Technical Specification

Transport and Main Roads Specifications MRTS16 Landscape and Revegetation Works

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Contents

1 Introduction

This technical specification applies to the construction of landscape and revegetation treatments in road works.

This technical specification shall be read in conjunction with MRTS01 I*ntroduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other technical specifications as appropriate.

This technical specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms used in this technical specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*. Additional terms used in this specification are defined in Table 2.

Table 2 – Definition of terms

Term	Definition
≤ 1 on 4 Slopes	Slopes equal to or flatter than 1 on 4.
> 1 on 4 Slopes	Slopes steeper than 1 on 4.
Broadacre	The areas beyond the toe of a fill embankment or top of a cut batter that are generally flat to gently sloping.
Clear zone	The area that commences at the edge of the trafficable lane and is available for emergency use by errant vehicles; the distance that the clear zone extends from the carriageway edge is dependent on the traffic volume, road geometry and design speed of the road. This area may consist of a shoulder, parking bays, a recoverable slope or a clear run-out area. Refer to the Department's *Road Landscape Manual – Safety* chapter.
Contained areas	Medians, separators; and planting beds bordered by garden edging.
Declared plant	Plants listed under three different classes that reflect the level of control required by law – refer to the *Land Protection (Pest and Stock Route Management) Act 2002* and the *Land Protection (Pest and Stock Route Management) Regulation 2003* for requirements.
Environmental weeds	A plant that invades native plant communities, farmland and urban areas. Refer to the Department of Environment and Heritage Protection and relevant local councils.
High profile areas	Off road areas, highly visible to the public including: a) pedestrian areas and shared paths b) transport stations c) areas fronting residential property, and d) key entries, gateways and intersections.
Pesticide	A pesticide is the collective term for herbicides, insecticides and fungicides.
Potable water	Water of a quality suitable for drinking.
Propagules	The reproductive parts of plants including seeds, stolons, roots, corms, bulbs and stems.
Recycled water	Appropriately treated effluent or storm water.
Representative soil sample	A representative soil sample is a sample that is representative of a single soil type and a single soil layer.
Seed germination / viability tests	Tests that indicate the live / viable seed percentages in a sample of seeds.
Seed purity test	A test that shows the percentages of pure seed, inert matter and other seed species in a sample of seeds.

Term	Definition
Sight visibility zone	An area calculated to provide the driver with adequate time to observe the road layout and react and stop if necessary, before entering the conflict zone. Refer to the Department's *Road Landscape Manual – Safety* chapter.
Soil	For the purposes of this Technical Specification, soil is considered to be in two distinct layers: a) topsoil, and b) subsoil.
Subsoil	For the purposes of this Technical Specification, subsoil is considered: a) the soil below the topsoil layer b) the outer face of a cut or fill embankment (subgrade), or c) the exposed soil in areas that have been stripped of topsoil in broadacre areas.
Stripped site topsoil	Non-ameliorated site topsoil stripped and stockpiled after the clearing and grubbing process.
Topsoil	For the purposes of this Technical Specification, topsoil refers to: a) surface soil that contain organic material b) screened and ameliorated site topsoil that complies with *Form D – Manufactured Site Topsoil Compliance Testing*, or c) imported topsoil that complies with *Form C – Topsoil Testing*.
Weeds	Plants which include declared plants, environmental weeds and the wrong plant in the wrong place or non-specified species. Plants that are known to impact negatively on the vigour and sustainability of the specified species.

3 Referenced documents

3.1 Material and practices

Table 3.1 lists documents referenced in this technical specification.

Table 3.1 – Referenced documents

Reference	Title
RLM	Road Landscape Manual (Transport and Main Roads)
PESTICIDES, WEED MANAGEMENT AND DISPOSAL	
	Chemical Usage (Agricultural and Veterinary) Control Act (1988)
	Agricultural Chemicals Distribution Control Act (1966)
	Land Protection (Pest and Stock Route Management) Act 2002
	Land Protection (Pest and Stock Route Management) Regulation 2003
MRTS04	General Earthworks
MULCH AND SOIL CONDITIONER	
AS 4454	Compost, soil conditioners and mulches
AS 4276.7	Water microbiology - Escherichia coli and thermotolerant coliforms - Membrane filtration method

Reference	Title
AS 3896	Waters - Examination for Legionella spp. including Legionella pneumophia
AS 5013.24.2	Microbiology of food and animal feeding stuffs – Horizontal method for the detection and enumeration of Listeria monocytogenes - Enumeration method
AS 4964	Method for the qualitative identification of asbestos in bulk samples
AS 4419	Soils for landscaping and garden use
SOIL	
AS 4419	Soils for landscaping and garden use
	Soil Chemical Methods : Australasia – Rayment & Lyons, CSIRO 2011
	Transport and Main Roads MR Materials Testing Manual
BITUMINOUS BINDER	
MRTS21	Bituminous Emulsion
CONTAINERISED PLANTS AND EX-GROUND STOCK	
	NATSPEC Guide: Specifying Trees
SUBSOIL DRAINS	
AS 2439.1	Perforated plastic pipes
RECYCLED WATER AND NON-POTABLE WATER	
	Queensland Water Recycling Guidelines (EPA 2005)
	Recycled Water Management Plan and Validation Guidelines (DEWS 2008)
	Guide to Workplace use of Non-potable Water Including Recycled Waters (DIER 2007)
AS/NZ 1319:1994	Safety Signs for the Occupational Environment
TIMBER PLANTING BED EDGING	
AS 1604.1	Specification for preservative treatment
AS 1214	Hot-dip galvanised coatings on threaded fasteners
CONCRETE PLANTING BED EDGING	
MRTS70	Concrete
MRTS03	Drainage, Retaining Structures and Protective Treatments
MRTS04	General Earthworks

Reference	Title
IRRIGATION	
AS 1477	UPVC pipes and fittings for pressure applications
AS 1604	Specification for preservative treatment
AS 2032	Code of practice for installation of UPVC pipe systems
AS 2033	Installation of polyethylene pipe systems
AS 2053	Conduits and fittings for electrical installations – General requirements
AS 2698	Plastics pipes and fittings for irrigation and rural applications – Polyethylene micro-irrigation pipe
AS 2845	Water supply – backflow prevention devices – Materials, design and performance requirements
AS 3000	Electrical installations
AS 3500	National Plumbing and Drainage Code for water supply connections
AS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS 4130	Polyethylene (PE) pipes for pressure applications
MRTS95	Switchboards and Cables
PRUNING	
AS 4373	Pruning of Amenity Trees

3.2 Standard drawings

Table 3.2 lists standard drawings referenced in this technical specification.

Table 3.2 – Standard drawings

Drawing Number	Title
1643	Planting Container Stock – Kerbed Medians and Separators
1644	Hardstand Abutments to Vegetation Works
1646	Roughening, Ripping and Cultivation
1647	Matting
1648	Plant Mats
1651	Turfing and Seeding
1653	Planting Container Stock < 25 L Container
1654	Planting Container Stock ≥ 25 L Container
1656	Guying Advanced Containers and Ex-Ground Stock

Drawing Number	Title
1659	Timber Planting Bed Edging
1660	Concrete Planting Bed Edging

4 Standard test methods

4.1 Test methods

Testing of all work shall be undertaken in accordance with Clause 4 of MRTS01 *Introduction to Technical Specifications*.

The standard test methods listed in Table 4.1 shall be used in this technical specification.

Table 4.1 – Test methods

Material to be Tested	Test Methods
Topsoil Testing	In accordance with MRTS16 Appendix *Form C*
Manufactured Site Topsoil Testing	In accordance with MRTS16 Appendix *Form D*
Subsoil Testing	In accordance with MRTS16 Appendix *Form E*
Drainage Basin Soil Testing	In accordance with MRTS16 Appendix *Form F*
Organic Soil Conditioner Testing	In accordance with AS 4454 *Composts, Soil Conditioners and Mulches*; and *Form G Organic Soil Conditioner Testing*
Non-potable Water Testing	In accordance with MRTS16 Appendix *Form I*
Imported Mulch	In accordance with AS 4454 *Composts, Soil Conditioners and Mulches*

Soil test methods have been developed by the Department specifically for Queensland soils to ensure:

- topsoil is capable of supporting pasture grasses and native vegetation, and
- subsoil is capable of supporting plant growth and to identify and manage dispersive / sodic / salinity soil risks.

The Topsoil Testing form is based primarily on components of AS 4419 *Soils for landscaping and garden use*, and *Soil Chemical Methods: Australasia*. The number of test parameters and parameter requirements of AS 4419 has been reduced relevant to naturally occurring topsoils and their use in road building projects.

The Manufactured Site Topsoil Compliance Testing form further reduces the number of parameters tested in the Topsoil Testing form, based only on those parameters affected by the amelioration process (including agricultural lime, dolomite, gypsum and / or organic soil conditioner).

The Subsoil Testing form is based on components of AS 4419 *Soils for landscaping and garden use*, and *Soil Chemical Methods: Australasia*. The number of test parameters and parameter requirements of AS 4419 has been reduced relevant to naturally occurring subsoils and their use in road building projects. The form has been developed to identify and manage erosion / dispersive / sodic risks and

other chemical properties to ensure the outer layer of subsoil is capable of supporting plant growth.

The Drainage Basin Soil Testing form has been developed to ensure basin material is a suitable construction material and capable of supporting plant growth. Test methods were extracted from AS 1289 *Methods of testing soils for engineering purposes*, TMR Test Methods Manual, AS 4419 *Soils for landscaping and garden use*, and *Soil Chemical Methods: Australasia*.

The Organic Soil Conditioner Testing form has been developed to ensure material will not cause health issues to workers or the general public. The Nitrogen Drawdown Index (NDI) parameter is tested to ensure material has reached maturity levels and is not detrimental to soil or vegetation establishment.

The Non-Potable Water Assessment and Testing form has been developed to ensure material will not cause health issues to workers or the general public. The requirements also ensure the chemical properties do not have a detrimental effect on soil or vegetation establishment.

4.2 Testing laboratory standards

Laboratory testing required as part of this technical specification shall only be carried out by a laboratory accredited by the National Association of Testing Authorities (NATA).

Laboratories that typically test for the engineering or geotechnical characteristics of soils are often not equipped or experienced in carrying out the soil test methods required for testing topsoil and subsoil. It is recommended Australasian Soil and Plant Analysis Council (ASPAC) certified laboratories be used to ensure correct test methods are used, results are reliable and to reduce the risks associated with failed vegetation treatments and rework.

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications* and Clause 8.3 of MRTS50 *Specific Quality System Requirements*.

The Hold Points, Witness Points and Milestones applicable to this technical specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.2.1		Submission of *Non-Potable Water Plan* and applicable permits.	
5.2.2			Submission of a *Soil Management Plan – Construction.*
5.2.2	1. Submission of a *Soil Management Plan – Construction* and assessment of suitability.		

Clause	Hold Point	Witness Point	Milestone
5.2.2	2. Submission of updates to the *Soil Management Plan – Construction* and assessment of suitability.		
5.3.1	3. Submission of a *Seed Supply Proposal* and assessment of suitability.		
5.3.2	4. Submission of a *Plant Supply Proposal* and assessment of suitability		
5.3.3	5. Submission of a *Plant Harvesting Proposal* and assessment of suitability.		
7.8.1.1		Joint plant nursery inspections.	
8.1.1.2		Weed free condition prior to other ground preparation operations.	
8.1.1.3		Application and incorporation of ameliorants to subsoil.	
8.1.1.4		Ripping of subsoil	
8.1.1.5		Cultivation of subsoil	
8.1.1.6		Roughening of subsoil	
8.1.2.3	6. Manufactured site topsoil is in accordance with Form D – *Manufactured Site Topsoil Compliance Testing*.		
8.1.2.4		Installation of topsoil.	
8.2.5		Plant delivery.	
8.2.5.1	7. Inspection of plant setting-out prior to planting.		
8.3.2.1	8. Submission of an irrigation design plan.		
8.3.2.2	9. Commissioning and testing of the irrigation system.		
9.1			Issue of the *Certificate of Commencement of the Establishment Period*.

Clause	Hold Point	Witness Point	Milestone
9.1.1.5	10. Submission of a proposal for an alternate species in re-installed treatments.		
9.2			Issue of the *Certificate of Commencement of the Monitoring Period.*
9.2			Issue of the *Certificate of Completion of the Monitoring Period.*
9.2.1.5	11. Submission of a proposal for an alternate species in re-installed treatments.		

5.2 Plans to be included in the Contract Plan

5.2.1 Non-Potable Water Management Plan (dam, creek, river and bore water)

Where a Contractor proposes to water vegetation works with non-potable water (excluding recycled water), they shall:

a) obtain the necessary permits and approvals (if required) for the use of water from proposed water source (dam, creek, river and bore), and

b) submit a *Non-Potable Water Management Plan*. **Witness Point**

The *Non-Potable Water Management Plan* shall be prepared in accordance with *Form H – Non-Potable Water Management Plan* of the MRTS16 Appendix.

5.2.1.1 Non-Potable Water Assessment Report

A Non-Potable Water Assessment Report shall:

a) be prepared for each non-potable water sample tested

b) be in accordance with *Form I – Non-potable Water Assessment and Testing Report* of the MRTS16 Appendix

c) be used to develop the *Non-potable Water Management Plan*, and

d) be incorporated as an Appendix to the *Non-potable Water Management Plan*.

5.2.2 Soil Management Plan – Construction

The *Soil Management Plan – Construction* is a Quality System document related to soil materials and associated activities.

The Contractor shall submit an initial *Soil Management Plan – Construction* as part of the *Environmental Management Plan – Construction (or interim submission of the Environmental Management Plan – Construction)*, in accordance with MRTS51. **Milestone**

The initial submission of the *Soil Management Plan – Construction* requires the following sections to be completed to ensure topsoil material requirement and soil related activities are considered at the commencement of the project:

a) Section 1 – Topsoil volumes assessment, and

b) Section 2 – Integrated soil management activities.

The *Soil Management Plan – Construction* shall be prepared in accordance with *Form A – Soil Management Plan – Construction* of the MRTS16 Appendix.

The *Soil Management Plan – Construction* shall be assessed for suitability by the Administrator. **Hold Point 1**

The *Soil Management Plan – Construction* is an evolving document and updates shall be provided to the Administrator at regular intervals when:

c) topsoil stripping, stockpiling and testing occurs

d) batter formation works and subsoil testing occurs, and

e) amelioration types and rates are determined.

The *Soil Management Plan – Construction* updates shall be assessed for suitability by the Administrator. **Hold Point 2**

The intent of the *Soil Management Plan – Construction* is to:

- identify and understand soil characteristics, deficiencies and associated risks
- determine amelioration types and rates
- ensure the appropriate management of soil throughout construction
- reduce the short and long term risk of erosion, vegetation failure and associated rework, and
- provide a Quality System to document soil material and construction related activities.

5.2.2.1 Soil Assessment Report

A Soil Assessment Report shall:

a) be prepared for each soil sample / soil test form

b) be prepared by a soil scientist with accreditations in accordance with Clause 6.2

c) be in accordance with *Form B – Soil Assessment Report* of the MRTS16 Appendix

d) be used to develop the *Soil Management Plan – Construction*, and

e) be incorporated as an Appendix to the *Soil Management Plan – Construction*.

Where soil has been tested by the Principal the soil test data and / or Soil Assessment Report may be provided. In such instances the data and / or reports are provided on an information only basis.

5.3 Proposals

5.3.1 Seed Supply Proposal

The Contractor shall submit a Seed Supply Proposal for a determination as to its suitability within 30 days of the date of Possession of Site or approval of documentation. **Hold Point 3**

The Seed Supply Proposal shall include:

a) seed species and application rates in accordance with Clause 7.4.1.4

b) where seed species are unavailable, substitute species

c) adjusted application rates, where seed purity and germination / viability percentages are less than 100%, as specified in Clause 7.4.1.1 and Clause 7.4.1.2

d) seed certificates in accordance with Clause 7.4.1.1 and Clause 7.4.1.2

e) seed pre-treatment requirements for hard cased native seeds, in accordance with Clause 7.4.1.3, and

f) adequate documentation to demonstrate seeds purchased and applied in project works.

A Seed Supply Proposal is not required where the only seed to be used is the default grass mix (*Cynodon dactylon* 60 kg / ha and 10 kg / ha cover crop).

The Seed Supply Proposal is a management tool to:

- promote the timely supply of seed species and quantities, reducing the need for substitutes
- where substitute species are unavoidable, allow the Administrator to view substitute and additional species
- allow the Administrator to confirm the species to be supplied and application rates meet the requirements of the Contract, and
- allow the Administrator to confirm seed pre-treatment requirements for hard cased native seeds are nominated.

It is beneficial for the Contractor to prepare a Seed Supply Proposal as early as practicable relevant to the various types of Contract delivery. It is beneficial to prepare a preliminary Seed Supply Proposal prior to the completion of documentation in Contract types such as Design and Construct, where the Contractor has Possession of Site prior to the completion of documentation.

5.3.2 Plant Supply Proposal

The Contractor shall submit a Plant Supply Proposal for a determination as to its suitability within 30 days of the date of Possession of Site or approval of documentation. **Hold Point 4**

The Plant Supply Proposal shall include:

a) plant nursery/s details

b) the plant species, planting densities and quantities in accordance with Clause 7.8.1

c) where specified plant species are unavailable, substitute plant species, mature height and width, densities and quantities for the substitutes

d) inspection report forms and documentation in accordance with NATSPEC Guide: *Specifying Trees*, for all containers ≥ 45 L and ex-ground stock

e) proposed plant delivery program and dates for joint inspections at the nursery, and

f) species to be supplied in accordance with a Plant Harvesting Proposal, where applicable.

The Plant Supply Proposal is a management tool to:

- promote the timely ordering and supply of container stock, particularly where large volumes are required, reducing the need for substitutes. Large volumes of plants are often contract grown and sufficient lead time is required to allow this process
- allow the Administrator to confirm the species and quantities to be supplied meet the requirements of the Contract, and
- where substitute species are unavoidable, allow the Administrator to view substitute species to determine their suitability.

It is beneficial for the Contractor to prepare a Plant Supply Proposal as early as practicable relevant to the various types of Contract delivery. It is beneficial to prepare a preliminary Plant Supply Proposal prior to the completion of documentation in Contract types such as Design and Construct, where the Contractor has Possession of Site prior to the completion of documentation.

5.3.3 Plant Harvesting Proposal

The Contractor shall submit a Plant Harvesting Proposal for a determination as to its suitability prior to harvesting plants. **Hold Point 5**

The Plant Harvesting Proposal shall include:

a) the proposed species to be harvested and their location

b) the proposed method of harvesting, and

c) the proposed method of storage and care.

Harvested plants shall be installed to areas as shown on Drawings and in accordance with Clause 8.2.5.

5.4 Quality system supplementary requirements

Quality system supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Item 1.1 of the MRTS16 Annexure.

6 General requirements

6.1 Landscape Representative

Where required in the Supplementary Conditions of Contract, the Contractor shall employ a Landscape Representative to be available for the duration of the Contract.

Nominating a Landscape Representative on large and / or complex projects can save project funds by reducing failures and associated rework, providing a more robust landscape for the Department at handover. Landscape and revegetation activities are unique to other road building activities as they involve the use of living materials (plant material) that require establishment so as to successfully reach their intended function.

The Landscape Representative should not be confused with the Environmental Representative as they have distinctly separate qualifications, skills and experience.

6.2 Soil Assessor accreditation

The Contractor shall have sampling, assessment and interpretation of soil test results carried out by a soil scientist:

a) with educational qualifications relating to soil science; agricultural science; soil survey and mapping; soil sodicity, acidity and salinity; disturbed land rehabilitation and / or erosion mitigation, and

b) with at least five years relevant experience in soil assessment and management

It is important soil sampling, assessment, interpretation and recommendations are provided by appropriately qualified and experienced specialists. Incorrect interpretation and recommendations can lead to additional costs, project delays and / or rework.

6.3 General requirements supplementary requirements

General requirements supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Item 2.1 of the MRTS16 Annexure.

7 Materials

The material requirements used throughout this technical specification are given below.

The Contractor shall store materials to ensure no deterioration or contamination occurs, including the potential for environmental harm.

Materials transported from a Red Imported Fire Ant restricted area require inspector approvals, as per *Department of Agriculture, Fisheries and Forestry* requirements, prior to delivery to site.

7.1 Pesticides

Pesticides shall:

a) be registered for use on roadsides and rights of way under the Chemical Usage (Agricultural and Veterinary) Control Act 1988, and

b) be registered for treatment of weeds by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

7.1.1 Knock-down herbicides

Knock-down herbicides shall be a broad spectrum, non-residual, glyphosate based herbicide that has been specifically manufactured for low aquatic toxicity.

7.1.2 Target herbicides

Target herbicides shall be used exclusively for the eradication of the target plant species. The type of herbicide and target vegetation to be controlled shall be specified in Item 3.1.1 of the MRTS16 Annexure.

7.1.3 Pre-emergent herbicides

Pre-emergent herbicide shall be oryzalin based.

7.1.4 Insecticides

Insecticides shall treat target insect species infesting vegetation works.

7.1.5 Fungicides

Fungicides shall treat target fungi infesting vegetation works.

7.2 Soil amelioration agents

Soil amelioration agents may include:

a) fertiliser

b) soil wetting agents

c) water holding agents

d) agricultural lime

e) agricultural gypsum

f) agricultural dolomite

g) microbial inoculants, and

h) organic soil conditioner.

7.2.1 Fertiliser

Fertiliser shall be applied in accordance with the manufacturer's application rate.

Controlled release / slow release fertilisers shall be prill or tablet form and have a minimum life of 3 months.

Planting treatments shall be fertilised with controlled release fertilisers.

Seeding and turf treatments may use:

a) uncontrolled release fertiliser

b) controlled release fertiliser, or

c) a mix of both fertilisers.

Uncontrolled release fertilisers shall not be used directly adjoining waterways.

Liquid fertilisers shall not be used.

Controlled release fertilisers:

- provide nutrients to plants over a longer period of time compared to uncontrolled release fertilisers
- are cost effective by reducing the requirement for additional fertilising, and
- have a reduced risk of nutrient deficient related failures in planting treatments.

Uncoated and liquid fertilisers:

- provide immediate but relatively short supply of nutrients
- are water soluble and highly leachable, with potential for translocating into water bodies or adjacent vegetation treatments and potentially causing potential harm
- have a high risk of nutrient deficient related vegetation failures if not reapplied during vegetation development.

The N:P:K ranges are intended to:

- address nutrient requirements for each vegetation treatment type, and
- allow flexibility to address soil nutrient deficiencies identified in the *Soil Management Plan – Construction.*

7.2.2 Soil wetting and water holding agents

Soil wetting agents (surfactants) shall:

a) have a life of at least 3 months from the time of application

b) be capable of reducing surface tension of soil particles

c) reduce soil water repellence / hydrophobicity

d) increase water penetration to soil, and

e) be free from matter toxic to plant growth.

Water holding agents shall:

f) have a life of at least 6 months from the time of installation

g) be manufactured from starch, synthetic polymers, porous ceramic clays and / or mineral wash

h) have the ability to hold water equal to at least 200 times their own mass

i) be hydrated / activated prior to installation, and

j) be free from matter toxic to plant growth.

7.2.3 Agricultural lime, agricultural dolomite and agricultural gypsum

Agricultural lime, agricultural dolomite and agricultural gypsum shall not be in a liquid form.

Agricultural lime shall be naturally occurring limestone (calcium carbonate $CaCO_3$).

Agricultural dolomite shall be naturally occurring dolomite (calcium magnesium carbonate $CaMg(CO_3)_2$).

Agricultural lime and agricultural dolomite shall meet the following parameter requirements:

a) have a neutralising value (NV) of 90 or above, determined using the Test Method 19A1 from the *Soil Chemical Methods: Australasia* (2011) by Rayment and Lyons

b) have a pH value of 8.5 +/- 0.5, determined using the test method in accordance with Clause 5.5 of AS 4419, and

c) have a particle size distribution of:

   i. 100% by weight to pass a 5 mm sieve

   ii. 95% by weight to pass a 3.5 mm sieve, and

   iii. 40% by weight to pass a 0.15 mm sieve.

Agricultural gypsum shall be naturally occurring gypsum (calcium sulfate $CaSO_4 2H_2O$). Crushed plaster board is not permitted.

Agricultural gypsum shall meet the following parameter requirements:

d) a minimum 80% of gypsum

e) a moisture content of < 15%

f) have a total content (x-ray fluorescence test) of:

   i. 20% calcium (Ca)

   ii. 15% sulphur (S), and

   iii. < 2% sodium chloride (NaCl)

g) if manufactured – have a total content of heavy metals:

   i. < 0.001% cadmium (Cd), and

   ii. < 0.01% lead (Pb)

h) have a particle size distribution of:

   i. 100% by weight to pass a 6 mm sieve

   ii. 80% by weight to pass a 4 mm sieve, and

   iii. 50% by weight to pass a 2 mm sieve.

7.2.3.1 Agricultural lime, agricultural dolomite and agricultural gypsum delivery docket

Delivery of agricultural lime, agricultural dolomite and agricultural gypsum shall be accompanied by a delivery docket stating at least the following information to certify the delivered material is in accordance with material requirements:

a) name of supplier

b) certification that material is in accordance with the material requirement

c) quantity, and

d) delivery docket number,

Delivery dockets shall:

e) be made available for inspection by the Administrator, and

f) be incorporated as an Appendix to *Soil Management Plan – Construction*.

7.2.4 Microbial inoculants

Microbial inoculants shall:

a) contain bacteria and / or fungi not toxic to plant growth, and

b) improve soil structure and improve plant heath.

7.2.5 Organic soil conditioner

Organic soil conditioner shall comply with:

a) AS 4454 Clause 3.1.1.1 (d) mature compost and Clause 3.1.1.2 (a) soil conditioner, and

b) *Form G – Organic Soil Conditioner Testing.*

7.2.5.1 Organic soil conditioner delivery docket

Delivery of soil conditioner shall be accompanied by a delivery docket stating at least the following information to certify the delivered material is in accordance with the tested material:

a) date of manufacture

b) name of manufacturer

c) manufacture batch number

d) quantity

e) delivery docket number, and

f) laboratory sample number noted on the associated *Form G – Organic Soil Conditioner Testing*.

Delivery dockets shall:

g) be made available for inspection by the Administrator, and

h) be incorporated as an Appendix to *Soil Management Plan – Construction*.

7.3 Soil

For the purposes of this technical specification, soil is considered to be in two distinct layers:

a) subsoil, and

b) topsoil.

Soil shall be free of contaminants harmful to plant growth or human health.

Why test and ameliorate soil when existing vegetation is successfully growing in the area?

Native vegetation has successfully evolved to grow on naturally occurring soils. Road building involves the formation of artificial landforms through the excavation of cut embankments and construction of fill embankments. The subsoil in embankments is typically material which has not previously supported vegetation and has poor nutrient levels. It can have extreme acidity or alkalinity; and erosive characteristics including dispersion / sodicity. Topsoils are stripped, stockpiled and spread over these embankments. Due to the shallow depths of topsoils, they are often unintentionally stripped with the upper layer of subsoil resulting in a poor quality material.

The road building process results in a highly modified, unnatural soil profile that typically requires amelioration to improve soil qualities and assist plant growth and to manage the erosive characteristics of subsoils. By ameliorating topsoil and subsoil / outer embankment material, vegetation can develop a sustainable root system and growth to withstand the extremes of the roadside environment while mitigating erosion.

A typical amelioration process is cost effective in the management of erosion and vegetation establishment risks and is easily incorporated into the road construction process.

As a result, topsoil and subsoil are tested and where required, ameliorated to:

- ensure it is capable of establishing and sustaining vegetation, and
- minimise the risk of erosion and subsequent land degradation that undermines road infrastructure and / or causing environmental harm to waterways.

7.3.1 Subsoil

Subsoil shall:

a) be tested in accordance with Clause 8.1.1.1, and

b) be ameliorated, in accordance with the recommendations of the *Soil Management Plan – Construction* to meet the requirements of *Form E – Subsoil Testing*.

7.3.2 Topsoil

Topsoil may be:

a) manufactured site topsoil, or

b) imported topsoil.

7.3.2.1 Manufactured site topsoil

Manufactured site topsoil shall:

a) be manufactured from material stripped and stockpiled during clearing and grubbing operations in accordance with MRTS04 *General Earthworks*

b) be initially tested in accordance with Clause 8.1.2.1

c) be manufactured in accordance with Clause 8.1.2.2, and

d) be tested for compliance in accordance with Clause 8.1.2.3.

When it is intended to use site topsoil, ensure Items 3.1 and 3.2 of the MRTS04 *General Earthworks* Annexure are completed and provide adequate quantities of suitable material. Where insufficient quantities are available, additional imported materials may be required.

Ensure topsoils with known contamination of weed seed are stripped separately and disposed.

7.3.2.2 Imported topsoil

Imported topsoil shall:

a) be tested in accordance with Clause 8.1.2.1

b) meet the requirements of *Form C – Topsoil Testing*, and

c) be certified weed free.

All test forms shall be included in the *Soil Management Plan – Construction.*

7.3.2.3 Imported topsoil delivery docket

Delivery of imported topsoil shall be accompanied by a delivery docket stating at least the following information to certify the delivered material is in accordance with the tested material:

a) date of manufacture

b) name of manufacturer

c) manufacture batch number

d) quantity

e) certification that topsoil is weed free

f) delivery docket number, and

g) laboratory sample number noted on *Form C – Topsoil Testing*.

Delivery dockets shall:

h) be made available for inspection by the Administrator, and

i) be incorporated as an Appendix to *Soil Management Plan – Construction*.

7.3.2.4 Backfill soil material

Backfill soil material, used in planting holes deeper than 300 mm, shall be ameliorated subsoil from the planting hole.

7.4 Seeding

7.4.1 Seeds

Grass seed shall be in accordance with Clause 7.4.1.1.

Native seed shall be in accordance with Clause 7.4.1.2.

It is recommended experienced agronomists, revegetation specialist and seed suppliers are consulted to develop grass seed and native seed mixes that are well suited to particular geographic regions and climatic zones of Queensland.

7.4.1.1 Grass seed

Grass species shall:

a) be perennial species (excluding annual cover crops)

b) not exceed a mature height of 700 mm, and

c) be typically found in the region.

A certificate for each species shall be included in the Appendix of the Seed Supply Proposal, and include the following:

d) species of the seed

e) purity percentage

f) germination / viability percentage, and

g) pre-treatments or coatings that have been applied to the seed.

The Contractor shall use the purity and germination / viability certificates to adjust the application rates to achieve an application rate of 100% live seed.

7.4.1.2 Native seed

Native species shall:

a) be typically found in the region

b) be tree and shrub species with a mature height and width greater than 1.5 m, and

c) not include groundcover species.

A certificate for each species shall be included in the Appendix of the Seed Supply Proposal, and include the following:

d) species of the seed

e) purity percentage

f) germination / viability percentage, and

g) pre-treatments or coatings that have been applied to the seed.

The Contractor shall use the purity and germination / viability certificates to adjust the application rates to achieve an application rate of 100% live seed.

7.4.1.3 Seed mix preparation / pre-treatment

Hard cased seed species shall be pre-treated by the supplier, by scarification of the seed case, unless otherwise specified in Seed Supply Proposal.

7.4.1.4 Seed mix and application rates

Grass seed mix and application rates shall be in accordance with Clause 7.4.1.5.

Native seed mix and application rates shall be in accordance with Clause 7.4.1.6.

Specified Seed Species and Application Rates

Where seed species and application rates are specified in Item 3.2.1 or Item 3.2.2 of the MRTS16 Annexure or shown on the Drawings, the Contractor:

a) shall regard the seed mix and application rates as the required minimum

b) may request to increase the seed species and / or application rates to ensure Clause 9.1.2 and / or Clause 9.2.2 completion criteria is achieved

c) shall substitute species not available

d) ensure substitute species meet the design constraints (clear zone, sight visibility and other vegetation setbacks and clearances):

   i. as shown on the Drawings, or

   ii. in the *Road Landscape Manual* – Appendix 4, where not shown on the Drawings

e) shall use the purity and germination / viability certificates to adjust the application rates to achieve an application rate of 100% live seed, and

f) shall include the seed mix and adjusted application rates in the Seed Supply Proposal

Contractor Supplied Seed Species and Application Rates

Where seed species and application rates are not specified in Item 3.2.1 or Item 3.2.2 of the MRTS16 Annexure or shown on the Drawings, the Contractor:

g) shall determine the seed species and application rates to ensure:

   i. species and rates are in accordance with the minimum requirements of Clause 7.4.1.5 and / or Clause 7.4.1.6

   ii. Clause 9.1.2 and / or Clause 9.2.2 completion criteria is achieved, and

h) shall ensure species meet the design constraints (clear zone, sight visibility and other vegetation setbacks and clearances):

   i. as shown on the Drawings, or

   ii. in the *Road Landscape Manual* – Appendix 4, where not shown on the Drawings.

i) shall use the purity and germination / viability certificates to adjust the application rates to achieve an application rate of 100% live seed, and

j) shall include the seed mix and adjusted application rates in the Seed Supply Proposal.

The following is an example of adjusting the application weight (2 kg) to achieve the specified seed rate (100% live seed) –

Specified Weight (2kg) ÷ Purity Percentage (70%) ÷ Germination / Viability Percentage (85%) = Application Weight (live seed)

2 kg ÷ 0.70 ÷ 0.85 = 3.36 kg

7.4.1.5 Grass seed mix

Grass seed mix application rates:

a) shall be in accordance with Table 7.4.1.5

b) shall be specified in Item 3.2.1 of the MRTS16 Annexure and shown on the Drawings

c) shall be included in the Seed Supply Proposal, and

d) are based on 100% live seed.

Table 7.4.1.5 – Grass seeded mix – minimum application rate

Time of Year	Description	Minimum Total Application Rate kg / ha
Perennial Species		
All	*Mix of perennial species	60
Cover Crop Species		
March – April	Annual Rye 60% and Millet 40% of application rate	10
May – August	Annual Rye	
September – October	Annual Rye 40% and Millet 60% of application rate	
November – February	Millet	

* Perennial species must not exceed a mature growth height of 700 mm.
* Urban Areas (High profile areas, as per Table 2 – Definition of Terms) – where no seed mix is specified, a default mix of *Cynodon dactylon* 60 kg / ha (minimum) and 10 kg / ha cover crop shall be used.
* Rural Areas and Low Profile Urban Areas (road batters / grassed drainage structures) – a mix of three perennial grass species and two prostrate, clumping legumes shall be included in the mix.

In developing seed mixes, consideration should be given to the adjoining landholder requirements (for example environmentally sensitive areas such State Forests / National Parks or pastoral / agricultural land) and minimising potential impacts.

A mixture of perennial grasses is required to reduce the risk of not achieving an acceptable outcome. Perennial grass species selection should prioritise species:

- commonly found in the area, particularly pasture areas
- suitable for the soil type and annual rainfall of the site / treatment area, and
- that are commercially available and cost effective.

Legumes are included in rural and low profile areas to provide an ongoing source of nitrogen. Ensure species are not capable of climbing and smothering vegetation.

It is important to note that some native grass species are not suitable for seeding due to:

- lower germination and establishment rates
- shape / morphology relative to mechanical applicators
- an inability to compete with exotic grass species (included in the seed mix or in sites adjoining the site), and
- high cost or availability.

Note – Minimum total application rate relates to the total of a category, for example 20 kg / ha of three different perennial grass species = a Total Application Rate of 60 kg / ha.

The following is an example grass mix from north Queensland:

Perennial Species

- 40 kg / ha Bothriochloa pertusa
- 5 kg / ha Cynodon dactylon
- 15 kg / ha Paspalum notatum
- 2.5 kg / ha Chamaecrista rotundifolia cv. Wynn
- 2.5 kg / ha Stylosanthes hamata cv. Verano

Cover Crop

- 10 kg / ha Japanese millet

7.4.1.6 Native seed mix

Native seed mix application rates:

a) shall be in accordance with Table 7.4.1.6

b) shall be specified in Item 3.2.2 of the MRTS16 Annexure and shown on the Drawings

c) shall be included in the Seed Supply Proposal, and

d) are based on 100% live seed.

Table 7.4.1.6 – Native seed mix – minimum application rate

Time of Year	Description	Minimum Total Application Rate kg / ha
Native Seed Species		
All	Mix of a minimum of five Acacia species	5
	Mix of a minimum of three tree species	1
	**Mix of a minimum of two shrub species	0.5
Perennial Grass Species		
All	*Mix of three perennial species and two prostrate, clumping legumes	20

Time of Year	Description	Minimum Total Application Rate kg / ha
Cover Crop Species		
March – April	Annual Rye 60% and Millet 40% of application rate	10
May – August	Annual Rye	
September – October	Annual Rye 40% and Millet 60% of application rate	
November – February	Millet	
* Perennial grass species must not exceed a mature growth height of 700 mm. ** Shrub species shall have a mature height and width greater than 1.5 m. Ground covers are not permitted.		

The minimum native seed mix is based on the need to:

- ensure seed mixes are cost effective
- prioritise the establishment of grass cover to stabilise the site in the interim to meet water quality and erosion minimisation requirements
- have a mix dominated by Acacia species, as these are a pioneer species suited to highly disturbed sites typical of a road project. Over time, pioneer species assist the establishment of the other native seeds in the mix, or native seeds which naturally exist / enter the site, and
- reduce the risk of failing to achieve the completion criteria.

Legumes are included to provide an ongoing source of nitrogen. Ensure species are not capable of climbing and smothering vegetation.

Factors to consider when specifying seed mixes to ensure the cost and risk of failure are minimised.

- Some species require specific conditions to germinate and establish in nature. Existing vegetation should be used as a guide to what grows locally, however not all species within the existing vegetation or regional ecosystem will be suited to the roadside environment. Preference should be given to pioneer species due to their ability to establish in disturbed areas, typical of road project conditions.
- Select species that are suitable for the soil, climate and location within the road formation. Conditions such as no shade or shelter; altered landforms such as high cut or fill batters, imported fill material; altered drainage systems and water availability in soil, should all be considered. For example, species suited to low, moist areas in the natural landscape are not suitable on a large free draining / dry fill batter.
- Ensure selected species are available at the required time, in the required quantities and at a cost that does not render the seed treatment impracticable.
- Ground covers and small shrubs (less than 1.5 m mature height and width) are excluded from the native seed mix due to their inability to compete with grass and weed species.

Note – Minimum totals of application rate relate to the total of a category – for example 1kg / ha of five different Acacia species = Total Application Rate 5 kg / ha.

7.4.2 Fibres

Fibres shall be free from:

a) matter toxic to plant growth

b) plant propagules

c) soil

d) rubbish, and

e) other deleterious materials.

7.4.2.1 Sugar cane

Sugar cane fibre shall be processed from sugar cane tops and of a small particle size, suitable for use in hydromulching equipment.

7.4.2.2 Wood

Wood fibre shall be defibrated.

7.4.2.3 Paper

Paper fibre shall be hammer-milled paper.

7.4.2.4 Straw

Straw mulch shall:

a) be crop residue, and

b) be predominantly stalk material.

7.4.3 Binders

Binders (tackifiers) shall be free from:

a) matter toxic to plant growth

b) plant propagules

c) soil

d) rubbish, and

e) other deleterious materials.

Types of binders include:

f) guar binder

g) organics blanket binder

h) bituminous binder, and

i) water-soluble polyacrylamide.

Binders shall be applied in accordance with manufacturer's specification and recommended rates.

7.4.3.1 Guar binder

Guar binder shall be a natural (non-cross linked) co-polymer binder with the following characteristics:

a) 100% pure guar

b) biodegradable

c) readily dispersible

d) highly soluble

e) self-hydrating, and

f) display a delayed development of viscosity before final thickening takes place.

7.4.3.2 Organics blanket binder

Organics blanket binder shall contain materials derived from natural and biodegradable materials.

Organics blanket binder shall have the following characteristics:

a) ability to be applied through a seed injection system

b) enhances the ability of the organics blanket to bond with the ground surface

c) stabilise organic soil conditioner material, and

d) be a nutrient resource for beneficial compost bacteria.

7.4.3.3 Bituminous binder

Bituminous binder shall:

a) be slow setting anionic bituminous emulsion in accordance with the requirements of MRTS21 *Bituminous Emulsion,* and

b) be free from petroleum solvent or other components toxic to plant growth.

7.4.3.4 Water-soluble polyacrylamide

Water-soluble polyacrylamide, or similar binder, shall:

a) be readily dispersible

b) be highly soluble

c) display a delayed development of viscosity before setting, and

d) be specifically manufactured for use in hydromulch or similar seeding applications.

7.4.4 Organics blanket

An organics blanket shall consist of:

a) organic soil conditioner in accordance with Clause 7.2.5

b) organics blanket binder in accordance with Clause 7.4.3.2

c) soil amelioration agents, and

d) seed mix.

7.4.5 Seeding fertilisers

Fertiliser shall:

a) be in accordance with Clause 7.2.1, and

b) have an N:P:K analysis in accordance with Table 7.4.5, unless nominated otherwise in the *Soil Management Plan – Construction.*

Table 7.4.5 – Seeding Fertiliser N:P:K Range

	Uncontrolled Release	**Controlled Release**
N	12 – 20	10 – 22
P	10 – 15	5 – 15
K	8 – 15	5 – 15
S	1 – 3	

7.5 Turfing

7.5.1 Turf

Turf shall:

a) have a minimum 30 mm depth of sod

b) be in a healthy condition free from weeds, pests, diseases and matter toxic to plant growth

c) show signs of active growth, and

d) be true to the form of the specified species.

A-grade turf shall consist of 95% of the specified turf species.

B-grade turf shall consist of 80% of the specified turf species.

Turf species, turf grade and roll width shall be specified in Item 3.3.1 of the MRTS16 Annexure.

A-grade turf should be used in high profile urban areas such as:

- pedestrian areas and shared paths
- transport stations, and
- areas fronting residential property.

B-grade turf is suitable for areas other than high profile urban areas such as table drains and around the perimeter of drainage structures and gabions.

7.5.2 Turf fertiliser

Fertiliser shall:

a) be in accordance with Clause 7.2.1*, and*

b) have an N:P:K analysis in accordance with Table 7.4.5, unless nominated otherwise in the *Soil Management Plan – Construction*.

7.6 Mulch

Mulch shall:

a) be site manufactured mulch, or

b) be imported mulch.

Mulch shall be free from:

c) weeds

d) soil

e) plant propagules

f) pests

g) diseases

h) contaminants, rubbish and deleterious material, and

i) matter toxic to plant growth.

7.6.1 Site manufactured mulch

Site manufactured mulch shall:

a) be manufactured from vegetation material set aside during clearing and grubbing operations in accordance with MRTS04 *General Earthworks*

b) not be manufactured from weed species

c) have a range of sized pieces, with a maximum dimension of 100 mm, and

d) be manufactured in accordance with Clause 8.2.3.1.

Site mulch type and size shall be specified in Item 3.4.1 of the MRTS16 Annexure.

Where vegetation exists on site and it is intended to use it to produce site manufactured mulch for use in permanent landscape works or temporary erosion and sediment control works, ensure Item 2.4 of the MRTS04 *General Earthworks* Annexure specifies the retention of adequate quantities of suitable material.

7.6.2 Imported mulch

Imported mulch shall comply with the requirements of AS 4454:

a) Clause 3.1.1.1 (c) composted product, and

b) Clause 3.1.1.2 (b) coarse mulch.

The Contractor shall provide written certification from the supplier that the imported mulch is in accordance with the material requirement and is weed free.

Mulch type and size shall be as specified in Item 3.4.2 of the MRTS16 Annexure.

7.6.2.1 Imported mulch delivery docket

Delivery of mulch shall be accompanied by a delivery docket stating at least the following information to certify the delivered material is in accordance with the tested material:

a) date of manufacture

b) name of manufacturer

c) manufacture batch number

d) quantity

e) certification that mulch is weed free

f) delivery docket number, and

g) certification the manufactured batch is in accordance with Clause 7.6.2.

Delivery dockets shall:

h) be made available for inspection by the Administrator, and

i) be incorporated as an Appendix to *Soil Management Plan – Construction*.

7.7 Matting

7.7.1 Matting

The type and roll size (length and width) of matting shall be as specified in Item 3.5.1 of the MRTS16 Annexure.

7.7.1.1 Matting – seeding

Matting used with seeding operations shall:

a) be an open mesh material suitable for seeding operations

b) protect topsoil and seeding from water and wind erosion

c) allow the exchange of air and water, and

d) not contain matter toxic to plant growth.

7.7.1.2 Matting – planting

Matting used with container planting operations shall:

a) be a high density material suitable for container planting operations

b) be made from 100% biodegradable fabric

c) minimise weed growth

d) reduce soil moisture loss

e) protect topsoil from water and wind erosion

f) allow the exchange of air and water, and

g) not contain matter toxic to plant growth.

Matting used with container planting operations in drainage structures shall be capable of withstanding design water velocities until vegetation is established.

7.7.1.3 Matting fixing pins

Fixing pins used to secure matting shall be a minimum 200 x 30 x 200 mm steel.

7.8 Planting

7.8.1 Containerised plants and ex-ground stock

Plants may be obtained from:

a) nurseries, and

b) harvested plant material from site.

Nurseries shall be members of *Nursery and Garden Industry Australia / Queensland*.

Plant container sizes include:

c) < 25 L container stock:

   i. Viro tube (macrophytes only)

ii. Full native tube

iii. 90 mm

iv. 140 mm

v. 200 mm

d) ≥ 25 L container stock:

i. 25 L

ii. 45 L

iii. 100 L

iv. 200 L

v. 400 L

vi. ex-ground stock

Plant material shall:

e) be acclimatised to the conditions of the site – by sun hardening and reducing watering

f) be of a size appropriate to the container size

g) be in a healthy condition free from weeds, pests and diseases

h) not be showing signs of nutrient deficiency

i) be showing signs of active growth relative to season and true to form of the species

j) have a healthy root system and not be pot bound

k) be clearly and correctly labelled according to botanical name

l) have water resistant labels and tied securely to a minimum one species per tray, and

m) be delivered to site in fully enclosed trucks.

Trees shall have a single leading stem unless otherwise specified.

Ex-ground stock and ≥ 45 L container stock shall conform to the requirements in *NATSPEC Guide: Specifying Trees*.

Plant species, quantities, container sizes, mature heights and widths; and planting densities shall be specified in Item 3.6.1 of the MRTS16 Annexure and shown on the Drawings.

7.8.1.1 Containerised plants and ex-ground stock inspections

Joint nursery inspections are required:

a) prior to the delivery of plants to site

b) within 2 months of the Administrator deeming the Plant Supply Proposal suitable, and

c) every 2 months where the growing period is greater than 2 months.

The Contractor shall give a minimum 5 days notice of joint inspections at nurseries. **Witness Point**

Plant root inspection shall:

d) not exceed 2% of the total of each species, or

e) not exceed 2 containers if less than 100.

If samples inspected are found to be defective, the entire species represented by the defective samples may be rejected. All plants rendered unsuitable as a result of an inspection will be rejected and considered as samples on which payment cannot be claimed.

7.8.2 Stakes and ties

Stakes shall:

a) be Type 1 600 x 10 mm diameter bamboo

b) be Type 2 1500 x 25 x 25 mm hardwood, and

c) be Type 3 1800 x 50 x 50 mm hardwood.

Ties shall be 50 mm wide jute material.

7.8.3 Guying

Guy ropes shall:

a) be wire rope

b) be sized to adequately support the particular plant, and

c) be encased in hosing where it encircles the plant trunk and branches.

Tree protection shall be jute material.

Wire rope grips / crimp shall be sized to suit the cable.

Turnbuckles shall be sized to suit the cable.

Anchoring stakes shall:

d) be minimum 900 mm in sandy soils, and

e) be minimum 600 mm in clay soils.

Flags or streamers shall be plastic.

Proprietary underground tree guying systems shall be used in high profile urban areas, to avoid pedestrian and maintenance conflicts with aboveground wire ropes.

7.8.4 Plant mats

Plant mats shall:

a) be made from 100% biodegradable fabric

b) minimise weed growth

c) reduce soil moisture loss

d) allow the exchange of air and water

e) not contain matter toxic to plant growth

f) be a minimum 500 x 500 mm for < 25 L containers, and

g) be a minimum 1000 x 1000 mm for ≥ 25 L containers.

Type and size of plant mats shall be specified in Item 3.6.2 of the MRTS16 Annexure.

7.8.4.1 Plant mat fixing pins

Fixing pins used to secure plant mats shall be 150 x 30 x 150 mm steel.

7.8.5 Site harvested plants

Site harvested plant species, method of harvesting and storage requirements are as specified in Plant Harvesting Proposal, in accordance with Clause 5.3.3.

7.8.6 Subsoil drain

Subsoil drains shall:

a) have a 100 mm perforated drainage pipe with textile sleeve compliant with AS 2439.1

b) have backfill material consisting of a single-sized aggregate of 20 mm or 10 mm particle size, with a maximum of 5% passing the AS 0.15 mm sieve, and

c) have a geotextile surround compliant with Clause 6 of MRTS27 *Geotextiles (Separation and Filtration)*.

7.8.7 Container and ex-ground stock fertilisers

Fertilisers shall:

a) be in accordance with Clause 7.2.1

b) be controlled release, minimum 6 months

c) applied in accordance with the manufacturer's application rate

d) have an N:P:K analysis within the following ranges, unless nominated otherwise in the *Soil Management Plan – Construction:*

   i. N: 7 – 22

   ii. P: 1 – 6

   iii. K: 2 – 10

7.9 Water

Water used for vegetation works shall:

a) have a pH between 6 and 8.5 (inclusive)

b) have a total soluble salts concentration less than 1000 mg / L

c) contain no substances toxic to plant growth

d) be potable water, and / or

e) be recycled water, and / or

f) be non-potable water (dam, creek, river and bore water).

7.9.1 Recycled water

Recycled water used for vegetation works shall:

a) be Class A or A+ only, in accordance with the *Queensland Water Recycling Guidelines (EPA 2005)*

b) be sourced from a supplier with a Recycled Water Management Plan prepared in accordance with the *Recycled Water Management Plan and Validation Guidelines (DEWS 2008)*

c) be managed and handled in accordance with the *Guide to Workplace use of Non-potable Water Including Recycled Waters (DIER 2007)*, and

d) have relevant signage erected in accordance with the AS/NZ 1319:1994 – *Safety Signs for the Occupational Environment.*

7.9.2 Non-potable water (dam, creek, river and bore water)

Non-potable water (excluding recycled water) used for vegetation works shall:

a) contain no substances toxic to plant growth

b) be sampled and tested in accordance with Clause 7.9.2.1

c) be managed and applied, in accordance with the *Form I – Non-potable Water Assessment Report and Testing*, and

d) have relevant signage erected in accordance with the AS/NZ 1319:1994 – *Safety Signs for the Occupational Environment.*

7.9.2.1 Sampling and testing

Sampling for each test shall comply with the following requirements:

a) dams:

   i. sample away from the edge of the dam, close to where the pump draws water.

b) creeks or rivers:

   i. sample from the main flow, where there is water movement.

c) bores:

   i. existing bores shall be allowed to flow for a sufficient time before sampling, to allow standing water in the pipes to be removed, and

   ii. new bores shall be allowed to run for sufficient time before sampling, to allow the bore to clear.

d) be approximately 1 L

e) contain no air spaces in the bottle

f) be placed in a clean, durable plastic bottle clearly labelled with

   i. Project Name

   ii. Job / Contract Number

   iii. Sample Date

   iv. Sample Location, and

g) be submitted to a laboratory for testing with a copy of the *Form I – Non-potable Water Assessment Report* and *Testing.*

Testing shall:

h) be in accordance with *Form I – Non-potable Water Assessment Report and Testing,* and

i) be in accordance with Clause 5.2.1.1.

7.10 Planting bed edging

Concrete edging is the preferred edging of garden beds in grassed areas requiring slashing or mowing. Type 1 is preferred where tractor slashing will occur, and Type 2 is preferred where manual / ride-on mowing will occur.

Timber edging is the preferred edging of garden beds abutting pedestrian, gravel maintenance access paths.

7.10.1 Timber planting bed edging

Timber planting bed edging shall:

a) have dimensions as specified in Table 7.10.1

b) be Hazard Class 4, preservative treated softwood in accordance with AS 1604.1, and

c) be free of pith, cracks, splinters, knots, and other major defects.

Fixings shall be hot dipped galvanized in accordance with AS 1214.

Stakes shall be hardwood.

Timber planting bed edging Type shall be specified in Item 3.7.1 of the MRTS16 Annexure and shown on the Drawings.

Table 7.10.1 – Timber planting bed edging

Type	**Size (mm)**
1	100 x 16
2	200 x 50
Ancillary Component	**Size (mm)**
Bracing	350 x 100 x 16
Stakes	400 x 50 x 50

7.10.2 Concrete planting bed edging

Concrete planting bed edging shall:

a) have dimensions as specified in Table 7.10.2

b) be Class 20 MPa / 20 concrete in accordance with the requirements of MRTS70 *Concrete*, and

c) have construction joints in accordance with the requirements of Clause 20 of MRTS03 *Drainage, Retaining Structures and Protective Treatments*.

Subgrade compaction shall be in accordance with the requirements of Clause 15 of MRTS04 *General Earthworks*.

Concrete planting bed edging Type shall be specified in Item 3.7.2 of the MRTS16 Annexure and shown on the Drawings.

Table 7.10.2 – Concrete planting bed edging

Type	Size (mm)
1	Type 1 Profile Standard Drawing 1033
2	150 x 150*

* Refer further dimension details – Standard Drawing 1660.

7.11 Irrigation system

Irrigation system materials shall:

a) comply with the relevant Australian Standards listed in Table 3.1, and

b) notwithstanding the above requirements, meet the requirements of the applicable Local Government.

Materials used for electrical cabling and fittings shall comply with the requirements of MRTS95 *Switchboards and Cables*.

Specific irrigation design type and requirements shall be specified in Item 3.8.1 of the MRTS16 Annexure.

7.12 Material supplementary requirements

Material supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Item 3.9 of the MRTS16 Annexure.

8 Construction

The extent and types of vegetation treatments shall be installed as shown on the Drawings, or as specified elsewhere in the Contract.

8.1 Ground preparation works

Ground preparation work operations include:

a) subsoil operations, and

b) topsoil operations.

Ground preparation shall be carried out manually:

c) within the drip line of vegetation to be retained

d) within 300 mm of paths, kerbs, road furniture or structures, and

e) in accordance with Standard Drawings 1644 and 1646.

8.1.1 Subsoil operations

Subsoil operations include:

a) sampling and testing

b) weed control

c) amelioration of subsoil

d) roughening

e) ripping, and

f) cultivation.

8.1.1.1 Subsoil sampling and testing

Sampling shall be conducted by a soil scientist with qualifications in accordance with Clause 6.2.

Where an accredited soil scientist is unavailable in a remote location, soil sampling will be carried out under the direction and supervision of the Administrator.

Sampling for each test shall comply with the following requirements:

a) be representative of the subsoil type and not include different soil types or layers

b) be composed of a composite of 10 sub-samples representative of the subsoil lot (top 300 mm of the surface or batter face) as per Table 8.1.1.1

c) be approximately 1 kg

d) be placed in clean, durable plastic bags clearly labelled with:

   i. Project Name

   ii. Job / Contract Number

   iii. Sample Date

   iv. Sample Location

   v. Sample Layer, and

e) be submitted to a laboratory for testing with a copy of the relevant testing Form.

Testing shall:

f) be in accordance with Table 8.1.1.1, and

g) be in accordance with Clause 5.2.2.1.

All test forms and associated soil reports shall be included in the *Soil Management Plan – Construction.*

Table 8.1.1.1 – Subsoil testing requirements

Soil Testing	Set of Tests Required	Testing Frequency / Lot Size
Subsoil	*Form E – Subsoil Testing*	One test per subsoil type
Drainage Basin Soil	*Form F – Drainage Basin Soil Testing*	One test per subsoil type

Consideration should be given to increasing the testing and sampling frequency. Benefits include:

- reduced risk of anomalies or errors made during the sampling process
- greater certainty of results and recommendations, minimising the risk of poor outcomes, and
- the cost effectiveness compared to reworks.

8.1.1.2 Weed control

Prior to the commencement of other ground preparation operations, the site shall be in a weed free condition. **Witness Point**

Weed control methods include:

a) mechanical application of herbicide using boom spray or high volume power applicator

b) manual application of herbicide from knapsack or similar applicator, or

c) manual methods including removal and disposal of weeds.

Where a herbicide is required to be applied to hazardous areas, as defined by the *Agricultural Chemicals Distribution Control Act (1966)*, the Contractor shall obtain and submit a distribution permit to the Administrator.

Handling and application of herbicides shall:

d) only be carried by a licensed contractor who possess qualifications and licences relevant to the products being applied

e) be in accordance with the *Agricultural Chemicals Distribution Control Act (1966)*

f) be in accordance with permit instructions under the *Chemical Usage (Agricultural and Veterinary) Control Act (1988)*

g) be in accordance with the manufacturer's instructions, and

h) be applied with biodegradable, non-toxic tracer dye to highlight areas sprayed.

Application devices shall be calibrated to deliver prescribed rates of product in accordance with the manufacturer's instructions.

Where herbicides are prohibited from use, weeds shall be removed by hand and disposed off site in accordance with Clause 11 of MRTS04 *General Earthworks* and relevant bio-security requirements. Manual methods of weed control, weed removal and target vegetation shall be specified in Item 3.1.2 of the MRTS16 Annexure.

8.1.1.3 Spreading of amelioration agent prior to ground preparation

Where required in the *Soil Management Plan – Construction*, amelioration agents shall:

a) be spread at the specified rates to the subsoil surface, and

b) be immediately incorporated into the subsoil with the proceeding ground preparation operation (roughening, ripping or cultivation).

The Contractor is to keep all ameliorant delivery dockets and photographic evidence of amelioration processes, as part of the Quality System.

The following ameliorant application rates are not to be exceeded unless justification is provided in the *Soil Management Plan – Construction*:

c) Agricultural lime ($CaCO_3$) 15 kg / m^3 (3 kg / m^2 amelioration to 200 mm of subsoil)

d) Agricultural dolomite ($CaMg(CO_3)_2$) 15 kg / m^3 (3 kg / m^2 amelioration to 200 mm of subsoil)

e) Agricultural gypsum ($CaSO_4.2H_2O$) 15 kg / m^3 (3 kg / m^2 amelioration to 200 mm of subsoil)

The Contractor shall give at least 3 days notice before application and incorporation of amelioration agents. **Witness Point**

The majority of subsoils do not require amelioration rates greater than the above rates to adjust them to a compliant standard. Maximum amelioration rates have been given to prevent unnecessary overuse of amelioration agents.

It is important for the Administrator to witness the amelioration agent application and incorporation operations to ensure the correct amount of ameliorant is applied and incorporated correctly, as there is no audit testing of the ameliorated subsoil to otherwise determine the success of the operation. It is particularly important in areas where subsoil is erodible and / or dispersive (sodic).

8.1.1.4 Ripping

Ripping shall:

a) be used in areas to be vegetated with slope ≤ 1 on 4 where soil has been:
   i. compacted, including site compounds and building pads, or
   ii. used by vehicular traffic, including decommissioned roads and haul routes
b) be a minimum 300 mm depth
c) have rip lines at 500 mm maximum spacing
d) be in accordance with Standard Drawing 1646
e) shatter compacted subsoil sufficiently to allow subsequent cultivation operation
f) incorporate amelioration agents into the subsoil, and
g) be combined with the cultivation operation.

The Contractor shall give at least 3 days notice before ripping. **Witness Point**

8.1.1.5 Cultivation

Cultivation shall:

a) be used in areas to be vegetated with slope ≤ 1 on 4
b) be a minimum 150 mm depth
c) be in accordance with Standard Drawing 1646
d) break up the surface of the subsoil to produce a finely tilled planting bed, and
e) incorporate amelioration agents into the subsoil.

Non-conforming stone, rubble and other deleterious material that is brought to the surface shall be removed.

The Contractor shall give at least 3 days notice before cultivation. **Witness Point**

8.1.1.6 Roughening

Roughening shall:

a) be used in areas to be vegetated with slope > 1 on 4
b) be a minimum 50 mm depth
c) be in accordance with Standard Drawing 1646

d) roughen and form keys in the subsoil to prevent subsequent material slipping down the face of the slope, and

e) incorporate amelioration agents into the subsoil.

Non-conforming stone, rubble and other deleterious material that is brought to the surface shall be removed.

The Contractor shall give at least 3 days notice before roughening. **Witness Point**

8.1.2 Topsoil operations

Topsoil work operations include:

a) sampling and testing

b) amelioration and screening of stockpiled site topsoil

c) importation of topsoil, and

d) installation of topsoil.

Topsoil may be sourced from:

e) stockpiled site topsoil, or

f) imported topsoil.

Where practicable, stripped site topsoil shall be prioritised over imported topsoil.

Topsoil stripping and stockpiling operations are covered in MRTS04 *General Earthworks*.

Allow sufficient time for soil sampling, testing assessment reporting; and amelioration and screening operations to minimise delays in the construction program.

8.1.2.1 Topsoil sampling and testing

Sampling shall be conducted by a soil scientist with qualifications in accordance with Clause 6.2.

Where an accredited soil scientist is unavailable in a remote location, soil sampling will be carried out under the direction and supervision of the Administrator.

Sampling for each test shall comply with the following requirements:

a) be representative of the topsoil type and not include different soil types or layers

b) be composed of a composite of 10 sub-samples representative of the topsoil lot, as per Table 8.1.2.1

c) where sampling stockpiles, sub-samples shall be sampled near the core of the stockpile

d) be approximately 3.0 kg

e) be placed in clean, durable plastic bags clearly labelled with:

   i. Project Name

   ii. Job / Contract Number

   iii. Sample Date

   iv. Sample Location

   v. Sample Layer, and

f) be submitted to a laboratory for testing with a copy of the relevant testing Form.

Testing shall:

g) be in accordance with Table 8.1.2.1, and

h) be in accordance with Clause 5.2.2.1.

All test forms and associated soil reports shall be included in the *Soil Management Plan – Construction.*

Table 8.1.2.1 – Topsoil testing requirements

Soil Testing	Set of Tests Required	Testing Frequency / Lot Size
Stockpiled Site Topsoil	*Form C – Topsoil Testing*	1 per 500 m³ with a minimum of 1 test per topsoil type
Manufactured Site Topsoil Compliance Testing	*Form D – Manufactured Site Topsoil Compliance Testing*	1 per 500 m³ with a minimum of 1 test per topsoil type
Imported Topsoil	*Form C – Topsoil Testing*	1 per 500 m³ with a minimum of 1 test per manufactured batch

Consideration should be given to increasing sampling and testing frequencies, as benefits include:

- reduced risk of anomalies or errors made during the sampling process
- greater certainty of results and recommendations, minimising the risk of poor outcomes
- reduced risk of inadequate amelioration recommendations for stockpiled topsoil, resulting in non-compliant results during compliance testing, required rework and further testing, and
- a relatively small increase in sampling / testing costs compared with the high costs and program delay of rework operations.

8.1.2.2 Manufacture of site topsoil

Where required in the *Soil Management Plan – Construction,* amelioration agents shall:

a) be applied at the specified rates to the stockpiled topsoil, and

b) be thoroughly incorporated into stockpiled topsoil immediately after being applied.

Topsoil amelioration, other than the use of fertilisers and wetting agents, shall not occur after installation of topsoil.

The following ameliorant application rates are not to be exceeded unless justification is provided in the *Soil Management Plan – Construction*:

c) Agricultural lime ($CaCO_3$) 10 kg / m³

d) Agricultural dolomite ($CaMg(CO_3)_2$) 10 kg / m³

e) Agricultural gypsum ($CaSO_4.2H_2O$) 10 kg / m³

f) Organic soil conditioner 0.2 m³ / m³

Where required in the *Soil Management Plan – Construction,* stockpiled topsoil shall be screened:

g) to achieve particle size requirements in accordance with *Form C – Topsoil Testing,* and / or

h) to incorporate amelioration agents.

The majority of topsoils do not require amelioration rates greater than the above to adjust them to a compliant standard. Maximum amelioration rates are to prevent unnecessary overuse of amelioration agents.

Where site constraints do not allow for stockpiling of stripped site topsoil in urban areas, it may be more cost effective to not strip topsoil and import topsoil or use a vegetation treatment such as organics blanket seeding which does not require the use of topsoil.

8.1.2.3 Manufactured site topsoil compliance testing

Ameliorated and / or screened stockpiled topsoil shall:

a) be sampled and tested in accordance with Clause 8.1.2.1 *(Form D – Manufactured Site Topsoil Compliance Testing)*, and

b) have additional amelioration and testing, where not in accordance with *Form D – Manufactured Site Topsoil Compliance Testing, until* compliance is achieved.

Stockpiled topsoil shall be in accordance with *Form D – Manufactured Site Topsoil Compliance Testing* prior to being used. **Hold Point 6**

8.1.2.4 Installation of topsoil

Topsoil shall be installed:

a) evenly over the surface of the prepared subsoil

b) within 5 days of the specified subsoil preparation, and

c) to the following minimum depths:

i. Seeding – drill, broadcast, hydromulch and straw mulch seeding, in accordance with Table 8.2.1

ii. Turfing in accordance with Table 8.2.2.1

iii. Planting < 25 L Containers in accordance with Table 8.2.5.2, and

iv. Planting ≥ 25 L Containers in accordance with Table 8.2.5.3.

The Contractor shall give at least 3 days notice before application and incorporation of amelioration agents. **Witness Point**

8.2 Vegetation works

Vegetation work operations include:

a) seeding

b) turfing

c) mulching

d) matting, and

e) planting.

8.2.1 Seeding

Seeding operations include:

a) drill seeding

b) broadcast seeding

c) hydromulch seeding

d) straw mulch seeding, and

e) organics blanket seeding.

Seeding, with exception of organics blanket seeding, shall be installed:

f) within 2 days of the topsoil being deemed suitable by the Administrator

g) to the prepared surface that has been moistened with a solution of water and wetting agent, and

h) in accordance with Table 8.2.1.

Table 8.2.1 – Seeding – Drill, Broadcast, Hydromulch and Straw Mulch Seeding

Slope	Standard Drawing	Detail	Ground Preparation Type and Minimum Depth	Minimum Topsoil Depth
≤ 1 on 4	1651	1	Cultivation 150 mm	75 mm
≤ 1 on 4	1651	2	Ripping 300 mm Cultivation 150 mm	75 mm
> 1 on 4	1651	3	Roughening 50 mm	75 mm
Seeding with Matting				
-	1647	6	Roughening 50 mm	75 mm

Drill seeding is suitable for relatively flat sites and rural areas where machinery is readily available. It is not suited to areas with prolonged moisture. It initially requires a high level of temporary sediment control, particularly in areas with high rainfall, until surface coverage is established.

Broadcast seeding is suitable for small areas or areas inaccessible by machinery. It initially requires a high level of temporary sediment control, particularly in areas with high rainfall, until surface coverage is established.

Hydromulch seeding is suitable for most situations, but is typically applied to cut and fill batters. It provides quick and efficient soil protection. It requires temporary sediment control to protect surfaces on steep slopes and drainage structures until surface coverage is established.

Straw mulch seeding is suitable in rural areas where site conditions are extreme as it retains soil moisture and moderates soil temperature. Generally not used in urban areas where air blown materials can coat road furniture and structures.

Organics blanket seeding is suited to sites where amelioration of site topsoil or the importation of topsoil is impracticable as the product is applied directly to the subsoil. It is suited to all road formations and is particularly suited to sites with steep batters and / or erosive and / or dispersive (sodic) soil.

8.2.1.1 Drill seeding

Drill seeding shall be installed:

a) in accordance with Clause 8.2.1

b) by drill seeding the seed mix and fertiliser into the topsoil, and

c) by lightly working the surface to ensure seeds are covered with topsoil.

Initial watering after installation of drill seeding shall:

d) be on the day of installation, and

e) be a minimum 10 L per m².

8.2.1.2 Broadcast seeding

Broadcast seeding shall be installed:

a) in accordance with Clause 8.2.1

b) by blending seed mix with a bulking agent such as dry, sharp sand or dry, fine sawdust

c) by broadcasting the blended mix and fertiliser on the topsoil, and

d) by lightly working the surface to ensure seeds are covered with topsoil.

Initial watering after installation of broadcast seeding shall:

e) be on the day of installation, and

f) be a minimum 10 L per m².

8.2.1.3 Hydromulch seeding

Hydromulch seeding shall be installed:

a) in accordance with Clause 8.2.1

b) with purpose-built equipment capable of:

   i. producing a homogenous slurry

   ii. uniformly applying the slurry

c) by applying the hydromulch slurry from at least two directions to prevent:

   i. a shadowing effect

   ii. uneven coverage of slurry, and

d) in an indirect, dispersed spray pattern to achieve a uniform cover.

The Contractor shall regard the material rates in Table 8.2.1.4 and Table 8.2.1.5 as minimum application rates. The Contractor shall determine:

e) fibre type

f) binder type

g) fertiliser type, and

h) water application rate.

No initial watering, of the hydromulch treatment, shall occur on the day of installation to allow the binder to set.

8.2.1.4 Hydromulch grass seeding – single pass

The Contractor shall install grass seed:

a) in a single pass process

b) in accordance with Clause 8.2.1.3, and

c) in accordance with Table 8.2.1.4

The single pass shall consist of a slurry of:

d) water

e) fibre

f) binder

g) seed, and

h) fertiliser.

Table 8.2.1.4 – Hydromulch grass seeding – single pass – minimum application rates

Slope	Minimum Application Rate kg / ha	Minimum Wet Thickness on Ground	Binder Application Rate
Hydromulch Seeding – Sugar Cane Mulch / Sugar Cane Mulch with Paper Pulp			
≤ 1 on 4	3000	3 mm	As per manufacturer's specification
> 1 on 4	4000	4 mm	
Hydromulch Seeding – Wood Fibre			
≤ 1 on 4	2500	2.5 mm	As per manufacturer's specification
> 1 on 4	3000	3 mm	

8.2.1.5 Hydromulch native seeding – double pass

The Contractor shall install native seed:

a) in a multiple pass process

b) in accordance with Clause 8.2.1.3, and

c) in accordance with Table 8.2.1.5

The first pass shall consist of a slurry of:

d) water

e) fibre

f) seed, and

g) fertiliser.

The second pass shall consist of a slurry of:

h) water

i) fibre, and

j) binder.

The Contractor shall allow sufficient drying time between passes such that slumping of the surface does not occur.

Table 8.2.1.5 – Hydromulch native seeding – double pass – minimum application rates

Slope	First Pass Fibre Application Rate kg / ha	Second Pass Fibre Application Rate kg / ha	Minimum Wet Thickness on Ground	Binder Application Rate
Hydromulch Seeding – Sugar Cane Mulch / Sugar Cane Mulch with Paper Pulp				
≤ 1 on 4	250	2750	3 mm	As per manufacturer's specification
> 1 on 4	250	3750	4 mm	
Hydromulch Seeding – Wood Fibre				
≤ 1 on 4	250	2250	2.5 mm	As per manufacturer's specification
> 1 on 4	250	2750	3 mm	

8.2.1.6 Straw mulch seeding

The Contractor shall regard the material rates in Table 8.2.1.6 as the required minimum.

Straw mulch seeding shall be installed:

a) in accordance with Clause 8.2.1, and

b) in a two pass process.

The first pass shall be:

c) drill seeded in accordance with Clause 8.2.1.1, or

d) broadcast seeded in accordance with Clause 8.2.1.2.

The second pass shall be applied through a straw mulching machine delivering:

e) straw, and

f) bituminous emulsion.

Initial watering after installation of straw mulch seeding shall:

g) be on the day of installation, and

h) be a minimum 10 L per m².

Table 8.2.1.6 – Straw mulch seeding – minimum application rates

Straw Mulch Rate kg / ha	Bituminous Emulsion L / ha
5000	2000

8.2.1.7 Organics blanket seeding

Organics blanket shall be installed:

a) within 5 days of the ground preparation works being deemed suitable by the Administrator

b) to the prepared surface that has been moistened with a solution of water and wetting agent

c) with a pneumatic blower to ensure a smooth, even surface is achieved, and

d) with the organics blanket binder and seed mix injected into the blanket as it is being installed.

The Contractor shall regard the application depths in Table 8.2.1.7 as the minimum required.

An organics blanket berm shall:

e) be installed to ensure water flows do not negatively impact on the organics blanket, and

f) be a minimum 400 mm wide x 250 mm high.

Initial watering after installation of organics blanket shall:

g) be on the day of installation

h) be a minimum 5 L per m², and

i) contain a wetting agent.

Table 8.2.1.7 – Seeding – organics blanket seeding minimum application rates

Slope	Standard Drawing	Detail	Ground Preparation Type and Depth		Organics Blanket Depth
≤ 1 on 4	1651	4	Cultivation	150 mm	75 mm
≤ 1 on 4	1651	5	Ripping	300 mm	75 mm
			Cultivation	150 mm	
> 1 on 4	1651	6	Roughening	50 mm	75 mm

8.2.2 Turfing

Turf shall be installed:

a) within 2 days of the topsoil being installed

b) within 24 hours of delivery, and

c) in accordance with Table 8.2.2.1.

Prior to turf installation:

d) fertilisers shall be broadcast evenly over topsoil, in accordance with the manufacturer's recommended rates, and

e) to the prepared surface that has been moistened with a solution of water and wetting agent.

Where turfing operations occur later than the specified timing, wetting agent shall be applied, in conjunction with watering to dampen topsoil prior the installation of turfing treatments.

Initial watering after installation of turf shall:

f) be on the day of installation, and

g) be a minimum 10 L per m².

Table 8.2.2 – Turfing

Slope	Standard Drawing	Detail	Ground Preparation Type and Depth		Minimum Topsoil Depth
≤ 1 on 4	1651	7	Cultivation	150 mm	75 mm
≤ 1 on 4	1651	8	Ripping	300 mm	75 mm
			Cultivation	150 mm	
> 1 on 4	1651	9	Roughening	50 mm	75 mm

8.2.3 Mulching

Mulch shall be installed:

a) within 2 days of the topsoil being placed

b) before planting of container stock in mass mulched areas

c) as soon as practicable after the completion of the planting operations where planting is individually mulched, and

d) to the following minimum depths:

   i. Planting < 25 L containers in accordance with Table 8.2.5.2, and

   ii. Planting ≥ 25 L containers in accordance with Table 8.2.5.3.

Contained areas, medians and separators with mulched plantings shall be treated with pre-emergent herbicide:

e) prior to installation of mulch, and

f) in accordance with the manufacturer's instructions.

Where seeding treatments of any type have been specified directly adjoining mulched areas, pre-emergent is not to be used under any circumstances.

8.2.3.1 Manufacture of site mulch

Site mulch shall:

a) be in accordance with Clause 7.6.1, and

b) be produced by double tub grinding vegetation material set aside during clearing and grubbing operations in MRTS04 *General Earthworks*, or

c) be produced by chipping vegetation material set aside during clearing and grubbing operations in MRTS04 *General Earthworks*.

Mulch stockpiles shall:

d) not be located:

   i. near water bodies, or

   ii. within the drip line of retained trees

e) be maintained weed free – weeds which appear shall be treated immediately

f) be limited to a height of 2 m and a width of 6 m

g) be spaced adequately to allow watering and machinery movements, and

h) be watered and turned at least once per week for 4 weeks.

8.2.3.2 Installation of mulch

Mulch shall be installed:

a) in accordance with Clause 8.2.3

b) to a minimum depth of 100 mm in planting areas

c) to a minimum depth of 150 mm by 1000 mm diameter to installed container stock ≥ 25 L

d) have pre-emergent herbicide applied and activated in locations in accordance with Clause 8.2.3, and

e) in accordance with the Standard Drawing 1653.

8.2.4 Matting

Matting shall be installed:

a) as soon as practicable after the completion of ground preparation works

b) prior to container planting operations

c) after seeding operations

d) with pins at spacings in accordance with the manufacturer's minimum requirements, and

e) in accordance with Standard Drawing 1648.

Matting with container planting operations shall only be used in drainage structures.

Matting with seeding operations may be used:

f) on slopes > 1 on 2 in areas with high rainfall and / or erodible soils, and

g) in grass drainage structures where additional protection is required due to water velocities.

8.2.5 Planting

Plants shall:

a) be installed within 5 days of mulch or matting being installed

b) be installed within 48 hours of delivery

c) be set out in accordance with Clause 8.2.5.1

d) be installed in accordance with Clause 8.2.5.2 where plants are < 25 L

e) be installed in accordance with Clause 8.2.5.3 where plants are ≥ 25 L

f) be staked in accordance with Clause 8.2.5.5, and

g) be guyed in accordance with Clause 8.2.5.6.

In raised medians and separators, subsoil drainage shall be installed in accordance with Standard Drawing 1643.

Where specified, plant mats shall be installed in accordance with Clause 8.2.5.4.

The Contractor shall give notice of plant deliverys to allow inspection of the plants. **Witness Point**

Prior to the installation of plants, the prepared surface shall be moistened with a solution of water and wetting agent.

Initial watering after installation of planting shall:

h) be on the day of installation

i) be as soon as practicable after installation, and

j) in accordance with Table 8.2.5.

Table 8.2.5 – Initial watering

Container Size	Quantity of Water
Individual Plantings	
< 25 L	10 L
≥ 25 L	15 L
≥ 100 L	50 L
Ex ground	100 L
Mass Plantings (≥ 2 plants per m²)	
Tube – 140 mm	10 L per m²

8.2.5.1 Setting-out of plants

Prior to setting-out plants the Contractor shall determine locations and extent of the following elements:

a) services

b) services easements

c) road furniture

d) lighting

e) road signs

f) structures

g) clear zones, and

h) sight visibility zones.

The Contractor shall:

i) set out plants in the locations as shown on the Drawings

j) adjust locations, as required, in accordance with vegetation setback and clearance table and notes:

i. as shown on the Drawings, or

ii. in accordance with the *Road Landscape Manual – Appendix 4*, where not shown on the Drawings

k) give notice of planting operations to allow the inspection of plant set out in accordance with Clause 8 of MRTS01 *Introduction to Technical Standards*. **Hold Point 7**

8.2.5.2 Planting < 25 L Containers

Plants < 25 L shall be installed:

a) in accordance with Clause 8.2.5, and

b) in accordance with Table 8.2.5.2.

Table 8.2.5.2 – Planting < 25 L Containers

Slope	Standard Drawing	Detail	Ground Preparation Type and Minimum Depth		Minimum Topsoil Depth	Minimum Mulch Depth	Alternate Surface Treatment
Planting Contained Areas							
≤ 1 on 4	1653	1	Cultivation	150 mm	300 mm	100 mm	-
≤ 1 on 4	1653	2	Ripping	300 mm	300 mm	100 mm	-
			Cultivation	150 mm			
Planting Contained Areas – Kerbed Median and Separators							
≤ 1 on 4	1643	1	Ripping	300 mm	300 mm	100 mm	-
			Cultivation	150 mm			
Planting Broadacre Areas							
≤ 1 on 4	1653	3	Cultivation	150 mm	150 mm	100 mm	-
≤ 1 on 4	1653	4	Ripping	300 mm	150 mm	100 mm	-
			Cultivation	150 mm			
Planting Slopes > 1 on 4							
> 1 on 4	1653	5	Roughening	50 mm	75 mm	100 mm	-
> 1 on 4	1653	6	Roughening	50 mm	Per planting hole	100 mm	-

Slope	Standard Drawing	Detail	Ground Preparation Type and Minimum Depth		Minimum Topsoil Depth	Minimum Mulch Depth	Alternate Surface Treatment
Planting Seeding Areas – Drill, Broadcast, Hydromulch and Straw Mulch Seeding							
≤ 1 on 4	1653	7	Cultivation	150 mm	75 mm	-	Seeding
≤ 1 on 4	1653	8	Ripping	300 mm	75 mm	-	Seeding
			Cultivation	150 mm			
> 1 on 4	1653	9	Roughening	50 mm	75 mm	-	Seeding
Planting in Matting							
-	1647	7	Roughening	50 mm	75 mm	-	Matting

Topsoil per planting hole – should only be used in small areas given the high labour costs associated with incorporating topsoil to individual planting holes.

Matting with container planting shall only be used in planted drainage structures.

8.2.5.3 Planting ≥ 25 L Containers

Plants ≥ 25 L shall be installed:

a) in accordance with Clause 8.2.5, and

b) in accordance with Table 8.2.5.3.

Table 8.2.5.3 – Planting ≥ 25 L Containers

Slope	Standard Drawing	Detail	Ground Preparation Type and Minimum Depth	Topsoil Depth Per Hole	Backfill Soil Per Hole	Minimum Mulch Depth Per Tree
Planting Mulch Areas						
≤ 1 on 4	1654	1	Ripping base of hole 200 mm	300 mm	Remaining depth of hole	150 mm
Planting Grass Areas						
≤ 1 on 4	1654	2	Ripping base of hole 200 mm	300 mm	Remaining depth of hole	150 mm
Planting Slopes > 1 on 4 – Free Draining Soils						
> 1 on 4	1654	3	Ripping base of hole 200 mm	300 mm	Remaining depth of hole	150 mm
Planting Slopes > 1 on 4 – Poor Draining Soils						
> 1 on 4	1654	4	Ripping base of hole 200 mm	300 mm	Remaining depth of hole	150 mm

8.2.5.4 Plant mats

Plant mats shall be installed in accordance with Standard Drawing 1648.

8.2.5.5 Stakes and ties

Stakes shall be installed:

a) in accordance with Table 8.2.5.5, and

b) in accordance with Standard Drawings 1653 and 1655.

Table 8.2.5.5 – Plant stakes

Type	Description	Container	Ties	Number of Stakes
1	600 x 10 mm diameter bamboo	Tube – 140 mm stock (Marker for supplementary planting in seeded areas only)	NA	1
2	1500 x 25 x 25 mm hardwood	200 mm – 25 L (tree species only)	50 mm wide	2
3	1800 x 50 x 50 mm hardwood	45 L – 100 L stock	50 mm wide	3
	Guying	200 L – Ex-ground		

Plant container stakes, installed as part of nursery production, shall be removed following planting operations.

8.2.5.6 Guying

Guying shall be installed:

a) with containers ≥ 200 L

b) with ex-ground tree stock, and

c) with transplanted trees.

Guying shall be:

d) in low profile areas or as recommended by an arborist, in accordance with Standard Drawing 1656, and

e) in high profile urban areas, in accordance with proprietary underground tree guying systems.

8.2.5.7 Harvesting of site plant material

Where plant stock has been identified in the Contract to be harvested from site, the Contractor shall submit a Plant Harvesting Proposal, in accordance with Clause 5.3.3, for a determination as to its suitability. **Hold Point 5**

Plants shall be harvested, stored and cared for in accordance with the Plant Harvesting Proposal.

8.3 Hardscape works

Hardscape work operations include:

a) planting bed edging, and

b) irrigation.

8.3.1 Planting bed edging

Planting bed edging shall be installed in accordance with Table 8.3.1.

Table 8.3.1 – Planting bed edging

Type	Standard Drawing
Timber	1659
Concrete	1660

8.3.2 Irrigation system

Permanent irrigation systems shall:

a) only be provided where specified in the Contract, and

b) meet the requirements of the applicable Local Government, where relevant.

8.3.2.1 Design

Design of the irrigation system shall:

a) provide a functioning sprinkler and / or drip irrigation system that delivers a quantity of water sufficient to maintain plant health and growth that is suitable to the Region

b) be in accordance with Clause 8.3.2

c) be carried out by a suitably qualified, certified irrigation designer

d) have 240V electrical components designed by an electrical engineer, and

e) be certified by the consultant organisation which carried out the design.

Documents produced shall include:

f) schematic Drawings of the irrigation system showing:

   i. the number and sequence of watering stations

   ii. the locations of:

      - water filters
      - water isolation valves
      - irrigation controller, and
      - electrical isolation equipment

g) detailed Drawings of the irrigation system showing:

   i. all pipe installations

   ii. conduits

   iii. sprinkler or dripper emitters

   iv. manual or automatic valve details

   v. backflow prevention devices

   vi. water filters

   vii. rain gauge / weather station / rain sensor

   viii. controllers

   ix. protection boxes and cabinets

   x. electrical connections, and

xi. water supply connections

h) a schedule showing the rates of application of all water outlet devices

i) installation specifications

j) a commissioning schedule and checklist

k) a statement of the design warranty, and

l) a comprehensive operating manual, including a parts list which sets out the description and suppliers of all components.

Prior to installation, the proposed design shall be submitted for a determination as to its suitability. **Hold Point 8**

8.3.2.2 Supply, installation and commissioning

The irrigation system shall be installed:

a) in accordance with the approved design

b) in accordance with relevant Australian Standard listed in, but not limited to, Table 3.1, and

c) by a suitably qualified, certified irrigation contractor.

All electrical installations shall be installed by a registered electrical contractor as defined under the *Electricity Act 1994*.

On completion, each water outlet device shall be removed from the supply line and the irrigation system shall be flushed.

The Contractor shall commission and test the irrigation system prior to being covered. **Hold Point 9**

The irrigation system shall be tested at current local government supply pressure or design operating pressure respectively for a minimum period of 30 minutes.

Automatic controllers shall be tested by individually operating each solenoid valve from the irrigation controller.

The irrigation system shall then be tuned and balanced so that the required quantity of water is delivered to each output device and the timer program set.

The Contractor shall:

d) provide training to the Principal's nominated representatives in the set up and operation of the irrigation system, and

e) provide documentation and warranties in accordance with Clause 8.3.2.3.

8.3.2.3 Warranties, Manuals and As Constructed Drawings

The Contractor shall provide:

a) construction and installation warranties

b) three hard copies of a comprehensive operating manual, including a parts list which sets out the description and suppliers of all components

c) three hard copies (A3 format) of the As-Constructed Drawings and specifications, and

d) one editable, electronic format copy of the As-Constructed Drawings and specification.

8.4 Construction supplementary requirements

Construction supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Item 3.9 of the MRTS16 Annexure.

9 Establishment and monitoring

Vegetation works maintenance consists of 2 distinct periods:

a) the Establishment Period, and

b) the Monitoring Period.

Contracts consisting of only grass seeding and / or turfing treatments require only an Establishment Period. All other vegetation works, including native tree and shrub seeding treatments, require an Establishment Period and a Monitoring Period.

Vegetation works maintenance is required for a lot or series of lots within a Contract. All vegetation maintenance works per lot are required to be completed and to satisfy the completion criteria before the specified end date of the Defects Liability Period.

9.1 Establishment Period

The Establishment Period shall commence when the installation of treatments is deemed compliant and a *Certificate of Commencement of the Establishment Period* has been issued by the Administrator. **Milestone** Where the Contractor has installed works in a series of lots, the Administer shall issue a *Certificate of Commencement of the Establishment Period* for each lot. All Establishment Period lots shall be completed on the same date.

The Establishment Period shall:

a) be a minimum duration of 90 days from the date of *Certificate of Commencement of the Establishment Works*, and

b) continue until all vegetation treatments meet the completion criteria of Clause 9.1.2.

9.1.1 Establishment Period operations

The Contractor shall care for the installed vegetation treatments to ensure their long term sustainability and to their compliance with the meet the completion criteria of Clause 9.1.2.

Establishment Period operations include:

a) watering

b) fertilising

c) weed control

d) pest and disease control

e) repair or re-installation of failed treatments

f) mowing, slashing and brush cutting

g) pruning

h) selective removal of non-complying plants

i) topping up of mulch, and

j) monthly program and inspection reporting.

9.1.1.1 Watering

During the Establishment Period watering shall:

a) be conducted in a manner that does not cause damage, run-off or subsequent erosion or displacement of treated areas

b) not spray onto, flow across or pond on paved areas including roadways, bikeways and footpaths, and

c) be in accordance with Table 9.1.1.1 and adjusted as per Item 4.2 of the MRTS16 Annexure.

Item 4.2 of the MRTS16 Annexure shall be completed using Table 9.1.1.1b.

Watering should be increased during periods of wind, drought and / or where soils have low moisture retaining characteristics. Rates may be decreased during periods of high rainfall. Ensure moisture is maintained in the soil in sufficient quantities to retain soil moisture content and promote plant growth after the installation of vegetation treatments.

Table 9.1.1.1 – Minimum watering schedule – Establishment Period

Establishment Period			
Container	**Minimum Frequency**		
	Week 1 – 4	**Week 5 – 8**	**Week 9 – 12**
Seeding			
–	5 L per m² Daily	10 L per m² Every second day	10 L per m² Two days a week
Organic Blanket			
–	5 L per m² Daily	10 L per m² Every second day	10 L per m² Two days a week
Turfing			
–	5 L per m² Daily	10 L per m² Every second day	10 L per m² Two days a week
Planting			
< 25 L	10 L per plant Daily	10 L per plant Two days a week	10 L per plant Once a week
≥ 25 L	20 L per plant Daily	20 L per plant Two days a week	20 L per plant Once a week
≥ 100 L	50 L per plant Daily	50 L per plant Two days a week	50 L per plant Once a week
Ex-ground	100 L per plant Daily	100L per plant Two days a week	100 L per plant Once a week
Mass Plantings (≥ 2 per m²)	20 L per m² Daily	20 L per m² Every second day	20 L per m² Once a week

Table 9.1.1.1b – Watering location and season adjustment table

	Summer Dec, Jan, Feb	Autumn Mar, Apr, May	Winter Jun, Jul, Aug	Spring Sep, Oct, Nov
South East Queensland	140 %	100 %	60 %	120 %
Cairns	140 %	120 %	100 %	140 %
Cloncurry	220 %	120 %	100 %	180 %
Townsville	200 %	120 %	100 %	180 %
Mackay	160 %	100 %	80 %	120 %
Rockhampton	160 %	100 %	80 %	140 %
Barcaldine	220 %	100 %	80 %	160 %
Bundaberg	160 %	120 %	80 %	120 %
Roma	200 %	100 %	80 %	160 %
Gympie	120 %	60 %	60 %	100 %
Toowoomba	140 %	80 %	60 %	120 %

The figures provided in Table 9.1.1.1 are based on average watering requirements in South East Queensland. Item 4.2 of the Annexure allows watering rates to be adjusted to accommodate different climatic conditions typical of the project site or time of year. Table 9.1.1.1b is based on historic evapotranspiration data from the Bureau of Meteorology and shall be used to broadly adjust application rates and quantity allowances. Where periods are across seasons, an average percentage of the two seasons should be adopted.

Prioritise early morning or night watering to lessen evaporation.

Below is a worked example for calculating water quantity requirements for a seeding operation based on an area of 1 hectare in a 100% zone.

Week 1 – 4	5 L x 28 days x 10,000 m² =	1,400,000 L =	1400 kilolitres / ha
Week 5 – 8	10 L x 14 days x 10,000 m² =	1,400,000 L =	1400 kilolitres / ha
Week 9 – 12	10 L x 6 days x 10,000 m² =	600,000 L =	600 kilolitres / ha
	Total	3,400,000 L =	3400 kilolitres / ha

Temporary irrigation system

Where the Contractor proposes to use a temporary irrigation system for Establishment Period watering purposes, the temporary irrigation system shall:

a) be designed and installed as such to deliver the quantities of water and frequency of watering in accordance with Clause 9.1.1.9

b) be conducted in a manner that does not cause damage or subsequent erosion or displacement of treated areas

c) not spray onto, flow across or pond on paved areas including roadways, bikeways and footpaths, and

d) be removed at the end of the maintenance period.

9.1.1.2 Fertilising

Fertilise seeding and turf treatments, as required, to ensure healthy vegetation growth and coverage is achieved to meet the completion criteria. Six weeks after seeding and turfing installations, the Contractor shall fertilise treatments with a fertiliser with an N:P:K analysis in accordance with Table 9.1.1.2.

Table 9.1.1.2 – 6 Week Turf and Seeding Fertiliser N:P:K Range

N	10 – 20
P	1 – 8
K	8 – 15
S	8 – 16

Fertilise container stock treatments, as required, to ensure healthy growth is achieved to meet the completion criteria.

9.1.1.3 Weed control

Vegetation treatments shall be maintained in a weed free condition.

Handling and application of herbicides shall be in accordance with Clause 8.1.1.2.

Where vegetation treatments are poisoned due to overspray, the Contractor shall replace the vegetation treatment with the originally specified treatment.

9.1.1.4 Pest and disease control

Vegetation treatments shall be maintained in a pest and disease free condition.

Handling and application of pesticides shall be in accordance with Clause 8.1.1.2.

9.1.1.5 Repair or re-installation of treatments

The Contractor shall repair / re-install failed treatments.

Prior to re-installation, the Contractor shall investigate the failed treatment to determine the cause of poor performance or failure.

Where subsoil and topsoil is eroded, the Contractor shall repair and re-ameliorate the subsoil, re-apply topsoil to the affected area and reinstall the vegetation treatment.

Seeding treatments

After 30 days seeding treatments shall be repaired / re-installed where a healthy cover crop has not adequately established.

Turfing treatments

After 30 days turfing treatments shall be repaired / re-installed where they have not established a healthy grass cover.

Container and ex-ground stock treatments

Throughout the Establishment Period container stock that dies shall be replaced, within 7 days of being identified, with the same species and container size as originally specified.

The most common cause of vegetation failure, presuming the subsoil and topsoil have been adequately ameliorated, is through a lack of water and / or a lack of nutrients.

If treatments are performing poorly, watering rates and additional fertilising should be considered before complete re-installation of treatments.

Where watering rates are adjusted and re-fertilising does not rectify the situation, the Quality Systems should be checked by the Administrator, prior to re-installing works.

If failure is determined to relate to the specification of unsuitable species, consideration should be given to using alternate species in the re-installation of treatments. The Contractor shall propose substitute species, and submit a proposal for a determination as to its suitability. **Hold Point 10**

9.1.1.6 Mowing, slashing and brush cutting

Slashing and brush cutting shall:

a) be in accordance with Table 9.1.1.6, and

b) be evenly windrowed or dispersed over the area.

Table 9.1.1.6 – Mowing, slashing and brush cutting schedule – Establishment Period

Vegetation Treatment (as shown in the Drawings)	Mow	Average Height Prior to Mowing (mm)	Average Height After Mowing (mm)
High Profile Areas / Pedestrian Areas			
Turfed Areas	1st and consecutive	50	30
Grass Seeded Areas	1st	200	50
	2nd	75	30
	3rd and consecutive	50	30
All Other Areas			
Turfed Areas	1st	150	100
	2nd	200	100

Vegetation Treatment (as shown in the Drawings)	Mow	Average Height Prior to Mowing (mm)	Average Height After Mowing (mm)
	3rd and consecutive	200	75
Grass Seeded Areas	1st	150	100
	2nd	200	100
	3rd and consecutive	200	75

9.1.1.7 Pruning

Pruning shall:

a) be used to remove damaged, diseased or pest infested parts of plants

b) be used to formatively prune trees to maintain sight visibility and general tree form, and

c) be in accordance with AS 4373 *Pruning of Amenity Trees*.

Care shall be taken to avoid placement of prunings in a manner that may be hazardous to public safety. Placement of prunings in clear zones, sight visibility zones and pedestrian areas is prohibited.

Pest or disease infested prunings shall be disposed off site in accordance with Clause 11 of MRTS04 *General Earthworks*.

9.1.1.8 Selective removal of non-complying vegetation

Potentially non-complying vegetation shall be removed in areas including:

a) sight visibility zones

b) clear zones

c) vegetation setbacks

d) below overhead services or structures

e) above underground services, and

f) service easements.

9.1.1.9 Topping up of mulch

One month before the completion of the Establishment Period, mulched treatments shall be topped up with mulch to achieve the originally specified depths in contained or high profile areas.

9.1.1.10 Monthly program and inspection report

A report shall be submitted to the Administrator every month, within 7 days of the inspection.

The report shall include:

a) monthly program of maintenance works

b) dates of maintenance visits and inspections

c) maintenance works undertaken

d) maintenance works in progress

e) watering application dates and volumes

f) failed or failing vegetation treatments and their general locations on marked up on plans

g) repair or re-installation of failed treatments

h) weeds (declared and non-declared) identified and method of treatment

i) issues identified during inspections and actions required to remedy these, and

j) damage to vegetation caused by vandalism or theft of vegetation.

All vandalism and theft claims shall be supported by photographic evidence and / or police report.

9.1.2 Establishment Period completion criteria

The Establishment Period shall be completed when:

a) seeding treatments meet the criteria of Clause 9.1.2.1

b) turfing treatments meet the criteria of Clause 9.1.2.2

c) container stock and ex-ground stock treatments meet the criteria of Clause 9.1.2.3, and

d) the lot has been established for the minimum 90 day duration.

9.1.2.1 Seeding treatments

Seeding treatments:

a) have a uniform cover of perennial and cover crop grasses over a minimum 90 % of the area

b) have a minimum perennial cover of 30 %

c) show no signs of nutrient deficiency

d) show no signs of water deficiency

e) have no rills or sheet erosion.

f) have no bare areas > 1 m², and

g) are mowed / slashed at a height in accordance with Table 9.1.1.6 (grass seeded areas).

9.1.2.2 Turfing treatments

Turfing treatments:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) contain no uneven jointing in pedestrian areas

d) have a healthy root system that has penetrated into the ground so that the turf cannot be easily lifted, and

e) are mowed / slashed at a height in accordance with Table 9.1.1.6.

9.1.2.3 Container and ex-ground stock treatments

Container stock and ex-ground stock treatments:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) show no signs of pests or disease

d) are established and well formed, showing evidence of growth typical of the species

e) have a healthy root system that has penetrated into the ground so that the plant cannot be easily lifted out of the ground, and

f) in contained or high profile areas, have a mulch depth in accordance with Clause 9.1.1.9.

9.2 Monitoring Period

The Monitoring Period shall commence with the issuing of the *Certificate of Commencement of the Monitoring Period* by the Administrator, following the completion of the Establishment Period. **Milestone**

The Monitoring Period shall:

a) be a minimum duration of 90 days, unless otherwise specified in Item 4.1 of the MRTS16 Annexure, from the date of *Certificate of the Commencement of the Monitoring Period*, and

b) continue until all vegetation treatments meet the completion criteria of Clause 9.2.2.

Upon successful completion of the Monitoring Period the *Certificate of Completion of the Monitoring Period* shall be issued by the Administrator. **Milestone**

Where a lot's Monitoring Period finishes outside the Defects Liability Period, the creation of a Separable Portion may be required to be negotiated with the Contractor.

Where native seed mixes are installed in Autumn and Winter consideration should be given to increasing the minimum Monitoring Period to ensure seeding has been successful. It is suggested to increase the Monitoring Period to the end of the wet season in this instance.

Where container stock has been installed, consideration should be given to increasing the Monitoring Period to ensure plants are mature enough to out-compete weeds beyond handover. It is suggested to increase the Monitoring Period to 180 days or greater.

For projects with Defects Liability Periods greater than 180 days it is suggested the Monitoring Period finish in line with the Defects Liability Period.

9.2.1 Monitoring Period operations

The Contractor shall care for the installed vegetation treatments to ensure their long term sustainability and to meet the completion criteria of Clause 9.2.2.

Monitoring Period operations include:

a) watering

b) fertilising

c) weed control

d) pest and disease control

e) repair or re-installation of failed treatments

f) mowing, slashing and brush cutting

g) pruning

h) selective removal of non-complying plants

i) topping up of mulch, and

j) monthly program and inspection reporting.

9.2.1.1 Watering

During the Monitoring Period watering shall:

a) be conducted in a manner that does not cause damage, run-off or subsequent erosion or displacement of treated areas

b) not spray onto, flow across or pond on paved areas including roadways, bikeways and footpaths, and

c) be in accordance with Table 9.2.1.1 and adjusted as per Item 4.3 of the MRTS16 Annexure.

Item 4.3 of the MRTS16 Annexure shall be completed using Table 9.1.1.1b.

Table 9.2.1.1 – Minimum watering schedule – Monitoring Period

Monitoring Period	
Container	**Minimum Frequency**
Seeding and Turfing	
-	10 L per m² – once a fortnight
Planting	
< 25 L	10 L per plant – once a fortnight
≥ 25 L	20 L per plant – once a fortnight
≥ 100 L	50 L per plant – once a fortnight
Ex-ground	100 L per plant – once a fortnight
Mass Plantings (≥ 2 per m²)	10 L per m² – once a fortnight

Rates should be increased during periods of wind, drought and / or where soils have low moisture retaining characteristics. Rates may be decreased during periods of high rainfall. Ensure moisture is maintained in the soil in sufficient quantities to retain soil moisture content and promote plant growth after the installation of vegetation treatments.

The figures provided in Table 9.1.1.1 are based on average watering requirements in South East Queensland. Item 4.2 of the Annexure allows watering rates to be adjusted to accommodate different climatic conditions typical of the project site or time of year. Table 9.1.1.1b is based on historic evapotranspiration data from the Bureau of Meteorology and shall be used to broadly adjust application rates and quantity allowances. Where periods are across seasons, an average percentage of the two seasons should be adopted.

Ensure adequate allowance is made for costs of watering during the Monitoring Period. Consideration should be given to the impact on costs when installing multiple lots and the requirement to water beyond the minimum 90 day duration. This is particularly important on large projects where works are typically installed in lots, due to the sequencing of works, and are maintained for longer than the minimum 90 day duration.

9.2.1.2 Fertilising

Fertilise seeding and turf treatments, as required, to ensure healthy vegetation growth and coverage is achieved to meet the completion criteria.

Fertilise container stock treatments, as required, to ensure healthy growth is achieved to meet the completion criteria. One month before the completion of the Monitoring Period, all container stock treatments shall be fertilised with a controlled release fertiliser.

9.2.1.3 Weed control

Weed control shall be carried out in accordance with Clause 9.1.1.3.

9.2.1.4 Pest and disease control

Pest and disease control shall be carried out in accordance with Clause 9.1.1.4.

9.2.1.5 Repair or re-installation of treatments

The Contractor shall repair / re-install failed treatments.

Prior to re-installation, the Contractor shall investigate the failed treatment to determine the cause of poor performance or failure.

Where subsoil and topsoil is eroded, the Contractor shall repair and re-ameliorate the subsoil, re-apply topsoil to the affected area and reinstall the vegetation treatment.

Grass seeding treatments

Seeding treatments shall be repaired / re-installed where a healthy perennial grass cover has not adequately established.

Native seeding treatments

Seeding treatments shall be repaired / re-installed where a healthy perennial grass cover has not adequately established and native seed strike is not evident.

Turfing treatments

Turfing treatments shall be repaired / re-installed where a healthy grass cover has not been maintained.

Container and ex-ground stock treatments

Throughout the Monitoring Period container stock that dies shall be replaced, within 7 days of being identified, with the same species and container size as originally specified.

> The most common cause of vegetation treatment failure, presuming the subsoil and topsoil have been adequately ameliorated, is through a lack of water and / or a lack of nutrients.
>
> If treatments are performing poorly, watering rates and additional fertilising should be considered before complete re-installation of treatments.
>
> Where watering rates are adjusted and re-fertilising does not rectify the situation, the Quality Systems should be checked by the Administrator, prior to re-installing works.

If failure is determined to relate to the specification of unsuitable species, consideration should be given to using alternate species in the re-installation of treatments. The Contractor shall propose substitute species, and submit a proposal for a determination as to its suitability. **Hold Point 10**

9.2.1.6 Mowing, slashing and brush cutting

Slashing and brush cutting shall:

a) be in accordance with Table 9.2.1.6, and

b) be evenly windrowed or dispersed over the area.

Table 9.2.1.6 – Mowing, slashing and brush cutting schedule – Monitoring Period

Vegetation Treatment (as shown in the Drawings)	**Mow**	**Average Height Prior to Mowing (mm)**	**Average Height After Mowing (mm)**
High Profile Areas / Pedestrian Areas			
Turfed and Grass Seeded Areas	1st and consecutive	50	30
Vegetation Treatment (as shown in the Drawings)	**Slash or Brush cut**	**Average Height Prior to Slashing / Brush cutting (mm)**	**Average Height after Slashing / Brush cutting (mm)**
All Other Areas			
Turfed and Grass Seeded Areas	1st and consecutive	200	75

9.2.1.7 Pruning

Pruning shall be carried out in accordance with Clause 9.1.1.7.

9.2.1.8 Selective removal of non-complying vegetation

Selective removal of non-complying vegetation shall be carried out in accordance with Clause 9.1.1.8.

9.2.1.9 Topping up of mulch

One month before the completion of the Monitoring Period, mulched treatments shall be topped up with mulch to achieve the originally specified depths in contained or high profile areas.

9.2.1.10 Monthly program and inspection report

Monthly reporting shall be carried out in accordance with Clause 9.1.1.10.

9.2.2 Monitoring Period completion criteria

The Monitoring Period shall be completed when:

a) seeding treatments meet the criteria of Clause 9.2.2.1

b) turfing treatments meet the criteria of Clause 9.2.2.2

c) container stock and ex-ground stock treatments meet the criteria of Clause 9.2.2.3, and

d) the lot has been monitored for a minimum 90 day duration, or as otherwise specified in Item 4.1 of the MRTS16 Annexure.

9.2.2.1 Seeding treatments

Seeding treatments shall:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency, and

c) contain no rills or sheet erosion.

Grassing treatments shall:

a) have 90% perennial grass coverage

b) contain no bare areas > 1 m², and

c) are mowed / slashed at a height in accordance with Table 9.2.1.6.

Native seeding (Acacia, tree or shrub) treatments:

d) have 90% perennial grass coverage (less, where native plant concentration is greater than 1 plant per 16 m² nominally, and plants are shading out grass)

e) show evidence of native seed strike, or

f) where the Monitoring Period has been extended to 365 days or greater, have native seed strike (Acacia, tree or shrub) of nominally one plant per 16 m² (nominally 4 m centres).

9.2.2.2 Turfing treatments

Turfing treatments shall:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) contain no uneven jointing in pedestrian areas

d) have a healthy root system that has penetrated into the ground so that the turf cannot be easily lifted, and

e) are mowed / slashed at a height in accordance with Table 9.2.1.6.

9.2.2.3 Container and ex-ground stock treatments

Container and ex-ground stock treatments shall:

a) show no signs of nutrient deficiency

b) show no signs of water deficiency

c) show no signs of pests or disease

d) are established and well formed, showing evidence of growth typical of the species

e) have a healthy root system that has penetrated into the ground so that the plant cannot be easily lifted out of the ground

f) have all stakes, ties and above ground guying removed, and

g) in contained or high profile areas, have a mulch depth in accordance with Clause 9.2.1.9.

9.3 Establishment and monitoring supplementary requirements

Establishment and monitoring supplementary requirements of MRTS16 *Landscape and Revegetation Works* shall be specified in Item 4.4 of the MRTS16 Annexure.

Appendix

Transport and Main Roads Specifications MRTS16 Landscape and Revegetation Works

April 2014

Contents

Form A – Soil Management Plan – Construction

The Contractor shall prepare a *Soil Management Plan – Construction* using this form.

Project Name		
Contract No.		**Date**
Site Description		

1 Topsoil volumes assessment	
Total scheduled volume of topsoil.	m³
Estimated total volume of potentially [1] suitable site topsoil, as per Clause 8.2 *Topsoil Stripping Dimensions*, of MRTS04 *General Earthworks*.	m³
If shortfall in site topsoil, estimated volume of topsoil to be imported.	m³
If surplus of site topsoil, estimated volume of topsoil to be disposed.	m³
If shortfall in suitable site topsoil [1], the Contractor may provide a proposal to adjust the areas and / or depths to be stripped; or where this is not practicable, propose to import topsoil:	
If surplus in site topsoil, the Contractor shall treat material in accordance with Clause 8.4.2 *Surplus Material* of MRTS04 *General Earthworks,* or provide a proposal to avoid surplus volumes by reducing areas to be stripped and / or depths of stripping:	

2 Integrated soil management activities The Contractor shall describe how topsoil and subsoil operations will be integrated with the requirements and associated operations of each of the following documents:
Road Construction Program - *including stripping depths and locations, topsoil stockpile locations, amelioration, road embankment construction, ground work operations, and placement of soil:*
Environmental Management Plan (Construction) – *in particular acid sulphate soils, contaminated soils, red imported fire ants, water quality and erosion and sediment control operations:*
Other documents:

3 Amelioration program and operations The Contractor shall refer to the Soil Assessment Report/s and provide a soil amelioration program and describe the amelioration operations for each of the following materials:
Stripped topsoil stockpiles:
Subsoil (broadacre area subsoils in areas to be vegetated):
Subsoil (cut and fill batters to be vegetated):

4 Appendix A – Soil Management Plan – Construction Site Plans

The Contractor shall include in Appendix A site plan/s (drawing/s) showing:

Topsoil

- ☐ areas specified not to be stripped of topsoil / not to be disturbed
- ☐ stockpile locations and stockpile identification numbers
- ☐ stockpiles to be disposed of on / off site
- ☐ if disposing of topsoil on site, location and footprint of disposal site
- ☐ amelioration agents and application rates per stockpile as per Soil Assessment Report

Subsoil

- ☐ batters not specified to be treated with a vegetation treatment
- ☐ cut and fill batter identification number
- ☐ location of each subsoil test site
- ☐ amelioration agents and application rates for subsoil areas as per Soil Assessment Report

5 Appendix B – Soil Assessment Report/s

The Contractor shall include a Form B – *Soil Assessment Report* and the associated test form per sample as follows:

Form / Set of Tests	**Material to be Tested / Managed**
Form C – *Topsoil Testing*	• stockpiled site topsoil • imported topsoil
Form D – *Manufactured Site Topsoil Compliance Testing*	• compliance testing of stockpiled site topsoil after amelioration
Form E – *Subsoil Testing*	• subsoil
Form F – *Drainage Basin Soil Testing*	• soil used in basins
Where organic soil conditioner is to be used as a soil ameliorant and / or where an organics blanket is specified, the Contractor shall include:	
Form G – *Organic Soil Conditioner Testing*	• organic soil conditioner and organics blankets
Where non-potable water is proposed, the Contractor shall include:	
Form H – *Non-potable Water Management Plan*	• dam • bore • creek / river • lake water
Form I – *Non-potable Water Testing and Assessment Report*	

6 Appendix C – Additional Information

The Contractor may include an Appendix C and provide additional information to support the Soil Management Plan – Construction – for example, delivery dockets for imported materials.

NOTE – [1] Suitable topsoil refers to stockpiled site topsoil, identified by a qualified Soil Scientist as being a soil that can be used with or without amelioration; and any required amelioration is considered to be practicable.

Form B – Soil Assessment Report

The Soil Scientist is to complete this form and attach the relevant soil testing forms (C, D, E or F) for each soil sample.

NOTE – A Soil Assessment Report <u>is not</u> required for certified complying, imported topsoil.		
Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Stockpile / Batter No:	
Form attached: C ☐ D ☐ E ☐ F ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Compliance		
Complies ☐ Non-compliant – ameliorate ☐ Non-compliant – impracticable to ameliorate ☐		

1 Interpretation of test parameter result

The Soil Scientist is to indicate (x) the non-compliant soil parameters and provide an interpretation for each parameter relevant to the soil test parameter requirement.

Soil Test Parameter	Non-compliant ☒	Interpretation
Bulk density (BD)	☐	
Organic matter (OM)	☐	
Wettability	☐	
pH (H2O, 1:5)	☐	
Electrical conductivity (EC)	☐	
Extractable phosphorus content (Extr. P)	☐	
Permeability	☐	
Texture	☐	
Large particles	☐	
Plant propagule	☐	
Water repellence class number	☐	
Dispersion – Emerson class number	☐	
Exchangeable calcium (Ca)	☐	
Exchangeable magnesium (Mg)	☐	
Calcium magnesium ratio (Ca:Mg)	☐	
Exchangeable sodium percentage (ESP)	☐	
Exchangeable potassium (K)	☐	
Exchangeable aluminium (Al) percentage	☐	

Effective cation exchange capacity (ECEC)	☐	
Soluble chloride (Cl –)	☐	
Extractable sulfur (S)	☐	
Slaking class number	☐	
Clouding (dispersion) class number	☐	

2 Assessment of test results of site topsoil

The Soil Scientist is to provide an assessment per sample relevant to:

Suitability and practicability of the topsoil to comply with Form C – *in particular describe how the parameters as a whole affect the suitability of the soil* –

Erodibility and / or dispersion risk of topsoil:

Best use of the topsoil relevant to vegetation treatment and installation location (batters, basins, drains and so on):

3 Amelioration treatment of topsoil – initial and compliance testing

The Soil Scientist is to provide an amelioration treatment in the schedule below, addressing the non-compliant topsoil parameters in Form C and Form D, as per sample and *in particular* –

- organic matter content (OM)
- acidity and / or alkalinity (pH)
- water repellence (hydrophobicity) class number
- calcium magnesium ratio (Ca:Mg)
- concentration of calcium (Ca)
- concentration of magnesium (Mg)
- exchangeable sodium percentage (ESP)
- slaking and / or clouding class number

Topsoil Amelioration Schedule

Ameliorant	Rate [1, 2]	Workings
	kg / m³	–
	kg / m³	–
	kg / m³	–

4 Assessment of test result of subsoil

The Soil Scientist is to provide an assessment per subsoil sample relevant to:

Suitability and practicability of the subsoil to comply with Form E:

Erodibility and / or dispersion risk of subsoil:

5 Amelioration treatment of subsoil

NOTE – Compliance testing of ameliorated subsoil is not required.

The Soil Scientist is to provide amelioration treatment addressing the non-compliant subsoil parameters and *in particular* –

- wettability
- acidity and / or alkalinity (pH)
- calcium magnesium ratio (Ca:Mg)
- concentration of calcium (Ca)
- concentration of magnesium (Mg)
- exchangeable sodium percentage (ESP)
- aluminium toxicity (Al)
- slaking and / or clouding class number

Subsoil Amelioration Schedule

Ameliorant	Rate [1, 2]	Workings	
	kg / m²	kg / m³ x 0.2 m =	kg / m²
	kg / m²	kg / m³ x 0.2 m =	kg / m²
	kg / m²	kg / m³ x 0.2 m =	kg / m²

6 Justification for exceeding ameliorants maximum amelioration rates

The Soil Scientist shall provide justification for recommending an application rate for a single or combination of agents that exceeds the maximum rate specified below:

NOTE –

[1] **Amelioration rate units and calculation standards**

Chemical ameliorant application rate of topsoil – shall be stated as dry weight (kg) of ameliorant to volume (m³) of stockpiled soil – (kg / m³).

Chemical ameliorant application rate of subsoil – shall be stated as dry weight (kg) of ameliorant to area (m²) of subsoil – (kg / m²). The volume of subsoil to be treated is the top 200 mm depth. The rate for amelioration of subsoil is not based on the depth of incorporation (depth of ground preparation operations). For example, a batter that is to be ameliorated with 5 kg / m³ of lime and roughened to the standard depth of 50 mm will receive 1 kg / m² of lime (and not 0.25 kg / m²).

Organic soil conditioner amelioration rate shall be stated as volume (m³) of ameliorant to volume (m³) of stockpiled topsoil – (m³ / m³).

[2] **Ameliorants maximum application rates**

The following ameliorant application rates are not to be exceeded unless justification has been provided and deemed suitable:

Ameliorant	Topsoil – Max. Rate	Subsoil – Max. Rate
• Agricultural lime – CaCO3	10 kg / m³	15 kg / m³
• Agricultural dolomite – CaMg(CO3)2	10 kg / m²	15 kg / m²
• Agricultural gypsum – CaSO4.2H2O	10 kg / m²	15 kg / m²
• Organic soil conditioner – by volume of topsoil	0.2 m³ / m³	–

Increasing Soil pH

The following rates are a guide to increase the soil pH by half a unit. Rates may vary depending on project soil types; the rates are based on using agricultural lime or agricultural dolomite with a neutralising value of 90:

- Sands and loamy sands – up to 1.0 kg / m³
- Sandy loams to clay loams – up to 2.0 kg / m³
- Sandy light clay to heavy clay – up to 2.5 kg / m³

Form C – Topsoil Testing

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Stockpile No:	
NOTE – sample shall be taken from topsoil layer and be a composite, representative sample per topsoil type ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Complies ☐ Non-compliant – ameliorate ☐ Non-compliant – impracticable to ameliorate ☐		
Imported Topsoil Only		
Date of Manufacture:	Name of the Manufacturer:	
Manufacture Batch Number:	Complies ☐	Non-compliant ☐

Soil Test Parameter	Test Method	Soil Test Parameter Requirement	Soil Test Result
Refer AS 4419 – Soils for landscaping and garden use – NOTE MODIFIED REQUIREMENTS			
Bulk density (BD)	Clause 5.2	> 0.7 kg/L	
Organic matter (OM) (relevant to the organic carbon concentration)	Clause 5.3	3 to 10%	
Wettability	Clause 5.4	> 5 mm/min. – < 150 mm/min.	
pH (H2O, 1:5) – a) General range b) Naturally occurring acid soils c) Naturally occurring alkaline soils d) Naturally occurring strongly alkaline soils	Clause 5.5	> 5.5 and < 7.5 > 5.5 and < 6.5 > 7.0 and < 8.5 ≥ 8.5	
Electrical conductivity (EC)	Clause 5.6	< 1.2 dS/m	
Extractable phosphorus content (Extr. P) a) Very P sensitive plants b) Moderately P sensitive plants c) Non-sensitive P plants	Clause 5.8	< 5 mg/kg < 20 mg/kg < 100 mg/kg	
Permeability	Clause 5.12	2 – 35 cm/hr	
Texture	Clause 5.13	Texture Classification	
Large particles – topsoil to: a) Turfed or grass seeded areas to be mown or slashed b) Batters to be mulched or hydraulic seeded and hydraulically mulched c) Broad acre areas to be seeded with native species	Clause 5.14	100% by weight to pass a 20 mm sieve 100% by weight to pass a 50 mm sieve 100% by weight to pass a 75 mm sieve	
Imported topsoil only – plant propagule content	Clause 5.15	Free from any living parts of plants generally considered to be weeds	
Refer MRTS16 Appendix – Test Method Q160 Determination of Water Repellency of a Soil			
Water repellence (hydrophobicity) class number	Table 1	Class 0 or 1	

Soil Test Parameter	Test Method	Soil Test Parameter Requirement	Soil Test Result
Refer AS 1289.3.8.1 – Methods of testing soils for engineering purposes			
Dispersion – Emerson class number	Method 3.8.1	Class 3 to 8	
Refer Soil Chemical Methods : Australasia – Rayment & Lyons, CSIRO 2011			
NOTE – Select soil texture range: a) ☐ b) ☐ c) ☐			
Exchangeable calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 ≥ 2 meq/100g ≥ 5 meq/100g ≥ 5 meq/100g	
Exchangeable magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 > 0.6 meq/100g > 1.0 meq/100g > 1.0 meq/100g	
Calcium magnesium ratio (Ca:Mg) Exchangeable form for – a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	2 – 10	
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 < 6 < 15 < 15	
Exchangeable potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 > 0.2 meq/100g > 0.4 meq/100g > 0.4 meq/100g	
Exchangeable aluminium (Al) percentage (Al base saturation % = % Al of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH < 6.0 Method 15G1	 < 25 < 40 < 40	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 15J1	 > 5 meq/100g > 10 meq/100g > 10 meq/100g	
When EC > 1.2 dS/m – Soluble Chloride (Cl -) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 5A	< 900mg/kg	
When EC > 1.2 dS/m – Extractable Sulfur (S) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 10B	< 100mg/kg	
Refer MRTS16 Appendix – Test Method Q161 Field Dispersion Indicator Test of Soil – Slaking			
Slaking class number	Table 1	Class 0 – 2	
Refer MRTS16 Appendix – Test Method Q162 Field Dispersion Indicator Test of Soil – Clouding			
Clouding (dispersion) class number	Table 1	Class 0 – 1	

Form D – Manufactured Site Topsoil Compliance Testing

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Stockpile No:	
NOTE – sample shall be a composite, representative sample taken from soil 300mm below the stockpile surface ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Complies ☐	Noncompliant – ameliorate ☐	

Soil Test Parameter	Test Method	Soil Test Parameter Requirement	Soil Test Result
Refer AS 4419 – Soils for landscaping and garden use NOTE MODIFIED REQUIREMENTS			
Organic matter (OM) (relevant to the organic carbon concentration)	Clause 5.3	3 to 10%	
pH (H2O, 1:5) – a) General pH range soils b) Naturally occurring acid soils c) Naturally occurring alkaline soils d) Naturally occurring strongly alkaline soils	Clause 5.5	> 5.5 and < 7.5 > 5.5 and < 6.5 > 7.0 and < 8.5 ≥ 8.5	
Electrical conductivity (EC)	Clause 5.6	< 2.4 dS/m when lime, gypsum or dolomite added: otherwise < 1.2 dS/m	
Texture	Clause 5.13	Texture Classification	
Refer MRTS16 Appendix – Test Method Q160 Determination of Water Repellency of a Soil			
Water repellence (hydrophobicity) class number	Table 1	Class 0 or 1	
Refer AS 1289.3.8.1 – Methods of testing soils for engineering purposes			
Dispersion – Emerson class number	Method 3.8.1	Class 3 to 8	
Refer Soil Chemical Methods : Australasia – Rayment & Lyons, CSIRO 2011			
NOTE – Select soil texture range: a) ☐ b) ☐ c) ☐			
Exchangeable calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 ≥ 2 meq/100g ≥ 5 meq/100g ≥ 5 meq/100g	
Exchangeable magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 > 0.6 meq/100g > 1.0 meq/100g > 1.0 meq/100g	
Calcium magnesium ratio (Ca:Mg) Exchangeable form for – a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	2 – 10	
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 < 6 < 15 < 15	

Soil Test Parameter	Test Method	Soil Test Parameter Requirement	Soil Test Result
Exchangeable potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 > 0.2 meq/100g > 0.4 meq/100g > 0.4 meq/100g	
Exchangeable aluminium (Al) percentage (Al base saturation % = % Al of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH < 6.0 Method 15G1	 < 25 < 40 < 40	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 15J1	 > 5 meq/100g > 10 meq/100g > 10 meq/100g	

Form E – Subsoil Testing

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Stockpile / Batter No:	
NOTE – Sampling of batters to be taken from surface to 300 mm depth ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Complies ☐	Non-compliant – ameliorate ☐	

Soil Test Parameter	Test Method	Soil Test Parameter Requirement	Soil Test Result
Refer AS 4419 – Soils for landscaping and garden use NOTE MODIFIED REQUIREMENTS			
Wettability	Clause 5.4	> 5 mm/min – < 150 mm/min	
pH (H2O, 1:5) – a) General range b) Naturally occurring acid soils c) Naturally occurring alkaline soils d) Naturally occurring strongly alkaline soils	Clause 5.5	> 5.5 and < 7.5 > 5.5 and < 6.5 > 7.0 and < 8.5 ≥ 8.5	
Electrical conductivity (EC)	Clause 5.6	< 1.2 dS/m	
Texture	Clause 5.13	Texture Classification	
Refer MRTS16 Appendix – Test Method Q160 Determination of Water Repellency of a Soil			
Water repellence (hydrophobicity) class number	Table 1	Class 0 or 1	
Refer Soil Chemical Methods : Australasia – Rayment & Lyons, CSIRO 2011			
NOTE – Select soil texture range: a) ☐ b) ☐ c) ☐			
Exchangeable calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 ≥ 2 meq/100g ≥ 5 meq/100g ≥ 5 meq/100g	
Exchangeable magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 > 0.6 meq/100g > 1.0 meq/100g > 1.0 meq/100g	
Calcium magnesium ratio (Ca:Mg) Exchangeable form for – a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	2 – 10	
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 < 6 < 15 < 15	

Soil Test Parameter	Test Method	Soil Test Parameter Requirement	Soil Test Result
Exchangeable potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH > 7.3 Method 15C1	 > 0.2 meq/100g > 0.4 meq/100g > 0.4 meq/100g	
Exchangeable aluminium (Al) percentage (Al base saturation % = % Al of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH < 6.0 Method 15G1	 < 25 < 40 < 40	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 15J1	 > 5 meq/100g > 10 meq/100g > 10 meq/100g	
When EC > 1.2 dS/m – Soluble Chloride (Cl -) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 5A	< 900 mg/kg	
When EC > 1.2 dS/m – Extractable Sulfur (S) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 10B	< 100 mg/kg	
Refer MRTS16 Appendix – Test Method Q161 Field Dispersion Indicator Test of Soil – Slaking			
Slaking class number	Table 1	Class 0 – 2	
Refer MRTS16 Appendix – Test Method Q162 Field Dispersion Indicator Test of Soil – Clouding			
Clouding (dispersion) class number	Table 1	Class 0 – 1	

Form F – Drainage Basin Soil Testing

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Stockpile / Batter No:	
NOTE – Sampling of batters to be taken from surface to 300 mm depth ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Complies ☐	Non-compliant – ameliorate ☐	

Soil Test Parameter	**Test Method**	**Soil Test Parameter Requirement**	**Soil Test Result**
Refer MRTS04 General Earthworks			
General fill material Class A	Table 9A	Requirements as per Table 9A – Embankment Material Properties	
Refer AS 1289 – Methods of testing soils for engineering purposes			
Material Testing Manual			
Construction moisture content	Q110A	± 2% (OMC)	
Refer AS 4419 – Soils for landscaping and garden use – NOTE MODIFIED REQUIREMENTS			
pH (H2O, 1:5) – a) General range b) Naturally occurring acid soils c) Naturally occurring alkaline soils d) Naturally occurring strongly alkaline soils	Clause 5.5	> 5.5 and < 7.5 > 5.5 and < 6.5 > 7.0 and < 8.5 ≥ 8.5	
Electrical conductivity (EC)	Clause 5.6 – Method 3A1	< 1.2 dS/m	
Refer Soil Chemical Methods : Australasia – Rayment & Lyons, CSIRO 2011			
NOTE – Select soil texture range: a) ☐ b) ☐ c) ☐			
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤ 7.3 Method 15B3 When pH 7.3 Method 15C1	< 6 < 15 < 15	
When EC > 1.2 dS/m – Soluble Chloride (Cl -) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 5A	< 900 mg/kg	
When EC > 1.2 dS/m – Extractable Sulfur (S) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 10B	< 100 mg/kg	
Refer MRTS16 Appendix – Test Method Q161 Field Dispersion Indicator Test of Soil – Slaking			
Slaking class number	Table 1	Class 0 – 2	
Refer MRTS16 Appendix – Test Method Q162 Field Dispersion Indicator Test of Soil – Clouding			
Clouding (dispersion) class number	Table 1	Class 0 – 1	

Form G – Organic Soil Conditioner Testing

Organic soil conditioner shall comply with –

a) AS 4454 *Clause 3.1.1.1 (c) mature product* and *Clause 3.1.1.2 (a) soil conditioner*; and
b) Form G.

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Stockpile No / Batch:	
NOTE – sampling shall be in accordance with AS4454 Clause 4.1 ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Date of Manufacture:	Name of the Manufacturer:	
Manufacture Batch Number:	Complies with AS 4454; and Form G ☐	Non-compliant with AS 4454 and Form G ☐

Organic Soil Conditioner Parameter	Test Method	Organic Soil Conditioner Test Parameter Requirements	Organic Soil Conditioner Test Results
Refer AS 4454 – Composts, soil conditioners and mulches – NOTE MODIFIED REQUIREMENTS			
Pathogen indicators – a) E. coli b) Salmonella spp. c) Faecal coliforms	Appendix D – Clause D5.4	< 100 MPN/g absent < 1000 MPN/g	
Nitrogen Drawdown Index (NDI)	Appendix O	> 0.5 NDI	
Refer AS 4276.7 – Water microbiology - Escherichia coli and thermotolerant coliforms - Membrane filtration method			
Thermotolerant coliforms	AS 4276.7	< 100 MPN/g	
Refer AS 3896 – Waters - Examination for Legionella spp. including Legionella pneumophia			
Legionnella spp	AS 3896	absent	
Refer AS 5013.24.2 – Microbiology of food and animal feeding stuffs – Horizontal method for the detection and enumeration of Listeria monocytogenes - Enumeration method			
Listeria spp	AS 5013.24.2	absent	
AS 4964 – Method for the qualitative identification of asbestos in bulk samples			
Asbestos containing material (ACM) – a) Bonded (tightly bound) asbestos b) Loosely bound (friable) asbestos	AS 4964	absent	
AS 4419 – Soils for landscaping and garden use			
pH (H2O, 1:5)	Clause 5.5	6.5 – 8.5	
Electrical conductivity – EC (H2O. 1:1.5)	Clause 5.6	< 1.2 dS/m	

Form H – Non-potable Water Management Plan

The Contractor shall refer to Form I – Non-potable Water Testing and Assessment Report and prepare a management plan using this form.

1 Integrated non-potable water management activities The Contractor shall describe how watering of vegetation treatments, using water sourced from the sampled water source, will be integrated with the requirements and associated operations of each of the following documents –
Environmental Management Plan (Construction) – *in particular water and soil quality operations* –
Guide to Workplace use of Non-potable Water Including Recycled Waters (DIER 2007) – *in particular the management and application of water* –
The Soil Management Plan – Construction – *in particular salt build-up in soils* –
Other documents –

2 Amelioration program and operations The Contractor shall refer to the Non-potable Water Assessment Report/s and provide the watering practices and watering program to manage the saline properties of the water – *in particular to include* –			
Salt tolerance of plant species – indicate if a vegetation treatment contains plant species that are salt sensitive, salt tolerant and / or very salt tolerant, as per Department of Agriculture, Fisheries and Forestry.			
Vegetation Treatment	**Salt sensitive**	**Salt tolerant**	**Very salt tolerant**
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
Water source/s description –			
Water amelioration –			
Watering program –			
Watering practices –			
Water monitoring program –			
Plant and soil monitoring program –			

Form I – Non-potable Water Assessment Report and Testing

Non-potable Water Assessment Report

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Water Body:	
Form attached: ☐		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Compliance		
Complies ☐ Non-compliant – ameliorate ☐ Non-compliant – impracticable to ameliorate ☐		

1 Interpretation of test parameter result

The Scientist is to indicate (x) the non-compliant water parameters and provide an interpretation for each parameter relevant to the water test parameter requirement.

Water Test Parameter	**Non-compliant** ☒	**Interpretation**
E. coli (median) MPN/100 mL	☐	
Enumeration of Coliform; and E. coli (Petri Film)	☐	
Total coliforms	☐	
Salmonella spp	☐	
pH	☐	
Electrical Conductivity (EC) a) Salt sensitive plants b) Salt tolerant plants c) Very salt tolerant plants	 ☐ ☐ ☐	
Bicarbonate (HCO_3^{1-})	☐	
Carbonate (CO_3^{2-})	☐	
Chloride (Cl^{1-})	☐	
Sulphate (SO_4^{2-})	☐	
Calcium (Ca^{2+})	☐	
Sodium (Na^{1+})	☐	
Magnesium (Mg^{2+})	☐	
SAR a) Salt tolerant plants b) Salt sensitive plants	 ☐ ☐	

2 Assessment of test results of water

The Scientist is to provide an assessment per sample relevant to –

Suitability and practicability of the water to comply with Form I –

NOTE – Water with EC > 5 dS/m is unsuitable for use irrigation water as amelioration is not practicable

A use of water relevant to the type and plant / seed species of vegetation treatment –

3 Amelioration and management of water

The Scientist is to provide an amelioration treatment and the watering program and best practice addressing the water parameters in Form I, per sample and *in particular* –

- E. coli
- Total coliforms
- Salmonella spp
- pH
- EC
- SAR
- Cl^{1-}

Water Amelioration Schedule		
Ameliorant	**Rate**	**Comments**
Watering program –		
Watering practices –		

Amelioration program and operations

The Contractor shall refer to the Non-potable Water Assessment Report/s and provide the watering practices and watering program to manage the saline properties of the water *in particular* –

- regular monitoring of water source/s by testing the parameters of concern, using *Form I*
- regular monitoring of plants by observation and soil by field testing the pH and EC of the soil using Form C parameter requirements; and inspecting plant foliage for signs of wilting and / or leaf burn
- watering program to –
  - prioritise night or early morning waterings to lessen evaporation and concentration of salts
  - avoid windy conditions to lessen leaf burn / death of seedlings
- watering practices to –
  - apply a volume of water that allows for some leaching to move salts away from plant roots
  - apply water that allows for deep wetting of the soil and subsequent reduction in the frequency of water to lessen salt build up in upper soil layers
  - maintain soil moisture to reduce damage to plants when applying salty water to dry soil
- sourcing an alternate low EC water source for intermittent leaching and removal of salt

Non-potable Water Testing

Site Sample Identification		Sample Date:
Project Name:	Sample Location:	
Job / Contract No:	Site / Water Source No:	
NOTE – Sampling of water to be in accordance with Clause 7.10.2.		
Testing Laboratory Sample Identification		
Laboratory:	Sample No:	Date Tested:
Complies ☐	Non-compliant – ameliorate ☐	Non-compliant – impracticable to ameliorate ☐

Water Quality Parameter	**Test Method**	**Water Test Parameter Requirement**	**Water Test Result**
E. coli (median) MPN/100 mL	AOAC Official Method 991.4	< 100 MPN	
Enumeration of Coliform; and E. coli (Petri Film)	AOAC Official Method 991.4	< 100 MPN	
Total coliforms	MPN Method	< 100 MPN	
Salmonella spp	MPN Method	Absent	
Refer Soil Chemical Methods : Australasia – Rayment & Lyons, CSIRO 2011			
pH	Water C	6 – 8.5	
Electrical Conductivity (EC) a) Salt sensitive plants b) Salt tolerant plants c) Very salt tolerant plants	Water B	 ≤ 1.6 dS/m ≤ 3 dS/m 3 – 5 dS/m	
Bicarbonate (HCO_3^{1-})	D	< 120 mg/L	
Carbonate (CO_3^{2-})	D	< 350 mg/L	
Chloride (Cl^{1-})	E	< 600 mg/L	
Sulphate (SO_4^{2-})	J	< 600 mg/L	
Calcium (Ca^{2+})	L	> 80 mg/L	
Sodium (Na^{1+})	L	< 300 mg/L	
Magnesium (Mg^{2+})	L	> 35 mg/L	
SAR a) Salt tolerant plants b) Salt sensitive plants	M3a	 ≤ 9 9 - < 24	

Certificate of Commencement of the Establishment Period

Copy to the Principal

Name and address of Principal

Contract Number

Project Name

To the Contractor

Name and address of Contractor

Certificate Number

Description of landscape and revegetation works – drawing number, landscape treatment type, location or Lot.

In accordance with MRTS16 I hereby certify that the date of commencement of the Establishment Period for the above landscape and revegetation works is:

Date

Certified by: _____

Administrator the Contract

Name or company name

Name of nominee

Signature

Date

Certificate of Commencement of the Monitoring Period

Copy to the Principal

Name and address of Principal

Contract Number

Project Name

To the Contractor

Name and address of Contractor

Certificate Number

Description of landscape and revegetation works – drawing number, landscape treatment type, location, Lot or Separable Portion.

In accordance with MRTS16 I hereby certify that the date of commencement of the Monitoring Period for the above landscape and revegetation works is:

Date

Certified by: _____

Administrator the Contract

Name or company name

Name of nominee

Signature

Date

Certificate of Completion of the Monitoring Period

Copy to the Principal

Name and address of Principal

Contract Number

Project Name

To the Contractor

Name and address of Contractor

Certificate Number

Description of landscape and revegetation works – drawing number, landscape treatment type, location, Lot or Separable Portion.

In accordance with MRTS16 I hereby certify that the date of completion of the Monitoring Period for the above landscape and revegetation works is:

Date

Certified by: _____

Administrator the Contract

Name or company name

Name of nominee

Signature

Date

Test Method Q160: Determination of water repellency of a soil

1 Source

This method applies the principles of the water drop penetration time (WDPT) test developed by Bessel D. van't Woudty, 1959 and classifies the soils wettability using a classification developed by Louis W. Decker, 1988.

2 Scope

This method sets out the procedure for determining water repellency (hydrophobicity) by using the water drop penetration time (WDPT[1]) test.

A measured amount of water in droplets is applied to a dried, smoothed, levelled and uncompacted soil surface and the time that lapses before the droplets are absorbed is determined.

3 Apparatus

The following apparatus is required:

3.1.1 Oven of suitable capacity, capable of heating a sample of soil to 40 ± 2ºC.

3.1.2 Tray, suitable size for drying soil.

3.1.3 Standard medicine dropper.

3.1.4 Stopwatch.

4 Materials

The following materials are required:

4.1.1 Deionised or distilled water.

5 Procedure

The procedure shall be as follows:

5.1 Obtain a test portion of soil with a minimum volume of 300 mL.

5.2 Place the test portion on a tray and level to a smooth but uncompacted surface.

5.3 Place the test portion and tray in the oven and dry to a constant mass (Note 7.1).

5.4 Remove the test portion and tray from the oven and allow to cool to room temperature

5.5 Using the standard medicine dropper, apply three water droplets to the surface of the from the standard medicine dropper.

5.6 Determine the time it takes for the water to infiltrate (disappear) into the soil and record as the water drop penetration time to the nearest second.

6 Reporting

Report the following values and general information:

6.1 Water drop penetration time to the nearest 1 second.

6.2 Water repellence class value (Table 1).

6.3 Water repellence rating description (if required).

7 Notes on method

7.1 Constant mass is achieved when, after the initial drying period, successive drying over 1 h periods gives rise to a weight loss of not more than 1% of the initial weight loss.

Table 1 – Soil water repellency class

Class	WDPT (seconds)	Water Repellence Rating
0	< 5	wettable; non-water repellent
1	5 – 60	slightly water repellent
2	> 60	strongly water repellent

Test Method Q161: Field dispersion indicator test of a soil - slaking

1 Source

This method is based on the procedure described in the SOILpak – southern irrigators - Readers' Note – Part C. Diagnosis of Soil, Chapter C7. Slaking and Dispersion; NSW Department of Primary Industry, 1999.

2 Scope

This method sets out the method for determining slaking of a soil. Slaking is the breakdown of soil aggregates into smaller fragments when placed in water.

Slaking indicates a soils resistance to erosion and how well it maintains its structure when wetted. Slaking is the breakdown of air-dry soil aggregates (> 2 – 5 mm) into smaller micro-aggregates (< 0.25 mm) when immersed in water. Slaking occurs when soil aggregates are not strong enough to withstand internal stresses caused by rapid water uptake as a result of swelling clay particles; trapped and escaping air in soil pores. Slaking results in detached soil particles that fill soil pores and cause surface sealing - reducing infiltration and plant available water; and increasing runoff and erosion (Note 8.1).

3 Apparatus

The following apparatus is required:

3.1 Clear petri dish or similar.

4 Materials

The following materials are required:

4.1 Deionised or distilled water.

5 Procedure

The procedure shall be as follows:

5.1 From the sample select three soil aggregates of 5-10 mm diameter.

5.2 If moist, air dry the aggregates.

5.3 Fill a petri dish with 5 mm of deionised or distilled water or at least enough water to cover the soil aggregates.

5.4 Carefully place the three soil aggregates into the water.

5.5 Do not knock, disturb or place the petri dish in a windy position.

5.6 Determine the class of slaking at 5 and 120 minutes for each aggregate using Table 1.

6 Calculations

Calculate the following:

6.1 The highest class value from the three aggregates at 120 minutes and record as the slaking class.

7 Reporting

Report the following values and general information:

7.1 Slaking class.

8 Notes on method

8.1 The slaking classes have been adapted from Soil Quality indicators; USDA Natural Resources Conservation Services, 2008.

Table 1 – Slaking class

Class	Aggregate Description at 5 min.	Aggregate Description at 120 min.
0	no change	no change
1	slight edge breakdown	slight edge breakdown
2	collapses in pieces	collapses in pieces
3	collapses into finer < 2 mm pieces	collapses into finer < 2 mm pieces
4	complete breakdown	complete breakdown

Test Method Q162: Field dispersion indicator test of a soil - clouding

9 Source

This method is based on the procedure described in the SOILpak – southern irrigators - Readers' Note – Part C. Diagnosis of Soil, Chapter C7. Slaking and Dispersion; NSW Department of Primary Industry, 1999.

10 Scope

This method describes the procedure for determining clouding (dispersion) of soil. Clouding is the separation of individual clay particles when placed in water.

When a sodic (dispersive) soil comes into contact with non-saline water, water is drawn between the clay layers causing the clay to swell so that individual clay layers separate from the soil aggregate, this process is known as dispersion.

Dispersion describes the behaviour of clay particles separating from one another in a moist soil. Dispersion causes soil aggregates to breakdown resulting in the clogging of soil pores by the dispersed clay particles. This results in the swelling of clay platelets and the collapse of clay aggregates.

Dispersion is often seen as 'muddy' or 'milky' water in dams and surface and runoff water (Note 8.1).

11 Apparatus

The following apparatus is required:

11.1 Clear petri dish or similar.

12 Materials

The following materials are required:

12.1 Deionised or distilled water.

13 Procedure

The procedure shall be as follows:

13.1 From the sample select three soil aggregates of 5-10 mm diameter.

13.2 If moist, air dry the aggregates.

13.3 Fill a petri dish with 5 mm of deionised or distilled water or at least enough water to cover the soil aggregates.

13.4 Carefully place the three soil aggregates into the water.

13.5 Do not knock, disturb or place the petri dish in a windy position.

13.6 Determine the class of clouding at 5 and 120 minutes for each aggregate using Table 1.

13.7 Record the presence of a milky ring around the aggregates, even if the soil collapses or bubbles.

14 Calculations

Calculate the following:

14.1 The highest class value from the three aggregates at 120 minutes and record as the clouding class.

15 Reporting

Report the following values and general information:

15.1 Clouding class.

16 Notes on method

16.1 Dispersion only occurs in non-saline water or rainwater; hence the use of deionised or distilled water for testing for clouding.

Table 1 – Clouding class

Class	Aggregate Description at 5 min	Aggregate Description at 120 min
0	no clouding	no clouding
1	slight milky ring	slight milky ring
2	moderate milky ring	moderate milky ring
3	strong milky ring	strong milky ring
4	complete dispersion very strong milky ring	complete dispersion very strong milky ring