# Landscape

DIPL Roadworks Master – March 2022

## Standards and Publications

Conform to the following Publications unless specified otherwise:

AS 2303 Tree stock for landscape use

AS 2698(set) Plastics pipes and fittings for irrigation and rural applications

AS 2698.2 - Polyethylene rural pipe

AS 2698.3 - Mechanical joint fittings for use with polyethylene micro-irrigation pipes

AS/NZS 3500(set) Plumbing and drainage

AS 4373 Pruning of amenity trees

AS 4419 Soils for landscaping and garden use.

AS 4454 Composts, soil conditioners and mulches

**Specification Reference**

Refer to the Northern Territory Government Standard Specification for Environmental Management.

**Landscape Defects Liability Period**

The defects liability period for the Landscaping portion of the works is: ***[enter data].***

[Select one of the following 3 options; (a)13 weeks from practical completion of the landscaping works OR (b) The same as for the entirety of the works but not less than 13 weeks from practical completion of the landscaping works OR (c) To dd/mm/yyyy.]

## Definitions

| **Table - Definitions – Landscape** | |
| --- | --- |
| **TERM** | **DEFINITION** |
| **Certified Seed** | Seed by record of origin, purity, and strain and conforming in character to the parent stock. |
| **Exotic Plants** | Any plants not native to Australia. |
| **Fine Tilth** | The friable soil resulting from cultivation. |
| **Germination Percentage** | The proportion of pure seed germinating in a fixed time under standard laboratory conditions. |
| **Mulch** | Stable material spread as a surface treatment to reduce soil erosion, water loss, and weed invasion. |
| **Native Plants** | Plants that are natural to Australia. |
| **NPK Ratio** | The ratio of Nitrogen (N), Phosphorus (P), and Potassium (K) in a fertiliser compound. |
| **Root Ball** | The finely bound fibrous root and soil removed intact from the container with the plant. |
| **Shall** | The term ‘shall’ is indicative of a mandatory requirement unless the context clearly indicates otherwise. |
| **Soil Binding Agent** | Material which stabilises and conditions soil and aids moisture retention. |

## Materials

Refer to AS 2303 for tree stock requirements.

### Trees, Shrubs and Ground Covers

Provide trees, shrubs and ground covers which have the following characteristics:

* Trunks/stems to be sturdy and well hardened.
* A well developed vigorous root system.
* A minimum of three months in their container.
* Be sound, healthy, vigorous, and free from insect pests, plant diseases, sun scalds, fresh abrasions of the bark, or other disfigurements.

### Grass

Seed shall be covered by an appropriately numbered seed analysis report or certificate cross referenced to the number on the seed sacks.

Seed shall be used only if its report or certificate has been issued within the previous six months.

Seed used shall be true to label.

Seed shall have minimum germination of 80%.

Seed shall comply with the following purity characteristics:

* Clean seed, minimum 94% by weight.
* Weed seed, maximum 0.2% by weight.
* Other crop seed, maximum 0.8% by weight.
* Inert matter, maximum 5.0% by weight.
* Shall not contain any Hyptis Sauveolens, Sida Acuta, Sida Cordifolia.

Seed mixes shall conform to the ***Table - Seed Mixes***.

| **Table – Seed Mixes** | | | | |
| --- | --- | --- | --- | --- |
| **Water Regime** | **General Latitude** | **Seed Type** | **Percentage By Weight** | **Mixture Application Rate** |
| Irrigated areas | All | Cynadon dactylon  (Couch) | 30 | Minimum 100 kg per hectare |
| Paspalum notatum pensicola | 35 |
| Paspalum notatum argentina | 35 |
| Dry grassland areas | North of Adelaide River | Paspalum notatum pensicola | 20 | Minimum 100 kg per hectare |
| Paspalum notatum argentina | 80 |
| Adelaide River to Katherine | Paspalum notatum pensicola | 20 | Minimum 50 kg per hectare |
| Bothriochloa petusa | 10 |
| Cynadon dactylon | 20 |
| Chloris Gayana | 30 |
| Urochloa mosambicensis  (Sabi Grass) | 20 |
| Katherine to Mataranka | Paspalum notatum pensicola | 20 | Minimum 50 kg per hectare |
| Bothriochloa petusa | 10 |
| Chloris Gayana | 30 |
| Urochloa mosambicensis  (Sabi Grass) | 20 |
| Urochloa mosambicensis | 20 |
| Cenchus Setiger  (Birdwood Grass) | 20 |

### Fertiliser

Fertilisers shall be stored in waterproof sealed bags under shelter away from water and direct sunlight.

Fertilisers shall conform to the ***Table - Fertilisers***.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table - Fertilisers** | | | |
| **Use** | **General Plant Category** | **Where Used** | **Component Requirements** |
| Planting | Native | Surface | Native Plant Feed Mix |
| Exotic | Surface | Exotic Planting and Feeding Mix |
| Native and/or Exotic | Hole | Granular or Tablet Slow Release (6 month minimum) 20:10:10 NPK ratio |
| Feeding | All existing plants | Surface | As for Planting - Surface |
| Grassing | All seeding, both new and existing | Surface | Fast Release 15:7:7 NPK ratio Trace Elements |
| Do not use fertiliser with Grevillia and Banksia plant varieties. | | | |

### Imported Soils - Hold Point - Witness Point

Imported topsoil shall conform generally to AS 4419 and the following requirements:

* Be free draining.
* Be red‑brown or black sandy loam.
* Contain no grass or weed growth.
* Maximum stone size of 50 mm.

**Hold Point** - Advise the name of the proposed supplier. Do not order soils without Superintendent’s approval of the supplier.

**Witness Point** - Provide a 5 kg sample of topsoil proposed for the works. Do not order soils without Superintendent’s approval of the sample. Provide copies of delivery dockets for the topsoil delivered to site for the works.

### Insecticide

Use Fipronil for termite control.

Insecticide shall be used strictly in accordance with the manufacturer’s instructions.

### Mulch - Hold Point - Witness Point

ORGANIC

* Shall be stable, free from impurity, and be sufficiently heavy to prevent dispersal by wind.
* Shall be shredded bark, wood chips, hay or similar.
* Wood chips shall be a maximum size of 50 mm, inert, and shall be free of resinous toxins and termites.
* Shall conform generally to AS 4454.

**Hold Point** - Advise the name of the proposed supplier. Do not order mulch without Superintendent’s approval of the supplier.

**Witness Point** - Provide a 5 kg sample of mulch proposed for the works. Do not order mulch without Superintendent’s approval of the sample. Provide copies of delivery dockets for the mulch delivered to site for the works.

INORGANIC

* Shall be washed and screened lateritic gravel or brick chips with particle sizes in the range 6 mm minimum to 25 mm maximum.

## Site Preparation

### Setting Out

The Contractor shall be responsible for accurately setting out the works in accordance with the drawings.

In particular, trees shall not be planted:

* within 30 m of the end of a central median for trees, or 10 m for shrubs, and not
* within 5 m of a road light pole, and not
* within 1.5 m of a fire hydrant, and not
* where their location will ultimately obscure traffic signs, signals, or other essential roadside features.

### Protection of Existing Vegetation

Ensure all trees, shrubs, and other vegetation to be retained within the limits of work are not damaged. Conform to the conditions shown below.

Protect vegetation prior to commencing construction work in the vicinity of that vegetation.

Do not place or dump any chemical type materials including oil, paint, bituminous products, fuels, and cement/concrete near the vegetation - even for short periods. Prevent windblown chemical type materials, such as cement, from affecting vegetation.

Do not stockpile bulk materials - such as spoil from excavation, boulders, cleared vegetation - under or near vegetation. Ensure such spoil is never placed against trunks, even for short periods.

Do not remove topsoil from within the dripline (i.e. canopy area) of vegetation unless essential to the works. For any excavation within the dripline keep open as short a period as possible, and use excavation methods that preserve the root system intact and undamaged.

Cut roots only where it is absolutely necessary. When cutting roots use a means which does not disturb the remaining root system.

Backfill excavation around tree roots with material of at least comparable quality to that excavated. Consolidate backfill and do not backfill around trunks above the original level. Thoroughly water backfilling.

Avoid damage to overhead limbs by machinery. Only remove the minimum amount required if limbs must be removed to allow machinery to work.

Where branches are to be removed, cut them back to the branch collar.

Compensation for damage to existing vegetation shall be borne by the Contractor and determined as follows:

Trees (including palms and cycads)

* Valuation rate of $10 per centimetre of trunk circumference at a height of 1 metre above the ground level, within the following limits:

Minimum valuation: $250 per tree.

Maximum valuation: $2,500 per tree.

Shrubs - Valuation rate of $8 per centimetre of trunk circumference at a height of 1 metre above the ground level.

### Earthworks

Remove from site all unwanted vegetation. Backfill and regrade over areas where trees have been removed.

Regrade all areas of excavation to ensure all finished surface levels are free draining.

Excavate or fill to lines and levels shown on the drawings.

Fill placed on areas to be landscaped shall be free from inorganic, deleterious material and stones greater than 100 mm nominal size.

Compact fill sufficiently to ensure initial settlement and provide a firm base.

Clear all subgrade surfaces of stones exceeding 100 mm diameter and rubbish, weeds and roots.

No excavation shall be allowed within 1.5 m of the canopy area of an existing tree.

### Topsoil

Excavate and stockpile material which is suitable for reuse as topsoil.

Imported topsoil shall be as specified in the ***Imported Soils*** sub-clause in the ***Materials*** clause in this work section.

Stockpile topsoil in a free draining area in stockpiles not exceeding 2.0 m in height.

Ensure stockpiles are properly maintained.

## Planting

### Setting Out of Holes – Hold Point

Accurately set out the locations for trees/shrubs to be planted in accordance with the drawings.

**Hold point** - Obtain approval of the set out from the Superintendent before commencing any planting.

### Preparation and Treatment of Holes

Identify all cable and services locations prior to excavating any holes.

Prepare holes initially in accordance with the ***Table - Initial Hole Preparation Chart*** appearing below.

Remove excess excavated material, rubbish and cut vegetation from site.

Excavate planting holes by mechanical/manual means.

Size of planting holes shall be twice the diameter and twice the depth of the plant container, unless shown otherwise on the drawings.

Break up glazed sides of holes.

Treat planting holes in hard, dense material prior to planting by

* placing 1 kg Gypsum or Claybreaker around the sides and bottom of the hole; and
* filling hole with water and allowing to drain.

Treat holes with Fipronil in accordance with manufacturer's instructions prior to planting.

| **Table – Initial Hole Preparation Chart** | | | | |
| --- | --- | --- | --- | --- |
|  | **Land Categories And Soil Characteristics** | | | |
|  | **Marine Sediments** | **Soil And Gravel** (depth greater than 600 mm) | **Shallow Soils** | **Surface Rock** (soil depth overlaying rock less than 600 mm) |
| **Visual appearance** | Grey and brown muds, silts and clays: occasionally pale beach sands | Usually red, yellow and brown sandy loams to sandy clay loams with varying amounts of ironstone gravel; occasionally siltstone and quartz gravel | Soil material similar to Category 2, overlaying laterite on siltstone\* | Very little or no soil; extensive areas out of cropping laterite on siltstone\* |
| **Operational Steps** | | | | |
| **Initial Rock Break** | - | - | - | Rip and rock break. |
| **Initial Excavation** | Hole size dependent upon species and area | Excavate to 600 mm. | Excavate hole till machine rejection (commonly bed rock layer). | Excavate hole to 600 mm minimum. |
| **Secondary Rock Break** | - | - | Rock break bottom to a depth of 1200 mm. | Rock break bottom further 600 mm down. |
| **Secondary** | - | Excavate rocks. | Excavate rocks greater than 150 mm. | Excavate rocks greater than 150 mm. |
| **Excavation Hole Backfilling** | In situ excavated material | If excavated soil has less than 30% gravel, then no additive is required. | Backfill with imported topsoil. | Backfill with imported topsoil. |
| If excavated soil has 30 to 70% gravel, then a 50% mixture with imported topsoil is required. If excavated soil has greater than 70% gravel, then backfill of imported topsoil is required. | NOTE  If existing soil is free draining or humic, then it may be substituted for imported topsoil. | |
| \* Laterite - rough textured rock, reddish brown in colour, with orange and yellow mottles (splotches of colour), contains ironstone gravels and pores.  \* Siltstones - relatively smooth textured, white, reddish and yellowish layered rock, often with mottles. No ironstone gravel and pores. | | | | |

### Supply of Plants

Place an order with an approved nursery for the supply of all plants required to complete the works within seven days of acceptance of tender.

Ensure that a minimum of five or 5%, whichever is the greater number, additional plants of each species nominated is available if necessary for replacement purposes.

Remove immediately from the site all dead, dying or diseased plants and replace with new plants of the same species.

### Treatment of Plants

Do not use chemicals on site.

Containerised plantings shall be well watered prior to despatch from the nursery and shall remain in the containers until required for planting.

Protect all plants during transportation, against excessive sunlight, wind and drought.

Trees and shrubs which are not immediately planted shall be stood upright on level ground, protected and maintained in good condition by the Contractor.

Replace immediately all plantings which have become damaged, missing or fallen below the specified standard.

Drive any tree stakes required into the ground before planting so as not to damage the root ball.

Check regularly for any termite/insect attack or fungal infestation. Carry out eradication by use of sprayed insecticide or fungicide in accordance with the manufacturer's instruction.

### Planting of Trees, Shrubs and Ground Cover

Planting shall take place only in conditions where temperature range is below 32°C.

Maintain the integrity of the plant root zone and the surrounding earth mould.

Place fertiliser in the hole adjacent to, but not in contact with, the root zone of the plant. Fertiliser shall be in accordance with the ***Table - Fertilisers*** in **Fertilisers**  sub-clause in **Materials** clause in this work section. Application rates in accordance with the ***Table - Fertiliser Application Rates*** appearing below.

| **Table - Fertiliser Application Rates** | | |
| --- | --- | --- |
| **Plant Type,**  **Use,**  **Planting Method** | **Size of container or plant** | **Application Rate per container or per plant** |
| Native,  Planting,  Surface | Tube stock  150 mm container  200 mm container  250 mm container  300 mm container  20 litre bag | 10 g  30 g  80 g  100 g  150 g  300 g |
| Exotic,  Planting,  Surface | Plant height:  0.5 m  1.0 m  2.0 m | 100 g  200 g  300 g |
| Native and/or Exotic,  Planting,  Hole | Ground covers and shrubs 10 cm tall  Ground covers and shrubs 20 cm tall | 10 g  20 g |
| Plants to 1 m  Plants to 2 m  Plants to 3 ‑ 4 m | 40 g  80 g  120 g |
| Advanced trees and palms 2 m -  Advanced trees and palms 3 m -  Advanced trees and palms 4 m - | 200 g  300 g  400 g |
| These rates apply to both granular compound and equivalent products. | |
| Native,  Feeding,  Hole and/or surface | Ground covers:  up to 300 mm wide  300 ‑ 600 mm wide  600 ‑ 900 mm wide  900 ‑ 1000 mm wide  Thereafter | 30 g  50 g  75 g  100 g  100 g per metre |
| Shrubs:  up to 300 mm high/wide  300 ‑ 600 mm high/wide  600 ‑ 900 mm high/wide  900 ‑ 1000 mm high/wide  Thereafter | 50 g  75 g  100 g  150 g  200 g/metre of height or width |
| Trees | 200 g/metre of height |
| Exotic,  Feeding,  Hole and/or surface | Plants | 250 g/metre of plant height |

### Backfilling

Backfill material shall be in accordance with the ***Table - Initial Hole Preparation Chart*** in **Preparation and Treatment of Holes** sub-clause in this clause.

Backfill the hole so that the plant is contained firmly in the ground in a vertical position.

Backfill the hole to finish surface level and dish to retain water.

Work surface fertiliser into top 50 mm of backfill. Fertiliser shall be in accordance with ***Table - Fertilisers*** in **Fertilisers**  sub-clause in **Materials** clause in this work section. Application rates in accordance with the ***Table -Fertiliser Application Rates*** in **Planting of Trees, Shrubs and Ground Cover** sub-clause in this clause.

Water backfill material immediately after surface fertilisation to ensure no air voids or loose material surround the plant root zone.

### Watering and Maintenance

Maintain each planting area in a moist condition to promote healthy growth.

Weed and prune as required to maintain plants in a healthy condition.

### Mulching

Supply mulch as specified that is free from weeds, seeds, sticks, stones, insects, diseases and other deleterious matter.

Provide, where specified, organic mulch in a 100 mm thick compacted layer for a 500 mm radius from the main stem.

Ensure a gap of 50 mm is retained between the main stem and the mulch.

## Grassing

### Ground Preparation

Bring the area to a fine tilth. Conform to the prescribed finished levels prior to the placement of grass seed.

Remove all stones over 50 mm diameter, debris and deleterious material.

Backfill with topsoil all voids created by the removal of obstructions and deleterious material.

Provide loose depth of topsoil to achieve a minimum topsoil thickness of 100 mm after natural settlement.

Compact the topsoil lightly to minimise subsidence.

Placement and spreading of topsoil shall not take place during periods of heavy rain.

Protect the area to prevent further compacting and trafficking once topsoiling is complete.

Take preventative measures to control erosion and siltation and restore/replace any portion which erodes, silts up or is otherwise damaged.

Apply fertiliser as specified in the ***Table - Fertilisers*** in **Fertilisers** sub-clause in **Materials** clause in this work section, at an application rate of ***[enter data]*** kg/hectare minimum, to the finished topsoiled surface and lightly work into the soil. The fertiliser may be applied simultaneously with the grass seed.

### Supply

Supply fresh seeds of the species nominated in the sub-clause **Grass** in the clause **Materials**.

### Application

Refer to the ***Table - Fertiliser Application Rates*** in Planting of Trees, Shrubs and Ground Cover sub-clause in Planting clause

Apply seed uniformly by mechanical means. Hand distribution shall only be in areas inaccessible to machinery.

### Reseeding

Reseed areas that fail to germinate and propagate after 28 days.

Bring areas requiring reseeding to a fine tilth by hand raking only.

Grass seed application to be in accordance with the ***Table - Seed Mixes*** in sub-clause **Grass** in the clause **Materials**.

### Irrigation

Water seeded areas as often as is required to keep the ground moist.

### Establishment

Maintain grassed area free of all weeds and insects.

Ensure grass has and maintains complete uniform coverage with active growth.

### Mowing

Mow the grass as follows:

* First cut when height reaches 150 mm.
* Further cuts to maintain grass height in range 50 ‑ 100 mm.

## Batter Protection by Hydroseeding

### General

Use an approved hydraulically-applied proprietary erosion control Engineered Fibre Matrix (EFM) product.

The EFM is to be 100% biodegradable, and is to be composed of 100% recycled, thermally refined (within a pressurized vessel) virgin wood fibres, crimped interlocking biodegradable fibres, mineral activators and wetting agents (including high-viscosity colloidal polysaccharides, cross-linked biopolymers, and water absorbents).

The EFM is to be phytosanitized, free from plastic netting, and when cured is to form an intimate bond with the soil surface to create a continuous, porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.

The EFM is to perform as a Bonded Fibre Matrix (BFM) product and may require a 4-24 hour curing period to achieve maximum performance.

### Contractor Submissions – Witness Point

**Witness Point -** Product Data: Submit manufacturer’s product data and installation instructions. Include required substrate preparation, list of materials and application rates.

### Delivery, Storage, and Handling

Deliver materials and products in UV and weather-resistant factory labelled packages.

Store and handle in strict compliance with manufacturer’s instructions and recommendations.

Protect from damage, weather, excessive temperatures and construction operations.

### Materials

The EFM must conform to the following typical property values when uniformly applied at a rate of 3,900 kilograms per hectare under laboratory conditions.

|  |  |  |
| --- | --- | --- |
| **Table – Engineered Fibre Matrix Properties** | | |
| **Property** | **Test Method** | **Required Tested Value** |
| **Physical** | | |
| Mass Per Unit Area | ASTM D65661 | ≥ 390 g/m2 |
| Thickness | ASTM D65251 | ≥ 4 mm |
| Ground Cover | ASTM D65671 | ≥ 98% |
| Water Holding Capacity | ASTM D7367 | ≥ 1,400% |
| Material Colour | Observed | Green |
| **Performance** | | |
| Cover Factor2 | Large Scale Testing | ≤ 0.05 |
| % Effectiveness3 | Large Scale Testing | ≥ 95 % |
| Cure time | Observed | 4 – 24 hours |
| Vegetation Establishment | ASTM D73221 | ≥ 600 % |
| Functional Longevity4 | ASTM D5338 | ≤ 12 months |
| **Environmental** | | |
| Ecotoxicity | EPA 2021.0 (USA) | 48-hr LC50 > 100% |
| Biodegradability | ASTM D5338 | Yes |
| **NOTES**  1. ASTM test methods developed for Rolled Erosion Control Products and have been modified to accommodate Hydraulically-Applied Erosion Control Products.  2. Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface.  3. % Effectiveness = One minus Cover Factor multiplied by 100%.  4. Functional Longevity is the estimated time period, based upon ASTM D5338 testing and field observations, that a material can be anticipated to provide erosion control and agronomic benefits as influenced by composition, as well as site-specific conditions, including; but not limited to – temperature, moisture, light conditions, soils, biological activity, vegetative establishment and other environmental factors. | | |

### Composition

All components of the EFM shall be pre-packaged by the Manufacturer to assure both material performance and compliance with the following values. Under no circumstances shall field mixing of components be permitted. No chemical additives with the exception of fertilizer, soil neutralizers and biostimulant materials should be added to this product.

* Thermally Processed\* (within a pressurized vessel) Virgin Wood Fibres – 77%
  + \**Heated to a temperature greater than 193 degrees Celsius for 5 minutes at a pressure greater than 345 kPa.*
* Wetting agents (including high-viscosity colloidal polysaccharides, cross-linked biopolymers, and water absorbents) – 18%
* Crimped Biodegradable Interlocking Fibres – 2.5%
* Micro-Pore Granules – 2.5%

### Packaging

Bags: Net Weight – 22.7 kg, UV and weather-resistant plastic film

Pallets: Weather-proof, stretch-wrapped with UV resistant pallet cover

Pallet Quantity: 40 bags/pallet or 909 kg/pallet

### Soil Testing – Witness Point

Soil Samples shall be taken and sent to a third-party, independent lab for analysis.

The tests shall include analysis and interpretation of results.

The soil testing methods used shall be compliant with recognized agronomic testing standards, for revegetation of disturbed sites.

Soil Analysis shall include results for:

* Soil pH
* Soluble Salts
* Excess Carbonate
* Organic Matter
* Nutrient readings for:
* Nitrogen, Phosphorus, Potassium
* Magnesium, Calcium, Sodium, Manganese, Sulphur, Zinc, Copper, Iron, Boron
* Cation Exchange Capacity
* Percent Base Saturation Sodium

**Witness Point** – Obtain Superintendent’s approval before using additives not listed above in Composition sub-clause. Approved additives are to be applied with the hydroseeding slurry at Manufacturer recommended rates based on soil test results.

### Vegetation Species Selection

Once soils have been analysed for agronomic potential and amendment recommendations, selection of suitable plant species for achieving sustainable growth and effective erosion control shall be determined by a qualified seed supplier, consulting professional and/or regulatory agency. Species selection and establishment shall be compliant with LANDSCAPE.

Site and project specific information considered for species selection shall include:

* Project Location and Planning
  + Climate
  + Elevation
  + Aspect
  + Slope/Gradient
  + Permanent or Temporary Planting
  + Installation Date(s)
* Soil Conditions
  + Soil Texture
  + Soil pH
  + Toxicities/Deficiencies noted in the previous section.
* Site Maintenance Requirements
  + Mowing
  + Irrigation
  + Animal grazing preference
* Preferred Vegetation
  + Drought Tolerant
  + Native Vegetation
  + Shrub Species
  + Turf Grasses
  + Cool Season
  + Warm Season
  + Blend of Cool and Warm Season
  + Legume Species
  + Cover Crops

### Substrate and Seedbed Preparation

Examine substrates and conditions where materials will be applied.

Apply products to geotechnically stable slopes that have been designed and constructed to divert runoff away from the face of the slope.

Do not proceed with installation until satisfactory conditions are established.

Depending upon project sequencing and intended application, prepare seedbed in compliance with other specifications.

### Installation

Strictly comply with equipment manufacturer's installation instructions and recommendations.

Use approved hydroseeding machines with fan-type nozzle (50-degree tip).

To achieve optimum soil surface coverage, apply EFM from opposing directions to soil surface.

Rough surfaces (rocky terrain, cat tracked and ripped soils) may require higher application rates to achieve 100% cover.

Slope interruption devices or water diversion techniques are recommended when slope lengths (3H:1V) exceed 15m. Slope interruption intervals may need to be decreased based on steeper slopes or other site conditions.

EFM is not recommended for channels or areas with concentrated water flow unless used in conjunction with a rolled erosion control product designed to accommodate the anticipated hydraulic conditions.

Unless approved by the Manufacturer and the Superintendent, no chemical additives with the exception of fertilizer, soil neutralizers and biostimulant materials should be added to this product.

For Erosion Control and Revegetation: To ensure proper application rates, measure and stake area.

For maximum performance, apply EFM in a two-step process\*:

Step One: Apply fertilizer with specified prescriptive agronomic formulations and typically 50% of specified seed mix with a small amount EFM for visual metering. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.

Step Two: Mix balance of seed and apply EFM at a rate of 22.7 kg per 316 litres of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer.

*\*Depending upon site conditions EFM may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with Manufacturer for further details.*

*Best results and more rapid curing are achieved at temperatures exceeding 15°C. Curing times may be accelerated in high temperature, low humidity conditions with product applied on dry soils.*

**Mixing:** Use a mechanically agitated hydroseeding machine:

* Fill 1/3 of mechanically agitated hydroseeder with water. Turn pump on for 15 seconds and purge and pre-wet lines. Turn pump off.
* Turn agitator on and load low density materials first (i.e. seed).
* Continue slowly filling tank with water while loading fibre matrix into tank.
* Consult application and loading charts to determine number of bags to be added for desired area and application rate. Mix at a rate of 22.7 kg per 316 litres of water.
* All EFM should be completely loaded before water level reaches 75% of the top of tank.
* Top off with water and mix until all fibre is fully broken apart and hydrated (minimum of 10 minutes — increase mixing time when applying in cold conditions). This is very important to fully activate the bonding additives and to obtain proper viscosity.
* Add fertilizer and any other approved additives.
* Shut off recirculation valve to minimize potential for air entrainment within the slurry.
* Slow down agitator and start applying with a 50-degree fan tip nozzle.
* Spray in opposing directions for maximum soil coverage.

**Application Rates:** These application rates are for standard conditions. Increase application rates on rough surfaces.

|  |  |
| --- | --- |
| **Table – Application Rates** | |
| **Slope Gradient / Condition** | **Application rate** |
| ≤ 4H to 1V | 2,800 kg/ha |
| > 4H to 1V and ≤ 3H to 1V | 3,360 to 3,400 kg/ha |
| > 3H to 1V and ≤ 2H to 1V | 3,900 to 3,920 kg/h |
| > 2H to 1V and ≤ 1H to 1V | 4,480 to 4,500 kg/ha |
| For slopes steeper than 1H to 1V use alternative stabilization methods. | |
| H = horizontal  V = vertical | |

Refer to Manufacturer’s information for additional details including mixing ratios/loading rates for specific machine sizes and visual keys for proper application.

### Cleaning and Protection

After application, thoroughly flush the tank, pumps and hoses to remove all material.

Wash all material from the exterior of the machine and remove any slurry spills. Once dry, material will be more difficult to remove.

Clean spills promptly.

Advise Superintendent of methods for protection of treated areas.

Do not allow treated areas to be trafficked or subjected to grazing.

### Inspection and Maintenance

All inspections and maintenance recommendations shall be conducted by qualified professionals.

Initial inspections shall insure installations are in accordance with the project plans and specifications with material quantities and activities fully documented.

Subsequent inspections shall be conducted at pre-determined time intervals and corrective maintenance activities directed after each significant rainfall event or other potentially damaging weather or site event.

## Irrigation

### Irrigation System - Hold Point

**General**

Standard: To AS/NZS 3500.1

Place a high priority on avoiding surface runoff when selecting system components. Use low trajectory sprinklers where possible. Select components to keep the sprinkler precipitation rate below the infiltration rate of the soil and/or use repeat cycles to allow water to soak into the root zones.

Where possible, separate station/zones for irrigation at the top and bottom of sloped areas.

**Materials**

Pipework upstream of control valves: Use uPVC class 12.

Pipework downstream of control valves: Use uPVC class 9 or high density polyethylene.

**Performance**

Coverage (mm of water over area to be watered): 50 mm per week during the establishment period and then progressively hardening off to the local conditions. Ensure that final water usage is such that plant health and vigour is maintained without wastage of water.

**Backflow**

Fit a backflow prevention device; To AS/NZS 3500.1 and as required to meet the approval of PowerWater.

**Pressure regulating valves**

Provide a pressure regulating valve at the take-off point which is adjustable between 100 and 700 kPa. Install an 800 mm filter sized to suit the flow immediately upstream from the pressure regulating valve, and provide gate valves upstream from the filter and downstream from the pressure regulating valve. Mount the assembly in an accessible position in a valve box or access pit as required.

**Irrigation Controller**

Use electric solenoid valves wired to an irrigation controller.

In the Darwin Region, the irrigation controller is to be compatible with a “Toro Irrinet” irrigation telemetry system. At the completion of the defects liability period, liaise with the Department’s landscape maintenance contractor to have the irrigation system handed over and included into the telemetry control system.

Mount the controller in a weatherproof lockable cabinet.

Include the following features:

* Variable timer for each station with a range from 1 minute to not less than 30 minutes.
* Manual cycle and individual station operation.
* Manual on-off operation of irrigation without loss of program.
* 240 V input and 24 V output capable of operating 2 control valves simultaneously.
* 24 hour battery program backup.
* Power surge protection.

Electrical connection: Connect to a 240 V supply and provide an isolating switch at the controller.

Automatic control valves: 24 V solenoid actuated hydraulic valves with flow control and a maximum operating pressure rating of at least 1 MPa. Provide valves able to be serviced without removal from the line. Install a gate valve of the same size immediately upstream from each automatic control valve. House both valves in a valve box with high impact plastic cover at finished ground level.

Control wires: Connect the automatic valves to the controller with building wire laid in sealed conduits, with the mainline where possible. Lay intertwined for their full length without joints except within valve boxes. Use waterproof connection. Provide expansion loops at each solenoid lead or joint.

**Hold Point** - Backfill trenches only after inspection and approval of wiring.

Minimum size active 1.5 mm2. Minimum size common 2.5 mm2 laid in closed loop.

**Sprinkler Heads**

Provide heads which maintain a preset arc of throw, adjustable for radius, during watering operations and which are vandal-resistant.

Pop-up type heads: Heads designed to rise out of their housings under supply pressure to a minimum "pop-up" height of 50 mm.

**Risers**

Mount all in-ground heads on reticulated risers. Mount above ground on fixed risers.

**Micro irrigation system**

Polyethylene irrigation pipe: To AS 2698.1 Class IRRIG with barbed fittings of similar pressure rating fastened with ratchet type clamps. Lay pipe on finished ground surface under planting bed mulch and anchor at minimum 1.5 m intervals with U‑shaped stakes. Connect micro-tube laterals with proprietary push in or screw in fittings.

Microsprays: Mount microsprays on stakes 300 mm above ground and connect to the pipework with microtubes.

Drippers: Use drippers which are turbulent flow types, easily dismantled for cleaning. Connect directly into the pipework or with microtubes.

Micro irrigation valve box: Use micro irrigation valve boxes which are of high impact plastic with snap lock covers at finished ground level, each housing a stop cock, filter (200 mm for microsprays, 100 mm for drippers), pressure reducing valve (170 kPa outlet pressure) and automatic control valve.

| **Table – Irrigation Schedule** | | | |
| --- | --- | --- | --- |
| Fittings and attachments include but are not limited to those scheduled below for specific locations or fixtures: | | | |
| **Location** | **Item** | **Requirement** | |
| At points shown on drawings | External hose cocks | Type | To AS/NZS 3500(set) |
| Size | 20 mm |
| As on approved design plan | Sprinkler | Type | Gear driven |
| As on approved design plan | Automatic valve | Type | Solenoid operated |
| Size | Maximum pressure loss 20 kPa |
| As shown on drawings | Quick coupling valve | Type | Polypropylene |
| Size | 25 mm |
| As required to achieve uniform coverage | Microsprays | Type | No moving parts |
| At each plant | Drippers | Type | Turbulent flow |
| At each plant | Bubblers | Type | Adjustable from  0 ‑ 10 litres per minute. |

### Design plans – Hold Point

**Hold Point** - Submit drawings to Superintendent for approval indicating design proposals showing all pipework, sprinklers, valves and control systems.

### Setting Out

Mark out the positions of the main irrigation lines, sprinkler heads, and valves, prior to excavation, and:

* ensure completed surface levels are in accordance with the design plans; and
* obtain information about the locations of existing services, including underground services, from the relevant authorities, and mark these locations on the ground prior to excavation.

### Excavation

Excavate in accordance with AS/NZS 3500.1.

Excavate to the lines, levels and grades as required for irrigation trenches. Trench depths and widths as required by AS 3500.1.

Liaise with relevant authorities to locate existing services.

Excavate within one metre from existing underground services only by hand or by hydro excavation.

Damage to existing services and vegetation to be rectified at Contractor's expense.

The Contractor shall be deemed to have allowed for the cost of performing the required excavations in whatever material may be encountered, and no extra payment shall be paid for excavation in rock.

Cut back roots encountered in trenches to not less than 600 mm clear of the pipework. Remove such other obstructions including stumps, boulders and the like which may, in the opinion of the Superintendent, interfere with the pipework.

At road crossings, provide under road boring at right angles to the road centre line, by an approved specialist subcontractor. Place all pipeline beneath roadways in heavy duty conduit casing. Refer to DIRECTIONAL BORING section.

Stockpile topsoil on site.

### Installation

Install pipework in straight lines and uniform grades. Keep the number of joints to a minimum.

Install conduits and pipes having grade or class identification marking so that the marking is visible for inspection.

Lay all pipework under paths, paving or slabs in conduits.

Install according to the approved irrigation design and specifications.

Obtain approval from PowerWater before connecting to water supply system.

Installation of all pressurised pipework, fittings, Class 12 UPVC and above pipework, and other fixtures, and connection to an existing water supply system, , is to be carried out by a qualified plumber licensed in the Northern Territory.

Provide 50 mm thick compacted bedding of clean granular sand free from stones and other debris over the total width of all excavations.

Clean all surfaces of UPVC joints with an approved cleaning fluid prior to jointing.

Solvent weld all UPVC joints, unless otherwise specified.

Flush all pipework prior to the attachment of sprinklers, drip emitters and the capping of pipeline ends.

Install and connect all fixtures shown on the design plans neatly, with waterproof joints. Install in accordance with the manufacturer's instructions.

Installation of all 240 volt electrical work must be carried out by a qualified electrician licensed in the Northern Territory. All wiring and jointing shall use PowerWater approved materials. Join 240 V electrical wiring with a waterproof jointing kit.

Install all solenoid valve wiring beside the appropriate pipework in the conduit. Size conduit to allow free movement of wiring and draw wire.

Run all electrical wire in continuous lengths between the controller and valve. Ensure the wire is not kinked.

Ensure adequate length of wire is available at valves during installation to enable future replacement of valves.

### Water Source

Liaise with PowerWater as the Department’s service liaison consultant in relation to water supply requirements associated with this contract.

Carry out the excavation necessary to locate and expose the connection point. On completion, reinstate surfaces and elements which have been disturbed such as kerbs, footpaths and nature strips.

Obtain approval from PowerWater before connecting to the water supply system.

### Testing – Hold Point

Check pipe joints, valve seats, tap washers, strainers and other elements for leaks. Repair or replace if damaged, and retest.

Provide all equipment necessary for testing.

All joints and connections are to remain visible during the test.

Measure pressure at the lowest section of pipework being tested.

Pressure minimum of 800 kPa shall be maintained for a minimum period of two hours in all pressure pipework and fittings up to and including the solenoid valves, except in spray, drip, and micro sprinklers.

Repair and retest all leaks prior to acceptance.

**Hold Point** - Obtain Superintendent's approval to proceed with backfilling other than spot filling to retain pipework from movement during pressure testing.

### Backfilling

Generally: Backfill trenches as soon as possible after approval of laid and bedded service.

Provide clean granular sand cover around the pipe and to a compacted thickness of 100 mm above the pipe.

Compact the sand with a vibrating plate or similar.

Place and compact select fill conforming to the PAVEMENTS AND SHOULDERS section to 100 mm below existing surface. Compact to density of surrounding material.

Place 100 mm of topsoil over select fill and treat similar to existing surface.

Remove all surplus material from site.

Ensure the surface of all backfilling does not pond water.

Remedy any surface settlement due to backfilling during the maintenance period.

## Telemetric Control Station Details

Telemetric operated Irrigation control stations shall be constructed to comply with the following requirements. Refer to drawing CS-3317. Refer to REFERENCED DOCUMENTS.

### Materials

**Mounting post**

* 3600 mm (length) x 75 mm square hollow section (SHS) of 3 mm gauge steel, sealed at both ends with welded steel plates.
* It shall have two horizontal metal brackets, 300 mm x 60 mm x 3 mm gauge, welded to it in the positions specified on the design drawings for mounting a control box. When constructed it shall be hot dip galvanized.

Lockable stainless steel control cabinet

* 600 mm (height) x 400 mm (width) x 200 mm (depth)
* The lock shall be incorporated into the design and the box shall be of sturdy ‘vandal-proof’ construction.

**Stainless steel whip aerial**

RF Industries model CD 28-41-70.

**Irrigation controller**

Must be compatible with Motorola IRRInet

**Radio**

Motorola Model GP328

Frequency - one of either of the following frequencies, depending on the location of the irrigation system within the Greater Darwin area (details of which can be obtained from the Superintendent).

* Area A – 150.825mhz
* Area B – 155.425mhz

**Solar panel**

Must have sufficient capacity to maintain the charge in the batteries of the control station equipment

### Installation

* Position the control station in the location specified in the design drawings.
* Position the post 600 mm into a concrete footing. The footing shall have minimum dimensions of 350 mm diameter x 650 mm deep. The post must be vertical.
* Affix the control box securely to the mounting brackets
* The base of the box shall be 1350 mm above the ground
* Use 4 x 316 stainless steel bolts with round heads to prevent theft
* Bolt head must be on the outside of the box with the nuts inside
* Control equipment will be affixed securely to the inside of the box and arranged neatly for ease of operation.
* Cabling
* cabling shall be run internally through the mounting post
* Flexible conduit shall be inserted in the entry and exit points to prevent chafing
* Conduits will be joined with a weatherproof seal
* Conduit shall be used between the post and the control box to provide weather proofing.
* Aerial shall be mounted vertically on top of the post.
* Solar panel
* Mount on top of the post
* Mount at an angle of 11 degrees to the horizontal with the cells facing north.

## As Constructed Information

Drawings are to show as installed locations of all pipework, fittings, sprinklers, control valves, controllers, wiring, accessories etc. Refer to **As Constructed Information** clause in MISCELLANEOUS PROVISIONS.

## Establishment Period

* Keep the site neat and tidy at all times.
* Ensure the irrigation system is maintained and performs in accordance with the design plans. The operating schedule is to be adjusted to suit wet/dry season conditions. Prevent excessive watering.
* Keep the root ball of all plants moist at all times.
* Keep all plants and grass in a healthy actively growing state.
* Keep the whole site weed free.
* Repair eroded areas and re‑establish to maintain the design.
* Replace all damaged, dying or dead plants within 10 working days.
* Maintain all plantings free from insects, pests and diseases.
* Fertilise all plantings and grass in accordance with the ***Table - Fertilisers*** in **Fertilisers**  sub-clause in **Materials** clause in this work section and with the ***Table -Fertiliser Application Rates*** in **Planting of Trees, Shrubs and Ground Cover** sub-clause in **Planting** clause in this work section, ensuring to work any fertilizer into the soil around the base and dripline of the plant to prevent runoff.
* Ensure mulch is maintained at the specified levels.
* Ensure all stakes and ties remain secured with adjust ties to suit plant growth. Replace broken stakes and ties immediately.
* Prune trees and shrubs as required, or as directed by the Superintendent, to encourage dense bushy growth; use only qualified personnel.
* Prune established trees for a 3 m clearance where high profile machinery will be required to use the area regularly.
* Remove all branches sweeping the ground.
* Remove all pruning within 2 m of the ground to within 10 mm of the main stem.
* Keep ground cover plants free of dead vegetation.
* Mow grass when grass height exceeds 100 mm and in accordance with the **Mowing** sub-clause in the **Grassing** clause in this worksection.
* Remove grass cuttings from site.
* Trim neatly all edges of grassed areas at the same time as mowing.
* Keep all stormwater drains clean of debris and silt to allow unrestricted flow of stormwater run‑off.
* Remove termite mounds and treat the specific site with Fipronil.
* Use all insecticides and fungicides for the control of termites/insects and other infestations in accordance with the manufacturer's instruction.

### Establishment Period Records

* Maintain accurate current records of all maintenance work during the establishment period, including; the number of employees on site and the work conducted.
* Unscheduled audits may be conducted by the Superintendent throughout the 13 week period.

Records shall be provided upon request.