum of one core per 1,000 square metres (minimum of four per mix type) after the asphalt has cooled throughout to ambient temperature. The cores shall be tested to determine the density ratio of the compacted material by an independent NATA registered laboratory.

Average thickness of the course will be determined on the basis of thickness measurements of the core obtained.

Measurement of individual cores will be made after cleaning of any adhering material from the bottom of the core and will be the average of four measurements of thickness made at approximately 90 degrees apart.

Measurements will be made to the nearest 1mm and the average of the four measurements expressed to the nearest 1mm.

All density holes shall be repaired by the Contractor.

## 4.7.15 Acceptance

### Compaction Requirements

Each layer shall be compacted to a density not less than 94% of the Marshall density.

### Tolerances on Level, Thickness and Shape of Finished Construction

Any course after final compaction shall be finished in conformity with the lines, grades, thicknesses, and cross-sections shown on the drawings within the following limits.

#### 1. Level

The top of the course shall not differ from the specified level by more than 10mm.

#### 2. Shape

No point on the finished surface of the wearing course shall differ more than 3mm either from a 3m straight edge laid parallel to the centreline of the pavement or at right angles to the centreline, except on crown sections.

Surface shape shall be such that water cannot pond at any point.

#### 3. Thickness

The compacted thickness of asphalt shall not be less than 25mm (+5mm - 0mm).

### Defective Work

The Superintendent will inform the Contractor in writing of the areas of pavement which contain defective asphalt.

Areas of asphalt assessed as defective with respect to the requirements specified herein for mix quality, density, surface finish, surface smoothness, or thickness, shall be corrected by the Contractor.

Any asphalt mix that has become damaged or contaminated with foreign material shall be removed and replaced as specified herein as directed.

Skin patching of an area that has been rolled will not be permitted.

Defective areas shall be removed and replaced with fresh materials. Patches shall be prepared by cutting and removing the defective asphalt to the full depth of the course such that the sides of the area are at right angles or parallel to the direction of traffic and the edges are vertical. The internal edges and surfaces of the area to be patched shall be cleaned of all cutting residue by flushing with water and all free water removed. The surfaces shall be tack coated with bituminous emulsion prior to placing of fresh material which shall be spread, compacted and finished in accordance with the specification at the Contractor's expense.

Patches shall be prepared by cutting and removing the defective asphalt to the full depth of the course such that the sides of the area are at right angles or parallel to the direction of traffic and the edges are vertical. The internal edges and surfaces of the area to be patched shall be cleaned of all cutting residue by flushing with water and all free water removed. The surfaces shall be tack coated with bituminous emulsion prior to placing of fresh material which shall be spread, compacted and finished in accordance with the specification at the Contractor's expense.

## 4.8 Extruded Kerbing

### 4.8.1 Scope

Supply and lay extruded concrete kerbing where indicated on the drawings. Kerb sections shall be to Shire of Northampton standards or as indicated on the drawings if Shire standards are not available.

### 4.8.2 Personnel

All work under this Section shall be carried out by competent personnel experienced in the laying of extruded concrete kerbing.

### 4.8.3 Concrete

Concrete for use in extruded kerbing shall be ready mixed concrete complying with all requirements of the current relevant Australian Standard. The aggregate size shall be 10mm nominal. The concrete cylinder compressive strength at 28 days shall be not less than 25 MPa, with a maximum slump of 50mm.

### 4.8.4 Line and level of work

The kerbing shall be laid on the alignment, grades and to the levels shown on the drawings. The top and face surface of the kerb shall be parallel to the ruling grade of the pavement and shall be free from depressions exceeding 3mm when measured with a 3m straight edge. The Construction tolerance shall be such that when a 3 metre long straight edge is laid on the top or face of the kerb, the surface shall not vary more than 3mm from the edge of the straight edge, except at grade changes or curves.

### 4.8.5 Construction details

The surface to receive the kerb shall be a fully compacted and primed base course. The Contractor shall prepare the surface by removing free or loose material to the satisfaction of the Superintendent immediately prior to the placing of the kerb. The Contractor shall give the Superintendent 24 hours' notice of the start of the kerb laying operations in order that the Superintendent may have the opportunity of inspecting the work.

Whenever shown on the drawings or required by the Local Council, kerbing shall be keyed into the base course on all radii less than 40 m as per the standard drawings.

The extruded kerb shall be finished whilst the concrete is still comparatively wet to give a smooth finish free of surface pits and depressions.

Expansion joints shall be constructed and provided at intervals, to Local Authority requirements or as shown on the drawings. Expansion joints shall be sawn vertically at right angles to the longitudinal line of the kerb, to give a 10 to 12mm wide cut for the full section of the kerb.

Expansion joints shall also be provided at all tangent points and adjacent to inlet structures and as shown on the drawings.

When the joint preparation has been inspected and approved by the Superintendent, the expansion joints shall be sealed with a strip of foam to a depth of 25mm to act as a backing for Butyl mastic seal. The seal shall finish 3mm below the face of the kerb.

Contraction joints shall be inserted immediately after final finish, to Local Authority requirements, or as shown on the standard drawings. Joints shall be formed with a grooving tool, not fully fitting through the section of the kerb. Alternatively, the joint may be formed by cutting a 5mm gap at least to 2/3 the depth of the kerb section. All contraction joints shall be sealed by approved means to prevent ingress of sand.

All joints where cutting is required, shall be cut not less than 24 hours following the laying of that section of kerb, with methods used to avoid staining the seal.

## 4.8.6 Curing

Within two hours of surface finishing, all exposed faces of the completed kerb shall be protected from moisture loss for a period of not less than 4 days after extrusion by covering with plastic sheeting or spraying with an approved curing compound.

Curing compounds shall meet the requirements of the current relevant Australian Standard.

Kerbing shall be treated with a sprayed application of a Local Authority approved membrane curing compound applied in accordance with manufacturer's specifications.

After the application of the curing compound, the kerb shall be covered with an approved polythene membrane for a minimum period of 7 days prior to:

- Any road materials being placed adjacent to the kerb,
- Any further work being done on the road, or
- Any backfilling adjacent to kerb

The membrane shall be replaced on completion of cutting and jointing operations.

## 4.8.7 Protection of works

The Contractor shall be held solely responsible for the replacement as necessary of any kerbing during the course of the works of the contract and for the Defects Liability period as specified.

## 4.9 Pavement Markings

All pavement markings shall have retro reflective properties in accordance with the current relevant Australian Standard and shall be installed in accordance with Main Roads standards and requirements.

Contractor is to maintain the site in a safe condition for all road users by the use of temporary signing and pavement markings, until permanent signs and pavement markings are installed.

The Contractor is to arrange for the removal of all existing redundant signs and pavement markings. Redundant signs to be taken to the Council depot.

## 4.10 Reinstatement of gravel emergency beach access for vehicles

The gravel emergency beach access for vehicles is to be reinstated and resheeted. Refer to Section 4.11 for gravel Resheet specifications.

## 4.11 Medium grade of Jacques Point Access Road

The gravel access road at Jacques Point is to be medium graded and tidied up.

This section provides the methodology for resheeting a gravel road and the table below demonstrates the volume of material required compared to a full gravel resheet.

Table 15 Unsealed road grading

Road repair treatment	Material import required
Gravel Resheet	Road formation reinstatement Reshape table drains Import 150mm compacted thickness of material
Heavy Grade	Road formation reinstatement Reshape table drains Import 50% of resheet material volume

Road repair treatment	Material import required
Medium Grade	Medium grading and trimming of unsealed road surface Reshape table drains Import 10-20% of resheet material volume
Light Grade	No importation of material Light trimming by grader of unsealed road surface only

#### 4.11.1 MRWA recommended guidelines – gravel resheet material

The material for construction of a gravel resheet must be a material consisting of a well-graded gravel sand mixture with a small proportion of clayey fines. The material must have a maximum Liquid Limit of 35 and a Plasticity Index of between 8-12. The material must be free from particles having any dimension greater than 50 mm and free from weeds, clods, stumps, roots, sticks, vegetable matter or other deleterious materials.

Gravel material having any dimension greater than 50 mm shall be deemed oversize and must not be delivered to the pavement construction area. The particle size distribution of the gravel material should be based on the following:

Table 16 Sieve Size Percentage Passing

Sieve Size	Percentage Passing
55	100
37.5	95 – 100
26.5	90 – 100
19	80 – 100
2.36	35 – 65
0.425	15 – 50
0.075	10 - 40
Plasticity (PI)	8 – 12
4 days soaked CBR	MIN 40%

Source: based on NAASRA (1980)

#### 4.11.2 MRWA recommended guidelines – gravel resheeting methodology

Note: Methodology to be adjusted for different levels of grading as set out in Table 15.

Place material in uniform layers over subgrade surface or lower layers of the pavement. Remove segregated and contaminated material from the site. Do not place material on a previous layer that has become waterlogged or cracked: and/or otherwise deteriorated. Mix the material uniformly throughout with water to achieve a moisture content within 2% of the optimum for the specified conforming Dry Density Ratio.

Each pavement layer worked must be generally parallel to the finished pavement surface and must extend to hinge point. The pavement layer must be worked in compacted layers not more than 200 mm nor less than 100 mm compacted thickness. Pavement material must be spread and compacted to achieve uniformity free from any evidence of segregation. During the whole of the compaction process the Characteristic Moisture Content of the pavement material must be within -2% to +2% of the optimum moisture content.

Compaction will be deemed to be satisfactory when the layer has been compacted with between four (4) and six (6) passes of a vibratory flat drum roller. Each pass will consist of complete longitudinal and transverse coverage of the section.

The vibratory flat drum roller must be a self-propelled roller with a total static mass of not less than ten (10) tonnes and a centrifugal force on the drum not less than 150 kN in the frequency range of 20 to 30 Hertz. The rolling speed for the vibratory roller must not exceed 7 km per hour. Only driven drum rollers must be utilised.

The gravel pavement for unsealed roads shall be judged to be acceptable when the crossfall is 4% crowned or 4% superelevation (+/- 0.5%) for straights and curves respectively. Completed pavement layers must be in a uniformly bound condition with no evidence of layering, disintegration or surface tearing. The finished surface should appear as a stone mosaic interlocked with fine material and must be dense, even textured and tightly bound.

The level of the completed pavement surface shall be judged to be acceptable when the level measured at any point on the surface is within -5 mm, +20 mm of the pavement level for that point as determined from the Drawings.

Completed pavement layers must be in a uniformly bound condition with no evidence of layering, disintegration, or surface tearing. The finished surface should appear as a stone mosaic interlocked with fine material and must be dense, even textured and tightly bound.

### 4.11.3 MRWA recommended guidelines - trim final pavement surface

Trim with a dense textured surface free of laminations. Remove sticks and any loose material. Ensure surface is free of cracking. Do not introduce new material to the surface after final compaction. Where pavement thickness is 200 mm or greater, scarify to not less than 100 mm depth and recompact where finish not achieved. Where pavement thickness is less than 200 mm scarify and recompact.

## 4.12 Concrete Footpaths

### 4.12.1 General

Unless otherwise shown on the approved drawings, the road verge shall be constructed to the approved cross-section of 2% positive grade from the top of the kerb.

### 4.12.2 Approvals

All service authorities (including Western Power, Alinta Gas, Water Corporation WA, Telstra, Dept of Land Administration etc.) are to be advised and to give written approval for construction of the path. No work is to commence until all approvals are received and copies provided to the Superintendent.

### 4.12.3 Layout

Footpaths and dual use paths within the road reserve to be constructed to the dimensions as shown on the drawings. The footpath shall generally extend from 1.8m to 3m from the kerb and be parallel to the kerb. Any deviation from this alignment requires the approval of the Superintendent.

At corners the footpath shall follow the general alignment, but may be formed in segments of up to 4 metres in length. The edges shall be parallel and the width maintained. A crossing connection shall be provided from the footpath to the edge of the road to allow crossing to each side of the intersection at corners and to roads intersecting with the road containing the footpath. The crossing connection shall be at the tangent point where the kerb starts to curve at the corners.

Where shown on the drawings provide standard kerb ramps.

Provide standard barrier rails at each end of Public access ways or at other locations as shown on the drawings in accordance with this specification.

### 4.12.4 Sub-grade

The sub-grade material is to be compacted to not less than 95% of maximum dry density as determined by the modified compaction test to a depth of at least 500mm. Special attention should be given to service authority



trenches. This shall be certified by a practising Civil Engineer and shall be submitted prior to the concrete pour. The Superintendent shall be given 24 hours' notice of concrete pours.

## 4.12.5 Construction

The path shall be constructed from concrete with at least a 28 day cylinder compressive strength of 20MPa. The ground shall be thoroughly wetted immediately prior to laying the concrete. The concrete shall be compacted by a vibrating screed board of sufficient capacity to effectively vibrate and compact the full thickness of the path.

## 4.12.6 Surface finish

Surface finish to be brushed with smooth edge to all outside edges and joints. All work to be of high quality, uniform appearance and executed in a tradesman-like manner.

## 4.12.7 Joints

Groove crack control joints to be at 1.25m centres for footpaths and 2.5m for footways and cycleways with a 12mm wide expansion joint at 5m centres (every fourth joint for footpaths and second joint for footways and cycleways). Expansion joints to be filled to full depth with 10mm thick bitumen impregnated canite-type material of approved type. An expansion joint shall be installed where the pathway butts to service access chambers and existing crossovers.

## 4.12.8 Joint filler

Approved canite-type material shall be such that when it is subjected to compression in hot weather, no bitumen is extruded. The following materials are approved.

Dimet - Jointex (58 – 62°C softening point bitumen)

Nonporite - bitumen impregnated canite by the cold solvent process.

Expandite - Flexcell.

## 4.12.9 Public access way (PAW) construction

Concrete path to be centrally placed and constructed to the dimensions as shown on the drawings. Any deviation from this alignment requires the approval of the Superintendent. All conditions for footpath construction apply to PAW's where appropriate.

Pipe barrier rails shall be placed at each entrance to a PAW on the road reserve boundary. The barrier rails shall be located and fabricated in accordance with the details shown on the drawings. A 200mm by 200mm block-out shall be used when pouring the PAW so that the rail posts can be placed after construction. The rail shall then be placed and concreted neatly in place with matching surface finish and with approved canite type material separating the 200mm by 200mm block-out area from the rest of the PAW.

## 4.12.10 Tolerances

Works shall be undertaken in the following tolerances:

- Vertical location of footpath in relation to 2% grade line from top of kerb  $\pm$  10mm.
- Grade access footpath shall be 2%  $\pm$  0.5%.
- Path surface shall be true to line and not deviate more than 10mm under a 3m straight edge.
- Surface irregularities, including abutting to service authority access chambers, etc shall not exceed 2mm.
- Spacing of expansion joints shall average 5m over any 30m section. Individual spacing shall be 5m  $\pm$  10mm.
- Thickness of footpath 100mm (-0mm + 10mm).

- A random testing programme will be used to check thickness and if any point is outside the tolerance, further testing shall be undertaken within that 5m section of the adjoining 2 sections on each side. Three or more additional thickness tests will be taken on each of the sections. If any of these show a reading that is outside the required tolerance, that section of footpath shall be removed and replaced with new work to this Specification.
- Width of footpath - 0mm + 20mm.

### 4.12.11 Acceptance

Any sections of footpath not meeting the requirements of this Specification or that in the opinion of the Superintendent is of inferior quality, shall be removed from the site and replaced to the satisfaction of the Superintendent, all at the Contractor's expense.

## 4.13 Test Certificates

### 4.13.1 Sub-grade

- A marked up plan shall be provided detailing areas and extent of areas of unsuitable material removed.
- A marked up road plan showing finished level, alignment and width at minimum 20m intervals.
- A compaction certificate from a NATA registered laboratory detailing compaction results undertaken at a minimum of 1 test per 20m of road or as otherwise specified.

### 4.13.2 Sub-base and base course

- A marked up road plan shall be provided showing finished level depth of layer, alignment and width at a minimum of 20m intervals.
- A compaction certificate detailing compaction results undertaken at a minimum of 1 test per 100m of road or as specified.
- A NATA test certificate of materials tests results taken at a minimum of 1 test per 100m of road length or part thereof, with a minimum of 4 tests.

### 4.13.3 Sprayed Primes and Seals

- A Suppliers certificate detailing material supplied and quality. A certificate for each coat per run is required.
- A bitumen spray record detailing actual bitumen application rate, temperature and area sprayed for each run.
- An application record of cover application rate for metal for each run.

### 4.13.4 Asphalt seal

A Suppliers certificate detailing mix supplied, at a rate of 1 per day. Delivery dockets detailing actual quantity supplied each load.

A certification by the Contractor that the rolling procedure required has been performed.

A marked up road plan detailing at minimum 20m intervals, the depth of layer and finished levels.

A certification by the Contractor for each road that no ponding occurs. A certification by the Contractor that the final surface shape is satisfactory.

# 5. Stormwater Drainage

## 5.1 General

All the Works must be constructed in accordance with the Drawings and this Specification. All pipes must be laid and trenches backfilled prior to construction of basecourse of new roads.

## 5.2 Materials

### 5.2.1 Pipes and precast components

All pipes and precast components incorporated in the works shall be in first class condition and free of cracks, chips and deformities. Any damaged items shall be rejected and shall be removed from the site.

### 5.2.2 Concrete pipes

All concrete pipes shall conform to AS 4058 and shall be rubber ring joint type, unless otherwise specified or authorised by the Superintendent. Strength class shall be "2" unless otherwise noted on the Drawings.

### 5.2.3 Precast concrete pit liners

Precast concrete liners for junction pits, grated gully pits and side entry pits, shall unless otherwise specified, be constructed of 1050mm nominal diameter reinforced concrete pipe segments. The segments shall be of equivalent strength of Class "2" pipes and shall have interlocking joints. For pits exceeding 1.3m depth, the segments shall have cast-in holes to accept step-irons. Under no circumstances shall step-iron holes be made with a hammer and/or chisel.

### 5.2.4 Precast concrete pit and headwall components

Precast concrete components shall be manufactured in accordance with the dimensions and details shown on the Drawings by reputable supplier(s) acceptable to the Superintendent. Proprietary components where shown on the Drawings or specified shall be in accordance with that manufacturer's latest published information.

### 5.2.5 Concrete

Concrete used for in-situ work shall conform to AS 3600 and be provided by a pre-mix concrete supplier conforming with AS 1379, or mixed on site using materials as specified and plant to the approval of the Superintendent.

Concrete for manholes, headwalls, endwalls, and keels shall have a minimum 28 day cylinder test compressive strength of 20 MPa. The slump shall not exceed 70mm or be less than 30mm. Maximum size of aggregate shall be 20mm.

### 5.2.6 Cement

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

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

## 5.2.7 Aggregate

Fine aggregate shall be well graded, clean, sharp and free from clay and organic impurities in accordance with AS 1141. Coarse aggregate shall be crushed granite or diorite clean and free from all impurities and dust in accordance with AS 1141. The maximum particle size shall not exceed 20mm.

## 5.2.8 Water

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

## 5.2.9 Sand

Sand for mortar shall be crushed stone or natural sand free from all deleterious substances and have a uniform grading.

Sand for bedding or backfilling shall be clean sand free from roots, clay or any deleterious matter.

## 5.2.10 Steel

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

Structural steel shall comply with the requirements of AS 4100.

# 5.3 Setting out

## 5.3.1 General

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

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

## 5.3.2 Pegging of pits

Each pit shall be pegged and levelled by the Contractor's Engineering Surveyor. The centre of each pit shall be pegged and at least two reference stakes at 5 metres offset on either side of the pit centreline shall be provided. The Contractor's Engineering Surveyor shall provide the Contractor's Foreman with a copy of his survey record for each drain. The record shall indicate all reference pegs, offset pegs, RL's of dumpy pegs, pit-to-pit distance, and the height of boning rods. Records shall be retained by the Foreman on Site and shall be available for checking by the Superintendent.

# 5.4 Excavation

## 5.4.1 Dewatering

The Contractor shall allow within his Tender the cost of all dewatering and any additional construction costs due to wet ground conditions. In the event of water being encountered, the Contractor shall make adequate provision to ensure that the excavation is kept free from water during the process of concrete pouring and for a period of at least 24 hours after the concrete pour. No bedding or pipes shall be laid in water and trenches are to be kept free from water until backfilling has commenced.

## 5.4.2 Trench excavation

- Trenching shall be carried out in accordance with the West Australian Work Health and Safety Act 2020.
- Trenches are to be cut to line and gradient.
- The trench widths shall be kept to a minimum consistent with the bed width requirements and the requirements of adequate working space and timbering.
- Tunnelling shall be only carried out where directed and to the approval of the Superintendent.
- Should the bed of the trench be over excavated, then the over-excavated volume shall be replaced with a similar material used for the bedding and compacted to a minimum of 90% maximum modified dry density, on the density of the surrounding soil, whichever is the greater, at the Contractor's expense, unless an alternative method is approved by the Superintendent.
- The excavation of trenches with irregular shaped sides shall be avoided and, where this occurs or there is any danger of sides collapsing, then adequate timbering and strutting shall be placed to the approval of the Superintendent, at the Contractor's expense.
- Trenches shall be kept free from water, debris and falling earth.
- The final trimming of the bottom 150mm of trench excavation must not be carried out until immediately prior to concreting or placing of pipe bedding. Excavation must be completed for a minimum of 10 metres length ahead of pipe laying.
- Adequate shoring to the approval of the Superintendent shall be used where the drain is within 2.0 metres plus the depth of the drain from a building, or load bearing structure, or where requested by the Superintendent. Details of the proposed method of shoring to be submitted to the Superintendent and approved prior to commencing excavation of this section of drain.
- The Superintendent may at any time during the Contract stop any works he considers necessary, if in his opinion, any part of the work is in an unsafe condition.
- All surplus or unsuitable materials resulting from trench excavation, pipe laying and backfill shall be removed from site at contractors cost.

## 5.4.3 Pit excavation

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

Where a firm pit foundation cannot be obtained, the Contractor shall place timber piles and raft. The depth of piles shall be as directed by the Superintendent.

The Contractor shall be responsible for safety at all times.

## 5.4.4 Blasting

Not used.

## 5.4.5 Measurement of excavation

Measurement of excavation for the purpose of costing variations shall be in accordance with the trench dimensions shown on the Drawings.

## 5.4.6 Obstruction to traffic

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

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

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

## 5.5 Drain Construction

### 5.5.1 Pipe setting

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

The acceptable tolerance of pipe setting shall be as specified in "Inspection and Tolerances" clause of this Specification.

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

Pipes shall be set using boning rods and profiles unless alternative methods are approved by the Superintendent.

### 5.5.2 Concrete pipe jointing

Spigot and socket pipes shall be jointed with the spigot fully home in the socket and rubber ring jointed, as shown on the drawings. Pipes shall be laid such that the sockets face upstream.

Externally flush interlocking pipe shall be jointed with the ends fully butting on the inside face of the pipe and caulked with a 3 part sand to 1 part cement mortar on the outer face of the joint. The mortar shall be neatly struck off flush with the outer surface of the pipe.

While waiting for backfilling, all mortar joints shall be covered with damp clean sand to prevent the mortar cracking.

### 5.5.3 Pipe and culvert bedding

Bedding for pipes and culverts shall be strictly in accordance with the details on the Drawings. In the event that soft or unstable material is encountered in the trench base, the Superintendent may direct that this be removed and replaced with approved, well compacted material.

Where socket pipes are to be used small recesses shall be left under pipe joints to allow the barrels to bear evenly on foundations for their full length.

Slotted pipes shall be laid on a minimum to 150mm of crushed rock which shall rise to mid height of the barrel of the pipe, also in a minimum thickness of 150mm. The crushed rock shall be a 'no fines', grading with maximum particle size of 14mm unless otherwise specified.

Where shown on the drawings, subsoil drains and slotted pipes, shall be wrapped in an approved geofabric material, such as "Bidum A14" and the trench backfilled with clean free draining sand.

## 5.6 Pits

Junction pits, grated pits and side entry pits, shall be constructed as shown on the drawings. The pits shall be constructed with the tops of the covers laid to the slope of the surface, flush with the verge or the pavement in road reserves and other paved areas. Elsewhere, the covers are to be finished approximately 40mm above the ground.

### 5.6.1 Precast concrete pits

Precast concrete pits shall be assembled accurately in strict accordance with the Drawings. It is important that the alignment of the pipe liners and the level and location of the matching pieces be accurately set in order that kerb level components can be properly constructed. If the pits are not constructed to the correct lines and levels, they shall be removed and rebuilt.

All joints between pit components shall be neatly grouted with 3:1 sand/cement mortar. Pipes entering pits shall be broken off flush with the liners, the reinforcement trimmed back, and the joint neatly grouted. Grouting shall take place immediately following the construction of the joint in order to avoid prolonged exposure of the reinforcement.

The lengths of pit liners shall be chosen with particular regard to the design of each pit. Generally, the number of joints should be minimised by the use of 0.9m and 1.2m lengths. Under no circumstances shall the top most

section be broken down to a length of less than 300mm. Any liners which are cracked during installation shall be rejected.

## 5.6.2 Manhole bases

Bases shall be founded on a well compacted layer of granular material of minimum 150mm thickness. Bases may comprise either precast or cast-in-situ slabs constructed to the dimensions shown on the Drawings.

## 5.6.3 Manhole covers

Standard rectangular or circular, reinforced concrete manhole covers for use on all manholes not under road pavements shall be as provided by a supplier, approved by the Superintendent.

Manholes under road pavements shall be fitted with Class B 900mm x 600mm two part approved "Gatic" type covers for heavy pavement type loadings, or alternatively a heavy duty circular "Gatic" cover case in a precast circular concrete surround.

Gully type entry pits shall have a concrete cover which contains a cast-in grate and frame. The grates and surrounds shall be fabricated as shown in the detail drawings. The grate must be hinged in the frame.

For all covers, the lids shall be fitted with suitable lifting keyholes and rings.

## 5.6.4 Step Irons

Where manhole or entry pits exceed 1.0 metres in depth, measured from top of cover to invert level of the lowest pipe, step irons consisting of 24mm diameter hot dipped galvanised deformed bars shall be provided at 300mm centres for the full depth of the manhole as detailed on the Drawings.

## 5.7 Inspection and tolerances

No backfilling shall be commenced until the drainage lines have been approved by the Superintendent.

On completion of backfilling, the Superintendent shall again inspect the drainage lines for alignment, level and gradient and all pipes must be free from debris.

Pipelines shall be within 20mm of design line and level at all points where design grade exceeds 1% and within 10mm of the line and level for grades flatter than 1%.

Pipelines which have not been constructed within tolerance shall be excavated and relayed at the entire cost of the Contractor.

## 5.8 Backfilling

### 5.8.1 Other than under pavements

Pipes shall not be backfilled until they have been inspected and approved by the Superintendent. Selected fill shall be used for backfilling to a height of 300mm above the top of pipes and shall be an approved granular material containing no stone over 25mm maximum dimension, clay, organic or other deleterious matter and compacted by means of an approved mechanical or a pneumatic tamper to a minimum of 95% of the Modified Maximum Dry Density (M.M.D.D.).

For slotted pipes, selected 14mm filter aggregate shall be used for bedding and backfilling to the pipe and shall be not less than 150mm thickness below and above the pipe and for the full width of the trench which shall be not less than 150mm either side of the pipe.

Care shall be taken so as not to disturb the pipe. For the remainder of the backfilling, material excavated from the trenches may be used provided that it is free from stone over 150mm diameter, clay, organic or other deleterious matter. The backfilling shall be placed in 300mm layers and be compacted to a minimum of 95% of the Modified M.D.D.

The surfaces of trenches after backfill shall be graded level with the surrounding ground.

## 5.8.2 Under pavements

The material used for backfilling of pipe trenches and pits in pavements shall be a clean granular material free from stones over 25mm dimension, clay, organic or other deleterious matter and shall be compacted in 300mm layers to a minimum of 95% of the Modified M.D.D., up to the subgrade level. The pavement shall be reinstated to its original condition.

## 5.8.3 Trench subsidence

If any subsidence of backfill occurs during the Contract period, including the Defects Liability Period, in any road, verge, footpath, pavement or elsewhere in the works, the Contractor shall at his own expense, make it good immediately if it appears.

In the event of the Contractor's failure to make good such defects, the Superintendent may take action under the provisions of AS 2124.



## 6. Limestone Block Retaining Wall

### 6.1 General

Construct limestone retaining walls as detailed on the Drawings, Scope of Work and the Technical Specifications.

### 6.2 Hold Points

Table 17 Minimum required hold points for limestone block retaining wall

Description	Hold point timing
Submission of blockwork supplier and compliance with Australian Standards	14 days prior to ordering
Superintendent to inspect rock levels and direct Contractor on how the wall will transition as shown on the Drawings	After completion of excavation to rock levels
Provision of mortar colour to match blockwork colour	Completion of trial section of wall
Sample wall to be erected to control joint. Superintendent to inspect sample wall and control joint.	During or at completion of sample wall
Testing and results of compaction tests	At completion of compacted layer and prior to placement of limestone blocks

### 6.3 Standards

All equipment, materials and workmanship supplied by the Contractor for incorporation into the Works shall comply with the respective Australian Standard applicable which is current as at the date of close of tenders.

Where an Australian Standard is nominated in this documentation, it is provided as a guide to the Contractor for the selection of appropriate materials and/or work practices which are required by the Shire of Northampton. Where a nominated Standard or Interim Standard has been revised, amended and/or designated or not current as at the date of close of tenders, the applicable Standard shall be the Australian Standard which is current as at the date of close of tenders.

Materials and workmanship shall conform to the current Australian Standards, where such Standard exists, including the following:

- AS/NZS 4455.1:2008: Masonry units
- AS/NZS 4456.2:2003: Masonry units, segmental pavers and flags - Methods of test
- AS 3700:2018: Masonry structures

### 6.4 Limestone Blocks

Stone shall be sound, free from stakes, cracks, vents, pockets, veins, fissures and other like defects.

Limestone shall have a density not less than 1800 kg/m<sup>3</sup> (dry).

Except where otherwise indicated on the Drawings, all limestone shall be tungsten cut to the sizes indicated on the Drawings and palletised for delivery to site.

Stone shall be stored on site clear of the ground on pallets and the stacks shall be covered with a waterproof cover to prevent wetting.

Blocks sizes as notated on the Drawings.

The Contractor shall ensure that the nominated blocks meet with the structural requirements of the specification and the appropriate Australian Standard.

## 6.5 Mortar

- Mortar shall comply with AS 3700:2018 and be used within 30 minutes of initial adding of water.
- Mortar in face stonework shall match the colour of the specified reconstituted limestone blocks to the approval of the Superintendent.

### 6.5.1 Materials for mortar

Materials to be included in mortar are as follows:

- Fine aggregate shall be sand
- Water shall be clean and of drinking quality, and
- Colouring pigments shall be metallic oxides insoluble in water.

Do not use admixtures unless specified. When specified, use admixtures strictly in accordance with the manufacturer's recommendations. When coloured mortar is specified, mix colouring pigments with cement and use fine aggregate compatible with the colour required.

### 6.5.2 Mortar mixing method

The mixing methodology is outlined below:

- Measure parts in mixes by volume in calibrated devices
- Thoroughly mix any colouring pigments with the cement before adding other ingredients,
- And Mechanically mix mortar to an even colour and consistency.

### 6.5.3 Mortar mix

Proportions for mortar are as follows:

- 1 part ordinary Portland cement
- 1 part lime putty, and
- 6 parts fine aggregate.

## 6.6 Workmanship

All stone work shall be carried out by tradespersons experienced in limestone work.

Provide all accessories and perform all operations necessary for the proper execution of first class masonry work, including selecting, cutting, dressing, carving, bedding, setting, fixing, pointing, grouting, caulking and the like.

Build in where indicated and as necessary, all reinforcements, ties and the like.

Cut openings, chases, mortices and the like for other services and fixings. Well wet down stone which is to be laid or grouted in cement mortar.

Use non-staining softwood wedges or lead or plastic buttons for positioning stones.

Set work out, plumb, level and properly bonded, with no part rising more than 1000mm above adjacent unfinished work.

Corners and other advanced work shall be raked.

Re-lay in fresh mortar any stonework which has been moved or jarred after initial laying.

Construct all exposed areas of walls/piers to face work standard.

## 6.7 Coursing and bond

Stonework shall be to face sizes and pattern shown on Drawings and shall consist of carefully cut and dressed stone with even joints.

Stone shall be selected on site to ensure that only clean, square edges are visible in top course and facework.

All edges shall be kept true and straight, with jointing running horizontally and vertically and finished to dimensions indicated.

## 6.8 Joints

Form joints uniformly in facework, filled solidly with mortar, rolled to a smooth finish and finished with clean, straight edges against the stone. Joint thicknesses shall be 20mm.

Do not fill minor chips or hollows in stone of facework with mortar.

## 6.9 Samples

Erect samples of limestone work as follows and obtain the Superintendent's approval prior to proceeding. All limestone work shall match the standard of the approved sample:

- 2 m<sup>2</sup> wall showing bond pattern and mortar joints
- First control joint constructed by Contractor

## 6.10 Footings to Limestone Walls

A limestone retaining wall shall be constructed on the underlying rock. If conditions vary from what is expected, the contractor shall notify the Superintendent as soon as practicable.

## 6.11 Drainage

Provide drainage as necessary through limestone retaining walls to allow water flow from car park and road and as indicated on the Drawings. Any additional drainage requirements through wall will be advised by the Superintendent as a variation to the Contract works.

## 6.12 Cleaning

Upon completion, clean down all new work and adjoining surfaces where necessary, by appropriate methods, which shall be subject to the Superintendent's approval.

## 6.13 Protection of Finished Work

Clean off mortar drippings and the like as soon as they occur. Protect all finished stonework from staining or damage. Use sheeting or casing where necessary.

Do not use hardwoods in contact with stone.

Stained or damaged stonework shall be replaced, not repaired, unless otherwise permitted by the Superintendent. Similarly protect adjoining surfaces during masonry work.

# 7. Rock revetment

## 7.1 Standards & Codes of Practice

The following Standards and Codes of Practice are referenced within this Specification. All materials, workmanship and testing shall conform to the requirements of the following Standards and Codes of Practice except as explicitly varied by this Specification:

- AS1141 Methods of sampling and testing aggregates;
- AS 2758.6 Guidelines for the Specification of Armour stone; and
- CIRIA 2007.The Rock Manual – The Use of Rock in Hydraulic Engineering (2nd Ed).

## 7.2 Hold Points Table

The minimum required hold points as specified in this specification are detailed below. Additional hold points are at the discretion of the Superintendent or as noted throughout the Specification.

Table 18 Minimum required hold points for rock revetment

Specification Section	Detail	Hold Point Timing
7.3.2	Quarry assessment of proposed materials	28 days prior to procurement
7.3.4	Inspection of sample load.	14 days prior to commencement of works
7.6.2	Pre toe placement survey	Prior to placement of the rock toe
7.6.2	Inspection of each placed layer of rocks	At the completion of each layer

## 7.3 Rock Materials

### 7.3.1 General

Rock materials to be incorporated in the works shall comprise individual stones which are naturally occurring, dense and sound material. The rock for this project is to be a combination of local occurring granite and sandstone, compliant with the Specification requirements and consistent in appearance to that which is already in place at along the coast in Kalbarri. The rock for use at each location is as follows:

- Blue Holes – revetment constructed of sandstone (armour and core)
- Jacques Point – revetment constructed of one layer granite armour (bottom) and one layer sandstone (top). Core material can be either granite or sandstone, compliant with the requirements of the specifications.

The quality of the rock materials shall be such that it:

- Conforms with the specified physical, chemical and petrographic test parameters detailed in this Specification;
- Does not contain visually observable or chemically detectable impurities or foreign matter defects which may result in breakdown, fracture or weathering of the stone during handling, during transport, during placing and in the environment of the site of the works; and
- Is of such character that it will resist disintegration and erosion by the action of air, water (fresh or seawater), wetting and drying, extremes of temperature and impact due to wave action or any other natural or climatic factors.

Rock materials shall be free from quarry fines, soil, peat, loam, clay or any organic matter.

## 7.3.2 Source of Materials

One month prior to the delivery of rock to site the Contractor shall submit to the Superintendent a quarry assessment(s) of the proposed source of the materials, noting that materials may come from more than one quarry. Details to be provided shall include:

- The location of the quarry(s);
- A ‘Geological Assessment’ of the Quarry, identifying the nature of the rocks within the quarry, the volume of the various rock formations, fracturing of the rock, orientation of rock bedding planes, foliations etc. The assessment shall document the Contractor’s conclusions with regards to the anticipated production potential of rocks of the various sizes/classes required for the works. Evidence by means of borehole assessment and the like that the quarry contains sufficient rock for the works may be required;
- The locations / quarry faces which the rock and quarry materials for each class of material are to be won;
- A Method Statement outlining how the proposed quarry operations will produce the specified gradings of rock and quarry materials for the works;
- Assessments of any changes anticipated in the geology of the production faces during the works that are likely to affect rock quality, type, block composition or integrity. Where potential changes are anticipated, details of the changing character of the rock shall be provided;
- Demonstrable evidence the proposed blasting pattern will minimise the production of latent fractures;
- Current results of testing by a NATA (National Association of Testing Authorities) accredited (or approved equivalent) testing laboratory of rock and quarry material from each location/ quarry face. Testing shall demonstrate the compliance of the proposed materials to this Specification. Testing which has been completed within the period two months prior to the submission of the test results shall be considered current.
- The volume of rock stockpiles to accommodate interruptions to production;
- The duration which stockpiled rock will lay in the quarry stockpile;
- Details of how the stockpiles will be worked to minimise the time rock will lay in the quarry prior to transport to site;
- Details of rock quality control procedures proposed at the quarry to provide demonstrable evidence that the rock and quarry materials comply with the requirements of this Specification;
- Evidence of a system for inspection and testing to identify rock which does not comply with the requirements of this specification prior to dispatch from the quarry;
- Details of how non-compliant rock will be quarantined from stockpiles of rock proposed for incorporation in the works; and
- Anticipated incidence of block fracture on site, based either on controlled drop tests or rock breakages during transit.

The Contractor shall notify the Superintendent and seek approval for any changes in the rock production / handling methods and of any relocation of the blast face within the quarry. Adequate provision shall be made by the Contractor to allow the Superintendent to inspect the rock at source.

## 7.3.3 Quality Control and Testing

Testing shall be carried out by the Contractor regularly throughout the works to monitor the quality and size of rock for compliance with the specified requirements.

The minimum frequency of testing is detailed in Table 19. The Contractor shall report the results to the Superintendent without delay. The Superintendent may order additional tests or more frequent testing by the Contractor if the quarry is worked inconsistently or the testing demonstrates variability in the character of the rock.

Quality control testing shall be carried out by Contractor at the quarry, prior to transportation to the site, in accordance with the approved Quality Control Procedures.

Rock which has been delivered to site, but is subsequently identified as failing to meet the acceptance criteria shall be removed from the site immediately and disposed of at the Contractor's expense, unless an alternative use is agreed with the Superintendent.

Table 19 Testing rock and quarry materials

Characteristic	Standard	Acceptance Criterion	Frequency of Testing
Lithological Classification	AS 2758	Rocks should be igneous or high grade thermal metamorphic rocks. Some limestones are also acceptable provided that the mechanical and visual requirements are satisfied.	Selection Phase
Visual Inspection	Evaluation of Shape, Grading, Rock Quality and Integrity by a qualified petrographer	Rock should be fresh or faintly weathered. Weathered rock is not acceptable.	Continual
Grading	Sampled tested and reported in accordance with Chapter 3 of The Rock Manual (CIRIA 2007).	Grading's specified within this Specification	Weekly testing or as instructed by the Superintendent.
Saturated Surface-Dry Relative Density	Sampled, tested and reported in accordance with AS 1141.6.1	2,500 kg/m <sup>3</sup> Minimum (Granite) 2,200 kg/m <sup>3</sup> Minimum (Sandstone)	Weekly testing or as instructed by the Superintendent.
Water Absorption	Sampled tested and reported in accordance with AS 1141.6.1	3% Maximum*	Weekly testing or as instructed by the Superintendent.
Abrasion Resistance	Los Angeles Abrasion Loss Test in accordance with AS 1141.23.	30% Maximum*	Weekly testing or as instructed by the Superintendent.
Rock Strength	Sampled, tested and reported in accordance with Point Load Strength Index Test in AS 4133.4.1 - 2007	4 MPa Minimum*	Weekly testing or as instructed by the Superintendent.

\*Acceptance criterion for Water Absorption, Abrasion Resistance and Rock Strength may be relaxed if required following approval by the Superintendent. However, under no circumstances should the Point Load Strength Index be less than 1.5 MPa.

## 7.3.4 Sample Production Loads

Two weeks prior to the supply of rock for incorporation in the works, the Contractor shall deliver sample production loads for each class and type of rock to be supplied under the Contract. Sample production loads shall be set aside both at the site and at the quarry(s) in areas approved by the Superintendent for the duration of the Contract. The sample production shall be used as a visual reference throughout the works.

The sample production loads shall be produced using the quarrying techniques proposed for full production. Each sample load shall be fully tested to demonstrate compliance with the requirements specified in the 'Testing Rock and Quarry Materials' included in this Specification

Inspection and review by the Superintendent of the sample loads shall not relieve the Contractor of his obligation to ensure all rock for incorporation in the works are to Specification.

To demonstrate compliance with the specified gradings, the Contractor shall provide:

- At least 3m<sup>3</sup> samples of each Class of rock; and
- Armour rock samples of masses approximately equal to the maximum, nominal and minimum rock sizes for each of the nominated classes of rock.

Each rock with a weight greater than 250 kg shall be weighed and a 'Sum of Girths' measurement shall be taken. Each rock shall be marked with its measured mass and 'Sum of Girths' measurement and retained at the site for visual reference purposes.

Either visual reference or the 'Sum of Girths' methods may be used as a means of estimating the weight of any individual stones. However, if directed by the Superintendent, weighing of Rocks may be ordered to verify and/or calibrate the 'Sum of Girth' estimate of rock weights. In the case such verification identifies a discrepancy between the actual measured weights and estimated weights, the actual measurement of weights shall take precedence over the estimated weights of rocks.

The 'Sum of Girths' measurement is assessed as the sum of two (2) girth measurements taken at right angles to each other. The two (2) girth measurements are to be approximately the minimum and maximum girths but they shall not be measured over major projections or irregularities. All girth measurements shall be taken in a manner as approved or directed by the Superintendent.

## 7.4 Shape and Grading of Rock and Quarry Materials

### 7.4.1 Rock Grading

The grading of each Class of Rock to be incorporated in the works shall comply with the details shown on the Drawings and described below. In order to define the acceptable grading of the rock, standard class limit system shall be used. These limits, usually referred as ELL, NLL, NUL and EUL are shown in Table 20 below. The limits are defined as below:

- ELL is Extreme Lower Limit. Only 5% of rocks for armour or 2% for coarse grade under layers should be lower than this limit.
- NLL is Nominal Lower Limit. 10% of rocks are allowed to be lower than this limit.
- NUL is Nominal Upper Limit. 70% of rocks are allowed to be lighter than this size.
- EUL is Extreme Upper Limit. 98% of rocks should be lighter than this limit.



Table 20 Testing rock and quarry materials

Rock Grading	D50 (m)	ELL (kg)	NLL (kg)	NUL (kg)	EUL (kg)
Granite Armour	0.64	200	3000	1000	1600
Sandstone Armour	0.9	420	750	2110	3220
Core – 60 – 300kg	0.4	30	60	300	450

## 7.4.2 Shape of Rock

Rock revetment shall not contain more than 50% by weight of stone with a length to thickness (L/d) ratio greater than 2. Not more than 5% of the rocks shall have a length to thickness (L/d) ratio greater than 3.

Where the length, L, is defined as the greatest distance between two points on the stone and the thickness, d, as the minimum distance between two enclosing parallel planes through which the stone can just pass. Testing for shape ratio determination shall be undertaken on samples of at least 50 pieces taken at random.

## 7.5 Transportation and Stockpiling of Rock and Quarry Materials

### 7.5.1 Rock Transport

Rock and quarry materials shall be transported to the site along haul routes as approved by the Superintendent.

### 7.5.2 Stockpiling

Separate stockpiles shall be made for different grades of rock both at the quarry and at the site. The stockpiles shall be formed so that they do not constitute a hazard; the locations, side slopes and heights and other factors affecting safety shall be as approved.

## 7.6 Rock Protection Construction

### 7.6.1 General

All layers which comprise the structure shall be placed to the lines and levels detailed on the Drawings to the tolerances nominated within this Specification. All completed works shall be to the approval of the Superintendent.

It shall be the sole responsibility of the Contractor to adopt construction methods and programming to ensure the stability of the toe throughout construction.

Prior to placing quarry material insitu, the Contractor shall submit detailed method statements to the Superintendent for approval. These method statements shall detail the Contractors working methods, work sequences, proposed plant, safety measures and contingency plans for inclement weather.

#### Protection of Works

Where extreme weather is forecast or where for some reason, beyond the control of the Contractor, placement of rock must cease, the Contractor shall immediately begin placing sufficient quantity of armour rock to prevent the exposed areas from suffering wave damage. A stockpile of armour rock shall be held on site against such an emergency. This clause does not relieve the Contractor of the responsibility of ensuring that the finished structures are to plan and specification.

It shall be deemed that the Contractor has allowed, within the rates and prices tendered, for all risks and contingencies associated with the exposure of the construction to storm waves and extreme water levels, and any emergency or rectification works resulting from such a storm.

## 7.6.2 Setting Out and Control of the Works

### 7.6.2.1 General

All survey work for setting out and control of construction shall be undertaken by a registered surveyor. The Contractor shall be responsible for establishing all survey marks necessary for the setting out of the works. Marks shall be placed at 10 metre intervals along the structure to mark the crest and profiles of the armour material.

Before the preparation of any toe protection or placing rock the Contractor shall:

- Submit to the Superintendent for approval details of the survey methods to be adopted to ensure accurate setting out, alignment, level and cross sectional control during construction; and
- Carry out initial ground, river and seabed survey lines cross sections at 10 metre centres, or other closer spacing if required, extending for at least 10 metres outside the final alignment of the toes or other edges of the structures. Longitudinal check lines shall also be surveyed along the alignment of the structure centreline and toes. Any discrepancies between the levels shall be investigated immediately and resolved prior to the commencement of construction.

After the preparation of toe placement, profile surveys shall be carried out using a probe with a spherical end of diameter 0.50 Dn50. (The Dn50 shall be that of the material in the layer which is being surveyed). For land based survey this will generally be connected to a staff or EDM target: for underwater survey it will generally be a weighted ball on the end of a sounding chain.

Measurements of cross sections along the length of the structure shall be at 10 metre spacing. The cross section locations shall remain the same for each layer placed. The cross sections shall extend at least 10 metres outside the final alignment of the toes or other edges of the rock structures.

Results of all surveys shall be presented as both digital and hard copy Drawings. The drawings shall identify the cross section location and the design cross section overlaid by the 'as surveyed' cross sections of the bed and each subsequent layer of construction.

No layer shall be covered by a subsequent layer until the profile of the former layer has been approved by the Superintendent.

### 7.6.2.2 Chainage markers

The Contractor shall provide and maintain chainage markers at 10 metre intervals along the riverbank. The chainage markers shall coincide with cross sections measured for the control of construction. Chainage markers should be visible from both the land and seaward side of the structure and clearly identify the chainage on the marker.

### 7.6.2.3 Notice of survey

The Contractor shall give a minimum of 24 hours prior notice to the Superintendent and shall provide facilities for his attendance during surveys. Cross sections shall be surveyed in an approved manner.

## 7.6.3 Placement of rock revetment

Placing of rock revetment shall comply with the following requirements:

- Place rock to the lines, levels and batters shown on the Drawings. The batter shown on the Drawings shall be adhered to over the full height of the structure;
- Armour rock shall be individually placed, unless noted otherwise, to achieve a dense, fully interlocked armoured slope so that each rock is securely held in place by its neighbours. Percentage of voids in the armour layer shall be 30% or less. Rocks shall be lowered into place individually with a drop height of less than 1m. Rocks shall not be placed so that they obtain their stability from frictional resistance on one plane alone;
- Where noted on the drawings, armour rock shall be selected to be placed with the flat side upwards to create natural "steps" in the revetment face. Proposed rocks for use are to be confirmed with the Superintendent prior to placement;

- Tipping of armour from vehicles, or bulldozing or dumping from hoppers or barges into final position shall not be permitted without the prior approval of the Superintendent. Such permission may only be given following placing trials;
- Placement should avoid damage to the surface below or to the geotextile arrangement;
- Rock revetment shall be placed to achieve a minimum ‘three-point support’ and be stable to the lines and levels shown on the Drawings. The surface of the armoured slope shall present an angular uneven face to the sea. Rocks shall generally be placed with their long axes normal to the slope. The finished rock revetment shall be at least two rocks thick except where shown otherwise on the Drawings. Smaller pieces of rock shall not be used to fill interstices, or to prop larger rocks in order to achieve the required profile; and
- Carry out placement of all rock in such a way as to minimise the breakdown of individual rocks. The placement method shall also cause minimum disturbance or dislodgement of underlying material.

## 7.6.4 Layer Placement Tolerances

All layers and elements of rock and quarry materials shall be placed within the tolerances nominated in this Specification for the respective layers and elements. Notwithstanding, the following shall apply to rock revetment layers:

- The tolerances on two consecutive mean measured profiles shall not be negative; and
- Notwithstanding any accumulation of positive tolerances on underlying layers, the thickness of the layer shall not be less than 80% of the nominal thickness when calculated using mean measured profiles. When an accumulation of positive tolerances arises and is acceptable to the Superintendent, the position of the design profiles will need to be adjusted.

The tolerance values which apply to the placement of Armour material for layers thicker than 400mm are provided in Table 21. For layers with a thickness less than 400mm, the vertical mean placing tolerance is +50mm. No negative tolerance is accepted.

**Table 21** *Rock revetment placement tolerances*

	<b>On individual Measurements</b>	<b>Design Profile with respect to measured mean</b>
Material Placed above the Level of Chart Datum	+/- 0.3 Dn50	+ 0.35 Dn50 - 0.25 Dn50
Material Placed Below the Level of Chart Datum	+/- 0.5 Dn50	+ 0.6 Dn50 - 0.4 Dn50

Note: All tolerances refer to the design profile to actual mean profile unless stated otherwise

## 8. Miscellaneous Items

### 8.1 Handrails and balustrade

Balustrade and handrails must comply with the BCA requirements and Australian Standards.

At Chinaman's Beach the balustrade is to be placed centrally to the top of the reconstituted limestone block wall and anchored into cored holes as described in the following drawings:

Drawing Number	Drawing Title
12596020-GHD-00-01-DRG-ST-00200	TYPICAL RETAINING WALL DETAILS
12596020-GHD-00-01-DRG-ST-00300	RETAINING WALL PROFILE SHEET 1 OF 3

Weldlok handrails have been specified where appropriate for disability access ramps. The handrails must comply with AS 1428.1.2022. Refer to Jacques Point drawing:

Drawing Number	Drawing Title
12596020-GHD-00-04-DRG-CI-00300	TYPICAL CAR PARK AND REVETMENT CROSS SECTIONS

Handrails provided as part of Replas stairs and other structures are to be in accordance with Australian Standards.

### 8.2 Replas furniture and stairs

#### Stairs (Blue Holes and Jacques Point)

Stairs and decking will be constructed from Replas material with H4 treated pine posts founded with concrete footings. The Replas handrails are to be in accordance with BCA requirements.

Shop drawings and/or product information is to be provided to the Superintendent for approval prior to delivery to site and installation.

#### Tables and benches (Sally's Tree, Chinaman's Beach, Blue Holes and Jacques Point)

Furniture is to be similar to furniture already used on the Kalbarri foreshore.

Product information is to be provided to the Superintendent for approval prior to delivery to site and installation.

### 8.3 Shade structures

Shade structures are required to resemble the existing shade structure located at Chinaman's Beach.

Shade structures shall have six timber posts and concrete floor slabs. The shelters shall have two sets of Replas tables and benches each.

The contractor shall submit shop drawings indicating their supplier's design and materials for approval.

#### 8.3.1 Concrete work

For concrete works, refer to the following drawings:

Drawing Number	Drawing Title
12596020-GHD-00-01-DRG-ST-00001	STRUCTURAL NOTES

## 8.4 Fencing

### 8.4.1 General

Requirement: Provide fences and barrier systems, as documented in the drawings.

#### 8.4.1.1 Performance

Requirements:

- Complete for their function.
- Conforming to the detail and location drawings.
- Firmly fixed in position.

### 8.4.2 Submissions

#### Products and materials

Requirement: Submit the manufacturer's standard drawings and details showing methods of construction, assembly and installation, with dimensions and tolerances.

### 8.4.3 Inspection

Inspection: Give notice so that inspection may be made of the following:

- Set-out before construction.
- Foundation conditions after excavation.
- Completion of installation.

### 8.4.4 Products

#### 8.4.4.1 Storage and handling

General: Deliver, unload and store components and accessories in unbroken manufacturer's packaging.

#### 8.4.4.2 Timber

##### Posts and rails

Hardwood: To AS 2082 (2007).

Softwood: To AS 2858 (2008).

##### Preservative treatment

Timber type: Provide only timbers with preservative treatment to the documented Hazard class.

Cut surfaces: Provide supplementary preservative treatment to all cut and damaged surfaces.

CCA treated timber: If proposed to be used, provide details.

#### 8.4.4.3 Steel

##### Steel tubes

Posts, rails, stays and pickets: To AS/NZS 1163 (2016).

##### Fencing wire

Chainwire, cable wire, tie wire and barbed wire: To AS 2423 (2002).

AS 2423 (2002) covers fencing wire, barbed wire, wire netting and chainwire and requires that all products for fencing be protected against corrosion by application of a metallic-coating during manufacture, optionally overlaid with an organic coating. AS 2423 (2002) clause 1.3.13 defines organic coatings.

#### **8.4.4.4 Concrete**

Standard: To AS 1379 (2007).

Exposure classification: To AS 3600 (2018) Table 4.3.

### **8.4.5 Execution**

#### **8.4.5.1 Construction generally**

##### **Set-out**

General: Set out the fence line and mark the positions of posts, gates and bracing panels.

##### **Clearing**

Fence line: Except for trees or shrubs to be retained, clear vegetation within 1 m of the fence alignment. Grub out the stumps and roots of removed trees and shrubs, and trim the grass to ground level. Do not remove the topsoil.

##### **Excavation**

Posts: Excavate post holes so that they have vertical sides and a firm base. Spread surplus material on the principal's side of the fence.

##### **Earth footings**

Base: Place 100 mm of gravel in the footing base under posts.

Compaction: Backfill with earth around posts, compacting firmly by hand or machine in 150 mm deep layers.

##### **Concrete footings**

In ground: Place mass concrete around posts to protect posts from waterlogged conditions and finish with a weathered top falling 25 mm from the post to ground level.

On slabs: Provide welded and drilled post base flanges for fixing with masonry anchors to the concrete.

##### **Erection**

Line and level: Erect posts vertically. Set heights to follow the contours of natural ground, unless documented otherwise.

### **8.4.6 Cleaning**

Requirement: Remove excess debris, metal swarf and unused materials. Clean all visible metal surfaces with soft clean cloth or brush and clean water or approved cleanser, finishing with a clean cloth. Do not use abrasive or alkaline materials.

Powder coated aluminium architectural applications: Clean completed assembly to AS 3715 (2002) Appendix C.

Powder coated metal, other than aluminium, architectural applications: Clean completed assembly to AS 4506 (2005) Appendix D.

Protection: Remove protective coatings using methods required by the manufacturer after completion.

### **8.4.7 Warranties**

Requirement: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the manufacturer and the installer.

- Form: Against failure of materials and execution under normal environment and use conditions.
- Period: As offered by the manufacturer and the installer.

## 8.4.8 Fencing, handrail and bollard schedule

Table 22 Fencing, handrails and bollards

Location	Description	Fencing type*	Number of bollards	Length	Units
Chinaman's Beach	Handrail along top of retaining wall - cored through the top 3 blocks	Weldlok DDA handrail (or similar approved)		175	m
	Fence along front of lower unsealed carpark	1m high H4 treated timber posts and rail fencing with ringlock wire size 7/90/30 at lower unsealed carpark with allowance for 3x beach access points		120	m
	Bollards at future carpark behind retaining wall	1.5m c/c 225Ø H4 treated timber bollards with domed top at future carpark adjacent to retaining wall	32 bollards		No.
	Handrail at limestone block stair access to beach	Weldlok handrail cored into staircase		6	m
	Repair existing pine log fencing along footpath up to the lookout	Pine log fencing with wire (existing)		40	m
	Bollard at disability parking area	115dia CHS in ground shared area bollard 1300mm high (1650mm total length) with 450dia concrete footing (disabled parking bay)	1		No.
Blue Holes	Fencing along rock revetment and edges of car park	1m High H4 treated timber posts and rail fencing with ringlock wire size 7/90/30 along rock revetment		150	m
	Fencing in dune behind kerb	H4 treated pine log dome top (length excludes spacing)		30	m
	Bollard at disability parking area and ramp	115dia CHS in ground shared area bollard 1300mm high (1650mm total length) with 450dia concrete footing	3		No.
Jacques Point	Along rock revetment, extend an additional 10m along the access road on the eastern end	1.0m high H4 treated timber post and rail fence with galvanised ringlock fencing wire size 7/90/30		140	m
	Repair existing pine log fencing with wire beach access from top car park down to beach at western end	Pine log fencing with wire (existing)		45	m
	Bollard at disability parking area	115dia CHS in ground shared area bollard 1300mm high (1650mm total length) with 450dia concrete footing (disabled parking bay)	1		No.

	Handrail along disability access ramp (close to shelter)	Weldlok DDA handrail		20	m
	Edge board along footpath	200 x 75 H4 treated edge board along edge of footpath, including 170Ø x 800mm long retaining post located at the midpoint between post (2.4m c/c)		140	m
Red Bluff Beach	Repair existing pine log fencing with wire at 3x beach accesses	Pine log fencing with wire (existing)		40	m

\*Note that fencing type is to be approved by Superintendent.

\*Note that Replas elements have not been included in this table.



## 9. Quality Assurance

The Contractor shall control the quality of the work and shall fully implement a quality management system under this Contract in accordance with the requirements of the current Australian and International AS/NZS ISO 9002:1994. In accordance with the Scope of Works (SOW), each section of this technical specification includes specific testing and reporting requirements. These requirements are integral to ensuring the quality, reliability, and compliance of the deliverables as they provide a clear framework for conducting tests, interpreting results, and reporting findings. Adherence to these requirements is crucial for maintain Quality Assurance/Control.

The Contractor shall be required to nominate a suitably qualified Quality Assurance Representative (QAR) who is at a management level with appropriate authority to effectively control the complete quality assurance process. For construction works the Representative shall be site based.

# Appendices

# Appendix A

**Safety in Design**

Notes: \*Designs with significant quantities of dangerous goods may require detailed risk assessments under Dangerous Goods or Major Hazard legislation  
 \* Most industrial processes will require an industry specific assessment, e.g. HAZOP and/or Quantitative Risk Assessment for facilities that have chemical or high-pressure processes under Dangerous Goods or Major Hazard legislation.

Design Life Cycle:	Investigation and Design	Setup, Construction and Commissioning	Operation	Maintenance	Disposal	Date:	18/12/2023	Revision No:							
Job Name:	Northampton Disaster Recovery Works		Job No:	61/12596020		Client:	Shire of Northampton			Design:	Chinaman's Beach, Jacques Point, Blue Holes and Red Bluff Beach Access: Preliminary Design				
People involved in Risk Assessment:		Pascale Ketelaar, Bec Barton, Antoinette Krause													
Design Ref	Design Life Cycle Stage (Select from Drop Down Box)	Hazards What could cause injury or ill health, damage to property or damage to the environment	Risk What could go wrong and what might happen as a result	Existing Control Measures	Initial Risk Rating			Potential Control Measures (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	Responsibility	By When	Decision / Status	Residual Risk Rating			Comments
					C	L	RR					C	L	RR	
	Setup, Construction and Commissioning	Adjacent structures	Existing road, walkways and beach accesses may not be shown on design plans. During construction there may be a clashes or works being undertaken in close proximity of adjacent structures, causing delays in construction or substandard construction.	Survey of the sites includes existing adjacent structures	C - Severe	2 - Unlikely	Low	If any adjacent infrastructure appear unstable or in conflict with proposed works, stop works and inform supervisor	Contractor	During construction activities.	Open	C - Severe	2 - Unlikely	Low	
	Setup, Construction and Commissioning	Services	Service strikes	Technical specification and/or Scope of Work specifies positive identification and protection of all services prior to commencing works.	D - Critical	3 - Possible	Significant	Adhere to Scope of Work and/or Technical Specification, regulations and SMWS.	Contractor	During construction activities.	Open	D - Critical	2 - Unlikely	Moderate	
	Setup, Construction and Commissioning	Community/public interaction/access	Residents or tourists wandering onto site could be injured by machinery or materials.	Scope of Work and/or Technical Specification instructs contractor to limit public access.	C - Severe	3 - Possible	Moderate	The site must be securely fenced with warning signs throughout construction.	Contractor	Before commencing	Open	C - Severe	2 - Unlikely	Low	
	Setup, Construction and Commissioning	Ground conditions	Debris from previously damaged infrastructure may still be on site and in some cases partially or even completely buried.		C - Severe	4 - Likely	Moderate	Undertake site walkover, carefully inspect all areas prior to mobilising equipment. Ensure work areas are stable. Remove debris prior to commencing works.	Contractor	Before commencing	Open	C - Severe	3 - Possible	Moderate	
	Setup, Construction and Commissioning	Dust/fumes/vapours	Dust and exhaust causing a nuisance to residents, neighboring caravan park and businesses.	Standard dust control measures in Scope of Work and/or Technical Specification.	B - Major	5 - Almost Certain	Moderate	Wet down dusty soils where possible.	Contractor	During construction activities.	Open	B - Major	3 - Possible	Low	
	Setup, Construction and Commissioning	Noise	Machinery causing disturbance to residents, neighboring tourist facilities and businesses.	Work hours specified in Scope of Work and/or Technical Specification.	B - Major	5 - Almost Certain	Moderate	Adhere to Scope of Work and/or Technical Specification.	Contractor	During construction activities.	Open	B - Major	3 - Possible	Low	
	Setup, Construction and Commissioning	Construction method	The construction method may introduce hazards such as lifting, manual handling, slips/trips/falls that may cause injury or fatalities.	Legally required job training and job safety analysis processes and procedures. Contractor required to provide SWMS.	E - Catastrophic	2 - Unlikely	Significant	Ensure all workers are properly trained for their tasks. Have a designated first aid officer on site at all times.	Contractor	During construction activities.	Open	E - Catastrophic	2 - Unlikely	Significant	
	Setup, Construction and Commissioning	Construction method	Working under lifted heavy items (for example limestone blocks, large rock for rock armour walls etc)	Limiting the size and complexity of items that need to be lifted. SWMS to be provided by the contractor.	D - Critical	3 - Possible	Significant	Ensure proper training, and use a spotter where necessary. Where required have an appropriate and approved	Contractor	During construction activities.	Open	D - Critical	2 - Unlikely	Moderate	
	Setup, Construction and Commissioning	Excavation	Risk of collapse and injury/fatality	Instructions in notes about barriers to excavations. Contractor required to provide SWMS	D - Critical	3 - Possible	Significant	Ensure proper training, and follow all worksafe guidelines.	Contractor	During construction activities.	Open	D - Critical	2 - Unlikely	Moderate	
	Setup, Construction and Commissioning	Extreme Weather	Flooding or severe storms, bushfire.	DFES warning system	D - Critical	3 - Possible	Significant	Pay attention to weather warnings, including heavy rain in the catchment. Prepare the	Contractor	During construction activities.	Open	D - Critical	2 - Unlikely	Moderate	
	Setup, Construction and Commissioning	Hot Works	Injury during sealing of road pavements	Legally required job training and job safety analysis processes and procedures. Contractor required to provide SWMS.	C - Severe	3 - Possible	Moderate	Ensure all workers are properly trained for their tasks. Implement SWMS. Have a designated first aid officer on site at all times.	Contractor	During construction activities.	Open	C - Severe	2 - Unlikely	Low	
	Operation	Slips/Trips/Falls	Disability and ambulant access	Disability complying parking, kerb ramps, fishing platform at Chinaman's Beach, footpaths and shelter access provided. This is an existing site and reinstatement of existing facilities. Compliance to disability access codes have been complied with as far as possible and practical at the sites.	C - Severe	2 - Unlikely	Low	Construct to design levels to ensure appropriate grades on disability parking spaces, footpaths etc.	Contractor	During construction activities.	Open	C - Severe	2 - Unlikely	Low	
	Operation	Extreme Weather	Extreme wave conditions cause structures to fail	Basis of design and wave analysis considers extreme weather events	D - Critical	1 - Very Unlikely	Moderate	Construct as per design levels.	Contractor	During construction activities.	Open	D - Critical	1 - Very Unlikely	Moderate	
	Operation	Ground conditions	Land slippage caused by erosion from wind and water.	The earth retaining structures are designed to prevent erosion of embankments. However, these structures require ongoing inspection and maintenance.	C - Severe	3 - Possible	Moderate	Faces of slopes should be protected from erosion, with vegetation, matting or stone pitching. Ongoing inspection and maintenance	Operator	Throughout lifetime		C - Severe	2 - Unlikely	Low	
	Operation	Community/public interaction/access	Driving over edge of parking spaces	Log fencing and/or barrier kerbs provided as appropriate for each site.	C - Severe	1 - Very Unlikely	Low	Managed through design and implementation during construction.			Closed	C - Severe	1 - Very Unlikely	Low	
	Operation	Slips/Trips/Falls	Injury from falling off the retaining wall.	Blue Holes: Height of the wall has been limited to 0.6m minimise risk of injury and remaining within current standards. Chinaman's Beach: appropriate handrails and barriers have been included in the design.	C - Severe	2 - Unlikely	Low				Closed	C - Severe	2 - Unlikely	Low	
	Maintenance	Laydown areas	If equipment or materials need to be brought to site during maintenance work, and are placed on the sloping ground, they may collapse and roll, causing injury to workers or general public.		D - Critical	2 - Unlikely	Moderate	Provide a flat and secure laydown area.	Contractor	As required	Open	D - Critical	1 - Very Unlikely	Moderate	
	Maintenance	Slips/Trips/Falls	General public falling into / over work areas.		D - Critical	2 - Unlikely	Moderate	Provide clear signage and barriers during any maintenance works	Contractor	As required	Open	D - Critical	2 - Unlikely	Moderate	
	Disposal	Structures	Uncontrolled collapse of structures	All above ground structures have been designed so that they can be unbolted and removed in manageable pieces.	C - Severe	2 - Unlikely	Low	Contractor to have demolition plan for any significant demolition or dismantling works.	Contractor	When infrastructure is decommissioned.	Open	C - Severe	2 - Unlikely	Low	



## GHD RISK ASSESSMENT MATRIX



Risk Assessment Matrix		CONSEQUENCE				
		MINOR	MAJOR	SEVERE	CRITICAL	CATASTROPHIC
LIKELIHOOD		A	B	C	D	E
ALMOST CERTAIN	5	Low	Moderate	Significant	Extreme	Extreme
LIKELY	4	Low	Low	Moderate	Significant	Extreme
POSSIBLE	3	Negligible	Low	Moderate	Significant	Extreme
UNLIKELY	2	Negligible	Negligible	Low	Moderate	Significant
VERY UNLIKELY	1	Negligible	Negligible	Low	Moderate	Moderate



# GHD SAFETY IN DESIGN RISK ASSESSMENT CONSEQUENCE & LIKELIHOOD DESCRIPTORS



## GHD CONSEQUENCE DESCRIPTORS

Select the **MOST LIKELY/PROBABLE** consequence descriptor for the information available).

Risk Consequence	Design Consequence Descriptors
E- Catastrophic	Could result in fatality.
D – Critical	Could result in permanent total disability.
C- Severe	Could result in permanent partial disability, injuries or illness that may result in hospitalisation of persons.
B - Major	Could result in injury or illness resulting in one or more lost work days(s)
A – Minor	Could result in injury or illness not resulting in a lost work day.

## GHD LIKELIHOOD DESCRIPTORS

Select the best likelihood descriptor for the information available).

Likelihood Descriptor	Design Likelihood Descriptors
5 – Almost Certain	Industry experience suggests design failure is almost certain to occur during the life of the product.
4 – Likely	Industry experience suggests design failure is likely to occur during the life of the product.
3 – Possible	Industry experience suggests design failure is possible some time during the life of the design.
2 – Unlikely	Industry experience suggests design failure is unlikely to occur in the life of design.
1 – Very Unlikely	Industry experience suggests design failure is very unlikely. It can be assumed failure occurrence may not be experienced,



# HIERARCHY OF CONTROLS



Having established a level of risk for a hazard, it is then necessary to determine and implement an appropriate control (or combination of controls if no single measure is sufficient). Below is a guide from most preferred to least preferred control measures.

<b>ELIMINATE THE HAZARD</b>	<b>ELIMINATE</b> - Get rid of the hazard out of the workplace.	<ul style="list-style-type: none"> <li>▶ Redesign the work process to remove the hazard</li> <li>▶ Redesign of the work process to eliminate exposure</li> </ul>		
<b>CHANGE THE WAY WORK IS DONE</b>	<b>SUBSTITUTE</b> - Try to replace or change plant, substances or materials to lower the risk from the hazard.	<ul style="list-style-type: none"> <li>▶ Consider using air-powered instead of electric powered tools</li> <li>▶ Consider using water based paints rather than solvent based ones.</li> </ul>		
	Try to <b>ISOLATE</b> the hazard	<ul style="list-style-type: none"> <li>▶ Insulation (i.e. sound proofing or insulation from the heat)</li> <li>▶ Guarding on machines.</li> </ul>		
	<b>ENGINEERING CONTROL</b> - Design and install equipment to counteract the hazard	<ul style="list-style-type: none"> <li>▶ Lifting devices</li> <li>▶ Exhaust ventilation system to extract dangerous fumes or dust.</li> </ul>		
	<b>ADMINISTRATIVE CONTROL</b> Arrange work so people spend less time around the hazard and monitor their understanding of the hazard and the controls	<ul style="list-style-type: none"> <li>▶ Health and safety related Training;</li> <li>▶ Develop Service Line JSEA for staff to follow</li> <li>▶ Restricted access to certain work areas, i.e. confined space</li> <li>▶ Operator certification for plant</li> <li>▶ Job rotation.</li> </ul>		
<b>PPE</b>	<b>PPE</b> Have people wear protective equipment and clothing while near the hazard	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> <li>▶ Is it appropriate for the staff member?</li> <li>▶ Does it control the risk for that staff member?</li> <li>▶ Does it control the risk?</li> <li>▶ Is the staff member informed of any limitations?</li> <li>▶ Has the staff member been given instruction and training on the proper use of PPE?</li> </ul> </td> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> <li>▶ Examples of PPE</li> <li>▶ Clothes</li> <li>▶ Respirator</li> <li>▶ Gloves</li> <li>▶ Helmets</li> <li>▶ Wide-brimmed hats Goggles</li> <li>▶ Safety Footwear</li> <li>▶ High visibility vests</li> <li>▶ Ear plugs and ear muffs</li> </ul> </td> </tr> </table>	<ul style="list-style-type: none"> <li>▶ Is it appropriate for the staff member?</li> <li>▶ Does it control the risk for that staff member?</li> <li>▶ Does it control the risk?</li> <li>▶ Is the staff member informed of any limitations?</li> <li>▶ Has the staff member been given instruction and training on the proper use of PPE?</li> </ul>	<ul style="list-style-type: none"> <li>▶ Examples of PPE</li> <li>▶ Clothes</li> <li>▶ Respirator</li> <li>▶ Gloves</li> <li>▶ Helmets</li> <li>▶ Wide-brimmed hats Goggles</li> <li>▶ Safety Footwear</li> <li>▶ High visibility vests</li> <li>▶ Ear plugs and ear muffs</li> </ul>
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