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WALGA SPECIFICATIONS

WALGA Specification 9 Erosion Control and Foreshore Protection

Submitted to:

Mr Andrew Blitz
Western Australian Local Government Association
PO Box 1544
WEST PERTH WA 6872

SPECIFICATION

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**WALGA SPECIFICATION 9
WATERWAYS PROTECTION COMPONENTS
REVISION REGISTER**

Date	Clause Number	Description of Revision	Authorised By



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WALGA SPECIFICATION 7 - EROSION CONTROL AND FORESHORE PROTECTION



1.0 SCOPE

This standard specifies the requirements for rock protection (including rock mattresses) and revetment mattresses for use in erosion control and foreshore protection.

(A revetment mattress is defined as a double-sided mattress that shall be positioned over the surface and then injected with a sand cement grout. The finished product shall follow the contours over which it is laid and shall be neat in appearance. The resultant product will be a stable mat of suitable weight and configuration.)

Quotations are to be supplied as set out in a Schedule of Rates included in Annexure A1 and in a Lump Sum Bill of Quantities included in Annexure A2, in accordance with this specification and the drawings.

Acknowledgment: The use of Main Roads WA specifications and guidelines and the Institute of Public Works Engineering Australia (WA Division) Local Government Guidelines for Subdivisional Development are gratefully acknowledged as the basis of these specifications.

2.0 REFERENCES

Australian Standards, MAIN ROADS Western Australia Standards and MAIN ROADS Western Australia Test Methods are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are given below:

Australian Standards

- AS 1141.22 Methods for Sampling and Testing Aggregates: Method 22: Wet/Dry Strength Variation
- AS 1726 Geotechnical Site Investigations
- AS 2758.4 Aggregates and Rock for Engineering Purposes Part 4: Aggregates for gabions baskets and wire mattresses
- AS 3704 Geotextiles – Glossary of Terms
- AS 3705 Geotextiles – Identification, Marking and General Data
- AS 3706 Geotextiles – Method of Tests

Other Standards & Publications

- AUSTROADS Waterway Design, a Guide to the Hydraulic Design of Bridges, Culverts and Floodways. Publication No. AP-23/94
- AUSTROADS Guide to Geotextiles. Publication No. AP-3/90
- MAIN ROADS Specifications Specification 302 – EARTHWORKS
- ASTM-D737-96 Test Method for Air Permeability of Textile Fabrics
- ASTM-D1117-99 Standard Guide for Evaluating Non Woven Fabrics
- ASTM-D4491-99 Test Methods for Water Permeability of Geo-textiles by Permittivity
- ASTM-D4833-00 Standard Test Method for Index Puncture Resistance of Geo-textiles, Geo-membranes, and Related Products.
- ASTM-D5034-95 Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)



Acts and Regulations

Environmental Protection Act 1986

Environmental Protection Regulations 1987

Aboriginal Heritage Act 1972

Wildlife Conservation Act 1950

Environmental Protection (Clearing of Native Vegetation) Regulations 2004

Health Pesticide Regulations 1956

Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007

Occupational Safety and Health Act 1984

Occupational Safety and Health Regulations 1996

Rail Safety Act

Road Traffic Code 2000

Main Roads Act 1930

PRODUCTS AND MATERIALS

3.0 SOURCE ROCK

Source rock for rock protection and rock pitching shall consist of clean, sound, durable, hard rock. Rock used shall be fresh to slightly weathered and of very high to extremely high strength, as defined in AS 1726. Rock that is laminated, fractured, porous or otherwise physically weak is unacceptable. Flat slab-like rock pieces, with the breadth or thickness less than one third its length, should be avoided due to poor interlocking and easy dislodgement by flow where not grouted.

Limestone (calcarenite) used for rock pitching shall be well to very well cemented and of medium to high strength, with reference to the Clark and Walker Classification System (AS 1726) for cementation and AS 1726 for strength.

Rock for use in bridgeworks shall be to the details shown on Bridgeworks Drawings. For roadworks and drainage works, rock shall conform to the details given in Table 1.

Prior to delivery to site, the Contractor shall certify to the Local Government Authority Representative that the rock conforms to the specified requirements for its intended use. Test results shall be reported on NATA endorsed documents.



Table 1: Rock Properties Rock Protection and Rock Pitching (General Requirements)

Rock Class	Rock Size (m) *	Approximate Rock Mass (kg)	Percentage of Rock Larger than Rock Size in the Second Column	Typical Use (Examples Only)
Type A	0.20 0.10 0.075		0 50 90	Catchpit Surrounds
Type B1	0.30 0.20 0.10		0 50 90	Culvert Outlets
Type B (Facing)	0.40 0.30 0.15	100 35 2.5	0 50 90	Culvert Outlets
Light	0.55 0.40 0.20	250 100 10	0 50 90	Floodway Batters
Quarter Tonne	0.75 0.55 0.30	500 250 35	0 50 90	Floodway Batters
One Tonne	1.15 0.90 0.55	2000 1000 250	0 50 90	Floodway Batters
Two Tonne	1.45 1.15 0.75	4000 2000 500	0 50 90	Floodway Batters
Rock Pitching	0.40 x 0.40 x 0.20 0.15 x 0.15 x 0.15		60 100	Landscaped Slopes (Typically Limestone)

* Assuming a specific gravity of 2.65 and spherical shape for Type B, Light, Quarter Tonne, One Tonne and Two Tonne.

4.0 ROCK FILL FOR GABIONS AND MATTRESSES

Rock fill for gabions and mattresses shall be produced or derived from dense, hard, durable and clean rock in accordance with AS 2758.4. It shall be resistant to weathering actions of air and water and shall be free from cracks and other structural defects.

Rock used for rock fill shall be fresh to slightly weathered and of very high to extremely high strength, as defined in AS 1726. The rock fill shall be clean, angular, durable and of uniform quality, free from dust, clay, dirt and other deleterious material and free from an excess of flat or laminated pieces.

For gabions the minimum rock size shall be 100mm and the maximum rock size shall be 250mm.

For mattresses the minimum rock size shall be 75mm and the maximum rock size shall be two-thirds the thickness of the mattress, or 250mm, whichever is the lesser. The rock supplied shall have a range of sizes and a degree of angularity to ensure mechanical interlocking between rocks.

When determined in accordance with AS 1141.22, the aggregate wet strength shall not be less than 100kN and the wet/dry strength variation shall not exceed 35%. The rock may be crushed so as to produce the aggregate suitable to test by AS 1141.22.

Prior to delivery to site, the Contractor shall certify to the Local Government Authority Representative that the rock fill conforms to the specified requirements for its intended use. Test results shall be reported on NATA endorsed documents.



5.0 ROCK SUPPLY BY PRINCIPAL

Where some or all the rock protection requirements are supplied by the Principal, details are provided at Annexure 406A. The Contractor shall supply any additional rock that is required for the works.

6.0 GEOTEXTILE LINING

6.1 General

The Geotextile used for rock protection shall be a non-woven fabric consisting of long chain synthetic polymer fibres, composed of at least 95% by mass of polyester or polyolefins (polypropylene, polyethylene), bonded by needle punching, heat or chemical bonding processes or combinations thereof. Bonded fibres must be capable of retaining their relative position in the geotextile. The polymer fibres shall be rot proof, chemically stable and have low water absorbency. The geotextile shall have a high ultraviolet resistance such that when tested in accordance with AS 3706.11 shall have retained strength of at least 50% after 672 hours of test exposure. The geotextile shall be free of any flaws or defects that may adversely affect the mechanical or physical properties of the fabric.

Each roll of geotextile shall be provided with a suitable covering to protect the fabric against moisture and ultraviolet radiation, and marked in conformance with AS 3705.

Prior to installation, the geotextile rolls shall be stored on site under a protective cover and supported off the ground. The Contractor shall take appropriate measures to protect the geotextile from damage. This includes adhering to any other recommendations on method of storage set by the supplier/manufacturer.

Prior to the use of geotextile, the Contractor shall submit to the Local Government Authority Representative product certificates of compliance from the supplier, showing that the geotextile complies with all the requirements of this specification for intended use. Test results shall be reported on NATA endorsed documents.

The Contractor shall also certify that the geotextile delivered to site meets the Specification requirements. Sampling, conditioning and statistical analysis of results for each batch of geotextile shall be carried out in accordance with AS3706.1. Sampling frequency shall be in accordance with Appendix A of AS 3706.1. The conformance testing shall include determining the mean weight (mass per unit area) of the geotextile, in accordance with AS 3706.1.

6.2 Geotextile for Rock Protection

The Equivalent Opening Size (EOS) of the geotextile shall be less than 200 μm , mean value determined in accordance with AS 3706.7. The Geotextile Strength Rating (G) shall be greater than 4500, as defined in AUSTRROADS "Guide to Geotextiles" where $G = (L \cdot h_{50})^{0.5}$. L (in Newtons) is the characteristic value of burst strength (CBR Plunger Method) for the batch tested determined in accordance with AS 3706.1 and AS 3706.4. h_{50} (in mm) is the characteristic puncture resistance (Drop Cone Method) value for the batch tested determined in accordance with AS 3706.1 and AS 3706.5. The characteristic values of L and h_{50} shall be calculated as the mean value less 0.83 standard deviation. If appropriate, the minimum G rating may be reduced to 2000 where the nominal maximum particle size of the rock is no greater than 200 mm.

6.3 Geotextiles for Gabions and Mattresses

All gabions and mattresses shall be laid on geotextile filter lining as per the Drawings.

The Equivalent Opening Size (EOS) of the geotextile shall be less than 200 μm , mean value determined in accordance with AS 3706.7. The Geotextile Strength Rating (G) shall be greater than 2000, as defined in AUSTRROADS "Guide to Geotextiles" where $G = (L \cdot h_{50})^{0.5}$. L (in Newtons) is the characteristic value of burst strength (CBR Plunger Method) for the batch tested determined in accordance with AS 3706.1 and AS 3706.4. h_{50} (in mm) is the characteristic puncture resistance (Drop Cone Method) value for the batch tested determined in accordance with AS 3706.1 and AS 3706.5. The characteristic values of L and h_{50} shall be calculated as the mean value less 0.83 standard deviation.



6.4 Geotextiles for Revetment Mattresses

6.4.1 Uniform Cross Section Fabric

Uniform cross section fabric shall consist of double layer fabric joined together by restraining ties of uniform strength. Hydrostatic uplift, where required, shall be provided by inserting plastic weep-hole assemblies through the mat at specified centres. The minimum thickness of the pumped mat shall be 750mm.

6.4.2 Fabric specifications

Warp & Weft:	1100 DTX High Density, Heavily U.V. stabilised, continuous filament Polyester.
Ends/Pick:	19.5/15.5 per cm
Fabric Weight:	400 – 470g/m ²
Grab Tensile Strength:	Warp above 2500 N per 50mm per fabric layer; Weft above 2400 N per 50mm per fabric layer
Grab Elongation at break:	Warp 25% Weft 25%
Tear Strength:	Warp above 1100 N per fabric layer Weft above 1100 N per fabric layer
Porosity:	850 – 1000 cub cm / min / sq cm
Burst Strength:	Above 2200 N
Puncture Strength:	Above 1100 N per single layer of fabric
Water Flow Rate:	85 – 125 cub cm / min / sq cm

7.0 GABIONS

Details of gabions shall be as shown on the Drawings.

The gabions supplied by the Contractor shall be flexible, woven, galvanised PVC coated steel wire mesh boxes to the overall dimensions as specified on the Drawings. Alternative equivalent or improved methods of corrosion protection such as Zinc-Aluminium alloy and polyethylene coatings are acceptable.

Gabions shall have a hexagonal mesh with nominal size of 80mm x 100 mm. The minimum steel core wire diameter for the mesh shall be 2.7 mm.

Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabion plus 100 millimetres.

Prior to use, the Contractor shall submit to the Local Government Authority Representative product certificates of compliance from the supplier, showing that the gabions, selvages and lacing wire comply with all the requirements of this specification for its intended use.

8.0 ROCK MATTRESSES

Details of rock mattresses shall be as shown on the Drawings.

The mattresses supplied by the Contractor shall be flexible, woven, galvanised PVC coated steel wire mesh boxes to the overall dimensions as specified on the Drawings. Alternative equivalent or improved methods of corrosion protection such as Zinc-Aluminium alloy and polyethylene coatings are acceptable.

Mattresses shall have a hexagonal mesh with nominal size of 60mm x 80mm. The minimum steel core wire diameter for the mesh shall be 2.0mm for mattresses with less than 350mm depth and 2.4mm for 350 to 550mm depth.



Each mattress shall be divided by diaphragms into cells across the width of the unit and at not more than 1m centres or as shown on the Drawings.

Prior to use, the Contractor shall submit to the Local Government Authority Representative product certificates of compliance from the supplier, showing that the mattresses, selvages and lacing wire comply with all the requirements of this specification for its intended use.

9.0 SELVEDGES

All edges of the gabions, mattresses, diaphragms and end panels shall be selvaged with a continuous wire, thicker than the corresponding wire of the gabion, mattress or diaphragm, to give the mesh rigidity when subjected to tension.

The selvaging must be such that the mesh will not unravel. In addition, the strength of the connection between the galvanised selvedge wire and the mesh shall be equal to or greater than the breaking strength of the mesh.

The minimum steel core wire diameter shall be 3.4mm for gabions, 2.4mm for mattresses less than 350mm depth and 3.0mm for mattresses between 350 to 550mm depth.

10.0 LACING/TYING AND CONNECTING WIRE

Lacing/tying and connecting wire must be supplied with the gabions and mattresses to perform all the wiring operations required for the construction of the gabions or mattresses on site.

The minimum steel core wire diameter, for lacing/tying and connecting either gabions or mattresses, shall be 2.2mm.

Where the selvedge has to be fastened to the cut ends of the mesh, its diameter shall be 3.4mm, and it shall be attached by binding the cut ends of the mesh about it so that a force of not less than 8 330N applied in the same plane as the mesh, at a point on the selvedge of a mesh sample of length 1 000mm, is required to separate it from the mesh.

CONSTRUCTION

11.0 GEOTEXTILE LINING

The correct geotextile filter lining shall be supplied to suit unconfined rock protection, or for use with gabions and mattresses.

The period between initial laying out and complete cover of the geotextile with rock embankment protection, gabions or mattresses shall not exceed 14 days. Where possible and practical, geotextile shall be placed just ahead of associated advancing construction work and covered by relevant construction materials or suitable protective sheeting within 48 hours of being placed.

Any geotextile allowed to remain exposed to sunlight for a period greater than 14 days shall be removed and replaced at no cost to the Principal.

The geotextile shall be laid in full roll widths as supplied with the length of the fabric laid in the direction of stream flow. Adjacent strips shall be overlapped a minimum of 500mm.

The Contractor shall take every reasonable care to ensure that the geotextile is not damaged during installation and cover placement operations. The laid geotextile shall be subjected only to pedestrian traffic.

Any geotextile torn shall be replaced or patched by the laying over of an additional piece of geotextile extending a minimum of 1m from the extremities of the tear. The fabric shall be held down by rocks or other suitable means to prevent movements before placement of the rock embankment protection, gabrock protection



12.0 ROCK PROTECTION

Rock protection shall be supplied to the specified classes of rock, and shall comprise hard, clean rock spalls or cobbles obtained from the excavation of a uniform type and colour and grading as specified in Clause 406.06, placed to the dimensions, shape and extent shown on the Drawings.

Excavation for any required trenching for the placement of rock protection shall be constructed to the line, level and dimensions shown on the Drawings. Surplus, oversize and unsuitable material from excavations shall be disposed of in accordance with Specification 302 EARTHWORKS.

The rock spalls shall be firmly placed into position to the required lines and levels with a minimum of voids and shaped to suit the drain grades or batter slopes to the following tolerances and compacted with at least 4 passes of a crawler tractor of mass not less than 11 tonnes:

- a) Batter slopes shall be smoothly shaped to a uniform plane;
- b) The dimensions of the rock layer shall not be less than that shown in the Drawings. Local surface irregularities of the finished surface shall not vary from the prevailing batter slope by more than +100mm or -50mm measured at right angles to the slope except for culvert outlet protection which shall not vary by more than +0mm or -100mm;
- c) On floodways, no rock shall project above the shoulder and pavement level.

Rock protection shall present a generally uniform finish with flat surfaces of larger individual spalls, facing uppermost, comprising the finished surface and thoroughly keyed to the adjoining rocks.

Care shall be taken during placement to prevent sand filling voids between the rocks.

Where grouted rock protection is specified, individual rock spalls shall be placed on a mortar bed and voids between spalls filled with mortar, as detailed in the Drawings. The size of the voids shall not exceed 50mm in any direction.

Mortar for grouting shall comprise a 3:1 mix of builder's sand and ordinary Portland cement, with all sand being from the same source.

13.0 ROCK PITCHING

13.1 Sample Panels

Prior to the commencement of rock pitching, the Contractor shall prepare a sample panel of each type of rock pitching required in the Works, each at least 1.5m high x 2m long, for the Local Government Authority Representative's approval.

The samples shall display rock colour, texture, grain, surface treatment, rock size and jointing detail. The sample shall remain until the completion of stonework in the Works.

The standard of construction approved for the samples shall be maintained throughout the Works.

13.2 Construction

The finished rockwork on sloping rock pitching shall present a uniform surface matching adjacent slopes. The finished surface shall be thoroughly cleaned of all excess mortar and other debris.

Transitions from pitched batter slopes to pitched level surface shall be in the form of a smooth vertical curve to both top and toe conforming to the dimensions and form as indicated on the Drawings.

Unless otherwise shown on the Drawings, the rocks shall be set level and flush for a lateral distance of 1.0m when located adjacent to other paving materials such as kerbs, paths and manholes.



Rocks at the top and toe of batter slopes shall be securely underpinned with mortar to prevent any vertical movement. No mortar shall be visible after adjacent finished levels have been restored. Voids shall be filled with mortar from the bottom to within 10mm of the exposed face of the rock.

Mortar shall comprise a 3:1 mix of builder's sand and ordinary Portland cement, with all sand being from the same source. Where limestone is used for rock pitching, mortar shall comprise a 3:1:1 mix of builder's sand, builders lime, and ordinary Portland cement, with all sand being from the same source.

14.0 INSTALLATION OF GABIONS AND ROCK MATTRESSES

The assembly and erection of the gabions and mattresses shall conform to the following and the manufacturer's recommendations. Prior to assembly, the wire mesh of the gabion or mattress shall be opened out flat on the ground and stretched as much as possible to remove all kinks and bends, and checked to make sure that all creases are in the correct positions for forming the box.

The gabion or mattress shall be assembled individually by lifting the side and end panels into vertical position to form a rectangular box, ensuring that the tops of all four sides are level.

The four corners of the gabion or mattress box shall be wired together with lengths of lacing wire supplied. Starting at the top, the end of the wire shall be secured by twisting it around the selvages and through each mesh in turn using alternate single and double loops. The wire at the bottom shall be secured with the lacing wire turned to the inside of the box on completion. The diaphragm panels shall also be secured in a similar fashion.

The assembled empty gabion or mattress boxes shall be positioned in the structure. The end or side from which work is expected to proceed shall be secured either to completed work or by stakes driven into the ground at the corners. These stakes must be secure and reach at least to the top of the gabion or mattress.

For gabions, the opposite end or side of the box shall be stretched using crowbars or a small winch and secured top and bottom by stakes placed at the corners, fixed at the bottom and tied back at the top. Lacing to adjacent boxes and filling shall be carried out whilst gabion boxes are under tension.

For mattresses, movement of the rockfill inside the cells, either due to gravity or flowing current, should be kept to a minimum. Mattresses on slopes shall be placed such that the long dimension lies up and down the slope i.e. internal diaphragms at right angles to the direction of the slope. In watercourses, the long dimension of the mattress should be aligned with the direction of flow i.e. internal diaphragms at right angles to the direction of flow. The boxes shall be wired together along all adjoining edges and at diaphragm points.

The gabion boxes shall be filled one third full and horizontal interval bracing inserted (approximately 0.30m apart) to prevent excessive bulging and distortion of the completed structure. This procedure shall be repeated when the box is two thirds full. For both gabions and mattresses, final filling shall be to a level 25 to 50mm above their tops to allow for subsequent settlement.

Closing and lacing down of lids for both gabions and mattresses shall proceed as soon as practicable after filling operations. The lids shall be stretched tight over the filling with suitably design closing tools and laced securely through each mesh along all edges, ends and diaphragms. The ends of all lacing wires shall be turned into the box on completion of all lacing operations.



15.0 INSTALLATION OF REVETMENT MATTRESSES

Individual mill width panels shall be cut to suitable length and the two layers of fabric separately joined edge to create a continuous concrete mattress. The fabric shall be positioned in its desired location with allowance made for the fabric's contraction.

Grout shall consist of a mixture of Portland cement, fine aggregate and water so proportioned and mixed as to provide a readily pumpable slurry. A cut shall be made in the top layer of the mattress, in which an injection hose shall be inserted, through which the grout is pumped. The cured grout shall exhibit a compressive strength of at least 20MPa after 28 days.

The mattress shall be tied down into an anchor trench on all perimeters as shown. This trench is then earth backfilled or concrete backfilled to prevent any washouts behind the mat, as detailed on the Drawings.

The finished product shall be fully inflated, free of wrinkles or flat spots and shall leave no gaps around any permanent structures that are to be protected.

16.0 REGULATORY REQUIREMENTS

The Contractor shall conform to all statutory and regulatory requirements concerning the environment, aboriginal heritage, wildlife conservation, dangerous goods, occupational safety and health, rail safety, and road safety.



17.0 ANNEXURE A1

Schedule of Rates

The quantities in this Schedule of Rates are the estimated quantities of the Works and are not to be taken as the actual or correct quantities. The Contractor shall be paid for the measured quantity of each section or item of work described below and executed under the contract at the rates and amounts entered applicable thereto.

Item	Description	Unit	Qty	Rate (i)	Amount	
					\$	¢
GST Exclusive Total						
GST Amount						
Total Amount of Tender						

Note (i): Rate to include all overheads, incidentals, mobilisation and demobilisations, testing and aggregate loading.



18.0 ANNEXURE A2

Price Schedule (Lump Sum Bill of Quantities)

All items in this Bill of Quantities shall be priced and extended by the Tenderer and the lump sum accepted by the Local Government Authority shall equal the TOTAL AMOUNT GST INCLUSIVE. Any errors in the rates or prices entered in this Schedule shall be corrected by agreement between the Tenderer and the Local Government Authority. Where no agreement can be reached, any errors shall be corrected as determined by the Local Government Authority so that the total amount of tender for all items in this Schedule continues to equal the lump sum accepted by the Local Government Authority.

Item	Description	Unit	Qty	Rate (i)	Amount	
					\$	¢
GST Amount						
Total Amount of Tender						

Note (i): Rate to include all overheads, incidentals, mobilisation and demobilisations, testing and aggregate loading.



Report Signature Page

GOLDER ASSOCIATES PTY LTD

Reg Leach
Senior Consultant - Pavements and Surfacing

RDL/DMS/shp

A.B.N. 64 006 107 857

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

**Golder Associates Pty Ltd
Level 3, 1 Havelock Street
West Perth, Western Australia 6005
Australia
T: +61 8 9213 7600**

